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Morlais Project
Environmental Statement

Volume I

Applicant: Menter Môn Morlais Limited

Author: Royal HaskoningDHV

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Morlais Project
Environmental Statement

Chapter 1: Introduction

Volume I

Applicant: Menter Môn Morlais Limited

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GLOSSARY OF ABBREVIATIONS

AEMP	Adaptive Environmental Management Plan
B&V	Black and Veatch Limited
EIA	Environmental Impact Assessment
ES	Environmental Statement
EU	European Union
FEED	Front-End Engineering Design
GW	Gigawatt
HDD	Horizontal Directional Drilling
HRA	Habitats Regulations Assessment
IEMA	Institute of Environmental Management and Assessment
IoACC	Isle of Anglesey County Council
ITPE	ITP Energised
MDZ	Morlais Demonstration Zone
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
NRW	Natural Resources Wales
NTS	Non-Technical Summary
ODA	Onshore Development Area
OfDA	Offshore Development Area
PDE	Project Design Envelope
TEC	Tidal Energy Converter
TEL	Tidal Energy Limited
TLP	Tidal Lagoon Power Ltd
TWAO	Transport and Works Act
UK	United Kingdom
WADZ	West Anglesey Demonstration Zone

1. INTRODUCTION

1.1. THE PURPOSE OF THIS DOCUMENT

1. This document is the Environmental Statement (ES) for the proposed Morlais Project (the Project). The Project is being developed by Menter Môn Morlais Limited (hereafter referred to as Menter Môn), the applicant, a not for profit social enterprise company. The Project will have a generating capacity of up to 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ).

2. Menter Môn has contracted Royal HaskoningDHV to undertake the Environmental Impact Assessment (EIA) for the Project. A full project description for the Project is provided in **Chapter 4, Project Description**.

3. The purpose of this ES is to document the assessment of potential significant environmental impacts resulting from the Project and to demonstrate that this assessment is robust and comprehensive. This ES highlights the key environmental issues associated with the Project and provides an unbiased assessment of their effects and their relative significance. This process has ensured that these effects are fully considered and where appropriate, mitigation has been integrated into the design of the Project.

4. This ES describes the findings of the assessment of the potential environmental impacts associated with the construction, operation, maintenance, repowering and decommissioning of the Project, including the onshore and offshore infrastructure.

5. This ES is produced in support of an application for a Marine Licence under the Marine and Coastal Access Act 2009 and a Transport and Works Act Order (TWAO) with deemed planning permission under the Transport and Works Act 1992 for the Project. **Chapter 2, Policy and Legislation** provides further detail on the requirements of each permission.

1.2. BACKGROUND

6. The Project is located within one of several marine energy demonstration zones located around the United Kingdom (UK) coast, which have been leased out by The Crown Estate in a bid to encourage and accelerate the marine energy industry. Each of the zones were identified because they offer appropriate marine energy potential and access to necessary infrastructure, including ports and electricity grid. Environmental considerations were used in the process of determining the zone locations. The marine energy demonstration zones were incorporated into a plan level Habitats Regulations Assessment (HRA) before the leasing process was finalised and seabed agreements signed (ABPmer, 2014). The Project is located within the West Anglesey Demonstration Zone (WADZ), a zone primarily selected for its tidal resource.

7. Menter Môn Cyf (which established Menter Môn Morlais Limited as a Special Purpose Vehicle (SPV) for the development of the Project) has been appointed as the manager of the WADZ by The Crown Estate; however, Menter Môn Cyf fulfils an enabling role for the Project and does not act as a technology developer. For simplicity, no distinction between Menter Môn Cyf and Menter Môn Morlais Limited is made from this point in the ES. In this ES, the WADZ is referred to as the MDZ.

8. Two scoping reports were previously submitted to Natural Resources Wales (NRW), the Marine Management Organisation (MMO) and the Isle of Anglesey County Council (IoACC) in support of earlier (lower capacity) versions of the Project. However, since those reports were submitted the proposed installed capacity of the Project has been increased in response to industry demand and the project is now seeking consent for up to 240 MW capacity.

9. A further request for scoping opinion, for the current 240 MW capacity Project, was submitted to the Welsh Government and NRW in April 2018, superseding the earlier scoping requests. The Welsh Government and NRW provided a detailed scoping opinion, which has been the starting point for consultation on the project. Consultation with the Welsh Government and NRW has been ongoing throughout the EIA to discuss developments in the Project, scope and design parameters, and to agree methodologies and approaches used for environmental surveys and assessments during the EIA process (see **Chapter 6, Consultation**).

1.2.1. Need for the Project and Potential Benefits

10. Climate change is a global issue as a result of carbon emissions released into the atmosphere due to human activity. Generating and harnessing energy from low carbon, renewable sources such as tidal energy is one of the solutions available to substantially reduce carbon emissions, whilst answering the challenges of meeting energy demand as part of a balanced energy portfolio. The UK has an ambitious target of reducing greenhouse gas emissions by 57 % relative to 1990 levels by 2030, and by 80 % by 2050. In 2018, more than 50 % of the UK's electricity was generated by low carbon sources (Imperial College London, 2019). Targets for CO_2 reduction and the use of renewable energy sources are discussed further in **Chapter 2, Policy and Legislation**.

11. In its 2010 Energy Policy Statement, the Welsh Government set out aspirations to reach 22.5 Gigawatt (GW) of installed capacity from renewable energy technologies in Wales by 2020/25 (Welsh Assembly Government, 2010). The Environment (Wales) Act 2016 requires Welsh Government to reduce greenhouse gas emissions in Wales by at least 80 % by the year 2050. Since the passing of the Environment (Wales) Act, guided by the Well-Being of Future Generations Act 2015, the Welsh Government has set targets and provided additional support for renewable energy.

12. In March 2019, the Welsh Government published a new Low Carbon Plan, which aims to reach targets to deliver clean growth, protect the environment and ensure a healthier society for future generations (Welsh Government, 2019). The Environment (Wales) Act 2016 requires Welsh Ministers to set five yearly carbon budgets and the Low Carbon Plan details how Wales aims to meet the first carbon budget (2016 to 2020), with the second carbon budget to be published in 2021. Achieving a low carbon pathway for Wales ensures maximisation of the seven national well-being goals and the Welsh Government's well-being objectives. The Project would present a significant proportion of the Welsh carbon budgets (further detail on renewable energy policy is presented in **Chapter 2, Policy and Legislation**).

13. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the Welsh National Marine Plan (WNMP). A draft version has been issued for consultation with the aim of publishing the document in summer 2019. The draft Welsh National Marine Plan also sets out support for marine renewable energy generation where the

development of technologies, proposals for renewable energy generation and collaboration between sectors to understand the opportunities for renewable energy are encouraged. Full details of the draft WNMP are set out in **Chapter 2, Policy and Legislation**, and although not yet implemented consideration is given to the WNMP in each marine technical chapter (**Chapters 7** to **16**).

14. Tidal energy is a clean, renewable and highly predictable source of energy. The European Union (EU) has identified tidal energy, and more widely ocean energy (tidal and wave combined), as having the potential to contribute significantly to climate change reduction, socio-economic and energy security objectives. In 2014, the European Commission presented its action plan for achieving the potential for 'blue energy' by 2020 and beyond, aimed at facilitating the further development of the renewable ocean energy sector in Europe.

15. The Project, allowing long-term commercial demonstration of different technologies and small arrays of tidal devices, is an important step in developing the tidal energy industry within the UK and internationally, with significant potential socio-economic benefits (see **Chapter 25, Socioeconomics, Tourism and Recreation**) as well as contributing towards the reduction of greenhouse gas emissions and greater security of energy supply.

1.2.2. Morlais Objectives – Meeting Local Needs

16. Menter Môn's objectives for the Project are detailed in **Section 1.2.5** below. Key is local economic growth, including the potential for job creation. The design of much of the Project infrastructure will be undertaken with a view to maximising local content and developing locally based skills, with social value (including sub-contracts) an important consideration in the procurement strategy. During development of the procurement strategy, efforts will be made to identify local suppliers and contractors who could undertake each contract.

1.2.3. UK Tidal Resource

17. It is estimated that the UK has approximately 50 % of Europe's tidal energy resource (Department for Business, Energy and Industrial Strategy, 2013). Wave and tidal stream energy has the potential to meet up to 20 % of the UK's electricity demand, representing a 30 to 50 GW potential installed capacity (Department for Business, Energy and Industrial Strategy, 2013). However, the number of sites with sufficient tidal velocity to allow commercial exploitation is limited, with the MDZ being located within an area of high resource. The tidal resource in the MDZ is presented in **Chapter 7, Metocean Conditions and Physical Processes**.

1.2.4. The Project

18. Development of the MDZ is being led by Menter Môn who have been allocated funding from EU Structural Funds prioritised for marine energy in Wales.

19. The development of the Project will provide a consented tidal technology demonstration zone, specifically designed for the installation and commercial demonstration of multiple arrays of tidal energy devices. The Project will include permanent communal infrastructure for tidal technology developers which provides a shared route to a local grid connection via up to nine export cable tails, an onshore landfall substation at Ty Mawr, and an onshore electrical cable route to a grid connection substation at Orthios via a switchgear building at Parc Cybi.

20. The consented footprint of the Project will also include a design envelope for tidal devices for which the deployment is allowed under the consent, and the key parameters of which will encompass a range of currently available tidal devices, as well as seeking to anticipate the parameters of future technology.

21. Development of the Project will support those objectives of the 2017 Anglesey and Gwynedd Joint Local Development Plan, aimed at promoting the development of renewable or low carbon energy technologies (Isle of Anglesey County Council and Gwynedd Council, 2017). The Project will prioritise maximising opportunities for local communities directly via employment and indirectly via the establishment of a local supply chain.

22. The Project will have an installed capacity of up to 240 MW, enough to provide electricity to the equivalent of over 188,000[1] homes.

23. The Project will provide the supporting electrical infrastructure to connect tidal energy converters (TECs) within the MDZ and export the electricity generated to grid. The Project aims to secure a broad consent envelope, which will encompass a range of tidal device types and technologies with the potential to be installed and operated as part of the Project. The final details of all equipment to be installed, including tidal devices, will be confirmed following consent.

24. The EIA assesses the potential significant environmental impacts for the following project elements, during the construction, operation and maintenance, repowering and decommissioning phases of the Project life cycle (see **Chapter 4, Project Description**):

- **Offshore Development Area**
  - Tidal devices, incorporating:
    - Foundations or anchors;
    - TECs;
    - Supporting structures holding TECs in place in the water and connecting to foundations or anchors; and
    - Seabed preparation for foundations and anchors if necessary.
  - Possible use of electrical hubs or connectors as a way of connecting electrical cables from multiple tidal devices to electrical export cables;
    - Inter-array cables and cable protection;
    - Export cables and cable protection;
- **Onshore Development Area**
  - Landfall works including transition pits;

[1]Calculated taking the number of installed megawatts (240 MW) multiplied by the number of hours in one year (8,766 hours), multiplied by an expected load factor for tidal stream (35 %), divided by the average household energy consumption (3,900 kWhr), giving an equivalent of 188,806 homes.

  - Landfall substation at Ty Mawr (hereafter referred to as the Landfall Substation);
  - Cable installation from landfall to Landfall Substation;
  - Switchgear building at Parc Cybi (hereafter referred to as the Switchgear Building);
  - Grid connection substation at Orthios (hereafter referred to as the Grid Connection Substation);
  - Cable installation from Landfall Substation to Grid Connection Substation, via the Switchgear Building, including cable junction pits;
  - Temporary road and right of way closures;
- Temporary laydown and construction areas, including fencing / walls, and accommodation;
- Levelling works; and
- Parking areas (including electric vehicle charging points) and site access.

25. The infrastructure outlined above will be located within two development areas, as follows:

- Offshore Development Area (OfDA): including all intertidal and offshore areas where offshore infrastructure may be placed and encompassing the MDZ and the export cable corridor. The Offshore Development Area is shown in **Figure 1-1 (Volume II)**; and
- Onshore Development Area (ODA): including all intertidal and onshore areas where onshore infrastructure may be placed. The Onshore Development Area is shown in **Figure 1-2 (Volume II)**.

26. From the arrays of tidal devices, electricity will flow via subsea inter-array cables to an offshore hub or other connection point(s), from where subsea export cables will connect to export cable tails in the nearshore, with the export cable tails continuing to landfall.

27. On reaching shore the export cable tails will be joined to underground onshore cables via an underground transition pit, near to the point of landfall. The onshore underground cables will connect to a landfall substation, and from that substation, will connect via underground onshore cables and a switchgear building to a grid connection substation and grid connection.

28. A Front-End Engineering Design (FEED) study was undertaken by ITP Energised (ITPE) on behalf of Menter Môn in 2018, to provide the proposed design of the project necessary to inform the EIA project description for consent (**Appendix 4.1, Volume III**). Further to a revision of proposed installed project capacity to 240 MW, an addendum to the study was undertaken for the offshore infrastructure elements (**Appendix 4.2, Volume III**) by ITPE. In parallel, Black and Veatch Ltd. (B&V) have been responsible for further design of, and updates to, the onshore infrastructure within the ODA.

29. As a pre-consented and grid connected commercial demonstration zone, a number of different tidal devices and array configurations may be deployed at the Project over its anticipated 37-year lifetime, including construction and operation. The types of devices that have been used to define the Project Design Envelope (PDE) for the project are discussed in **Chapter 4, Project Description**.

1.2.5. The Developer

30. The Project's developer and the applicant for consent is Menter Môn. Menter Môn is a not for profit, third sector social enterprise, delivering socioeconomic development projects across North Wales. Menter Môn's motivation for the Project is to position itself as a community agency at the centre of renewable innovation, and to establish Anglesey as a marine energy hub, thereby securing maximum added value for the local economy and community.

31. Menter Môn has identified the following Project objectives;

- Generation of long-term financial income / resources for reinvestment in socio-economic and environmental projects to support the wider community;
- Development of locally based skills;
- Attracting investment to the area;
- Becoming a centre of excellence for tidal stream technologies;
- Providing a world class facility for tidal technology development;
- Preserving the environment; and
- Securing a sustainable energy supply for the area.

1.3. STRUCTURE OF THE ENVIRONMENTAL STATEMENT

32. The ES comprises three volumes:

- Volume 1: ES chapters (chapter list shown in **Table 1-1**);
- Volume 2: Figures; and
- Volume 3: Appendices.

33. A standalone Non-Technical Summary (NTS) is available which summarises the key characteristics of the Project and the findings contained within the ES.

Table 1-1 Structure of the Environmental Statement

Chapter Number	Title
1	Introduction
2	Policy and Legislation
3	Site Selection and Consideration of Alternatives
4	Project Description
5	EIA Methodology
6	Consultation
7	Metocean Conditions and Coastal Processes
8	Marine Water and Sediment Quality
9	Benthic and Intertidal Ecology
10	Fish and Shellfish Ecology
11	Offshore Ornithology
12	Marine Mammals

Chapter Number	Title
13	Offshore Archaeology and Cultural Heritage
14	Commercial Fisheries
15	Shipping and Navigation
16	Infrastructure and Other Users
17	Water Resources and Flood Risk
18	Ground Conditions and Contamination
19	Onshore Ecology
20	Onshore Archaeology and Cultural Heritage
21	Noise and Vibration
22	Air Quality
23	Traffic and Transport
24	Seascape, Landscape and Visual Assessment
25	Socio-Economics, Tourism and Recreation
26	Cumulative Impacts and In-Combination Effects
27	Summary

1.4. KEY PROJECT TERMINOLOGY

34. The terminology presented in **Table 1-2** is used throughout the ES when describing the Project.

Table 1-2 Morlais Project Terminology

Applicant	Menter Môn Morlais Limited.
Array	A group of tidal devices connected to each other and to a common export cable.
Array Area	The area taken up by an array, including spaces between devices.
Array Export Cable	Export cable connecting an array of tidal devices to an export cable tail, and from there to grid via permanent infrastructure.
Berth	Discrete area of the Morlais Demonstration Zone identified for a specific tenant's array project demonstration.
Cable Protection	Protective materials strategically placed on sections of the export cable, export cable tails and inter-array cables, to hold them in place.
Code of Construction Practice	A document detailing the overarching principles of construction, contractor protocols, construction-related environmental management measures, pollution prevention measures, the selection of appropriate construction techniques and monitoring processes.
Cumulative effects	The combined effect of the Morlais Project in combination with the effects from a number of projects, on the same single receptor / resource.
Cumulative impact	Impacts that result from changes caused by other past, present or reasonably foreseeable actions together with the Morlais Project.
Device Area	Plan view surface area occupied by a tidal device.
Device Type	A grouping of tidal devices, with similar characteristics. For example, grouping on the basis of the nature of the Tidal Energy Converter (TEC) technology or grouping on the basis of the location and scale of the tidal device during operation, without consideration of the type of TEC deployed.
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.

Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an EIA Report.
Export Cables	Up to nine lengths of cable from arrays within the Morlais Demonstration Zone (MDZ), connected to the export cable tails.
Export Cable Corridor	The corridor within which the export cables and export cable tails will be routed from the Morlais Demonstration Zone site to the landfall location at Abraham's Bosom.
Export Cable Tails	Up to nine lengths of cable installed from the transition pit in the landfall area, to a point in the nearshore offshore seabed via Horizontal Directional Drilling (HDD) or trenching.
Footprint	The surface area of a tidal device that is in physical contact with the seabed.
Grid Connection Substation	Grid connection substation at Orthios.
Horizontal Directional Drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
Hub	Electrical infrastructure used to connect two or more tidal devices within an array.
Inter-Array Cables	Offshore cables which link the arrays to each other and the offshore electrical platforms, these cables will include fibre optic cables.
Joint Pits	Underground structures constructed at regular intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into buried ducts within the road.
Landfall	The area (from Mean Low Water Springs) where the offshore export cables would make contact with land and connect to the onshore cables.
Landfall Substation	Landfall substation at Ty-Mawr.
Morlais Demonstration Zone (MDZ)	Defined by The Crown Estate Lease boundary, the area within which the tidal devices/arrays will be deployed along with associated infrastructure such as inter-array cables, export cables, marker buoys, site monitoring equipment and electrical connections to the export cables. An offshore area of 35km^2 within which the Project will deploy arrays of tidal devices and associated infrastructure.
Offshore Development Area (OfDA)	The combined area of the Morlais Demonstration Zone and the Export Cable Corridor.
Offshore Infrastructure	All offshore infrastructure including tidal devices, foundations or anchors, inter array cables, hubs, export cables, export cable tails and cable protection.
Onshore cables	The cables which take the electricity from the landfall transition pit to the grid connection substation.
Onshore Cable Corridor	The area within which the onshore cables and associated infrastructure such as joint bays, will be located.
Onshore Development Area (ODA)	The area including the intertidal landfall location at Abraham's Bosom, the short onshore cable route between landfall and the landfall substation infrastructure (up to and including landfall substation/control room), and the onshore cable route to the grid connection substation. This area is larger than the order limits proposed within the Transport and Works Act Order.
Project Design Envelope (PDE)	The parameters within which the potential maximum extent of the project in terms of materials, scale, time and location can be described. Sometimes referred to as the 'Rochdale envelope'.
Repowering	The removal of a tenant's infrastructure at the end of a demonstration period and replacement with new tenant infrastructure.

Safety Zones	A marine area declared for the purposes of safety around a renewable energy, installation or works / construction area under the Energy Act 2004, the Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007 and Transport and Works Act Order.
Substation	A compound containing electrical equipment to enable connection to the existing electricity network. This also contains equipment to help maintain stable grid voltage.
Subzone	A part of the Morlais Demonstration Zone, within which defined types of tidal device may be deployed.
Swept Area	The cross-sectional area of the Tidal Energy Convertor perpendicular to the current flow.
Switchgear Building	Switchgear building at Parc Cybi.
Tenant / developer	A company or organisation which reaches agreement with Menter Môn to deploy tidal devices within the Morlais Demonstration Zone.
Tenant infrastructure	Tidal devices, hubs, inter array cables, cable protection, monitoring platforms / buoys and marker buoys.
Tidal Device	One complete unit including: Tidal Energy Convertor(s) (i.e. rotors and nacelle), foundations, support structure.
Tidal Energy Convertor (TEC)	A device that convert kinetic and potential energy contained within moving tidal water into electricity.
Transition Pit	Underground structures at the landfall and grid connection substation that house the joints between trenched and trenchless export cable sections.
Under-keel clearance	The vertical distance between the deepest underwater point of a vessels hull and the shallowest point of seabed or of an underwater structure.
Visually prominent	A tidal device where the large proportion of the support structure is visible above the water to the extent it is visually prominent, together with ancillary elements such as navigation lights, railings and mast

1.5. EIA PROJECT TEAM

35. Royal HaskoningDHV, in collaboration with MarineSpace, has been commissioned to undertake the EIA, providing consenting and licensing support to Menter Môn.

36. Royal HaskoningDHV has extensive experience in renewable energy EIA and a detailed understanding of the potential impacts of wave and tidal devices, having taken the lead EIA role for the following projects: the SeaGen project, Strangford Lough (tidal); the Kyle Rhea array project (tidal), the Sound of Islay (tidal) array project, the Lewis array (wave) project; and Perpetuus Tidal Energy Centre (tidal). As a company, Royal HaskoningDHV is an accredited member of the Institute for Environmental Management and Assessment (IEMA) and registrant of the EIA Quality Mark, which provides a benchmark for EIA activities and allows demonstration of commitment to effective practice. Royal HaskoningDHV has used in-house experts in the following areas to compile this ES: terrestrial archaeology; hydrology; geology; water quality; coastal processes; terrestrial ecology; marine mammals; ornithology; air quality; traffic and transport and onshore noise.

37. MarineSpace is a specialist marine consultancy and has supported a range of projects including providing consultancy support to Tidal Energy Limited (TEL) on its Ramsey and St David’s Head projects and consenting support to Tidal Lagoon Power Ltd (TLP) in developing the Adaptive Environmental Management Plan (AEMP) for the Swansea Bay Tidal Lagoon project. MarineSpace has used in-house experts in the following areas to compile this ES; benthic and intertidal ecology, fish ecology and fisheries, marine archaeology, and navigation.

38. External expertise has been sourced from the following subcontractors:

- Partrac Limited – geophysical survey;
- BSG Ecology – ecological survey;
- Ocean Ecology Limited – benthic survey;
- Wessex Archaeology – terrestrial archaeological survey and desk-based assessment;
- Marico Marine – navigational risk assessment and navigation survey;
- Anatec – navigation survey;
- Aquaterra – socio-economics, tourism and recreation impact assessment;
- Axiom Traffic Ltd. – road traffic survey;
- Wynns Ltd. – Abnormal Indivisible Load; and
- SLR Consulting, with support from Hepla – seascape and landscape visual impact assessment.

39. Public consultation support and management of the public consultation record has been provided by Ateb.

1.7. REFERENCES

ABPmer (2014) Wave and Tidal Further Leasing Plan HRA: Principles Document. Report R.2160a. April 2014. A report for The Crown Estate

Department for Business, Energy and Industrial Strategy (2013). Wave and tidal energy: part of the UK's energy mix. Available at URL: https://www.gov.uk/guidance/wave-and-tidal-energy-part-of-the-uks-energy-mix. [Accessed on: 24/04/19].

Imperial College London (2019). Electric Insights Quarterly Reports: October to December 2018. Available at URL: https://electricinsights.co.uk/#/reports/report-2018-q4/overview?_k=oeqv8u [Accessed 24/04/19].

Isle of Anglesey County Council and Gwynedd Council (2017). Anglesey and Gwynedd Joint Local Development Plan. Available at URL: https://www.anglesey.gov.uk/en/Residents/Planning-building-control-and-conservation/Planning-policy/Joint-Local-Development-Plan-Anglesey-and-Gwynedd/Joint-Local-Development-Plan-Anglesey-and-Gwynedd.aspx [Accessed 24/04/19].

Welsh Assembly Government (2010). A Low Carbon Revolution – The Welsh Assembly Government Energy Policy Statement. Available at URL: https://www.marineenergywales.co.uk/wp-content/uploads/2016/01/WAG-low-carbon-revolution2.pdf [Accessed 24/04/19].

Welsh Government (2019). Prosperity for All: A Low Carbon Wales. Available at URL: https://gweddill.gov.wales/docs/desh/publications/190321-prosperity-for-all-a-low-carbon-wales-en.pdf [Accessed 24/04/19].

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Morlais Project
Environmental Statement

Chapter 2: Policy and Legislation

Volume I

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GLOSSARY OF ABBREVIATIONS

AONB	Area of Outstanding Natural Beauty
BEIS	Business, Energy and Industrial Strategy
CBD	Convention on Biological Diversity
CfD	Contract for Difference
CRoW	Countryside and Rights of Way Act
EIA	Environmental Impact Assessment
EPS	European Protected Species
ES	Environmental Statement
EU	European Union
HRA	Habitats Regulations Assessment
JLDP	Joint Local Development Plan
MCAA	Marine and Coastal Access Act
MCZ	Marine Conservation Zone
MPS	Marine Policy Statement
MSFD	Marine Strategy Framework Directive
MSPD	Maritime Spatial Planning Directive
NERC	Natural Environment and Rural Communities
NNRP	National Natural Resource Policy
NPS	National Policy Statement for
NTS	Non-Technical Summary
O&M	Operation and Maintenance
PDE	Project Design Envelope
PDZ	Policy Development Zone
RA	Resources Area
RBMP	River Basin Management Plan
RES	Renewable Energy Strategy
RLB	Red Line Boundary
SAC	Special Areas of Conservation
SMP	Shoreline Management Plan
SPA	Special Protection Area
SRA	Strategic Resource Area
SSSI	Site of Special Scientific Interest
TAN	Technical Advice Note
UK BAP	UK Biodiversity Action Plan
WFD	Water Framework Directive
WNMP	Welsh National Marine Plan

2. POLICY AND LEGISLATION

2.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) identifies the key National and European legislative and policy drivers and commitments in areas of climate change and renewable energy, which are relevant to the Morlais Project (the Project). It also outlines the key consenting legislation and planning policy (both national and local) under which consent for the Project would be delivered. The technical chapters (**Chapters 7 to 26**) outline any legislation which is specific to the relevant receptors.

2. The Project aims to:

- Generate long-term financial income / resources for reinvestment in socio-economic and environmental projects to support the wider community;
- Develop locally based skills;
- Attract investment to the area;
- Become a centre of excellence for tidal stream technologies;
- Provide a world class facility for tidal technology development;
- Preserve the environment; and
- Secure sustainable energy supply for the area.

2.2. POLICY BACKGROUND

2.2.1. Climate Change and Renewable Energy

3. Climate change is one of the greatest environmental challenges facing the world today, with increasing pressure to reduce carbon emissions as a way of mitigating predicted increases in average global temperatures. As a result, climate change and reducing the rate of global warming is a key driver behind the continued development of the renewable energy industry. A summary of relevant climate change policies is provided in **Table 2-1**.

4. The UK is currently a member of the G7 (formerly the G8) and plays a leading role in tackling climate change at an international level. Whilst the UK remains within the European Union (EU), the UK is obliged to continue to meet its commitments to reducing climate change. Through the Kyoto Protocol (1997) and the Paris Climate Agreement (2015), the UK has a legally binding target to reduce emissions of greenhouse gases. The Environment (Wales) Act 2016 sets target to reduce emissions by at least 80 % by 2050 and provides the legislative framework for establishing a carbon budgeting approach in Wales. Since the passing of the Environment (Wales) Act, guided by the Well-Being of Future Generations Act 2015, the Welsh Government has set targets and provided additional support for renewable energy.

5. In March 2019, the Welsh Government published a new Low Carbon Plan, which aims to reach targets to deliver clean growth, protect the environment and ensure a healthier society for future generations (Welsh Government, 2019). The Environment (Wales) Act 2016 requires Welsh Ministers to set five yearly carbon budgets and the Low Carbon Plan details how Wales aims to

meet the first carbon budget (2016 to 2020), with the second carbon budget to be published in 2021. Achieving a low carbon pathway for Wales ensures maximisation of the seven national well-being goals and the Welsh Government's well-being objectives.

6. The Climate Change Act 2008 also formally commits the UK to reduce its carbon emissions by at least 80 % by 2050, in line with commitments under the Kyoto Protocol. In order to achieve this, the UK Government sets carbon budgets to benchmark the reductions. Currently targets are to reduce carbon emissions by 37 % below 1990 levels in the period 2018-2022. The forward planning targets are for a 51 % reduction (below 1990 levels) in greenhouse gases by 2025 and a 57 % reduction by 2030 (Committee on Climate Change, 2018).

7. Renewable energy is seen as a primary method of reducing emissions of greenhouse gases, in particular CO_2. The UK has implemented the EU Renewable Energy Directive (Directive 2009/28/EC) into UK law, primarily through the Promotion of the Use of Energy from Renewable Sources Regulations 2011, to deliver national targets and priorities in greenhouse gas reductions as well as our domestic targets of reducing greenhouse gas emissions by 80 % by 2050 (HM Government, 2011).

8. In addition to the reduction in greenhouse emissions, renewable energy is an important element in working towards a more varied energy mix and increased energy security to insulate the UK against global fluctuations in energy prices. Currently, renewable energy generation has been able to provide up to 24 % of the UK's energy requirements during periods of optimum conditions. The renewable energy industry has also been an important economic driver helping to create direct and indirect jobs and benefit the wider economy.

9. Specific measures for renewable energy were set out in the UK Renewable Energy Strategy (RES) which was published in parallel with the UK Low Carbon Transition Plan in July 2009 (HM Government, 2009a; HM Government, 2009b).

10. The RES sets out the path by which the UK can meet the legally-binding target of 15 % energy consumption from renewable sources by 2020. The UK interim target was for 5.4 % of energy consumption to be provided by renewable energy by 2013. Preliminary calculations indicate that this target was met.

11. The Renewable Energy Roadmap (DECC, 2011a; DECC, 2012; DECC, 2013) updated some of the aims within the RES and identifies eight types of technology capable of providing 90 % of the renewable energy required to meet the UK's 2020 target of 15 % of energy consumption derived from renewable sources. It reports that energy from tidal stream devices could make a significant contribution to meeting the UK future energy needs.

Table 2-1 Summary of Relevant Climate Change Legislation

Policy	Summary
United Nations Framework Convention on Climate Change (Paris Climate Agreement)	▪ Limit global temperature increase to below 2 °C, while pursuing efforts to limit the increase to 1.5 °C; ▪ Commitments by all parties to prepare, communicate and maintain a Nationally Determined Contribution; and

Policy	Summary
	▪ In 2023, and every five years thereafter, a global stocktake will assess the collective progress towards meeting the purpose of the Agreement.
European Union Renewable Energy Directive	▪ A reduction of 20 % in greenhouse gases by 2020 (below 1990 levels); and ▪ 20 % of the total EU energy (electricity, heat and fuel) consumption to come from renewable sources by 2020.
The Environment (Wales) Act 2016	▪ A reduction of 80 % in greenhouse gases by 2050; and ▪ Welsh Ministers must set interim emissions targets for 2020, 2030 and 2040, together with 5-year carbon budgets for the periods 2021-2025 and 2026-2030.
The UK Climate Change Act 2008	▪ A reduction of 34 % in greenhouse gases by 2020 (below 1990 levels); and ▪ A reduction of 80 % in greenhouse gases by 2050 (below 1990 levels).
The UK Energy Act 2013	▪ Introduction of provisions to enable a statutory 2030 decarbonisation target range for the GB electricity sector; and ▪ Electricity Market Reform including introduction of the Contracts for Difference (CfDs) support mechanism.

2.2.2. Renewable Energy Policy Wales

12. Welsh renewable policy focuses on the transition to a low carbon energy system and maximising the benefits for both Wales and Welsh communities. The 2012 Welsh Government policy document, Energy Wales: A Low Carbon Transition, updated in 2016, outlines the Welsh Government's approach to utilising the marine environment for renewable energy deployment (Welsh Government, 2012b). Marine renewable energy has been identified as a key way of meeting renewable energy objectives, with an aim to capture 10 % of the potential tidal stream and wave energy off the Welsh Coastline by 2025.

13. The Welsh Government policy document sets out the Welsh goals for providing and encouraging growth of renewable energy generation within the energy mix whilst ensuring development is pursued in a socially, environmentally and economically responsible manner that is compliant with the policies outlined in the Welsh Government resource management paper; Sustaining a Living Wales (Welsh Government, 2012a).

14. The Welsh Government has outlined the Anglesey Energy Island Programme which sets out to promote Anglesey as a hub for energy developments such as the Minesto Holyhead Deep project, Wylfa B Nuclear Power Station and Holyhead Biomass Energy Centre (IoACC, 2010). Through this, the Welsh Government is aiming to maximise socio-economic benefits to Anglesey and the wider area. The Project, whilst not identified in the Programme, will help achieve this objective and is being developed to maximise local socio-economic benefits where possible.

15. The Welsh First Minister has also set up the Energy Wales Unit, who's remit is to build on the policies set out in the 2012 Policy document and focus on progressing marine energy.

2.3. CONSENTING REGIME

16. The Project will be authorised via the following principal consents:

- A Transport and Works Act Order under the Transport and Works Act 1992; and
- A Marine Licence under the Marine and Coastal Access Act 2009 (MCAA).

17. The following is proposed to be authorised through the Transport and Works Act Order:

- The establishment of Marine Safety Zones;
- Public Rights of Way temporary closures; and
- The carrying out of street works.

18. Deemed planning permission will be granted with the Transport and Works Act Order.

19. The following is proposed to be addressed via the Marine Licence:

- Marine Disposal Sites.

20. Applications for consent to perform specific activities will also be made. These are likely to include, but not limited to:

- European Protected Species Licence (if required).

21. This ES presents the results of the EIA which will be submitted with the applications for consent.

2.3.1. Transport and Works Act 1992

22. The Transport and Works Act 1992 empowers orders to be made authorising the construction and operation of linear and other guided transport schemes and other types of infrastructure in England and Wales, including works that interfere with rights of navigation in waters up to the limits of the territorial sea provided that they will fall within a prescribed category of works; these include both offshore installations and utilities structures. The Department for Business, Energy and Industrial Strategy (BEIS) administers applications made under the Transport and Works Act 1992 in respect of energy-related projects in those UK territorial waters adjoining England; however, for developments adjacent to Wales, the National Assembly for Wales is the determining body.

2.3.2. Marine and Coastal Access Act 2009

23. The MCAA introduced a new system for marine planning in the marine and coastal environment in England and Wales. Under the MCAA, a Marine Licence is required for carrying out a 'licensable marine activity' in Welsh waters, including construction works on the seabed, depositing of any subject, dredging and aggregate extraction. The Welsh Government is the licensing authority for the Welsh inshore and offshore region; however, the Marine Licensing Team in NRW administers marine licenses on behalf of the Welsh Government.

24. The MCAA also provides the Welsh Government with the powers to introduce Marine Conservation Zones (MCZs) in the Welsh inshore area. The primary aim of MCZs is to deliver the Government's vision for an 'ecologically coherent network of MPAs across the UK and to

ensure the health of the wider UK marine environment'. In 2014, the first MCZ in Welsh waters was established, Skomer MCZ. These sites are intended to protect habitats and species not necessarily covered by existing mechanisms and complement the existing MPA network designated under the Habitats and Birds Directives (see **Section 2.4.3**).

2.3.3. Planning (Wales) Act 2015

25. The application for the Transport and Works Act Order will be accompanied by an application for deemed planning permission. The decision in respect of the application will have due regard to the requirements of the Planning (Wales) Act 2015.

26. The Planning (Wales) Act 2015 sets out the legislative changes to deliver reform of the planning system in Wales. The main objectives of the Planning (Wales) Act 2015 are to improve the existing planning process by producing a modernised framework for the delivery of planning services, strengthening the plan led approach, improving resilience, improving the development management system and enabling effective enforcement. The Planning (Wales) Act 2015 introduced a statutory framework for the planning system in Wales, and any statutory body carrying out a planning function must exercise those functions in accordance with the principles of sustainable development as set out in the Well Being of Future Generations (Wales) Act 2015 (see **Section 2.3.5**).

2.3.4. Wales Act 2017

27. The Wales Act 2017 introduces a new reserved powers model of devolution for Wales. The Wales Act 2017 makes the National Assembly a permanent part of the UK's political framework. As a result, the National Assembly will be able to legislate on anything not reserved to the UK Parliament. The Wales Act 2017 therefore devolves powers to the National Assembly and Welsh Government in areas including consenting for new energy projects. The Wales Act 2017 provides significant powers and responsibility to the Welsh Government over energy and environmental matters, including authorising planning permission for energy generating schemes up to 350 MW. Although the Wales Act 2017 came into force in 2017, whilst the powers rest with the Welsh Government, the framework for the majority of changes, including the exercise of the reserved powers model, is not yet in place.

2.3.5. The Well Being of Future Generations (Wales) Act 2015

28. The Wellbeing of Future Generations (Wales) Act 2015 promotes improvement of the social, economic, environmental and cultural well-being of Wales. The Wellbeing of Future Generations (Wales) Act 2015 places a statutory duty on public bodies in relation to sustainable development, based on seven well-being goals, outlined in **Table 2-2**.

29. Climate change is integral to the wellbeing goals, which recognise that the case for action on climate change is clear and fundamental to future prosperity and the future resilience of communities. The Wellbeing of Future Generations (Wales) Act 2015 provides a mechanism for public bodies to set targets and report progress against indicators. Through its well-being objectives, the Wellbeing of Future Generations (Wales) Act 2015 sets a clear agenda for sustainable development.

Table 2-2 Well-Being Goals and Adherence by the Project

Well-being Goal	Description	How is this addressed by the Project
A prosperous Wales	An innovative, productive and low carbon society which recognises the limits of the global environment and therefore uses resources efficiently and proportionately (including acting on climate change); and which develops a skilled and well-educated population in an economy which generates wealth and provides employment opportunities, allowing people to take advantage of the wealth generated through securing decent work.	If built, the Project would have a design life of approximately 37 years, after which it may be either decommissioned or repowered (subject to separate consenting). During its operation the project would contribute to reaching global, European and national targets on CO_2 reduction and renewable energy production. It is estimated that the Project could produce enough electricity each year to power the equivalent of over 188,000 houses. Further information on tidal energy is provided in **Chapter 1, Introduction**.
A resilient Wales	A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).	The ES details the considerations of the Project on the baseline environment for a number of key receptors. A habitats regulations assessment (HRA) report has been compiled to inform the assessment as to whether the Project has the potential to have an adverse effect on the integrity and features of a Natura 2000 site. Where appropriate, mitigation measures are provided to ensure that no residual significant impacts are caused by the Project. The technical chapters (**Chapters 7** to **26**) outline any legislation which is specific to the relevant receptors. Information to support the HRA is provided in **Document MOR/RHDHV/DOC/0067, Information to Support HRA**.
A healthier Wales	A society in which people's physical and mental well-being is maximised and in which choices and behaviours that benefit future health are understood.	An assessment of the impacts of the project on Health and Socio-economics is provided in **Chapter 25, Socioeconomics, Tourism and Recreation**. The Project will have no significant negative impact on health and wellbeing, and is expected to have a minor beneficial impact to a number of receptors.
A more equal Wales	A society that enables people to fulfil their potential no matter what their background or circumstances (including their socio-economic background and circumstances).	An assessment of the impacts of the project on Socio-economics is provided in **Chapter 25, Socioeconomics, Tourism and Recreation**. The Project is being developed by Menter Môn Morlais Limited (hereafter referred to as Menter Môn). Menter Môn is a not for profit, third sector social enterprise, delivering socioeconomic development projects across North Wales. Menter Môn's motivation for the Project is to position itself

Well-being Goal	Description	How is this addressed by the Project
		as a community agency at the centre of renewable innovation, and to establish Anglesey as a marine energy hub, thereby securing maximum added value for the local economy and community.
A Wales of cohesive communities	Attractive, viable, safe and well-connected communities.	The developers of the Project have a strong local presence on Anglesey and are committed to developing renewable energy on the Island. The developers of the Project also have a desire to increase and diversify employment and economic development opportunities across the communities.
A Wales of vibrant culture and thriving Welsh language	A society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts, and sports and recreation.	Menter Môn is a welsh-speaking not for profit company providing solutions to the challenges facing rural Wales. The developer works with businesses, communities and individuals, to deliver meaningful projects, that harness their strengths and contribute to a sustainable future. Menter Môn embrace and recognise the value of our resources and seek to add value for the benefit of the community. These include natural and built environment, cultural heritage, agricultural and food sectors and most importantly the Welsh people. Copies of the Morlais Non-Technical Summary (NTS) and the Transport and Works Act Order are available in Welsh.
A globally responsible Wales.	A nation which, when doing anything to improve the economic, social, environmental and cultural well-being of Wales, takes account of whether doing such a thing may make a positive contribution to global well-being.	The Project seeks to provide a platform for commercial tidal energy device development, the first of this scale in the world. Evidencing the Projects importance, the development phase has been supported by the European Regional Development Fund.

2.3.6. Maritime Spatial Planning Directive

30. The Maritime Spatial Planning Directive (EU Directive 2014/89) (MSPD) has been in effect since September 2014. The Directive requires EU countries to draw up maritime spatial plans no later than 31st March 2021. These plans will enable public authorities to organise human activities in marine areas ensuring efficiency and sustainability of ecological, economic and social objectives.

31. Draft Resource Areas (RA) and Strategic Resource Areas (SRA) are identified within the draft Welsh National Marine Plan (WNMP) currently under preparation. RAs are broad areas that describe the distribution of a particular resource that has the potential to be used or is used by certain marine sectors, e.g. aggregates, aquaculture or marine energy. SRAs are used to further allocate space and focus future use of the Welsh inshore and offshore areas. These are areas of good opportunity for future use by a particular sector over the plan period and beyond. SRAs lie within the related RA. SRAs have been identified at a broad scale; local issues and

constraints that relate to the general policies that have a spatial dimension will be taken into account when considering individual proposals. As laid out in the WNMP, the Project is located within a SRA identified for Tidal Stream Energy.

2.3.7. National Policy Statements

2.3.7.1. National Policy Statement

32. The Project is seeking consent for a Transport and Works Act Order from the Welsh Ministers and a Marine Licence from Natural Resources Wales (NRW). Although this Project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP), therefore guidance relevant to NSIPs is considered appropriate to use for this Project. Guidance that is relevant to assessing impacts on marine water and sediment quality for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to marine water and sediment quality include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011b); and
- NPS for Renewable Energy Infrastructure (EN-3), July 2011 (DECC, 2011c).

33. The NPS for renewable energy infrastructure (EN-3) does not cover other types of renewable energy generation that are not at present technically viable over 50MW onshore or over 100MW offshore such as schemes that generate electricity from tidal stream or wave power. It is expected that tidal range schemes may be the subject of applications to the IPC within the near future (DECC, 2011c).

2.3.7.2. Marine Policy Statement

34. The Marine Policy Statement (MPS) adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made in order to enable sustainable development. The MPS sets out a vision of having ‘clean, healthy, safe, productive and biologically diverse oceans and seas’ by supporting the development of Marine Plans.

35. The MPS states that “*Marine based activities can provide opportunities for employment in long established industries such as…offshore electricity transmission. This employment provides wide and long-term benefits for both national and local economies*.”

36. Furthermore, it is expected that “*Wave and tidal stream technologies also have significant potential in the medium to long-term*”. The MPS estimated that up to 20 % of the UK’s current energy demand could be supplied by wave and tidal energy.

37. The MPS states that “*It is important for marine planning to take account of appropriate locations for such developments alongside more established uses of marine space and to recognise the timescales and stages against which the sector is likely to progress, including the lead time for grid and infrastructure development. For example, pre-commercial demonstration deployments will need to manage the potential environmental impacts in relation to the scale of risks and*

legislative requirements while recognising that not all uncertainties can be addressed in the early life of this technology."

38. The document suggests to developers that adaptation and mitigation methods for these technologies may be supported by detailed monitoring programmes and co-ordinated research initiatives, including post deployment of devices. This approach is being followed by Menter Môn, with the intention to supply a detailed construction and operation monitoring and mitigation plan.

39. All public authorities are to take into account the MPS and relevant Marine Plans when making decisions in regard to the marine area. This ensures that marine resources are used in a sustainable way in line with the high-level marine objectives.

2.3.7.3. Welsh National Marine Plan

40. By adopting the MPS, the Welsh Government committed to the requirement to introduce Marine Plans for Wales. The Project adheres directly to the vision for the Welsh inshore and offshore marine planning region, which states that during the 20-year plan period the Welsh Government will ensure that "*Through the responsible deployment of low carbon technologies, the Welsh marine area is making a strong contribution to energy security and climate change emissions targets*".

41. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the WNMP. The WNMP is being developed in accordance with the MCAA, the MPS and the MSPD. A draft version has been issued for consultation with the aim of publishing the document in summer 2019.

42. Until the WNMP comes into effect, the MCAA, MPS and MSPD will be adhered to and the guidance within the draft WNMP has been referred to within this section.

43. The Project falls within the supporting sector policy 'ELC_01: Low carbon energy (supporting)', as detailed within the draft WNMP. The draft WNMP states that "*Proposals for all types of marine renewable energy generation (wind, tidal and wave energy) and associated infrastructure are strongly encouraged, especially: a) in corresponding wave, tidal stream and any other defined renewable energy technology test and demonstration zones; and b) in corresponding wave, tidal stream and tidal lagoon Strategic Resource Areas. Relevant public authorities should, in liaison with the sector and other interested parties, collaborate to understand opportunities for the sustainable use of: a) renewable energy Strategic Resource Areas; and b) wider natural resources that provide renewable energy potential in order to support the sustainable growth of the renewable energy sector through marine planning".*

44. The draft WNMP contains the policies in **Table 2-3** which are particularly relevant to the Project.

Table 2-3 WNMP Policies Relevant to the Project

Policy	Details	Where this is considered within the ES
ECON_01: Blue growth	Proposals for economically sustainable activities are encouraged, particularly where they contribute to: ▪ a more resilient economy; ▪ employment opportunities particularly for coastal communities; ▪ generating wealth; ▪ allowing people to take advantage of the wealth; ▪ protecting and creating employment at all skill levels; ▪ maintaining communities with a high-density of Welsh speakers; ▪ tackling poverty by supporting deprived coastal communities; and / or ▪ the sustainable management of natural resources thereby supporting ecosystem resilience.	Chapter 1, Introduction and Chapter 25, Socioeconomics, Tourism and Recreation
SOC_02: Well-being of coastal communities	Proposals that contribute to the well-being of coastal communities are encouraged.	Chapter 25 Socio-economics, Tourism and Recreation
SOC_05: Historic assets	Proposals should demonstrate how potential impacts on historic assets and their settings have been taken into consideration at an early stage and should, in order of preference: a) avoid adverse impacts on historic assets and their settings; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Opportunities to enhance historic assets are encouraged.	Chapter 13 Offshore Archaeology and Cultural Heritage Chapter 20 Onshore Archaeology and Cultural Heritage Chapter 24 Seascape, Landscape and Visual Impact Assessment
SOC_06: Designated landscapes	Proposals that demonstrate that they are compatible with the purposes and special qualities for which National Parks or Areas of Outstanding Natural Beauty have been designated are encouraged.	Chapter 24 Seascape, Landscape and Visual Impact Assessment
SOC_07: Seascapes	Proposals should demonstrate how potential impacts on seascapes have been taken into consideration at an early stage and should, in order of preference: a) avoid adverse impacts on seascapes; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Opportunities to enhance seascapes are encouraged.	Chapter 24 Seascape, Landscape and Visual Impact Assessment
SOC_12: Support for wider resilience to climate change	Relevant public authorities should support opportunities that contribute towards climate change adaptation and/or mitigation	Chapter 2 Policy and Legislation

Policy	Details	Where this is considered within the ES
ENV_05: Underwater Noise	Proposals should demonstrate that they have considered man-made noise impacts on the marine environment and, in order of preference: a) avoid adverse impacts; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding	Chapter 9 Benthic and Intertidal Ecology, Chapter 10 Fish and Shellfish Ecology, Chapter 12 Marine Mammals, Chapter 14 Commercial Fisheries
ENV_06: Air and Water Quality	Proposals should demonstrate that they have considered their potential air and water quality impacts and should, in order of preference: a) avoid adverse impacts; and/or b) minimise adverse impacts where they cannot be avoided; and/or c) mitigate adverse impacts where they cannot be minimised. If significant adverse impacts cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding.	Chapter 8 Marine Water and Sediment Quality, Chapter 22 Air Quality
ELC_01: Low carbon energy (supporting)	Proposals for all types of marine renewable energy generation (wind, tidal and wave energy) and associated infrastructure are strongly encouraged, especially: a) in corresponding wave, tidal stream and any other defined renewable energy technology test and demonstration zones; and b) in corresponding wave, tidal stream and tidal lagoon Strategic Resource Areas. Relevant public authorities should, in liaison with the sector and other interested parties, collaborate to understand opportunities for the sustainable use of: a) renewable energy Strategic Resource Areas; and b) wider natural resources that provide renewable energy potential in order to support the sustainable growth of the renewable energy sector through marine planning.	Chapter 1 Introduction, Chapter 3 Site Selection and Consideration of Alternatives and Chapter 4 Project Description
GOV_01: Cumulative effects	Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	Chapter 26, Cumulative Impact Assessment

45. The WNMP outlines the following aspects that Menter Môn should be undertaking to ensure that the Project is in accordance with the plan:

- Engage early across and between relevant stakeholders;
- Apply the general cross-cutting and sector-specific policies set out in this plan to guide proposals;
- Consider the potential beneficial and adverse impacts of their proposed activity on the economy, society and the environment; minimise adverse effects and maximise opportunities for coexistence and securing multiple benefits;
- Supply the information required for the relevant public authorities to assess their proposal(s) including fit with relevant planning policy; and
- Ensure that evidence provided is sound and proportionate given the development in question and its associated risks.

46. Each of the above has been provided throughout the EIA process (**Chapter 5, EIA Methodology**).

2.3.7.4. Planning Policy Wales

47. Planning policy for Wales is set out in the document Planning Policy Wales (Welsh Government, 2018). The planning policy document outlines the Welsh Government's approach to ensuring that the planning system contributes to the delivery of sustainable development and improves the social, economic, environmental and cultural well-being of Wales, as required by the Planning (Wales) Act 2015 and the Well-Being of Future Generations (Wales) Act 2015.

48. The Planning Policy also takes into consideration meeting the aims of Sustaining a Living Wales document to ensure that development does not take precedence over and impact on other factors. The policy encourages a positive approach to the development of renewable and low carbon energy development and encourages collaboration where possible.

49. The Project falls within the following Planning Policy Wales key planning principles:

- Growing Our Economy in a Sustainable Manner;
- Making Best Use of Resources;
- Facilitating Accessible and Healthy Environments;
- Creating and Sustaining Communities; and
- Maximising Environmental Protection and Limiting Environmental Impact.

50. The following Planning Policy Technical Advice Notes (TAN) have been reviewed within the relevant chapters of the ES:

- TAN 5: Nature Conservation and Planning;
- TAN 8: Renewable Energy;
- TAN 11: Noise;
- TAN 12: Design;
- TAN 13: Tourism;
- TAN 14: Coastal Planning;

- TAN 15: Development and Flood Risk;
- TAN 18: Transport;
- TAN 21: Waste;
- TAN 23: Economic Development; and
- TAN 24: The Historic Environment

2.3.8. Regional Plans

2.3.8.1. Anglesey and Gwynedd Joint Local Development Plan (JLDP)

51. Development of the Project will support those objectives of the 2017 Anglesey and Gwynedd Joint Local Development Plan, aimed at promoting the development of renewable or low carbon energy technologies. The project will prioritise maximising opportunities for local communities directly via employment and indirectly via the establishment of a local supply chain.

52. Of the policies contained in the JLDP, those presented in **Table 2-4** are considered to be of particular relevance to the Project.

Table 2-4 Relevant Policies of the Anglesey and Gwynedd JLDP

Policy	Description	Where considered within the ES
Strategic Policy PS 1: Welsh Language and Culture	Promote and support the use of the Welsh language in the Plan area.	Menter Môn are a welsh-speaking company. Copies of the NTS and the draft Transport and Works Act Order are available in Welsh.
Strategic Policy PS 2: Infrastructure and Developer Contributions	New development to ensure sufficient provision of essential infrastructure (either on-site or to service the site) is either already available or provided in a timely manner to make the proposal acceptable.	**Chapter 3, Site Selection and Consideration of Alternatives** **Chapter 4, Project Description**
Policy ISA 1: Infrastructure Provision	Proposals will only be granted where adequate infrastructure capacity exists or where it is delivered in a timely manner.	
Policy TRA 2: Parking Standards	Parking provision for all modes of transport should be in accordance with the Councils' Parking Standards.	Parking, traffic and transport impacts during construction and operation are outlined within **Chapter 23, Traffic and Transport**.
Policy TRA 4: Managing Transport Impacts	Where appropriate, proposals should be planned and designed in a manner that promotes the most sustainable modes of transport	
Strategic Policy PS 5: Sustainable Development	Development will be supported where it is demonstrated that they are consistent with the principles of sustainable development	The nature of the Project is to alleviate the causes of climate change and develop low carbon technologies.

Policy	Description	Where considered within the ES
Strategic Policy PS 6: Alleviating and Adapting to the Effects of Climate Change	Proposals will only be permitted where it is demonstrated that they have fully taken account of the energy hierarchy and reducing greenhouse gas emissions	**Chapter 4, Project Description**
Policy PCYFF 1: Development Boundaries	Proposals within Development Boundaries will be approved in accordance with the other polices and proposals of this Plan, national planning policies	The Project considers the relevant Development Boundaries within the JLDP. All relevant local and national plans and policies are considered within **Chapter 2, Policy and Legislation**.
Policy PCYFF 2: Development Criteria	A proposal should demonstrate its compliance with: 1. Relevant policies in the Plan; 2. National planning policy and guidance	
Policy PCYFF 3: Design and Place Shaping	All proposals will be expected to demonstrate high quality design	**Chapter 3, Site Selection and Consideration of Alternatives**; **Chapter 4, Project Description**; **Chapter 24, Seascape, Landscape and Visual Impact Assessment**
Policy PCYFF 4: Design and Landscaping	All proposals should integrate into their surroundings	
Strategic Policy PS 7: Renewable Energy Technology	the Plan area wherever feasible and viable realises its potential as a leading area for initiatives based on renewable or low carbon energy technologies	**Chapter 1, Introduction**; **Chapter 3, Site Selection and Consideration of Alternatives**; **Chapter 4, Project Description**
Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	Proposals for renewable and low carbon energy technologies, other than wind or solar, which contribute a low carbon future will be permitted, provided that the proposal conforms to certain criteria	**Chapter 7** to **26** present the assessments of impacts from the Project on all receptors.
Policy ARNA 1: Coastal Change Management Area (CChMA)	Proposals for the following types of new non-residential development will be permitted on sites within the CChMA predicted as being at risk from coastal change during the second indicative policy epoch (2026 – 2055), subject to a compliant Flood Consequence Assessment or a Stability Assessment.	**Chapter 17, Water Resources and Flood Risk**. A Flood Risk Assessment has been prepared and is appended to **Chapter 17, Water Resources and Flood Risk**.
Strategic Policy PS 13: Providing Opportunity for a Flourishing Economy	Whilst seeking to protect and enhance the natural and built environment, the Councils will facilitate economic growth in accordance with the spatial strategy of the Plan	**Chapter 3, Site Selection and Consideration of Alternatives**; **Chapter 25, Socioeconomics, Tourism and Recreation**.
Strategic Policy PS 14: The Visitor Economy	Ensuring compatibility with the local economy and communities and ensuring the protection of the	Menter Môn will ensure design of the Project takes appropriate consideration of landscape and seascape sensitivities.

Policy	Description	Where considered within the ES
	natural, built and historic environment	**Chapter 24, Seascape, Landscape and Visual Impact Assessment**
Strategic Policy PS 19: Conserving and Where Appropriate Enhancing the Natural Environment	Manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline	**Chapter 19, Onshore Ecology**; **Chapter 24, Seascape, Landscape and Visual Impact Assessment**, **Chapter 25, Socioeconomics, Tourism and Recreation**
Policy AMG1: Area of Outstanding Natural Beauty (AONB) Management Plans	Proposals within or affecting the setting and/ or significant views into and out of the AONB must, where appropriate, have regard to the relevant Area of Outstanding Natural Beauty Management Plan.	
Policy AMG 4: Coastal Protection	Developments in Heritage Coasts must have overriding economic and social benefit and not cause unacceptable harm	**Chapter 19, Onshore Ecology**; **Chapter 20 Onshore Archaeology and Cultural Heritage; Chapter 24, Seascape, Landscape and Visual Impact Assessment; Chapter 25, Socioeconomics, Tourism and Recreation**
Policy AMG 5: LOCAL Biodiversity Conservation	Proposals must protect and, where appropriate, enhance biodiversity that has been identified as being important	**Chapter 19, Onshore Ecology; Document MOR/RHDHV/DOC/0067, Information to Support HRA.**
Policy AMG 6: Protecting Sites of Regional or Local Significance	Proposals that are likely to cause direct or indirect significant harm to Local Nature Reserves (LNR), Wildlife Sites (WS) 1 or regionally important geological / geomorphologic sites (RIGS) must have overriding economic and social benefit and not cause unacceptable harm	**Chapter 7, Metocean Conditions and Coastal Processes**; **Chapter 19, Onshore Ecology**
Policy PS 20: Preserving and Where Appropriate Enhancing Heritage Assets	It is important that heritage assets - encompassing archaeology and ancient monuments, listed buildings, conservation areas and historic parks, gardens and landscapes are preserved	**Chapter 20, Onshore Archaeology and Cultural Heritage**; **Chapter 24, Seascape, Landscape and Visual Impact Assessment**

2.3.8.2. Shoreline Management Plan

53. A Shoreline Management Plan (SMP) provides a large-scale assessment of the risks associated with coastal evolution and presents a policy framework to address these risks to people and the developed, historic and natural environment in a sustainable manner. In doing so, an SMP is a high-level document that forms an important part of the Department for Environment, Food and Rural Affairs (Defra) strategy for flood and coastal defence (Defra, 2001).

54. The SMP is a non-statutory policy document for coastal defence management planning. It takes account of other existing planning initiatives and legislative requirements and is intended to

inform wider strategic planning. The shoreline of Wales is divided into a number of Policy Development Zones (PDZ). The coastal area of the Project lies within PDZ17 – Holy Island and West Anglesey (Twyn y Parc to Twyn Cliperau). Further information on the baseline environment presented in the SMP is shown in **Chapter 7**, **Metocean and Coastal Processes**.

2.4. ENVIRONMENTAL LEGISLATION

2.4.1. The EIA Directive

55. Environmental Impact Assessment (EIA) was introduced under the EU EIA Directive 85/337/EEC in 1985 (as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC). In 2011, the original EIA Directive and amendments were codified by EIA Directive 2011/92/EU (as amended by Directive 2014/52/EU) (the EIA Directive). The EIA Directive ensures that projects likely to have significant effects on the environment are subject to an EIA prior to their approval or authorisation. The requirement to comply with them is transposed into law by regulations and/or amendments legislation such as the Transport and Works Act 1992 and Transport and Works (Applications and Objections Procedure) (England and Wales) Rules 2006.

56. Key changes which are of note relate to:

- A requirement to provide a description of the likely significant effects of the development on the environment resulting from impacts on climate change, risks to human health and use of natural resources;
- Ensuring EIA quality by requiring that those who undertake the work are competent experts;
- More detailed demonstration of the consideration of reasonable alternatives to the proposed Project; and
- Further consideration of how to avoid, prevent, reduce and / or off-set significant adverse effects where possible and develop monitoring strategies.

2.4.2. The Marine Works (Environmental Impact Assessment) Regulations 2010 (as amended)

57. In respect of works in respect of which a marine licence is required, the EIA Directive has been implemented in to national legislation by The Marine Works (Environmental Impact Assessment) Regulations 2010 as amended by the Marine Works (Environmental Impact Assessment) (Amendment) Regulations 2017. These Regulations implement the EIA Directive, referring to Annex I projects that require mandatory EIA and Annex II projects which may be subject to an EIA, should certain thresholds be exceeded. The Project will require an EIA as an Annex II project that exceeds the relevant thresholds.

58. Schedule 3 of the Marine Works (EIA) Regulations 2010 (as amended) sets out information that must be included in the ES, including:

- A description of the Project;
- A description of the reasonable alternatives studied by the applicant;

- A description of the baseline environment and an outline of the likely evolution thereof without implementation of the Project;
- A description of the factors likely to be significantly affected by the Project;
- A description of the likely significant effects of the project on the environment, including direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects;
- A description of the forecasting methods or evidence used to identify and assess the significant effects on the environment including details of difficulties (for example, technical deficiencies or lack of knowledge) encountered compiling the required information and the main uncertainties involved;
- A description of the measures envisaged to avoid, prevent, reduce or if possible offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements (for example, the preparation of a post-project analysis);
- A description of the expected significant adverse effects of the Project on the environment deriving from the vulnerability of the project and the regulated activity to risks of major accidents or disasters which are relevant to the Project and the regulated activity concerned;
- A non-technical summary of the information provided; and
- A reference list detailing the sources used for the descriptions and assessments included in the report.

2.4.3. The Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017

59. Following the amendment to the EIA Directive, the Town and Country Planning (EIA) (Wales) Regulations 2017 came into force. The Town and Country Planning (EIA) (Wales) Regulations 2017 restate the EIA Regulations, with amendments to reflect the changes required by the 2014 Directive and some domestic policy.

60. The primary purpose of the Town and Country Planning (EIA) (Wales) Regulations 2017 is to transpose the changes made to the EIA Directive in respect of land use planning. The Town and Country Planning (EIA) (Wales) Regulations 2017 would therefore be engaged by the grant of deemed planning permission for the onshore works.

2.4.4. Habitats and Birds Directive

61. EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (known as the Habitats Directive) is intended to protect biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed in the Annexes to the Directive at a favourable conservation status. It provides robust protection for those habitats and species of European importance.

62. EC Directive 2009/147/EC on the Conservation of Wild Birds (known as the Birds Directive) provides a framework for the conservation and management of, and human interactions with, wild birds in Europe. It sets broad objectives for a wide range of activities.

63. For territorial waters in England and Wales, where the Project is located, the Habitats Directive and the Birds Directive are implemented under the Conservation of Habitats and Species Regulations 2017 (the Habitats Regulations). The provisions of the Birds Directive are implemented through the Wildlife and Countryside Act 1981 (as amended) and the Habitats Regulations, as well as other legislation related to the uses of land and sea.

64. Under this legislative framework a network of protected areas (the Natura 2000 network) has been established. These protected areas include Special Areas of Conservation (SAC) for habitats and species, and Special Protection Areas (SPA) for wild birds.

65. Ramsar Sites are designated under the Convention on Wetlands of International Importance, ratified by the UK in 1976. Ramsar sites are afforded protection as if they were part of the Natura 2000 network (i.e. SPAs and SACs as set out in the Habitats Regulations). The majority are also classified as SPAs and all terrestrial Ramsar sites in Wales are also notified as Sites of Special Scientific Interest (SSSIs) (see **Chapter 19, Onshore Ecology**).

66. Under the Habitats Regulations the Secretary of State, before granting consent for a plan or project, must consider whether a plan or project has the potential to have a significant effect on a Natura 2000 site either alone or in combination with other plans or projects if it is not directly connected with or necessary to the management of that site. If there is potential for a plan or project to have a likely significant effect on a Natura 2000 site, there is a requirement for the competent authority (in this case NRW (Marine Licence) and Welsh Government (Transport and Works Act Order)) to carry out an Appropriate Assessment. This process is known as Habitats Regulations Assessment (HRA). However, it is the developer's responsibility to provide sufficient information to the competent authority to enable them to assess whether there are likely to be any significant effects and to enable them to carry out the Appropriate Assessment. A standalone Habitats Regulation Assessment (HRA) report is submitted alongside this ES as part of the application (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). This report will provide all the necessary information for the competent authority to carry out the Appropriate Assessment as required before determining applications for the Transport and Works Act Order and Marine Licence.

67. European Protected Species (EPS) are animals and plants listed in Annex IV of the Habitats Directive for whom Great Britain is their natural range. They are listed in Schedules 2 and 5 of the Habitats Regulations. The Habitats Regulations make it an offence to kill, injure, capture or disturb marine EPS and to pick, collect, cut, uproot or destroy a wild plant which is an EPS. In relation to the Project, **Chapter 12, Marine Mammals** will identify whether an EPS licence is expected to be required for disturbance of cetaceans in the study area and **Chapter 19, Onshore Ecology** will discuss the potential requirement of an EPS licence for terrestrial species. The need for an EPS licence will be determined in consultation with NRW.

2.4.5. Water Framework Directive

68. The EU Water Framework Directive 2000/60/EC is transposed into law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. The Regulations mean that the requirements of the Water Framework Directive (WFD) need to be considered at all stages of the planning and development process, which may impact on water bodies. The WFD requires that Environmental Objectives are set for all surface waters and ground waters in each EU Member State.

69. The WFD set a target of aiming to achieve at least ‘good status’ in all water bodies by 2015. However, provided that certain conditions are satisfied, in some cases the achievement of good status may be delayed until 2021 or 2027.

70. Specific mitigation measures are set for water bodies to achieve the Environmental Objectives of the WFD. These are listed within the Programme of Measures for each River Basin Management Plan (RBMP). RBMPs have been drawn up for each River Basin District across England and Wales and propose measures to protect and improve the water environment. These measures have been developed in consultation with organisations and individuals and are intended to mitigate impacts that have been or are being caused by human activity, such as flood and coastal defence works, with the aim of restoring and enhancing the quality of the existing environment. The Project is located within the Western Wales River Basin District. **Chapter 17, Water Resources and Flood Risk** provides further information on the WFD as well as providing an assessment of the project in relation to the WFD objectives.

2.4.6. Marine Strategy Framework Directive

71. The Marine Strategy Framework Directive 2008/56/EC (MSFD) establishes a common approach and objectives for the prevention, protection and conservation of the marine environment. The MSFD outlines a transparent legislative framework for an ecosystem-based approach to the management of human activities, which supports the sustainable use of marine goods and services. It requires countries to develop strategies and set targets to achieve ‘good environmental status’ by 2020, which include measures that protect the marine ecosystem and ensure economic activities linked to the marine environment are sustainable.

72. The Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention) plays a key role as one of the co-ordinating mechanisms to help Member States meet the obligations of the MSFD. The OSPAR Convention has been signed and ratified by sixteen Contracting Parties, including the United Kingdom, and contains a series of Annexes covering prevention and elimination of pollution, assessment of the quality of the marine environment and protection and conservation of the ecosystems and biological diversity of the maritime area. **Chapter 8, Marine Water and Sediment Quality** provides further information on the MSFD.

2.4.7. Wildlife and Countryside Act 1981

73. The Wildlife and Countryside Act 1981 is the principal legislative mechanism for the protection of wildlife in Great Britain and is the means by which the Convention on the Conservation of European Wildlife and Natural Habitats (the 'Bern Convention') and the Habitats Directive are implemented. For territorial waters in England and Wales, where the Project is located, the Habitats Directive and the Birds Directive are implemented under the Conservation of Habitats

and Species Regulations 2017 (the Habitats Regulations). The provisions of the Birds Directive are implemented through the Wildlife and Countryside Act 1981 (as amended) and the Habitats Regulations, as well as other legislation related to the uses of land and sea.

74. The Wildlife and Countryside Act 1981 is divided into four parts. Those relevant to the Project are as follows:

- Part I: relates to the protection of wildlife; and
- Part II: deals with the protection of Sites of Special Scientific Interest (SSSIs) and other designated sites.

75. The Wildlife and Countryside Act 1981 provides for the notification and confirmation of Sites of Special Scientific Interest (SSSIs) through the local planning authority. SSSIs are sites identified for their flora, fauna, geological or physiographical features by Natural England in England and NRW in Wales. The Act also contains measures for the protection and management of SSSIs.

76. Any potential impacts on terrestrial flora and fauna are discussed further in **Chapter 19, Onshore Ecology** and those on marine flora and fauna in **Chapter 9, Benthic and Intertidal Ecology**, **Chapter 12, Marine Mammals**, and **Chapter 10, Fish and Shellfish**.

2.4.8. Countryside and Rights of Way Act 2000

77. The Countryside and Rights of Way Act 2000 (CRoW) provides for public access on foot to certain types of land, increases measures for the management and protection of SSSIs, strengthens wildlife enforcement legislation and provides for better management of Areas of Outstanding Natural Beauty (AONB).

78. The CRoW requires local authorities to produce management plans for each AONB, and enables the creation of Conservation Boards in order to assume responsibility for AONBs, particularly where the land designated crosses several local authority jurisdictions. The CRoW also requires all relevant authorities to have regard to the purpose of conserving and enhancing the natural beauty of AONBs when performing their functions. Any potential impacts as a result of the Project on the natural beauty of AONBs are discussed further in **Chapter 24, Seascape, Landscape and Visual Impact Assessment.**

2.4.9. Natural Environment and Rural Communities Act 2006

79. The UK Biodiversity Action Plan (UK BAP), published in 1994, was the UK Government's response to signing the Convention on Biological Diversity (CBD) at the 1992 Rio Earth Summit. The new UK post-2010 Biodiversity Framework replaces the previous UK level Biodiversity Action Plan.

80. The Natural Environment and Rural Communities (NERC) Act came into force in 2006. Section 42 (s42) of the NERC Act 2006 requires the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in Wales. The NERC Act is repealed by the Environment (Wales) Act 2016 (**Section 2.4.10**).

81. Fifty-five habitats and 557 species of principal importance are included on the s42 lists. These are all the habitats or species in Wales that were identified as requiring action in the UK BAP

and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework. They include terrestrial, freshwater and marine habitats and species.

82. Any potential impacts on habitats and species of principal importance as a consequence of the Project are discussed further in **Chapter 19, Onshore Ecology** and on marine flora and fauna in **Chapter 9, Benthic and Intertidal Ecology**, **Chapter 12, Marine Mammals** and **Chapter 10, Fish and Shellfish**.

2.4.10. The Environment (Wales) Act 2016

83. The Environment (Wales) Act 2016, which replaces the Section 40 and Section 42 duty in the NERC Act 2006, puts in place a modern statutory process to plan and manage natural resources in Wales. The Environment (Wales) Act 2016 enables Welsh resources to be managed in a more proactive, sustainable and joined up way and provides Welsh Ministers with powers to put in place statutory emission reduction targets. The Environment (Wales) Act 2016 also places a duty on Welsh Ministers to prepare and implement a statutory National Natural Resource Policy (NNRP) which should be used to set out priorities in relation the natural resource management.

84. Section 6 under Part 1 of the Environment (Wales) Act 2016 introduces a duty on local authorities in Wales to seek to enhance biodiversity and resilience of ecosystems when carrying out functions. Section 7 under the Environment (Wales) Act 2016 replaces the Section 42 duty in the NERC Act 2006. Welsh Ministers are required to publish and review lists of species and habitats in Wales, which are of key significance to sustain and improve biodiversity in relation to Wales. All public authorities, in complying with the Section 6 duty, must have regard to the Section 7 list of habitats and species. Currently, the interim list is exactly the same as the previous list under Section 42 of the NERC Act 2006; however, it is under review in consultation with NRW.

2.5. PROJECT DESIGN ENVELOPE (ROCHDALE ENVELOPE)

85. An essential element of any EIA is defining the project description against which impacts will be assessed. Due to the nature of the Project and the evolving nature of the tidal energy sector, full details of the offshore element of the proposed development cannot be fixed at the time of the application. For example, the tidal devices to be installed are dependent on an array selection process, and the detailed installation method is dependent on the tidal device type and the availability/procurement of vessels at the time of installation. Therefore, the project description and methods upon which this application for consent is based, fall within a range of defined criteria – an envelope of potential development, which describes the maximum potential extent and nature of the development. This approach allows a degree of flexibility in determining the final specific project details, while still meeting the requirements of the EIA process.

86. This approach is termed the 'Rochdale Envelope' approach in the context of applications for Development Consent Orders, with associated case law established in R.v Rochdale Metropolitan Borough Council ex p. Milne (2000). This approach is endorsed in the revised draft Overarching National Policy Statement (NPS) for Energy (EN-1), the revised draft NPS for Renewable Energy Infrastructure (EN-3), and guidance provided in the Infrastructure Planning Commission (IPC, now the Planning Inspectorate) Advice Note Nine.

87. The ‘Rochdale Envelope’ approach defines a series of realistic maximum extents and magnitudes for the description of a development (an envelope), of which the impacts are assessed. In this way a realistic ‘worst case scenario’ is assessed. Post consent, a detailed design of the scheme can vary within that envelope and the parameters assessed, without rendering the EIA inadequate. By adopting this approach, the ES can conclude that the environmental impact of the Project will be no greater than that set out in the ES and may be less.

88. **Chapter 4, Project Description** sets out the parameters of the Project. Where site specific details have not yet been finalised, then a minimum and maximum number have been presented. Where that specific parameter is relevant to the assessment, the worst case for that element has been identified by the relevant specialist and used as the basis for that assessment. Each technical chapter (**Chapters 7** to **27**) provides an outline of the relevant worst case for that receptor.

89. The design will be refined in response to technology availability, consultation, environmental sensitivities, choice of contractors and economic considerations. Best efforts have been made to incorporate all permutations of infrastructure that may be associated with the Project.

90. Prior to each array deployment, it is expected that there will be consent conditions requiring documentation to be submitted to the licensing authorities (Welsh Government and Natural Resources Wales, NRW) outlining the parameters of the tidal devices to be installed as well as providing details of the construction methodology, O&M strategy, and the array removal (decommissioning) methodology. This will allow review of each array’s characteristics against the consented Project Design Envelope (PDE).

91. A statement confirming that each array deployment fits within the PDE will be submitted by Menter Môn to the Welsh Government and NRW for approval. If an array deployment is outwith the PDE, additional consenting or amendment to the Project consent will be required before deployment.

92. In addition to the development site flexibility, options are included within the onshore site to allow the consent to be future proofed in relation to land availability and to allow flexibility to avoid constraints if identified during pre-construction site investigations. In particular, the Onshore Development Area (ODA) encompasses sufficient area to allow the micro-siting and potential relocation of onshore infrastructure if required.

2.6. REFERENCES

Committee on Climate Change (2018). Carbon Budgets: How We Monitor Emissions Targets. https://www.theccc.org.uk/tackling-climate-change/reducing-carbon-emissions/carbon-budgets-and-targets/ (accessed August 2018).

Department of Energy and Climate Change (DECC) (2011a). UK Renewable Energy Roadmap: 2011. https://www.gov.uk/government/publications/renewable-energy-roadmap (accessed August 2018).

DECC (2011b). Overarching National Policy Statement for Energy (EN-1). July 2011.

DECC, (2011c). National Policy Statement for Renewable Energy Infrastructure (EN-3). July 2011

(DECC (2012). UK Renewable Energy Roadmap: 2012 Update. https://www.gov.uk/government/publications/uk-renewable-energy-roadmap-update (accessed August 2018).

DECC (2013). UK Renewable Energy Roadmap: 2013 Update. https://www.gov.uk/government/publications/uk-renewable-energy-roadmap-second-update (accessed August 2018).

HM Government (2009a). The UK Renewable Energy Strategy. https://www.gov.uk/government/publications/the-uk-renewable-energy-strategy (accessed August 2018).

HM Government (2009b). The UK Low Carbon Transition Plan: National Strategy for Climate and Energy. https://www.gov.uk/government/publications/the-uk-low-carbon-transition-plan-national-strategy-for-climate-and-energy (accessed August 2018).

HM Government (2011). UK Marine Policy Statement. https://www.gov.uk/government/publications/uk-marine-policy-statement (accessed August 2018).

Isle of Anglesey County Council (IoACC) (2010). Energy Island Programme – Key Project Facts. http://www.anglesey.gov.uk/business/energy-island-isle-of-anglesey-north-wales/key-project-facts/energy-island-programme/ (accessed August 2018).

Welsh Government (2012a). Sustaining a Living Wales: A Green Paper on a New Approach to Natural Resource Management in Wales. https://gov.wales/betaconsultations/environmentandcountryside/sustainingwales/?lang=en (accessed August 2018).

Welsh Government (2012b). Energy Wales: A Low Carbon Transition. https://gov.wales/topics/environmentcountryside/energy/energywales/?lang=en (accessed August 2018).

Welsh Government (2018). Planning Policy Wales, Edition 9. https://gov.wales/planning-policy-wales (accessed April 2019).

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Morlais Project
Environmental Statement

Chapter 3: Site Selection and Consideration of Alternatives

Volume I

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-003

Chapter 3: Site Selection and Consideration of Alternatives

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GLOSSARY OF ABBREVIATIONS

DP	Dynamic Positioning
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ES	Environmental Statement
FEED	Front End Engineering and Design
GBS	Gravity Based Structures
HDD	Horizontal Directional Drilling
km	Kilometres
kV	Kilo volts
LAT	Lowest Astronomical Tide
MDZ	Morlais Demonstration Zone
MW	Megawatts
NRW	Natural Resources Wales
O&M	Operation and Maintenance
PDE	Project Design Envelope
RLB	Red Line Boundary
rpm	Rotations per Minute
TEC	Tidal Energy Converters
TWAO	Transport and Work Act Order
UKC	Under Keel Clearance

GLOSSARY OF TERMINOLOGY

Axial Flow	Horizontal axis rotors.
Category 1 tidal device	Seabed Mounted Sub-Surface Tidal Devices.
Category 2 tidal device	Buoyant Mid-water Column Tidal Devices.
Category 3 tidal devices	Floating and / or Surface Emergent Tidal Devices.
Cross Flow	Vertical axis rotors.

3. SITE SELECTION AND CONSIDERATION OF ALTERNATIVES

3.1. INTRODUCTION

1. Menter Môn Morlais Limited (hereafter referred to as Menter Môn) proposes the development of 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ). Development of the Morlais Project (the Project) will support the objectives of the Anglesey and Gwynedd Joint Local Development Plan (JLDP), aimed at promoting the development of renewable energy technology. The Project will prioritise the maximisation of opportunities for local communities directly via employment and indirectly via the establishment of a local supply chain. Through development of the Project, Menter Môn seeks to establish Anglesey as a marine energy hub.

2. The development of the Project will provide a consented tidal technology demonstration zone, specifically designed for the installation and demonstration of arrays of tidal energy devices (tidal devices). The Project will provide communal infrastructure to its tenants, tidal technology and project developers, enabling a shared route to grid connection using the Project's export cables, Landfall Substation, onshore cable route and Grid Connection Substation.

3. Details of the infrastructure that forms the Project and is considered in this ES, are provided in **Chapter 1, Introduction** and in **Chapter 4, Project Description**.

4. This chapter summarises the site selection process for the Project, including the background to selection of the MDZ, tidal devices, the offshore cable route, cable landfall location, landfall substation location, the onshore cable route, Switchgear Building location and the Grid Connection Substation location.

5. This chapter presents an overview of the decision-making process for each element of the project outlined above and is separated in to these discrete sections. However, note that these aspects are often interrelated and were undertaken in a parallel and iterative basis, rather than sequential approach. For example, selection of the landfall substation location was based on an overview of onshore constraints but also took into consideration the outcomes of the assessment of offshore export cable corridor and cable landfall point locations.

6. The broad process of project selection is outlined in **Plate 3-1**. The processes are iterative, ensuring that the ES chapters inform the decision-making process.

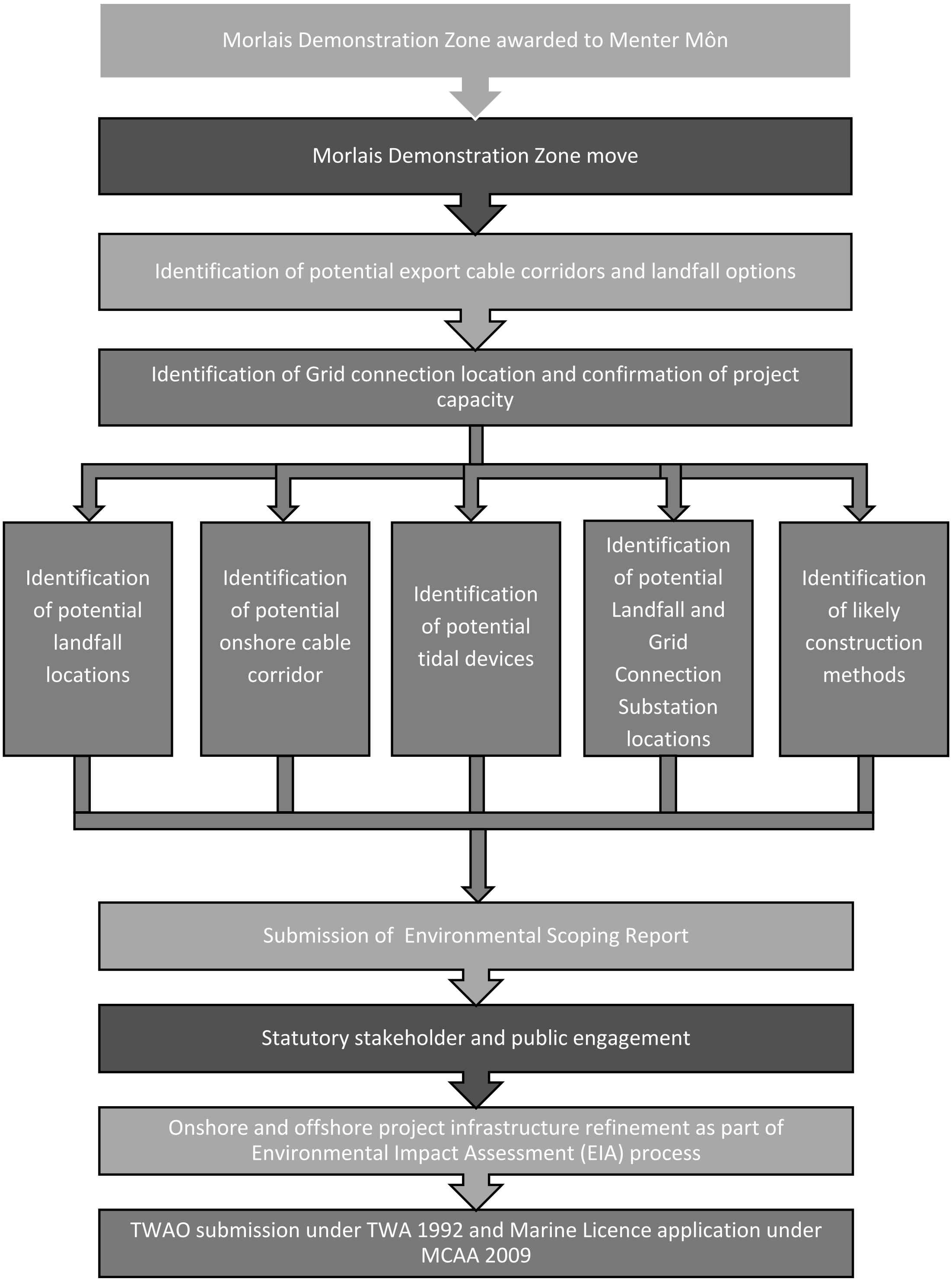

Plate 3-1 Site selection process for the Project

3.2. LEGISLATION AND GUIDANCE

3.2.1. Environmental Impact Assessment Regulations

7. The consideration of alternatives and major design decisions made during the development of a project has been part of Environmental Impact Assessment (EIA) legislation since the adoption of the original European Union (EU) EIA Directive 85/337/EEC in 1985 (as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC) and is also included within amended Directive 2014/52/EU.

8. The Marine Works (Environmental Impact Assessment) (Amendment) Regulations 2017 and The Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2016 provide the following description of what should be included within the Environmental Statement (ES); "*A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects*."

9. The Transport and Works (Applications and Objections Procedure) (England and Wales) Rules 2006 amend the wording slightly but do not significantly change the position. The legislation requires an ES to include "*an outline of the main alternatives to the proposed works studied by the applicant and an indication of the main reason for his choice, taking into account the environmental effects*".

3.3. WHY ANGLESEY?

10. The United Kingdom (UK) has the largest wave and tidal resource in Europe. The Marine Renewable Energy Strategic Framework (MRESF), found a potential for 1.5 to 6.5 GW of installed capacity in Welsh waters (Regeneris, 2013). **Chapter 1, Introduction** provides an overview of the tidal resource of the UK.

11. The MDZ is one of several development areas around the UK which have been identified by The Crown Estate (TCE) in a bid to encourage and accelerate technology development. Each area was identified because it offered appropriate wave and tidal energy potential, as well as access to necessary infrastructure, including ports and electricity grid.

12. The MDZ is an area of 35 km^2 located west of Holy Island, itself off the west coast of the Isle of Anglesey. The MDZ is approximately 7 km from north to south and 5 km from east to west, with the eastern boundary less than 1 km from shore at its closest point. The strength of tidal flow varies across the site with higher levels experienced to the north of the MDZ and in those parts of the MDZ closest to the coast of Holy Island.

13. The MDZ has a mean and maximum water depth of 38.4 m and 80 m, respectively. A mean spring peak velocity (V_{msp}) was estimated by TCE to be 1.7 m/s. Other sources estimate peak spring tide currents (V_{pk}) in excess of 2.5 m/s across large areas of the region (Piano *et al*., 2015), with the potential to reach accelerated flows of up to 3.1 m/s V_{msp} in some parts of the MDZ. The highest velocities within the MDZ are recorded just off Holy Island (4.0 m/s) (see **Chapter 7, Metocean Conditions and Coastal Processes**).

14. A feasibility study commissioned by Isle of Anglesey County Council (IoACC) (Feasibility Study for a Marine Energy Programme – a Marine Energy Sector Development Programme 2013) described the marine energy sector as "*a major opportunity for transformational economic growth*" for North Wales and recognised the importance of "*supporting and encouraging local marine skills capability and supply chain capacity…to create positive regional impacts and benefits*."

15. In pursuit of this commitment, IoACC established The Anglesey Energy Island Programme, a collective effort between several stakeholders within the public, private and third sectors working in partnership, putting Anglesey at the forefront of low carbon energy research and development, production and servicing, and bringing with it potentially huge economic rewards.

16. Energy Island's vision is to create a once-in-a-lifetime opportunity for jobs, economic growth and prosperity through capitalising on a number of transformational projects on Anglesey. The Energy Island Programme collaborates with a number of key stakeholders to:

- Attract and de-risk major strategic investment;
- Influence potential developers;
- Support development of competitive people and communities;
- Support development of competitive businesses;
- Support development of competitive infrastructure;
- Realise the benefits major projects can bring and mitigate adverse impacts; and
- Maximise long-term legacy benefits.

17. The developer, Menter Môn, is a not for profit social enterprise company providing solutions to the challenges facing North Wales. Menter Môn has a strong local presence on Anglesey and a passion for developing renewable energy on the Island, and to increase and diversify employment and economic development opportunities.

3.4. PROJECT ALTERNATIVES

18. A number of alternatives have been considered as part of the decision-making process. The early strategic project consideration of alternatives which fed directly into the site selection process are detailed in **Table 3-1**.

Table 3-1 Outline of Alternative Considerations and Final Selection

Topic	Consideration of alternatives	Final selection for the Project
Project size	The initial project concept had a capacity of less than 100 MW. However, the availability of tidal resource (velocities between 2.2 to 2.8 m/s across most of the site, with peak of 4.0 m/s) across the MDZ, updates in technology and increased interest from tidal device developers for deployment in the MDZ led to an increase in the proposed installed	The final capacity for the Project to be applied for consent is 240 MW.

Topic	Consideration of alternatives	Final selection for the Project
	capacity, initially to 180 MW and now to 240 MW.	
MDZ location	A review of the baseline metocean conditions highlighted that the tidal range across the MDZ is variable and is greater to the north and east of the MDZ. Shortly after appointment of Menter Môn as managers of the MDZ by TCE, Menter Môn requested to TCE that the MDZ be moved north, so as to include more areas of greater tidal resource.	Menter Môn consulted with marine stakeholders on the request to move the MDZ north. TCE subsequently agreed to the request.
Tidal devices	A wide variety of devices was initially proposed as providing exemplars to define the design envelope for the Project. The list of devices considered was revised to allow for removal of devices for which insufficient information was available to allow definition of design parameters.	12 shortlisted devices (those with sufficient information from developers), were used to define this aspect of the project design envelope. The tidal devices have been placed into categories depending on their scale, and their position in the water column (see **Section 3.8.1**).
Export cable corridor	An area from Holyhead to Trearddur Bay was analysed to identify suitable landfall points and substation locations. An initial review of the baseline physical environment by Menter Môn identified that cable burial would not be possible throughout the majority of the potential export cable corridor.	A variety of alternative cable laying options was reviewed due to the existing geomorphological conditions. This will be refined post submission; however, a worst-case scenario forms the basis of the Morlais ES (**Chapter 4, Project Description**).
Landfall area	A long list of 15 landfall areas with a variety of construction techniques was reviewed for suitability to the variable Holy Island coastline.	Landfall sites were shortlisted on the basis of a number of considerations including, nature conservation designations, existing infrastructure, feasibility of construction, seabed suitability for cable laying and length of export cables.
	A short list of four landfall locations within the Abrahams Bosom area of west Holy Island were selected for further investigation. Due to the cliff and foreshore geology, a range of construction techniques were reviewed.	Key receptors included noise and visual disturbance to residential properties adjacent to the landfall site, and minimising disturbance to both ecological designations, foreshore and cliff line within Area of Outstanding Natural Beauty (AONB) and Heritage Coast. Options for split pipe cable laying within trenches, and Horizontal Directional Drilling (HDD) were identified.
Landfall Substation	A long list of 13 landfall substation locations was considered. Landfall substation locations were shortlisted based on a number of considerations, including nature	A final site was chosen based on further consideration of nature conservation designations and landowner discussions. Further consideration of potential visual impacts results in the position of the Landfall Substation within

Topic	Consideration of alternatives	Final selection for the Project
	conservation designations, existing infrastructure and potential visual impacts. Key considerations were the feasibility of landfall construction using the preferred trenching and HDD methods, and the distance of the Landfall Substation from the landfall. A short list of four options, within Abrahams Bosom were selected for further investigation.	a recessive location in the landscape and uses the landform to help integrate the substation into the landscape.
Grid connection point	The closest four options to the project site were considered. Those were refined to the three closest, with two on Holy Island to minimise disturbance during cable trenching works; one at the Parc Cybi employment site and one at the existing Anglesey Aluminium and Orthios site.	The preferred location for connection to the existing electricity network, for the full 240 MW installed capacity, is the Grid Connection Substation at Orthios. This is due to the proximity to an existing substation for minimising visual impacts, technical considerations and the use of land within a brownfield site, in order to minimise disturbance to onshore ecology and local residents.
Switchgear station	The location of a substation at Parc Cybi was considered as one of 4 grid connection point options (above).	The 33 kV connection point at ‘Parc Cybi’ is selected as a suitable location for a switchgear building. This offers connection of early phases of the Project to the local electricity network, whilst the 132 kV grid connection point ‘Orthios’ is connected to the national transmission network.
Onshore cable route	Given the rural nature of the project, the location of the AONB, public perception and consultation with IoACC, it was decided that overhead cables would not be appropriate. Only options for traditional trenching methods of cable installation between the Landfall Substation and Grid Connection Substation were reviewed.	The final onshore cable route is selected to minimised disturbance to the natural environment on Holy Island. Therefore, the onshore cable route will be of up to 8.1 km total route length, dependent on final detailed route design, with the cables trenched into the local road network so much as is practicable given constraints in road width and services already within the road. The final cable corridor and proposed route is presented in **Chapter 4, Project Description**.

3.5. SITE SELECTION PROCESS

19. The siting, design and refinement of the Project has followed a site selection process, taking account of environmental, physical, technical, commercial and social considerations and opportunities, as well as engineering requirements. The aim has been to identifying sites that will be environmentally acceptable whilst also being technically and financially achievable. A multi-disciplinary design team was formed to undertake the site selection process, which included engineering and EIA consultants.

20. Menter Môn has undertaken extensive pre-application engagement with stakeholders, communities and landowners in order to refine the final project design, and to communicate decisions made to achieve those refinements.

21. Consultation and refinements to project layout and configurations has been undertaken since Menter Môn Cyf had been awarded the right to manage what was then known as the West Anglesey Demonstration Zone (WADZ) in July 2014. Further details of consultation are outlined in **Chapter 6, Consultation** and described in detail in the Consultation Report (**Document MOR/RHDHV/DOC/0066, Consultation Report**). In summary, mechanisms used to refine the project have included:

- Drop in Exhibitions held at locations within and adjacent to the Onshore Development Area;
  - First Public Information Day (PID) held on the 19th March 2019; and
  - Second PID held over three sessions on 11th, 12th and 17th June 2019.
  - Feedback from each group at the PIDs is incorporated into the Consultation Report (Document MOR/RHDHV/DOC/0066, Consultation Report) and used in the relevant receptor impact assessments, as well as being outlined in the ES.
- Community engagement events, focussing on town and community councillors;
- Engagement with relevant local authorities, landowners, community councils and other local stakeholders, in order to raise awareness of the Project, to outline the consenting process and to highlight opportunities to input to proposals.
  - Consultation has been undertaken directly with landowners and interested parties including tenants, occupiers and other parties with land rights. Engagement with individual land owners within or adjacent to the proposed development was managed directly by Menter Môn, with support from their appointed Land Agent. Letters were sent to all potentially affected parties offering to meet to discuss the project proposals;
- Menter Môn's land agents have contacted the affected landowners. A number of onshore cable route change suggestions have been put forward by those affected by the red line boundary (RLB). Menter Môn have been able to incorporate a number of those suggestions into the final design of the Project. Newsletters distributed throughout the Scoping Area, as described in the Consultation Report. These newsletters were distributed prior to each PID event; in March and June;
- Leafleting relevant communities to 'capture' hard to reach groups;
- Provision of a dedicated project website; and
- Regular and targeted discussion with regulators and other stakeholder bodies through various means including Technical Working Group meetings, where the siting of project infrastructure was discussed in detail. More information is provided in **Chapter 6, Consultation**.

22. In addition to the consultation activities presented below, Menter Môn met with the Planning Inspectorate and IoACC's Planning Officer on a regular basis throughout the development of

the Project, to provide updates and to seek advice on subjects including the site selection process, approach to the EIA and drafting the application documents.

3.6. DEFINING THE SCOPING AREA

23. The initial offshore scoping area followed the boundaries of the MDZ. The onshore scoping area encompassed the location of all landfall, substation and cable route options being considered, including appropriate buffers around each location (minimum of 500 m around landfall and onshore substation locations and 300 m around onshore cable routes). The buffers applied include all areas required for temporary construction.

24. The scoping area around the potential onshore infrastructure locations was developed to identify sensitive receptors likely to be present a distance of the development where they are likely to receive impacts. For most receptors, physical disturbance is likely to be a key consideration. Disturbance from noise is also likely to be a key consideration, particularly to ecological and human receptors.

25. Onshore construction works will be restricted to the footprint of the substations and onshore cable routes, plus an appropriate buffer, ensuring that physical disturbance is localised.

26. Noise receptors within 500 m of the substation are likely to be most impacted, although potential for impacts to occur beyond 500 m will also be considered within the EIA.

27. Potential for visual impact over a far greater area exists and zones of theoretical visibility (ZTV) were used to define the potential scale of impacts.

28. Terrestrial ecological receptors are anticipated to be less sensitive to cable installation, and a 300 m buffer was used for identifying sensitive receptors for this reason. The potential to impact on receptors further than 300 m away will also be considered in greater detail during the EIA.

29. Following the definition of the offshore project area, site selection for all other infrastructure was assessed in a strategic manner such that the areas identified would be sufficiently assessed and to allow for site refinement.

30. A number of external studies were commissioned by Menter Môn, including the following;

- Cable Routing Report (ITP Energised Ltd. (ITPE), 2018a);
- Device Developer Consultation Report (ITPE, 2018b);
- Generation Connection Options (Sustainable Electrical Supply Ltd. (SESupply) 2016;
- Morlais Above Ground Landfall construction options (ITPE, 2017);
- Preliminary Design Options Report (ITPE, 2018c); and
- Substation Location Feasibility Study (ITPE, 2016d).

31. The outputs of these technical studies are provided in sections (**Section 3.9.1** to **Section 3.12**).

32. Utilising the details within these technical studies, a Front-End Engineering Design (FEED) study was undertaken by ITP Energised (ITPE) on behalf of Menter Môn in 2017, to provide the

proposed design of the project necessary to inform the EIA project description for consent **(Appendix 4.1, Volume III)**. Further to a revision of proposed installed project capacity to 240 MW, an addendum to the study was undertaken for the MDZ elements **(Appendix 4.2, Volume III)**, also by ITPE. In parallel, Black and Veatch Ltd. (B&V) have been responsible for further design of, and updates to, the onshore infrastructure within the ODA.

3.7. IDENTIFICATION OF THE MORLAIS DEMONSTRATION ZONE

33. TCE's site selection process began in 2013 with the identification of 11 wave and tidal energy demonstration zones. The MDZ was identified as being a suitable location for the installation of tidal devices in the short to medium term, having a good tidal current resource, over a relatively uniform water depth to seabed and a relatively low wave regime.

34. TCE undertook extensive consultation with marine user groups during the process of demonstration zone identification and a competitive leasing process was then undertaken to identify suitable locally based organisations to manage and sub-let the sea bed within each of the zones.

35. In July 2014 TCE announced that Menter Môn had been awarded the right to manage what was then known as the West Anglesey Demonstration Zone (WADZ), and to sub-let use of the seabed to other bodies who could take forward the development of tidal technology in the UK. The WADZ is described in this ES as the Morlais Demonstration Zone (MDZ).

36. After an assessment of the distribution of tidal stream resource within the MDZ, in 2015, Menter Môn applied to TCE for the movement of the MDZ further to the north, to better capture the main areas of significant tidal stream flow to the west of Anglesey. Menter Môn consulted stakeholders on the proposed move and TCE approved the change in 2016.

3.8. IDENTIFICATION OF TIDAL ENERGY DEVICES

37. In order to understand the potential consent requirements for the project and the design envelope needed, it was necessary to identify the potential tidal devices which could be deployed within the MDZ.

38. A detailed review of the device types and technologies with realistic potential to be deployed in the MDZ was undertaken. A key objective of this review was to allow the Project Design Envelope to be defined to encompass a realistic range of tidal devices and technologies.

39. A number of tidal technology developers were contacted, either those expressing an interest in the project, or those whose technologies were considered to be potentially available at the time of the Project's construction.

40. The developers contacted were

- Andritz Hydro Hammerfest;
- Aquantis;
- Atlantis Resources Corporation;

- Instream Energy Systems;
- Magallanes;
- Nova;
- OpenHydro (now no longer trading);
- QED Naval;
- Renewable Devices;
- Repetitive Energy;
- Sabella;
- Orbital Marine Power;
- TidalStream (Schottel Hydro);
- Tocardo;
- Verdant Isles;
- Hydroquest; and
- Big Moon.

41. Consultation was undertaken to obtain information on the technical data of the devices, infrastructure requirements, and deployment, operation and maintenance requirements. Other objectives included obtaining an understanding of the approximate deployment timescales and phasing options and the power output characteristics to inform grid connection studies. A number of parameters were discussed and are summarised in **Table 3-2**.

Table 3-2 Design Considerations of Potential Tidal Devices to Inform PDE Development

Component	Design Considerations
Timing	Planned installation dates and phasing
	Length of deployments
Subzone layout	Number of devices
	Device spacing and potential layout of devices and infrastructure within the sub-zone
	Aggregation strategy
	Connection to transmission infrastructure
Device design	Device size
	Device configuration (axial/transverse/other)
	Surface piercing/floating/sub surface
	Foundation/mooring type and design (GBS/piled)
	Footprint of deployment
	Blade number, dimensions and rotation speed
	Electrical output – rated capacity and voltage; and import power requirements
	Control strategy including location of converters
	Communications and electrical isolation methodology
	Structure and materials

Component	Design Considerations
	Fluids on board and potential discharges
Installation approach	Duration and seasonality of offshore installation activity
	Installation equipment and vessels to be used
	Methodology
	Port requirements
	Hard standings and road access
Operational and maintenance considerations	Personnel and vessels required
	Frequency of scheduled maintenance interventions
	Frequency and type of scheduled surveys
	Unscheduled maintenance
	Back-up electricity supply requirement
	Port requirements
Decommissioning	Approach to decommissioning

3.8.1. Device Selection Methodology

42. A range of devices were identified during the initial consultation, from axial flow and cross flow turbines to turbine neutral platforms. The largest devices are 2 MW, and the smallest are between 50 kW and 100 kW. Rotor sizes vary between 5 m and 27 m in diameter. Some developers have a design employing more than one rotor on their structure. The average speed of TEC rotation considered within the Project Design Envelop (PDE) is between 7.5 and 26.7 rotations per minute (rpm).

43. Some developers would deploy surface emergent technology at the site. Whilst some require deep water (greater than 40 m), others would prefer shallower areas for deployment. Three foundation/mooring types are required: gravity base systems, drilled monopile and driller multi-pin pile.

44. The footprint of deployment varies significantly between developers, with single, bottom mounted turbines requiring a smaller seabed area per device (<300 m^2) in comparison to floating devices with a 'Swept Area' (area that could be subject to mooring line drag) up to 1,000 m^2 per device, in some cases.

45. Based on the information gained, significant consideration has been given to those device types which would be least likely to have an adverse effect on the particular site sensitivities (i.e. visual impact, collision risk to marine mammals and birds). There is a wide range of novel device types available; however, in order to achieve a meaningful impact assessment, some limitations were imposed. The typical, as well as the 'worst case', parameters for all of the devices are summarised in ITPE's Project Design Envelope Definition report to Menter Môn (ITPE, 2018c).

46. A number of device categories were excluded from further consideration due to technology status, or wider potential consenting risks. Those categories included;

- Surface emergent, seabed mounted tower;
- Large seabed mounted cross flow, horizontally orientated;

- Ducted cross-flow; and
- Other 'novel' designs.

47. The devices to be included within the Project Design Envelope have been categorised into three categories: seabed mounted devices, mid-water column devices and surface emergent / floating devices. Devices in each category can support single or multiple tidal energy converters (TEC), with those TECs potentially being of a horizontal axis, or vertical axis form. The categories are described in more detail in **Chapter 4, Project Description**, however, the following key elements are common across the device types:

- Foundation or anchors on the seabed;
- A supporting substructure;
- A Tidal Energy Converter (TEC);
- Seabed preparation; and
- Cable connections.

48. Further detail on the device types is included in **Chapter 4, Project Description**. The device types assessed in this EIA, are deemed to represent the most realistic worst case device parameters for deployment at Morlais. Any device types which are not encompassed by the Project Design Envelope, but which are proposed for deployment at Morlais following consent, will require additional licencing from the Welsh Government and NRW.

3.8.2. Zoning

49. The MDZ has been provisionally divided into eight indicative subzones. Each subzone should have the potential to be developed with up to 30 MW of installed capacity in terms of resource availability and physical space for deployment. However, the eventual installed capacity of each subzone will vary based on the nature of environmental constraints, potential requirements for phasing of deployment and the needs of specific tidal device developers. The Project Design Envelope is designed to represent a realistic worst-case scenario, incorporating the technologies most likely to be deployed, at a capacity and in a location that is realistic.

50. Indicative layouts, each with a different combination of device arrays (sub-categories) in different locations were examined, based on a number of constraints, such as tidal resource, water depth navigation and potential seascape impacts. Further information on the devices included in the PDE and indicative layouts are presented in **Chapter 4, Project Description**.

3.9. IDENTIFICATION OF EXPORT CABLE CORRIDOR AND LANDFALL AREA

3.9.1. Route Feasibility and Screening

51. An area of coast from Holyhead to Trearddur Bay was analysed to identify suitable cable landfall points export cable corridors. Areas outside of this region were not considered due to the length of the subsea cables that would be required from the offshore development site.

52. Offshore constraints identified in the export cable route feasibility exercise were as follows:

- Distance from the development site offshore to the identified landfall points;
- Bathymetry;
- Ground conditions and water depth in the area at landfall;
- Shipping and navigation routes;
- Existing infrastructure;
- Military Practice and Exercise Areas (PEXAs);
- Aggregate dredging grounds;
- Nature conservation designations;
- Commercial fishing; and
- Sensitive seabed features.

53. The majority of the coastline in this area is covered by high level designations, including:

- Glannau Ynys Gybi / Holy Island Coast Special Protection Area (SPA), Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI);
- North Anglesey Marine / Gogledd Môn Forol SAC;
- Anglesey Terns / Morwenoliaid Ynys Môn SPA;
- Ynys Mon / Anglesey Area of Outstanding Natural Beauty (AONB);
- South Stack Cliffs Royal Society for the Protection of Birds (RSPB) Reserve; and
- Holyhead Mountain Heritage Coast.

54. In parallel with the landfall and export cable corridor assessment, Menter Môn identified location options for provisional landfall substations (described further in **Section 3.10**). **Figure 3-2 (Volume II)** illustrates the nearby nature conservation designations and initial long list of landfall and landfall substation locations.

55. Due to the heterogenous and complex nature of the coastal area evidenced by the large number of designations, a comprehensive site selection and feasibility assessment was undertaken to better understand the ecological and geological risks associated with each landfall and offshore export cable corridor option. Where possible, sensitive designation have been avoided. From this, offshore export cable corridors were outlined (see **Figure 3-1, Volume II**).

3.9.2. Export Cable Specifications

56. Three main options (and variations on these) for connecting the MDZ to the landfall location were reviewed as part of the route feasibility process;

- **Option 1:** Individual cable to shore for each subzone
    - Option 1a: Multiple cables for each subzone
    - Option 1b: Multi-core cable used so sub-zones are combined in pairs, with one 6 core cable per 2 sub-zones

- **Option 2:** Single 132kV cable to shore for all subzones with offshore substation
    - Option 2a: As Option 2 but with multiple sub-surface hubs
- **Option 3:** Radial arrangement with sub-zones strung along main cable
    - Option 3a: Passive offshore hub
    - Option 3b: Multiple 33kV cables to shore.

57. A detailed assessment of each of these options was undertaken within the Morlais Preliminary Design Options Report (ITPE, 2018). Option 1 was the overall preferred option for a project of this scale. It offers the most flexibility to the Morlais developers and would fulfil many of the points raised throughout the developer consultation exercise. It represents the least technical risk out of all the options as no unproven technology will be deployed. Furthermore, most of the active electrical systems will be located onshore thus further reducing the risk, operation and maintenance (O&M) costs and minimising reliability issues.

58. Option 2 and Option 3 were not deemed to be suitable as a feasibility basis for this project.

3.9.3. Export Cable Corridor Route Options

59. In parallel with the ECC route selection, three landfall options were identified from the search areas, Abraham's Bosom, Porth Dafarch and Holyhead (Soldier's Point), based on a review of offshore constraints.

60. Following this assessment, high-level routes were identified based on the following parameters (**Figure 3-1, Volume II**);

- Nine separate cable tails installed through the landfall by HDD;
- Eight subsea export cables connecting the Morlais tails to developer projects deployed within each sub-zone; installed independently;
- Separation of 10 m between HDD entry points;
- Separation of 20 m between HDD exit points;
- Cable tail length would be equal to the water depth multiplied by three, plus an additional 5 m buffer;
- Avoiding the worst of the seabed features, and slopes of more than 10 degrees; and
- At least 10 m separation between cables where possible.

61. The Morlais Substation Location Feasibility Study (ITP, 2016) provides an initial assessment of the potential offshore cable route, taking into consideration ground conditions and seabed hazards. Due to the hard and rocky nature of the seabed at the Project site, cable burial is not viable along the offshore sections of the export cable routes.

62. Gradients and complex bathymetry are likely to mean that even surface laid cables will be at risk of moving or sliding if laid across these gradient slopes. Cables in this position could slide and become snagged on rocks, potentially leading to cable damage and failure through abrasion and wear. This is particularly relevant for the cables in the Morlais project as they are being

installed in a high current environment. In addition, the complex bathymetry could result in suspensions due to the inability of the cable to conform to bottom irregularities. Large suspensions could also lead to potential cable damage through strumming, abrasion and wear.

63. Selection of cable protection will be based on the site-specific hazards expected in the MDZ (i.e. fishing). This is especially important as the admiralty charts show an anchorage area close to the landfall locations. Where possible, steep gradients will be avoided, and cables laid in line with the tide to minimise cross current effects. This will in part be mitigated against by careful positioning and routing of the cables.

3.9.4. Refinement of Export Cable Corridor

64. In parallel with the ECC refinement, Menter Môn were undertaking a detailed feasibility of the landfall point and landfall substation location, described further in **Section 3.10**. This resulted in three preferred landfall options at Abrahams Bosom; known as Option 1, Option 5a, Option 8 (and Option 8a). The refined area of the export cable corridor is shown in **Figure 3-3 (Volume II).** Porth Dafarch and Holyhead (Soldier’s Point) were both discounted due to reasons associated with the landfall point and onshore cable corridor, in conjunction with the long export cable corridor routes from the MDZ compared to the Abrahams Bosom option**.**

65. Soldier’s Point (search areas V, W, X, Y on **Figure 3-2, Volume II**) was discounted due to the proximity to the Breakwater Country Park and the high visibility from most locations within the Park. The area was also discounted, as indicated in **Plate 3-2**, due to the disruption to the main town of Holyhead associated with the installation of the onshore cable route selection within the road network.

Plate 3-2 Onshore cable route options to Grid Connection

66. The Porth Dafarch search areas (N, R, Q, S, U on **Figure 3-2**, **Volume II**) included Porth Dafarch beach, which is owned by the National Trust. This sheltered sandy beach is very popular, especially divers as there is a wreck of a cargo ship lost in 1886 (SS Missouri) a short distance from shore. The beach also has a subsea communications cable buried within it and there would not be sufficient space to avoid this cable. A number of constraints were present, such as;

- Narrow inlets in the area give little room for cable landfall;
- Areas of steep and high ridges to the south west of the South Stack Cliffs Nature Reserve requiring the cable to route around and therefore require a longer offshore cable route than most other options;
- The area is fairly visible with little natural screening available in some cases;
- Rock cutting or blasting required to bury cables where minimal sediment cover on beaches.

67. The Cable Routing Report (ITPE, 2018) provides a detailed review of both the offshore and onshore cable routes for the Morlais project. The Project will install up to nine export cables connecting the Landfall Substation to the offshore arrays. An overview of each route is provided in **Section 3.9.4.1** to **3.9.4.3** below.

3.9.4.1. Routes from Landfall Option 1

68. The total length of the nine zone export cables (to the easternmost boundary of each subzone only) is approximately 31 km with this option.

69. Up to 120 individual rock bags or concrete mattresses is estimated to be required for this option.

70. This route uses the most northerly landfall of the three options. It presents slightly more cable installation challenge as the Horizontal Directional Drill (HDD) exit points are furthest into the bay and the sub-zone export cables require routing round the complex bathymetry to the north of the bay.

3.9.4.2. Route from Landfall Option 5

71. The total length of the nine export cables (to the easternmost boundary of each subzone only) is approximately 30.5 km with this option.

72. Up to 120 individual rock bags or concrete mattresses is estimated to be required for this option.

73. This route uses the central landfall of the three options. It has the shortest total HDD drill length and although the drill exit points are far into the bay, they are in the middle, emerging into a relatively flat area, allowing good routing options towards the MDZ.

3.9.4.3. Route from Landfall Option 8

74. The total length of the nine export cables (to the easternmost boundary of each subzone only) is approximately 27.5 km with this option.

75. Up to 120 individual rock bags or concrete mattresses is estimated to be required for this option.

76. This route uses the most southerly landfall of the three options. The HDD exit points are furthest out into the bay at presents a good line for the most northerly routes/cables.

3.9.4.4. Selected Offshore Cable Route

77. This study was undertaken in parallel with the identification of landfall substation location, which is described fully in **Section 3.10** and should be read in conjunction with this Section (**Section 3.9**). From this assessment, Option 1 is the preferred landfall option based upon proximity to the preferred landfall substation location. The ECC presented in **Figure 3-3** (**Volume II**) illustrates the area within which each export cable will be positioned from each array, along the coastline where necessary and into Abrahams Bosom.

78. The final export cable route will be undertaken at the detailed design stage, utilising fine scale geophysical data. These may be installed either as a continuous export cable from onshore substation, each cable installed by a tenant to the Project or as a cable tail installed from the onshore substation to a location several hundred metres and each up to 620 m long. Each ‘tail’ would be terminated in the near shore of the export cable corridor, shortly after the ‘break out’ of planned HDD or trenching.

3.10. IDENTIFICATION OF LANDFALL AND LANDFALL SUBSTATION LOCATION

3.10.1. Site Feasibility and Screening

79. The cable landfall point for a tidal project is a critical part of the whole project; not only does it determine the length of the export cables in the subsea environment, but to a large extent, the approximate location of the landfall substation. This is because the landfall substation should be

as close as possible to the landfall point to reduce the distance the nine export cables would be laid onshore. This study was undertaken in parallel with the identification of the ECC, which is described fully in **Section 3.9** and should be read in conjunction with this Section (**Section 3.10**).

80. The initial desk-based search focussed largely on landfall sites, with associated substation locations identified nearby. A site visit to each of those locations was then undertaken. Important factors that were considered in the initial selection / screening of the cable landfall and substation sites are shown in **Table 3-3**.

Table 3-3 Key Considerations for Screening of Cable Landfall and Substation Site Selection

Factors	Criteria	Comments for Screening of Sites
Inter-project aspects	▪ Minimise the distance from landfall to the substation location ▪ Availability of space to locate an onshore substation, laydown and construction areas ▪ Consideration of likely grid connection points ▪ Ease of access to the substation and landfall site particularly for construction and delivery vehicles ▪ Subsea cable route length and challenges	▪ Preference for substation to be less than 1 km from landfall, to minimise extent of disruption ▪ Ease of access to the substation and landfall site for construction and delivery vehicles important, particularly to minimise disruption on Holy Island's minor roads ▪ Factors affecting the subsea cable route considered include; distance from the MDZ site; sea bed topography; water depth and ground conditions in the area immediately offshore from landfall
Physical baseline	▪ Avoid very high cliffs, hard rock strata and uneven and rocky ground ▪ Flood risk constraints	▪ The coastline in the search area has very few areas that are not high or has steep cliffs and the bedrock is extremely hard. ▪ Hard constraints for the search were taken as cliffs with a height above 50 m and extremely rocky or steep ground, thus the majority of the South Stack Cliffs Nature Reserve was excluded.
Environmental baseline	▪ Onshore nature conservation designations are generally avoided where possible ▪ Marine sensitivities to be considered for offshore cable route required to make landfall option ▪ Natural screening potential	▪ The search area has a large number of designated areas including Special Protection areas (SPAs), Special Areas of Conservation (SACs), AONBs, and Sites of Special Scientific Interest (SSSI) designations, as well as local nature reserves and a Country Park ▪ Marine sensitive areas that the route will cross such as environmental designations and fishing grounds minimised ▪ Designations could be avoided except where there existed a particularly attractive landfall or substation site

Factors	Criteria	Comments for Screening of Sites
Socio-economic baseline	▪ Proximity of residences ▪ Cultural heritage designations	▪ The majority of the Holy Island headland is covered by the Holyhead Mountain Heritage Coast

81. The desk-based search for suitable cable landfall and onshore landfall substation locations used Ordnance Survey maps, as well as aerial photography from Google Earth and Bing Maps. GIS data on environmental and cultural designations, sensitive habitats, landscape quality, coastal features, elevation, geology, bathymetry and seabed characteristics, flood risk and other constraints (such as proximity to residences) were also mapped for the search area. Additionally, considerations such as access and technical feasibility of likely construction methods were also applied to each potential location.

82. The search identified 15 possible landfall locations, with 13 associated possibilities for landfall substation locations identified. Two locations allowed the possibility of co-locating the landfall and substation (search area ‘B’ and ‘N’). All potential locations and routes were visited by the project engineering team. Landfall sites were also viewed from the sea during a vessel-based search. Each potential area is illustrated in **Figure 3-2 (Volume II)**.

3.10.2. Landfall Construction Options

83. The nature of the coastline at the landfall site is a key consideration in determining how landfall is achieved. An ‘open cut trench’ is the standard method of achieving landfall for offshore energy projects; however, this requires a generally flat coast and route to the onshore substation / control room location.

84. HDD is the preferred construction method proposed for the landfall, given the presence of cliffs, reefs, dunes and other sensitive habitats as well as hard rocky strata. However, the use of ducts or J-tubes pinned to the cliff and laid in a trench / slot are also assessed within the EIA, as a back-up should HDD be found to be technically infeasible at a later stage.

3.10.3. Site Short-Listing

85. Between June and October 2016, ITPE carried out a feasibility study to identify possible landfall and substation locations for the Project. The site visits and walkovers entailed an assessment of space, land cover, visibility, possible ground conditions, land stability issues and constraints to development, as well as confirming features, elevations and measurements on maps. Proposed cable routes and possible access routes were driven and areas of difficulty such as tight corners and narrow sections assessed. During the site visits, soil probing was also undertaken across the search areas visited to give an indication of the depth of soil for cable trenching, in conjunction with the use of soil cover maps from the NERC (Natural Environment Research Council).

86. Using exiting information and new knowledge gained from the site visits, the GIS system and a comparative costing exercise, as well as further assessment against all of the technical requirements and constraints, the list of sites was refined. A comparison between the potential onshore infrastructure locations was undertaken taking into account the following:

- Nature Conservation Designations;
- Sensitive habitats and environments;
- Considerations for substation location (e.g. space, proximity to residences, amenity and sensitivity of surrounding area);
- Ease of (and options for) landfall;
- Able route between landfall and substation;
- Ground conditions;
- Route to grid connection;
- Subsea cable route (length as well as possible installation concerns);
- O&M considerations; and
- Costs.

87. At the time, the outline design and construction method statement for all options was based on the following assumptions:

- 12 cable runs offshore – 12 cables will be laid individually, cables would be bundled for installation. Eight cables will require fewer runs;
- 12 HDD routes are required – for 24 cables, two cables will be pulled through each duct. Eight cables will require fewer drills;
- A transition pit is required for all cases where HDD is undertaken to joint subsea cables to land cables. A maximum of three cables are jointed in any one pit;
- Cables are laid approximately 800 mm apart in the onshore trench, requiring a 20 m wide trench for 24 cables; and
- Offshore cable tails are installed upon the seabed, to a distance of several kilometres offshore.

88. A full assessment of the landfall and substation search areas shown on **Figure 3-2** (**Volume II**) was conducted. A summary of the key constraints and outcomes is provided in **Table 3-4**.

Table 3-4 Long List of Landfall and Substation Search Areas

Search Area	Project Area	Description	Assessment
A	Substation	Consists of 11 fields and some small pockets of heathland	▪ The area closest to South Stack Road is sloping and highly visible from many viewpoints. To the north of those five fields there is an area adjoining Welsh Water reservoirs. This location is up to 1 km from the landfall point.
B	Substation	Consists of five sloping fields at cliff top overlooking Abrahams Bosom	▪ The site is in an exposed location is situated on high cliffs which adjoin the South Stack Cliffs RSPB Reserve, and the Holy Island Coast SSSI, SAC and SPA.

Search Area	Project Area	Description	Assessment
			▪ The cliffs to the south of the area appear to be variable in nature, with some areas of visible landslip, making this more less technically feasible for HDD works.
C	Landfall	Consists of two fields, between South Stack Road and the coast	▪ There are higher cliffs than most of the preferred landfall locations which also appear to be variable in nature, with some areas of visible landslip, potentially making this more challenging for drilling. ▪ Drill setback required for cliff height likely to make this option less technically feasible. ▪ The site is close to residences.
D	Landfall	Consisting of a single large field	▪ The is situated slightly further from the coast than other search area option and offers better prospects for achieving landfall.
E	Landfall	Consists of six fields and high cliffs	▪ Drill setback required for cliff height would severely restrict the space available to undertake the number of drills required, making the works less technically feasible.
F	Landfall	Single field separated from the cliff by the coastal road	▪ Search area is situated within the South Stack RSPB Reserve. ▪ The rocky seabed in the immediate vicinity is likely to require a slightly longer drill than other areas
G	Landfall	Two large fields	▪ Search area is situated within the South Stack RSPB Reserve. ▪ The cliff is higher in the area than the surrounding areas, this area will require a longer set-back distance than others, placing restrictions on the potential drill locations. ▪ A longer drill would be required (to the west) due to protruding rocks in the sea at the foot of the cliff.
H	Substation	Consists of a total of 12 fields surrounding farm building	▪ Two of these three areas may potentially have issues with water levels as they adjoin wetlands ▪ The area to the north of the main residence is quite visible from many viewpoints in the surrounding area. ▪ The location closest to the house has mounds of earth / rock on two sides, allowing for some natural screening for the substation. ▪ The location does not lie adjacent to the landfall point
I	Landfall	Consists of four adjoining fields	▪ Search area is situated within the South Stack RSPB Reserve. ▪ Adjoins a potential substation area, offering a very short onshore trench and the possibility of avoiding

Search Area	Project Area	Description	Assessment
			the need for transition pits by taking the subsea cables directly to the substation. ▪ The fields next to this potential landfall point are steeply sloped and quite visible from other viewpoints. Drills may have to be directed in a more westerly direction than straight out to sea to achieve sufficient setback. ▪ This landfall option offers one of the shortest possible subsea cable routes, broadly similar to the Abraham's Bosom option.
J	Substation	Consists of two fields adjacent to residential property	▪ This area is also close to a caravan park as well as adjoining the South Stack Cliffs RSPB Reserve and Holy Island Coast SSSI, SAC and SPA ▪ There is limited space for a substation and is highly visible from the surrounding area. ▪ The nearest landfall point is very close, approximately 400 m.
K	Substation	Consists of seven fields	▪ There are multiple options within this location that could be suitable and is quite well obscured. ▪ There are three landfall possibilities for this location.
L	Substation	Consists of a single field	▪ Site is within close proximity to Standing Stones heritage asset. ▪ The site is raised and on a slight gradient which makes it quite visible to the surrounding area. ▪ The nearest landfall points are at a distance of approximately 900 m to 1200 m.
M	Substation	Consists of two fields	▪ The site is higher in altitude than surrounding land and therefore quite visible. ▪ Site is also further from the coast than nearby alternatives.
N	Landfall and Substation	Consists of three fields and a narrow inlet	▪ The cliffs in this immediate area are low and this location is relatively obscured, however the Isle of Anglesey Coastal Path passes through the area. ▪ This inlet is within the Holy Island Coast SSSI, SAC and SPA designations and the steep bank to the north would need to be excavated for the trench. ▪ If HDD works were undertaken, the rock appears to have weak layers crossing the drill path causing eroded areas visible along the side of the inlets. ▪ The subsea cable route from the offshore site would have to either cross through or be routed around the area of steep and high ridges to the south west, thus a longer subsea cable route is required for this location.

Search Area	Project Area	Description	Assessment
O	Substation	Consists of four fields	▪ The fields in this area are fairly visible from the surrounding area. ▪ Situated to the north west of Porth Dafarch Beach adjoining the coastal road.
P	Substation	Consists of four fields	▪ The eastern most corner of this area offers a well obscured location ▪ Lies approximately 700 m to 800 m to the north east of Porth Dafarch Beach. ▪ The site is a long distance from the nearest landfall locations which are both challenging and would require a long onshore trench.
Q	Landfall	Area includes Porth Dafarch beach; owned by The National Trust.	▪ This sheltered sandy beach is very popular, especially divers as there is a wreck of a cargo ship lost in 1886 (SS Missouri) a short distance from shore. ▪ The beach also has a subsea communications cable buried within it. ▪ The subsea cable route from the offshore site would have to either cross through or be routed around the area of steep and high ridges to the south west, thus a longer subsea cable route is required for this location.
R	Landfall	Consists of a single field	▪ A long drill will be required in order to achieve landfall as the ground conditions are difficult due to little flat / even grounds. ▪ The subsea cable route from the offshore site would have to either cross through or be routed around the area of steep and high ridges to the south west, thus a longer subsea cable route is required for this location.
S	Landfall	Area of field and including the Porth y Corwgl beach	▪ Gentle gradient from the beach, however there is minimal sediment cover. ▪ This area offers the prospect of landing the subsea cables with no drilling ▪ The subsea cable route from the offshore site would have to either cross through or be routed around the area of steep and high ridges to the south west, thus a longer subsea cable route is required for this location.
T	Substation	Several fields to the north east of Porth y Corwgl	▪ The Western site boundary is adjoining the Holyhead Golf Club ▪ The furthest north east corner as this portion of the site is well obscured, however there are a number of residences within close proximity to the site.

Search Area	Project Area	Description	Assessment
			▪ The nearest landfall is approximately 550 m to 1000 m
U	Landfall	Area of land between two beaches	▪ This area offers the prospect of landing the subsea cables with no drilling ▪ As there is minimal sediment cover on either of these beaches; rock cutting or blasting will be required to bury cables if surface laying would not be acceptable at his location. ▪ This area is within close proximity to many residences; it would be difficult to route a wide enough cable trench through houses, and/or along the narrow road to the nearest substation location. ▪ Porth y Post beach has a subsea communications cable installed within it; although it is unclear whether this is still in use. ▪ The subsea cable route from the offshore site would have to either cross through or be routed around the area of steep and high ridges to the south west, thus a longer subsea cable route is required for this location.
V	Landfall	Consists of three fields and cliff top land	▪ A wastewater treatment works outfall pipe (WwTW) was previously installed in this area. As work was previously undertaken at this site, the ground conditions are known. ▪ This site is located within the Breakwater Country Park and is highly visible from most locations within the Country Park. ▪ The cliffs along this area is relatively low which means there could be many drill locations at this wide area. ▪ Due to distance from the MDZ, this option will require longer subsea cable route.
W	Landfall	The pebble beach immediately to the west of the Holyhead breakwater	▪ The wide beach offers approximately 100 m of 'useable' width to achieve landfall through open cut trenching. ▪ The beach consists of large cobbles and boulders (upwards of 200 mm in diameter) with a few isolated areas of exposed bedrock. ▪ Due to distance from the MDZ, this option will require significantly longer subsea cable route.
X	Substation	Area is located to the south of Holyhead breakwater	▪ Area adjoins a Stena Line storage shed. There would be no need for change of land use from current industrial use.

Search Area	Project Area	Description	Assessment
			▪ Short distance from landfall point, approximately 200 m.
Y	Substation	Land located to the south of the Breakwater Country Park	▪ This site sits outside the park boundary as well as other designations, however as the area is slightly raised, it is visible from the country park. There is a limited amount of flat space in this search area. The distance to the closest possible landfall point is between 400 and 500 m.
Z	Landfall	Consists of one field and a narrow inlet with a beach	▪ Consists of a beach with approximately 18 m of 'useable' width ▪ This site is within the South Stacks Cliffs nature reserve and was possibly the former site of a lifeboat station. Landfall at this location could possibly be achieved with open cut trenching, ▪ This inlet is within the Holy Island Coast SSSI, SAC and SPA designations and the steep bank to the north would need to be excavated for the trench. ▪ The subsea cable route from the offshore site would have to either cross through or be routed around the area of steep and high ridges to the south west, thus a longer subsea cable route is required for this location.

89. This assessment resulted in 14 different potential options of landfall and substation combinations, comprising seven different landfall sites and nine different substation locations, as summarised in **Table 3-5**.

90. From this, nine options were selected; Option 1; Option 2; Option 5; Option 6; Option 7; Option 8; Option 8a; Option 9; and Option 13. With the exception of Option 13, which is located in Holyhead, all sites are located in areas close to Abraham's Bosom.

91. The outline designs for each of the short-listed options are shown in the Project Design Envelope Definition (ITPE, 2018). Possible outline layouts for each option are available for both a trenched landfall and HDD approach.

Table 3-5 Comparison of Potential Onshore Infrastructure Location Options

Option No. (landfall & substation)	Distance from Nature Conservation Designation (m)[1]					Distance from Heritage Coast Designation (m)	Landfall construction method	Closest residential property (m)[2]	Cable route to substation (km)	Grid connection route (km)	Subsea cable route (km)[3]
	SSSI	SPA	SAC	AONB	RSPB						
Option 1 (D & A)	<10	<10	<10	0	<10	<10	HDD	<100	0.7	8.3	44
Option 2 (F & A)	<10	<10	<10	0	0	<10	HDD	250	1.1	8.3	44
Option 3 (F & H2)	50	50	50	0	0	<10	HDD	250	0.4	7.0	44
Option 4 (G & H2)	<10	<10	<10	0	<10	<10	HDD	250	0.5	7.0	43
Option 5 (G & H1)	<10	<10	<10	0	<10	<10	HDD	150	0.4	6.7	43
Option 6 (I2 & H1)	<10	<10	<10	0	<10	<10	HDD	150	0.2	6.7	43
Option 7 (I1 & H1)	<10	<10	<10	0	<10	<10	HDD	150	0.6	6.7	43
Option 8 (I1 & K)	<10	<10	<10	0	0	<10	HDD	<100	0.5	6.0	43
Option 8a (I1 & J)	<10	<10	<10	0	<10	<10	HDD	<100	0.3	6.5	43
Option 9 (I2 & K)	<10	<10	<10	0	0	<10	HDD	<100	0.5	6.0	43
Option 10 (N &N)	<10	<10	<10	0	300	<10	Trench	250	<0.1	6.0	85
Option 11 (N & P)	<10	<10	<10	0	300	<10	Trench	150	1.4	3.5	85
Option 12 (N & T)	<10	<10	<10	0	300	<10	HDD	150	1.7	3.5	85
Option 13 (X & W)	<10	<10	<10	700	900	900	Trench	<100	<0.1	5.0	81

[1] Closest distance of either substation or landfall location to nature conservation designation
[2] Closest distance of either substation or landfall location to residential properties
[3] Assuming 12 cables

92. In association with this study, proposed onshore cable routes and possible access routes were also taken in to consideration and areas of difficulty such as tight corners and narrow sections assessed. The selection of the onshore cable route is described in more detail in **Section 3.12** but should be read in conjunction with this Section (**Section 3.10**).

93. Through elimination of the less feasible options, the preferred landfall location was narrowed down to four possibilities, with some variation possible if necessary**.** These are outlined below and shown on **Figure 3-4 (Volume II)**:

- Option 1;
- Option 5a;
- Option 8a; and
- Option 8.

3.10.3.1. Option 1

94. The proposed Option 1 landfall substation was initially positioned in the furthest northern point of the search area identified **(Figure 3-4, Volume II)**. The substation location was considered to be well obscured next to an existing water works. However, the cable routes to grid connection as well as between landfall and substation were considered to be long and therefore other substation locations closer to the landfall were explored for this option.

3.10.3.2. Option 5a

95. The proposed Option 5a landfall and landfall substation is located far from roads and most designations and is a well obscured location. However, there are access issues and challenging ground conditions with possible flood issues. The space is also very small. The landfall is outside of the RSPB reserve, but very close to the boundary. The steep cliffs and then gradually sloping seabed also make HDD more challenging. Multiple landowners are present and initial discussions identified that some were not supportive. Therefore Option 5 was not taken forward for development.

3.10.3.3. Option 8 and 8a

96. The proposed landfall for Option 8 has a very short cable route to the proposed landfall substation location, which is the most accessible and one of the best prospects for connection to the onshore cable corridor. However, the substation was considered to be very visible and in close proximity to residences. Therefore Option 8 and 8a were not taken forward for development.

3.10.4. Refinement of Landfall and Substation Locations

97. As outlined above, Option 1 for the landfall location was the option selected on the basis of landowner support, minimising visual impact and technical feasibility.

98. Further refinement of the landfall substation location has been undertaken since the FEED study undertaken by ITPE. Black and Veatch Ltd. (B&V) have been responsible for the further design

of the onshore infrastructure within the ODA, including the landfall substation. Micro-siting of the landfall substation within the search area shown on **Figure 3-4 (Volume II)**, was undertaken in parallel with the completion of the EIA. Due to the position of the substation within the AONB, the potential visual impact was an important consideration. In collaboration with visual impact specialists from IoACC and NRW, a final site was chosen, within a recessive location in the landscape and uses the landform to help integrate the substation into the landscape.

99. Owning to the landfall substation location within the vicinity of the Ty Mawr farm, landowner consultation was undertaken frequently during the selection process.

3.11. IDENTIFICATION OF THE GRID CONNECTION POINT

100. It was assumed that a grid connection at 132 kV would be required. Four possible grid connection points were assessed by ITPE;

- ‘Orthios’ 132 kV connection point;
- ‘Parc Cybi’ 33 kV connection point;
- ‘Valley’ 132 kV connection point; and,
- Caergeiliog 132 kV connection point.

101. The 132 kV grid connection point ‘Orthios’ is the closest suitable 132 kV connection point and there are multiple options for cable routing in minor roads or cross country to minimise disruption during construction. The location is a brownfield site and already developed therefore there would be no significant change to the nature of the surroundings with further development.

102. Although the infrastructure of the 33 kV connection point at ‘Parc Cybi’ is not sufficient to accommodate the full project capacity, this would offer connection to the local electricity network. The location of Parc Cybi offers cable routing along mainly minor roads from all but the Holyhead landfall search area, as well as some potential cross-country routes.

103. The 132 kV connection point ‘Valley’ may be a suitable alternative to Orthios, however there is potential for disruption to major roads if the cable is not to be routed cross country. Valley is also a greenfield site rather the brownfield site (such as the Orthios site). There is possibly slightly better connection point about 700 m to the west, which is the same line into which connection at Anglesey Aluminium would be achieved, albeit some distance further south, and necessitating crossing of the estuary. Owing to the above reasons and the distance from the landfall location, it was considered to be significantly less attractive than the ‘Orthios’ point.

104. The 132 kV connection point ‘Caergeiliog’ is located further south east from Valley. This connection point also offers good connection potential within the existing grid substation site. There would likely be less road disruption than with the nearby ‘Valley’ connection point, although the minor road offering the best option for a cable route is very narrow and appears to support several utilities already. Due to the distance from the landfall location, it was also considered to be significantly less attractive than the ‘Orthios’ point.

3.11.1.1. Selected Grid Connection Point

105. The 132 kV grid connection point 'Orthios' is the most attractive prospect for grid connection for the full scale 240 MW project, being the closest suitable 132 kV connection point to the selected landfall location. There is sufficient space available at the connection point to enable construction of a separate substation and there are multiple prospects for cable routing in minor roads or cross country offering little disturbance to adjacent habitats during construction. minimising of visual impacts was considered in detail during the selection of these sites.

106. In addition, the 33 kV connection point at 'Parc Cybi' is selected as a suitable location for a switchgear building. This would offer connection of early phases of the Project to the local electricity network, whilst the 132 kV grid connection point 'Orthios' is connected to the national transmission network. The two connections provide flexibility in supporting the connection of the Project to the existing electricity supply and in the way in which the Project can best suit the demand for capacity and consumers.

107. In parallel with the completion of the EIA, outline design of a grid connection substation at the 132 kV grid connection point 'Orthios' (hereafter referred to as Grid Connection Substation) and a switchgear building at the 33 kV connection point at 'Parc Cybi' (hereafter referred to as Switchgear Building) has been completed. B&V have been responsible for the further design of the onshore infrastructure within the ODA, including the Landfall Substation.

3.12. IDENTIFICATION OF THE ONSHORE CABLE ROUTE

108. Given the rural nature of the project, the location of the AONB, public perception and consultation with IoACC, it was decided that overhead cables would not be appropriate. The cables will be trenched into the local road network, so much as is practicable to avoid impacts to adjacent habitats during construction and will minimise disruption to local landowners.

109. The route options were broken down into segments because there are multiple options for certain sections of the route, therefore many permutations of options are possible to form the overall route. An overview of the segments of the route is illustrated in **Figure 3-5** (**Volume II**).

110. The segment approach simplifies the overall assessment by allowing each segment to be assessed and added separately. The onshore cable route feasibility was undertaken in parallel with the landfall site selection and therefore these shortlisted route options were selected based on the anticipated likely landfall locations, Option 1, Option 5a and Option 8 and 8a. The assessment was refined during the full site selection process and the final route selection is based on the selection of Option 1 as the preferred landfall option.

111. The Segment 1 options provide a route from the expected landfall area substation to the Switchgear Building shown on **Figure 3-5** (**Volume II**). The Segment 2 options connect Segment 1 to the Grid Connection Substation **Figure 3-5** (**Volume II**).

112. Segment 3 covers the possible cable route options from the 132kV Orthios substation to the 132kV overhead lines at Valley. Due to the grid connection point at Valley being discounted early in the site selection process (as described in **Section 3.11**), Segment 3 is not considered further in this section, although initial feasibility options for access were assessed (**Table 3-6**).

Table 3-6 Onshore cable route Segment 3 options

Option	Description
A5 Stanley Embankment	▪ From the Orthios site, this route follows east and picks up the A5 across the Cymyran Strait, utilising either the road itself, the pedestrian pathway alongside it, or the existing services trench adjacent to the pedestrian path. ▪ The route turns north to the Valley connection site either in the first field east of Stanley Embankment, at Gorad Road, or at the A5025 road.
A55 Expressway Bridge	▪ From opposite the Orthios site, south side of the railway, this route follows east through the A55 across the Cymyran Strait. ▪ On the east side of the straight the route follows north through fields to pick up the eastern end of the A5 Stanley Embankment option.
HDD under the Cymyran Strait	▪ An alternative option for Segment 3 would be to HDD under the Cymyran Strait. ▪ The crossing would be over 1,500 m in length. ▪ An HDD of this length is beyond the normal range of HDD and this could also introduce issues with excessive pulling forces exerted on the cables. ▪ Entry and exit compounds would be required on either side of the strait and no area is apparent on the west side other than Orthios itself. Due to the unlikely feasibility and appetite for this option.

113. For Segment 1, the preferred option is the Porthdafarch Road and Holyhead Leisure Centre. This route option appears to be feasible and has clear advantage over the alternatives which would pass through or near to residential areas and narrow roads within Holyhead town.

114. For Segment 2 the preferred route is along the A5153 and the A5 London Road, or to access the Grid Connection Substation from a location near the Switchgear Building and to the south of the A55 using HDD.

115. A qualitative assessment of the route options for a given cable route segment has been undertaken to understand the issues and challenges for cable installation. The route was divided into three segments representing possible connection to three different connection points: Parc Cybi, Orthios and Valley. The following criteria were considered for each option;

- **Space** – refers to the general space or corridor width available for cable construction works along the route. It also includes localised width restrictions such as bridge crossings, or areas where land use, geology, infrastructure, or environmentally sensitive areas restrict the width for construction. This also considers related health and safety risks such as working in narrow roads with heavy traffic or working near livestock or overhead electricity lines. The availability of any verge adjacent to the road has been included for consideration, where possible, and whether any close settlements or structures are built up alongside the road, which would prevent use of the verge for construction or the cable trench.
- **Obstacles** - localised constraints which the cable route would need to cross via open cut trenching, or in some instances more specialised methods, such as cable bridges, auger boring or by HDD. Obstacles could be, for example, railways, major roads (such

as A or B roads), bridges, watercourses, and small woodlands or rough terrain, or services. A view has been provided on health and safety risks such as where the cable route crosses electricity lines or similar.

- **Services** – whether additional crossings are required to avoid assets such as underground electricity cables, gas pipelines, telecommunication lines, and water or sewage mains. The presence of other services affects useable installation space, disruption of works, technical feasibility and impacts on health and safety.
- **Access** - ease of access for construction, such as distances for parts of the cable route from major transportation arteries such as A or B roads, freight lines, or ports, or through roads with significant weight, width or height restrictions. Health and safety risks have been considered such as if dangerous vehicle movements are required for construction.
- **Environmental constraints** – consideration of ecological and land use constraints, including nature conservation designations, minimising disturbance to adjacent habitats, species, landowners, avoidance of archaeological and heritage assets.

3.12.1. Route Segment 1

116. **Table 3-7** contains the options for Segment 1 of the onshore cable route. These options follow public highway from the landfall to the Parc Cybi area

Table 3-7 Onshore cable route Segment 1 options

Option	Description	Assessment
South Stack Road	▪ From the landfall substation area, this route follows South Stack Road to the northeast to Holyhead. ▪ From there the route follows roads in town to connect to Kingsland Road. ▪ The route follows Kingsland Road to the A5153 and Parc Cybi road. ▪ The route crosses to the north of the A55 at a point near the Parc Cybi 33kV substation. ▪ The route follows along the north side of the A55 to Orthios substation.	▪ This is a two-lane road and appears to have space for a cable trench. ▪ There are hedgerows close to the north side of the road and residences with pavement, a stone wall and lighting services along the south side of the road. ▪ Through parts of the town there is pavement and stone wall on both sides of the road. ▪ There appears to be services in the road (water and drainage) and services which cross the road overhead. ▪ To the North approaching Holyhead, installation through this area is likely to be very disruptive for residents. There is likely to be several services in the road which presents a risk that there will not be enough space for the cables. ▪ From here the route follows the A55 then Kingsland Road which are two-lane roads. Several roundabouts would need to be negotiated. Kingsland Road passes through a built-up residential area with pavements either side.

Option	Description	Assessment
Plas Road	▪ From the landfall substation area, this route follows the road along the coast to Penrhosfeilw, then Plas Road to the northeast to Holyhead. ▪ The route would need to go through some narrow roads near Holyhead to join Kingsland Road. ▪ The route follows Kingsland Road to the A5153 and Parc Cybi road. ▪ The route crosses to the north of the A55 at a point near the Parc Cybi 33kV substation. ▪ The route follows along the north side of the A55 to Orthios substation.	▪ This road along the southern coast is single lane and flanked by stone walls on either side. ▪ There are several 90-degree bends in the road. ▪ There are certain areas where the road passes residences and there are walls on either side of the road. ▪ Other large portions of the road have a stone wall and hedgerow along its east side and hedgerow/scrub plus overhead service on its west side. ▪ Installation through this area is likely to be very disruptive for residents, likely requiring partial closure for the working section. ▪ The north end of the road follows through Kingsland which is built up with residential housing, where it joins the 'South Stack Road' option which is described above.
Porthdafarch Road	▪ From the landfall substation area, this route follows the road along the coast to Porth Dafarch, then Porthdafarch Road to the northeast to Holyhead where it joins Kingsland Road. ▪ The route follows Kingsland Road to the A5153 and Parc Cybi road. ▪ The route crosses to the north of the A55 at a point near the Parc Cybi 33kV substation. ▪ The route follows along the north side of the A55 to Orthios substation.	▪ Overhead services cross the road at multiple locations. ▪ There is a rock formation very close to the east side of the road for about a 200 m stretch. ▪ There are hedgerows, scrub and stone walls along portions of the road. ▪ The road passes through Caer Bothan and Kingsland. Through this residential section there appears to be a water network in or near the road, the pavement switches to the east side of the road, and there is lighting services alongside the pavement. ▪ Residences are built close to the road. Installation through this area would seriously affect residential access. ▪ There are likely to be services in the road which means there is a risk that space will not be available for the cables.
Porthdafarch Road and Mill Road	▪ From the landfall substation area, this route follows the road along the coast to Porth Dafarch, then Porthdafarch Road to the northeast. ▪ The route turns eastward and follows Mill Road to Holyhead. ▪ The route picks up the A5153 and Parc Cybi road.	▪ Mill Road is a small side road providing access to at least one farm and several residences. ▪ The southwestern end has a wide bell mouth which would facilitate turning the cables through this road. This end is also relatively flat and varying in width between 4 m and 6 m, with several bends in the road but none too severe. ▪ At the northern section of the road, there are more residences, some very close and directly adjacent to the road, with hedgerows up

Option	Description	Assessment
	▪ The route crosses to the north of the A55 at a point near the Parc Cybi 33kV substation. ▪ The route follows along the north side of the A55 to Orthios substation.	against the other side, and some of these land plots are used for animal grazing. Installation would cause significant disruption to the residences close to the road. ▪ There appears to be evidence of a service trench through the middle of the road, and there is an overhead service adjacent to the west side of the road.
Porthdafarch Road and Holyhead Leisure Centre	▪ From the landfall substation area, this route follows the road along the coast to Porth Dafarch, then Porthdafarch Road to the northeast. ▪ The route turns eastward on Mill Road and follows it for 500 m. ▪ At this point the route diverts to the field and follows alongside or through the Holyhead Leisure Centre. ▪ The route picks up the A5153 and Parc Cybi road. ▪ The route crosses to the north of the A55 at a point near the Parc Cybi 33kV substation. ▪ The route follows along the north side of the A55 to Orthios substation.	▪ The route would cut across the field in a north-westerly direction, avoiding the sharp bend in the road. This field appears to be used as a pasture for livestock and there is a field gate access. ▪ The route would cross about 50 m of this field to reach the boundary of the Holyhead Leisure Centre site. ▪ The area to the southwest and west of the site appears to be disused scrubland. ▪ An alternative route would be through the leisure centre road and car park itself, there are the presence of water, drainage or sewage services which would need to be crossed.

3.12.2. Route Segment 2

117. **Table 3-9** contains the options for Segment 2 of the onshore cable route. These options connect the end of Segment 1 and the Parc Cybi area, where the Switchgear Building is to be location, to the eastern part of the Orthios site, where the Grid Connection Substation is to be located.

Table 3-8 Onshore cable route Segment 2 options

Option	Description	Assessment
A5153 and A5 London Road	▪ From near the Parc Cybi area, this route would follow the A5153 to cross the railway utilising the road bridge or the pavement on either side of the road bridge. ▪ The route follows the A5153 through several roundabouts to the A5. ▪ The route follows the A5 to the east side of the Orthios site.	▪ This bridge has a roundabout between the road and the railway bridge sections and is about 20 m wide overall, consisting of a 6-8 m wide lane in each direction and 1-2 m pedestrian pavements on both sides. There is likely to be some low voltage power supply cables in the pavement ▪ From north of the railway, the A5 is one wide lane in each direction and follows around the

Option	Description	Assessment
		north of the Orthios site, providing access for the industrial site and a few small residences. ▪ There is a national cycle path which follows on its eastbound (north) side of the road, separated by about a 1 m grassy verge.
Edge of Orthios Site	▪ From near the Parc Cybi substation, this route follows north and crosses the A55 and railway just to the southwest of the Orthios property. ▪ It follows the southern boundary of the Orthios site, adjacent to the north side of the railway, to the 132kV substation.	▪ There is a wooded area on the north side of the railway directly opposite this location. This route would cross the A55 and railway with HDD from a location east of the wooded area to the southwest corner of the Orthios site. Space seems to be available for HDD compounds on either side. ▪ Several private rail tracks running along the southern side of the Orthios site which are likely to be disused due to closure of the aluminium works. They would require removal to allow space for the cable trench.
A55 North Wales Expressway	▪ From the Parc Cybi substation, this route would either follow in the A55 or in the verge of the A55 to a position opposite the 132kV Orthios substation south of the railway. ▪ The route crosses the railway at this location to the Orthios substation.	▪ The A55 can be reached from Parc Cybi to its north. Through this area the A55 is a dual carriageway with a median of about 4.5 m wide. It may be possible to install the cables through the median, or in one of the lanes. This may require closure of one direction of traffic for access and safe working. ▪ To cross the railway to the Orthios site, the best place for HDD would be from the field just east of the 132kV Orthios substation to the large field on the south side of the A55. Both fields appear to offer sufficient space.

3.12.3. Refinement of Onshore Cable Route

118. Following the above assessment, on option has been progressed from each of the two segments. From Segment 1, the selected onshore cable route follows Porthdafarch Road and past Holyhead Leisure Centre to the Switchgear Building. This avoids the residential areas of Holyhead and minimises disruption to local residents.

119. From Segment 2, the preferred option is to use HDD to cross the A55, avoiding disturbance to the main route between Holy Island and the Isle of Anglesey. This decision was subject to extensive investigation with relevant stakeholders

120. The preferred options for each of the route segments are summarised in **Table 3-9**.

Table 3-9 Onshore Cable Route Preferred Options

Segment	Preferred Option	Notes
1	Porthdafarch Road and Holyhead Leisure Centre	This preferred option for Segment 1 follows public highway for most of the route whilst largely avoiding busy areas of Pont Hwfa, Holyhead and Kingsland. The diversion through the leisure centre would be a good alternative to the north portion of Mill Road, allowing for less disruption to local traffic within Holyhead and a more direct route to Parc Cybi. From Mill Road the route joins the A5153 and on to Parc Cybi road to meet the Parc Cybi site
2	A5153 and A5 London Road	The preferred option for Segment 2 follows the A5153 to cross the A55 and railway utilising trenchless crossing methods. The route follows the A5153 through several roundabouts to the A5, then follows the A5 to the east side of the Orthios campus.

3.13. REFERENCES

Piano, M., Ward, S., Robins, P., Neill, S., Lewis, M., Davies, A.G., Powell, B., Owen, A.W. (2015) Characterizing the tidal energy resource of the West Anglesey Demonstration Zone (UK), using TELEMAC-2D and field observations. Conference Paper: 22nd Telemac & Mascaret User Club. STFC Daresbury Laboratory, UK, 13-16 October, 2015. DOI: 10.13140/RG.2.1.3246.7609

Regeneris Consulting Ltd. (2013) The Economic Impact of the Development of Marine Energy in Wales. A study for Welsh Government. July 2013

Morlais Project
Environmental Statement

Chapter 4: Project Description

Volume I

Applicant: Menter Môn Morlais Limited Document Reference: PB5034-ES-004 Chapter 4: Project Description Author: Royal HaskoningDHV			
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GLOSSARY OF ABBREVIATIONS

ADCP	Acoustic Doppler Current Profilers
BPEO	Best Practicable Environmental Option
dB	decibels
DP	Dynamic Positioning
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ES	Environmental Statement
FEED	Front End Engineering and Design
GBS	Gravity Based Structures
HDD	Horizontal Directional Drilling
HGV	Heavy Good Vehicles
IALA	International Association of Lighthouse Authorities
ICS	Impressed Current System
km	Kilometres
kV	Kilo volts
LAeq	A-weighted equivalent continuous sound level
LAT	Lowest Astronomical Tide
LV	Low Voltage
MCA	Maritime and Coastguard Agency
MDZ	Morlais Demonstration Zone
MFE	Mass Flow Excavator
MV	Medium Voltage
MVA	Megavolt-ampere
MW	Megawatts
nm	nautical miles
NRW	Natural Resources Wales
OfDA	Offshore Development Area
ODA	Onshore Development Area
O&M	Operation and Maintenance
PDE	Project Design Envelope
ROV	Remotely Operated Vehicle
rpm	Rotations per Minute
TEC	Tidal Energy Convertors
TH	Trinity House
TWAO	Transport and Works Act Order
UKC	Under Keel Clearance
UXO	Unexploded Ordnance

GLOSSARY OF TERMINOLOGY

Active hub	Hub containing a transformer, switchgear and possible control equipment.
Axial Flow	Horizontal axis rotors.
Category 1 tidal device	Seabed Mounted Sub-Surface Tidal Devices.
Category 2 tidal device	Buoyant Mid-water Column Tidal Devices.
Category 3 tidal devices	Floating and / or Surface Emergent Tidal Devices.
Cross Flow	Vertical axis rotors.
Multicat	Multi-purpose catamaran workboat for offshore works and transport,
Megaripples	Undulations on a non-cohesive surface produced as a result of the interaction of waves or currents on a sediment surface.
Nacelle	A cover that houses all of the generating components in a TEC, including the generator, gearbox, drive train, and brake assembly.
Passive Hub	Hub containing a busbar joining multiple TECs together.
Screw Piles	Steel piles with helical steel plates welded to the pile shaft in accordance with the ground conditions.
Visually Prominent	A visually prominent tidal device is a tidal device where the large proportion of the support structure is visible above the water, to the extent it is visually prominent, together with ancillary elements such as navigation lights, railings and mast.

4. PROJECT DESCRIPTION

4.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) presents details of the Project Design Envelope (PDE) for the Morlais Project (the Project).

2. The Project will provide a consented area for the installation and commercial demonstration of multiple arrays of tidal energy devices, to a maximum installed capacity of 240 Megawatts (MW).

3. The Project will also provide permanent communal infrastructure through the provision of electrical infrastructure, including substations and onshore electrical cable route to grid connection. The Project is being developed by Menter Môn Morlais Limited (hereafter 'Menter Môn'), a not for profit social enterprise company. When consented, the Project's infrastructure will be operated by Menter Môn.

4. This chapter describes the following stages of the proposed development for both the onshore and offshore elements:

   - Construction;
   - Operations;
   - Maintenance;
   - Repowering; and
   - Decommissioning.

5. **Figure 1-1** (**Volume II**) shows the location and boundary of the Morlais Demonstration Zone (MDZ) and Export Cable Corridor (ECC). The two areas combined can be referred to as the Offshore Development Area (OfDA).

6. **Figure 1-2** (**Volume II**) shows the location and boundary of the Onshore Development Area (ODA) which includes the landfall site, onshore cable route, substations and grid connection location.

7. The OfDA and the ODA represent the extent of assessment for the technical chapters in this Environmental Statement. This area is larger than the order limits proposed within the TWAO.

8. A Front-End Engineering Design (FEED) study was undertaken by ITP Energised (ITPE) on behalf of Menter Môn in 2018, to provide the proposed design of the project necessary to inform the EIA project description for consent (**Appendix 4.1, Volume III**). Further to a revision of proposed installed project capacity to 240 MW, an addendum to the study was undertaken for the MDZ elements (**Appendix 4.2, Volume III**), also by ITPE. In parallel, Black & Veatch Ltd. (B&V) have been responsible for further design of, and updates to, the onshore infrastructure within the ODA.

4.2. FLEXIBILITY THROUGH PROJECT DESIGN ENVELOPE

9. Consent for a broad PDE is sought, to ensure maximum flexibility in the tidal technology types consented for deployment by the Project. This approach allows for deployment of a variety of

currently available technologies, whilst also allowing for evolution of the designs of tidal devices over time.

10. However, the range and flexibility sought within the consent application has been limited by careful consideration of development scenarios designed to rationalise the likely approach to development and to set workable limits on potential impacts. The PDE approach used in this ES, has been tested in planning law and is often referred to as the 'Rochdale Envelope' approach (see **Chapter 2, Policy and Legislation**).

4.2.1. PDE to Inform Impact Assessment

11. The project description outlined within this Chapter has been used to shape the impact assessments undertaken in this ES. Characterisation of the PDE for the Environmental Impact Assessment (EIA) has focussed on those characteristics known to interact with environmental receptors, i.e. foundations, cables, moving parts and visible components. The approach considers a range of design parameters and identifies the likely worst-case of each parameter, for each specific receptor.

12. To inform FEED studies and provide information for the EIA project description, consultation with tidal device developers was undertaken between 2017 and 2019. The results of this consultation have been used to determine the technical and physical parameters of tidal devices, any requirements for deployment of the tidal devices and the level of interest from device developers in deploying their devices at the Project. Based on this consultation, appropriate devices were used to define parameters in the PDE.

13. Due to the wide range of tidal devices currently available, any specific tidal devices referred to within this document are provided as examples for reference only and should therefore be viewed as representative of several device types which may be deployed by the Project. Review of tidal device parameters has allowed the identification of realistic worst-case parameters for a number of generic tidal device types. These worst-case parameters have been used to define the PDE in terms of both tidal device parameters and realistic worst-case scenarios for the deployment of arrays of tidal devices and for the deployment of the Project as a whole.

14. Following consent award, tidal device developers will be allocated locations or "berths" within the MDZ, within which they will be able to deploy anything from one device to arrays of multiple tidal devices. Repowering is the replacement of one array of tidal devices with another array of tidal devices, normally with a different, newer or / and updated technology. Array deployments will vary in duration; therefore, the allocation of berths may be repeated throughout the life of the Project, as one berth is removed, its capacity within the Project become available, and a new array is then be deployed, either at the same berth or at a different location.

15. The intention is that the flexibility within the PDE, carried forward into the EIA and reflected in appropriate consent conditions, will allow the Project to encompass many current technologies as well as future technological development. This allows for continued development of tidal devices, their infrastructure and its management, in areas such as:

- Tidal device installation techniques;
- Health and safety;

- Operation and maintenance (O&M); and
- Improved efficiency and reductions in the cost of energy.

16. Consideration of a broad PDE during the EIA and a flexible consent is particularly important in the following areas:

- The total number of tidal devices deployed within the MDZ;
- Layout of tidal devices within the MDZ (location, density, array spacing);
- Device types;
- Foundation/mooring types;
- Location of electrical hubs and monitoring equipment;
- Number and routing of inter-array and export cables; and
- Location and lighting/marking requirements of navigational aids.

4.2.2. PDE Refinement During the Detailed Design Stage

17. To support a variety of tidal device types within the Project and to accommodate different developer requirements, the shared infrastructure installed by the Project will be as flexible as possible. **Section 4.3.5** details the shared infrastructure that will be installed at the Project.

18. The design of key aspects of parts of the permanent works (onshore infrastructure and offshore export cable landfall) is relatively advanced and refined; whereas, the positioning of marine infrastructure (offshore export and array cables, hubs) will be developed via detailed design work post consent.

19. The design of arrays of tidal devices and related moorings, anchors or foundations will be determined on a case by case basis by the tenants to the Project, prior to deployment of their devices. This will be dependent on the requirements of the device type and influenced by a number of factors, including:

- Physical environmental parameters such as:
  - Depth;
  - Tidal resource; and,
  - Seabed substrate.
- Mitigation requirements identified in the ES and enforced as consent conditions; and,
- Wake effects, depending on the tidal technology and number of tidal devices to be installed.

20. In addition to the flexibility within the MDZ, options are included within the onshore infrastructure to allow flexibility to avoid constraints if identified during pre-construction site investigations. In particular, the ODA, which defines the extent of the Project for EIA purposes encompasses sufficient area to allow the micro-siting of onshore infrastructure if required.

4.2.3. Pre-Deployment Stage

21. Even though site-specific information on these types of factors will be available from the EIA characterisation surveys, final positioning of tidal devices may require additional studies to be undertaken by each tenant prior to construction. Such surveys, if required, could include targeted high definition site investigations for geology and archaeology.

22. The information presented in this chapter has been used to inform the technical chapters contained within the ES and is considered to represent the PDE for use within the EIA.

23. Prior to each array deployment, it is expected that there will be consent conditions requiring documentation to be submitted to the licensing authorities (Welsh Government and Natural Resources Wales, NRW) outlining the parameters of the tidal devices to be installed as well as providing details of the construction methodology, O&M strategy, and the array removal (decommissioning) methodology. This will allow review of each array's characteristics against the consented PDE.

24. A statement of confirming that each array deployment fits within the PDE will be submitted by Menter Môn to the Welsh Government and NRW for approval.

25. The Project will comprise an OfDA including the MDZ covering an area of 35 km^2, combined with an ECC with an area of 4.75 km^2, plus associated onshore infrastructure (see **Section 4.2.4** and **4.2.5** below) contained within an ODA of 1 km^2.

26. The total installed capacity of the project will be no more than 240 MW. The currently programmed life of the project is 37 years, which has been the basis of impact assessments. This period includes time required for construction, commissioning, repowering and decommissioning.

4.2.4. Offshore

27. The MDZ is located to the west of Holy Island, Anglesey. The ECC connects the MDZ to the landfall location at Abraham's Bosom on the west coast of Holy Island. The location, scale and co-ordinates for the MDZ and ECC are shown in **Figure 1-1** (**Volume II**).

28. The seabed across the MDZ and much of the ECC is dominated by outcropping rock at surface and coarse sediment types such as gravel, with consistent boulders overlaying. There are a number of wreck features within and around the MDZ and ECC, but no historic wrecks. No presence of Unexploded Ordnance (UXO) is indicated within the MDZ or the ECC.

29. Water depths across the MDZ reach over 72 m Lowest Astronomical Tide (LAT) in the northwest of the site, with an average depth across the main site of approximately 40 m LAT. Depths within the ECC range from over 38 m LAT to the intertidal at landfall. All depths in this chapter shown as depth at LAT.

30. Throughout the MDZ, megaripples features occur sporadically. However, within the ECC, the area to seaward of the proposed landfall at Abraham's Bosom has an almost linear deposition of finer material across the entrance which is up to 7 m deep in parts. The intertidal (landfall)

area is bedrock interspersed with discrete patches of barren shingle and occasional areas of sandy sediment.

31. The key components of the offshore works associated with the Project are outlined in the following paragraphs.

32. Tidal devices will be deployed in multiple arrays within the MDZ, to a maximum installed capacity of 240 MW. The tidal devices installed by the Project and within the PDE will have the following key elements:

- A foundation or anchor on or within the seabed;
- A supporting substructure or mooring;
- Tidal Energy Convertors (TEC); and
- Cable connections.

33. Each single array will be comprised of the same type of tidal device (technology type) and located within a discrete location, or berth, within the MDZ. The installed capacity per array is expected to generally be up to 30 MW, but may in practice be greater or smaller than this, being determined by a number of factors including the individual capacity of the export cables supporting each array, the installed capacity of the Project in full, and the requirements of the tidal devices. The installed capacity of individual arrays is not a parameter of bearing upon the ES, and all installed arrays, when summed, will fall within the total installed capacity for the Project of 240MW.

34. For deployment of arrays, the MDZ may be spilt into a series of subzones, with the zones allowing the demarcation of different technology types. Eight indicative subzones within the MDZ are shown in **Figure 4-1** (**Volume II**), however, these indicative zones may be modified to meet the requirements of tenants and regulators. Arrays and associated tenant infrastructure to be deployed in the MDZ are described further in **Section 4.3.1** to **Section 4.3.4**.

35. A phased approach to deployment of the project may be taken, with scale and timeframe of phasing determined by assessments and consideration of mitigation and management undertaken within the ES. Further detail is provided in **Chapter 11, Marine Ornithology**, **Chapter 12, Marine Mammals**, and **Chapter 25, Socioeconomics, Tourism and Recreation**.

36. Dependent on the type of tidal device, full deployment to 240 MW could comprise up to a maximum of 620[1] tidal devices, supporting up to 1,648 TECs and up to 740 inter-array cables within the MDZ. This represents the worst-case scenario as outlined in **Section 4.3.1.2**.

37. Water depths and tidal resource vary across the MDZ. The eight indicative subzones are located in parts of the MDZ that support stronger tidal resource, while also offering a range of depth parameters. Across indicative subzones 1, 2 and 3 approximate water depths are mainly between 30 and 40 m, with some deeper areas of 40 to 45 m, whilst within the majority of

[1] Based on an indicative worst-case maximum deployment scenario of 240MW deployment of arrays of small devices (each device 0.2 to 0.5 MW).

indicative subzones 4, 5, 6 and 7 the approximate water depths are generally in the range 30 to 35 m. Across indicative subzone 8 approximate water depths range from 40 m to 60 m.

38. The MDZ and ECC will also contain the following ancillary infrastructure;

- Up to nine export cables;
- Up to nine export cable tails (shared with onshore components);
- Navigation and environmental monitoring equipment;
- Mooring and foundation structures; and
- Offshore electrical infrastructure, including submerged, floating or surface emergent hubs.

4.2.5. Onshore

39. The boundary for the ODA is provided in **Figure 1-2** (**Volume II**). Landfall will be located within the bay on the western coast of Holy Island known as Abraham's Bosom. Because of the overlap of marine and terrestrial planning jurisdiction in the intertidal, an area of 15,102 m^2 (0.0151 km^2) of the intertidal is shared between the terrestrial and marine areas of the Project. This area will be included in both the Transport and Works Act Order (TWAO), deemed planning permission and Marine Licence applications for consent.

40. The key components of the onshore works associated with the Project include:

- Cable landfall works, including;
    - Up to nine HDD ducts or trenched equivalents,
    - Up to nine transition pits or bays, and
    - Up to nine export cable tails (shared with offshore components).
- A landfall substation at Ty-Mawr (hereafter referred to as 'Landfall Substation');
- A switchgear building at Parc Cybi (hereafter referred to as 'Switchgear Building');
- A grid connection substation at the existing Orthios Eco-Park to the east of Holyhead (the site of the former Anglesey Aluminium works) (hereafter referred to as 'Grid Connection Substation');
- Onshore cable circuits installed between Landfall Substation, Switchgear Building and Grid Connection Substation; and,
- Onshore cable route joint bays (along onshore cable route between Landfall Substation, Switchgear Building and Grid Connection Substation).

41. The landfall consists of exposed rocky shore, backed by a hinterland of coastal heath and farmland. The Landfall Substation location is within currently farmed land, in the area of Holy Island known as Penrhos Feilw. From transition pits or bays, export cables will be trenched to the Landfall Substation. From the transition pits to landfall, HDD is the preferred method for installation of export cables. However, if HDD is not feasible then an alternative method consisting of trenching marine cables from transition pit to shallow subtidal, with installation and pinning of ducting and cables to cliff face using split-pipe.

42. From the Landfall Substation the majority of the onshore cable will be trenched within the existing minor road network (**Figure 1-2, Volume II**). The proposed cable corridor follows South Stack Road, Porthdafarch Road and Mill Road towards the Switchgear Building. The cable will be trenched from the Switchgear Building to the Grid Connection Substation, with a section installed via Horizontal Directional Drilling (HDD) beneath the A55 and the Holyhead to Bangor rail line.

4.2.6. Mitigation

43. During the development of the detailed engineering design, a number of embedded mitigation measures have been included to reduce the potential impacts of the project. Where significant adverse impacts have been identified as a result of the Project, additional mitigation measures are proposed to seek to reduce residual impacts to acceptable (non-significant) levels, full details are provided in the relevant technical chapters (**Chapter 7** to **Chapter 25** and **Chapter 27, Summary**).

44. Those measures embedded into the project design, within both the OfDA and ODA are outlined in **Table 4-1**.

Table 4-1 Mitigation Measures Embedded into Project Design

Project Infrastructure	Embedded Mitigation Measure
MDZ	Preference for the deployment of seabed mounted or buoyant mid water tidal devices in the north of the MDZ to maintain under keel clearance of 20 m or more, as appropriate to large vessels using those parts of the MDZ. Mitigation through the application of the spatial measure shown and defined in Figure 4-1, shown in the purple area labelled “Submerged tidal devices with 20 m Under Keel Clearance (UKC) only”.
	Maintenance of an area inshore of any floating / surface emergent arrays deployed in the MDZ, with a minimum distance of 1 km from floating / surface emergent arrays to the nearest coastline, and within which a minimum Under Keel Clearance (UKC) of 8 m is maintained to allow safe passage of small vessels. Maintenance of a minimum separation distance of 1 km from the coastline to any visually prominent tidal devices, to increase the separation distance between such structures from the coastline. A visually prominent tidal device is a tidal device where the large proportion of the support structure is visible above the water to the extent it is visually prominent, together with ancillary elements such as navigation lights, railings and mast Mitigation through the application of the spatial measure shown and defined in Figure 4-1, where a light blue area is labelled “Submerged tidal devices with an 8 m UKC only”. When combined with the export cable corridor (where no devices are deployed) and shown in Figure 4-1 as a blue cross hatched area, a minimum distance of 1km to shore from any floating / surface emergent array is achieved.
	Mitigation through the preference for the deployment of surface emergent devices in the south of the MDZ. Potential in the future for deployment of visually prominent tidal devices in more northern parts of the MDZ will be kept under review on a case by case basis with regulators.
	Minimising visually prominent elements of the Project as much as practicable within the MDZ to help ensure the composition of offshore elements is as simple as possible.

Project Infrastructure	Embedded Mitigation Measure
	Project Design Envelope for tidal devices defined using parameters available from established tidal device technologies, which has been assumed will be developed sufficiently for commercial use at time of deployment.
	Mitigation by micro-siting and avoidance or modification of construction foundation design for potential channel areas (unless archaeological value confirmed as low).
ECC	Selection of cable corridor to minimise length of export cables within the marine environment.
Landfall Substation	Selecting a recessive location in the landscape, in a relatively low-lying position and using the landform to help integrate the Landfall Substation (cutting into the valley side rather than building a platform out).
	Arrangement of plant and equipment at the Landfall Substation within three buildings, resulting in a collection of buildings that break up the scale of the development and create a form and massing that is comparable with local agricultural buildings.
	Using colours and materials (including natural materials) that are consistent with the vernacular associated with agricultural buildings and are recessive in the local context.
	Using the buildings to define the boundaries of the substation, reducing the requirement for security fencing.
	Considering limited application of planting to help integrate the substation, acknowledging the limitations associated with this in the open and exposed coastal landscape.
	Using stone walls and stock proof fencing as part of new boundaries.
	Minimising the use of external lighting in this rural location.
	A 3.5 m high acoustic demountable fence will be installed around the HDD equipment and a 2 m high solid hoarding fence will be built around the works compound boundary.
Onshore Cable Corridor	Use of underground cabling to provide the connections between all Project elements, avoiding the need for overhead cables.
	Routing the underground cable within the local road corridors to minimise potential disruption to field boundaries.
Grid Connection Substation	Positioning of the substation in a location where industrial structures form an established part of the baseline context, and where established vegetation surrounding the site provides effective visual enclosure.
Switchgear building	Positioning of this element within an allocated employment site, adjacent to an existing substation and where surrounding development will be comparable in form, massing and appearance.

45. Embedded mitigation measures relating to navigational safety in **Table 4-1**, above, are derived from the Navigation Risk Assessment (**Appendix 15.1, Volume III**), undertaken for **Chapter 15, Shipping and Navigation**. These measures are not taken into consideration as embedded mitigation measures within this chapter, due to the requirement to consider only safety measures as embedded mitigation within the impact assessment.

4.3. OFFSHORE INFRASTRUCTURE

46. The key components of the offshore works associated with the Project are detailed in this Section, in the following order:

- Tidal device;

- Foundations;
- ECC and electrical infrastructure (i.e. hubs); and
- Navigation and monitoring equipment.

4.3.1. Tidal Device Envelope

4.3.1.1. Review of Existing Tidal Technologies

47. Based on the developer consultation undertaken over the period 2017 to 2019, significant consideration has been given to which types of tidal devices to include in the PDE of the Project. The device types included in this project description chapter, and therefore assessed in this EIA, are deemed to represent the most realistic parameters for deployment by the Project.

48. Tidal devices comprise of the TEC, the supporting structure, and the anchor or foundation. **Plate 4-1** shows the two forms of TEC that may be mounted on a tidal device, either horizontal axis or vertical axis TECs.

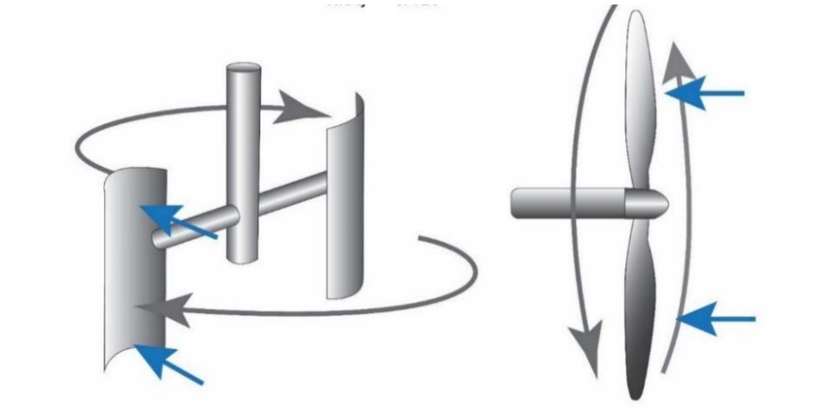


Plate 4-1 Illustration of Vertical (Left) and Horizontal (Right) Axis TEC Types

49. **Plate 4-2**, **Plate 4-3** and **Plate 4-4** show the tidal devices and their respective components, using three generic types of tidal device as exemplars. Note that the actual form of tidal devices and numbers of TECs supported will differ between the technologies deployed.

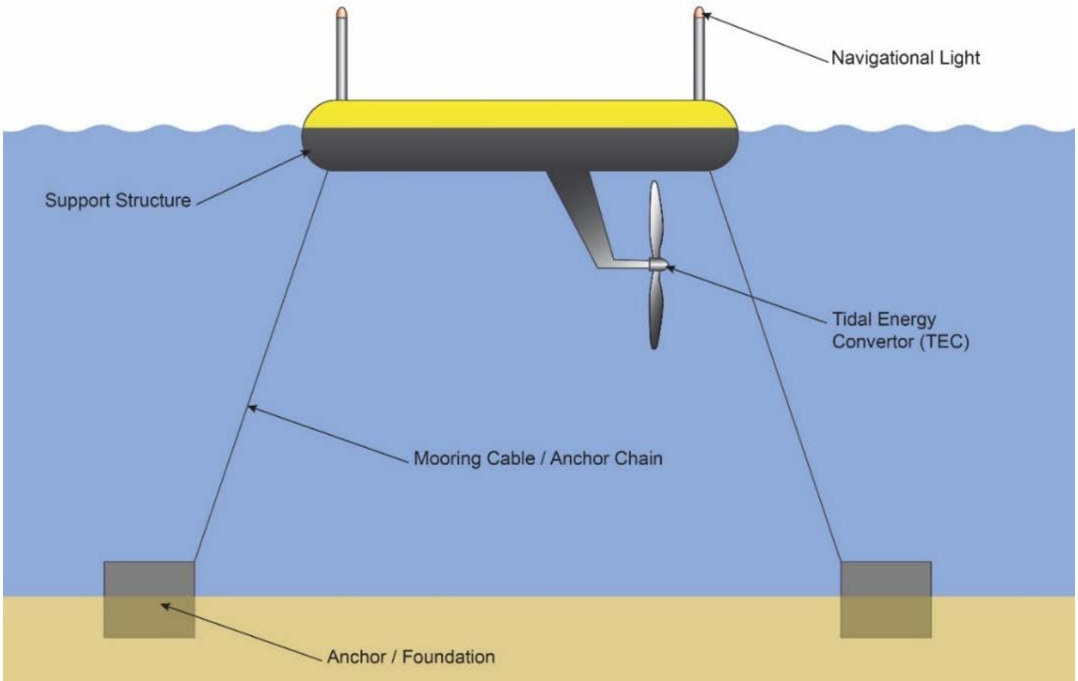


Plate 4-2 Generic Tidal Device Exemplar 1 – Floating or Surface Emergent Tidal Device, Comprised of TEC, Support Structure, Mooring Cables / Anchor Chains and Anchors / Foundations

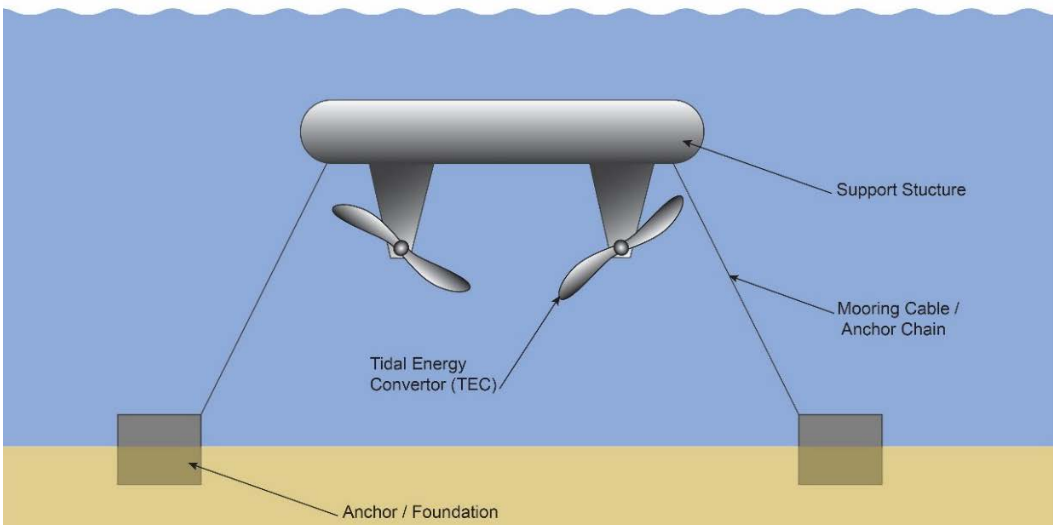


Plate 4-3 Generic Tidal Device Exemplar 2 – Mid Water Column Tidal Device, Comprised of TEC, Support Structure, Mooring Cables / Anchor Chain, and Anchor / Foundation[2]

[2] Note this device is shown facing into direction of current flow

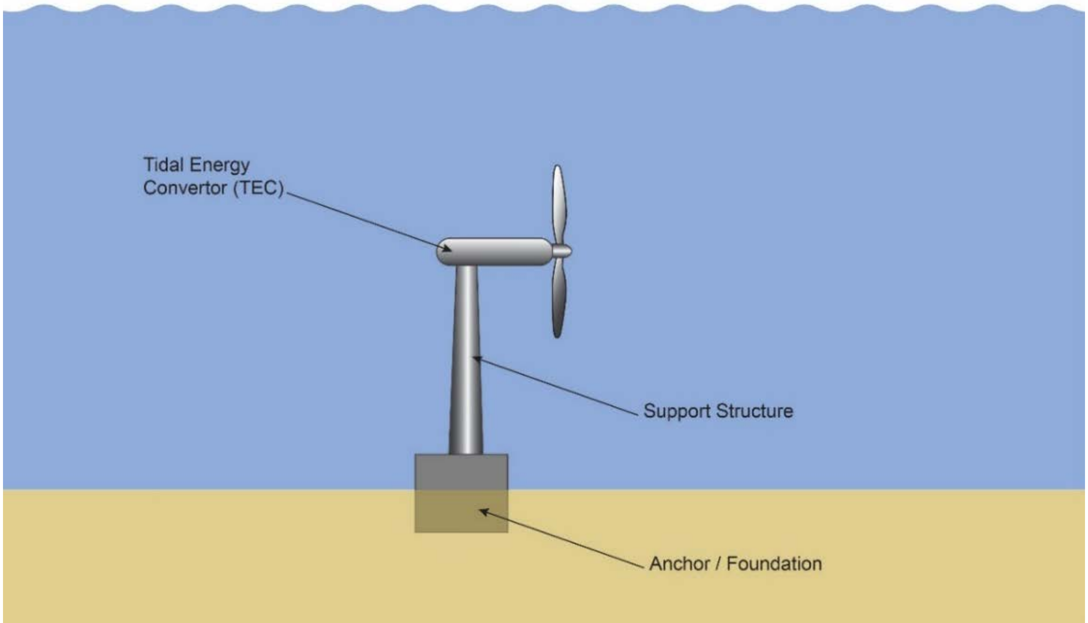
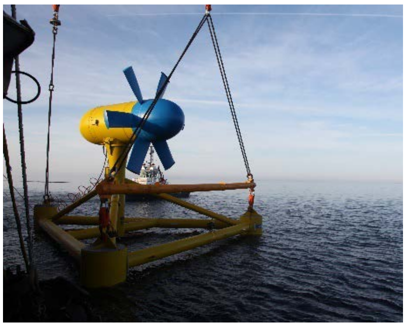


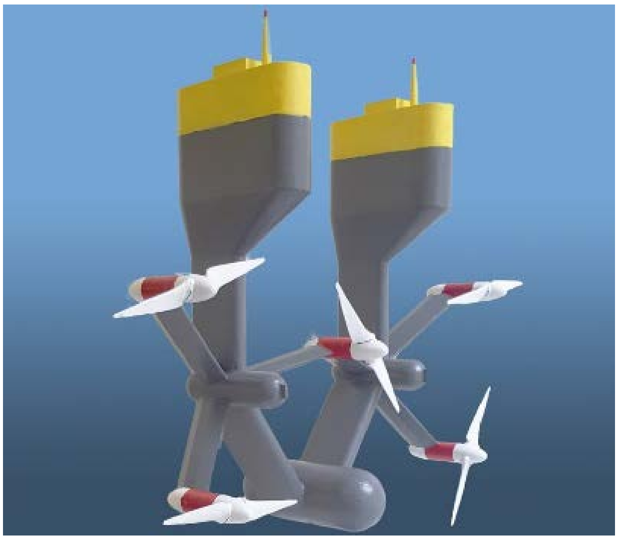
Plate 4-4 Generic Tidal Device Exemplar 3 – Seabed Mounted Sub Surface Tidal Device with TEC Supporting Structure and Foundation

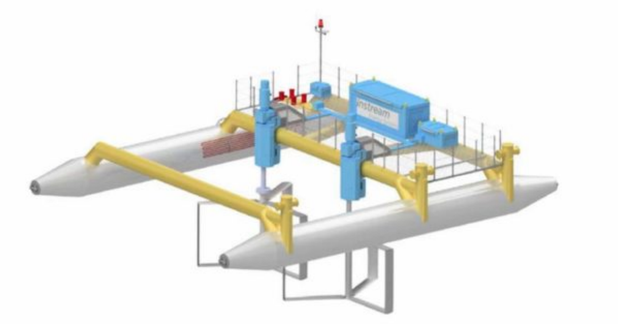
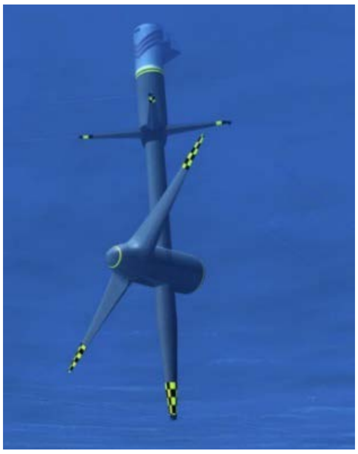
50. The device types considered suitable for the PDE are shown in **Table 4-2**, with example technologies for each TEC.

Table 4-2 Categorisation of Devices for the Project Design Envelope

Sub-Category	Exemplars (Developer or Device Names)	
Category 1: Seabed Mounted Sub-Surface Devices		
Large rotor(s) (>10 m diameter)	▪ SIMEC Atlantis Energy ▪ Andritz Hydro Hammerfest	 Developer: SIMEC Atlantis Energy Source: (https://twitter.com/simecatlantis/-status/534996023178178560

Sub-Category	Exemplars (Developer or Device Names)	
Small (<10 m diameter) rotors	▪ Verdant Power ▪ QED Naval SubHub ▪ Nova Innovation ▪ Sabella	 Device/Developer: Gen5Tidal/Verdant Power Source: Verdant Power  Device/Developer: D10-1000/Sabella Source: Sabella
Vertical axis turbine	▪ Repetitive Energy	 Developer: Repetitive Energy Source: http://www.repetitiveenergy.com/our-technology/

Sub-Category	Exemplars (Developer or Device Names)	
Category 2: Mid-Water Column Devices		
Multiple small (<10 m diameter) rotor upon submerged buoyant platform	▪ SME PLATO platform or similar with Tocardo or Schottel TECs ▪ Renewable Devices Marine Ltd.	 Developer: Renewable Devices Marine Ltd. Source: https://www.theenergytimes.com/ distributed-energy-ecosystem/scots-push-new-tide-turbine-tech
Category 3: Floating or Surface Emergent Devices		
Large rotor (>10 m diameter) floating or emergent devices	▪ Orbital Marine Power ▪ Magallanes	 Developer: Orbital Marine Power Source: https://marineenergy.biz/2018/11/16/orbital-marine-unveils-o2-turbine-blueprints/
Small rotor (<10 m diameter) floating devices	▪ Tocardo TFS	 Developer: Tocardo Source: https://marineenergy.biz/2018/06/06/-tocardo-strengthens-management-with-finance-appointments/

Sub-Category	Exemplars (Developer or Device Names)	
Floating vertical axis devices	▪ Instream	 Developer: Instream Source: https://www.marineenergywales.co.uk/-instream-and-itpenergised-full-scale-demonstrator/
Large rotor (>10 m diameter) surface emergent spar buoy	▪ Aquantis	 Developer: Aquantis Source: https://www.f6s.com/aquantisinc

4.3.1.2. Tidal Energy Convertor Parameters

51. Several representative tidal technologies have been considered in order to capture the likely range of TECs that may be demonstrated within the MDZ. The TECs to be installed will fall into one of two main types as shown in **Plate 4-4**:

- Horizontal axis (axial flow) rotors; or
- Vertical axis (cross flow) rotors.

52. As shown in **Plates 4-1** to **4-3**, the TEC support structure may be:

- Seabed mounted and submerged;
- Buoyant and mid-water column; or
- Floating.

53. The nominal outputs of tidal devices included within the PDE range from 200 kW to 4 MW, with individual devices potentially supporting one or several TECs. The potential output of individual

TECs within tidal devices could range from 50 kW to 2 MW. Tidal devices with a maximum installed capacity value of 2 MW exist, however, it is anticipated that with improvements in efficiency of technologies, devices of up to 4 MW may become available, while all other PDE parameter maximums remain unchanged.

54. Under Keel Clearance (UKC) of devices below LAT will take account of shipping and navigation constraints (as detailed in **Chapter 15, Shipping and Navigation**). Across much of the MDZ the UKC of seabed mounted sub-surface devices or buoyant mid water column devices will be greater than 8 m, however, this may be reduced where a lack of navigation constraints allows shallower deployment of appropriate devices. In deeper parts of the MDZ (in the north and north west of the MDZ), the UKC will be greater to accommodate larger vessel navigation requirements, with the Project maintaining an UKC of at least 20 m below LAT in these areas.

55. Where floating and surface emergent tidal devices are deployed in the MDZ, their physical support structures are present at surface and therefore there can be no UKC. It should be noted, however, that the uppermost point of TECs deployed on these devices will be located several metres below water surface.

56. The number of TECs per device will be typically between one and four, although for some multiple TEC surface platforms this may increase to up to five per device. For those devices, if each TEC is assumed to have three rotor blades, then the maximum number of blades could be 15 for each single device.

57. The number of rotor blades associated with each TEC is typically two or three per TEC, although TECs within the PDE could have up to six rotor blades.

58. The maximum TEC rotor diameter within the PDE is 27 m. Typically, the rotor diameters will be between 10 to 16 m. The area of leading edge per rotor will be between 1.5 and 15 m^2.

59. The average speed of TEC rotation considered within the PDE is between 7.5 and 26.7 rotations per minute (rpm). For smaller (10 m or less in diameter) open rotor devices the average speed of TEC rotation could be between 13.6 and 26.7 rpm. For larger (more than 10 m in diameter) open rotors the average speed of TEC rotation is generally lower, between 7.5 and 10.1 rpm.

60. The PDE allows for a maximum number of individual TECs within the Project to be limited to up to 1,648 TECs spread across up to 620 tidal devices and with a total of 4,750 blades. This assumes the Project at full 240 MW capacity and a deployment scenario which is dominated by devices with larger numbers of TECs per device. The actual number of tidal devices, associated TECs and their rotor blades deployed to achieve 240 MW may be much smaller, but maxima are used here to define the worst-case in this PDE.

4.3.1.3. Seabed Mounted Sub-Surface Devices (Category 1)

61. **Table 4-3** provides a review of parameters for the example tidal technologies outlined in **Table 4-2**, in order to define the worst-case scenario for seabed mounted sub-surface device types in terms of TEC parameters, numbers of devices and swept area. A range of capacities are provided for each device type and the maximum number of devices per subzone is based on the smallest capacity from each range as a factor of a proposed potential array capacity of 30 MW.

Table 4-3 Seabed Mounted Sub-Surface Device Parameters (Worst-Case Highlighted in Blue)

Device Type	Number of devices (in a 30 MW array)	Number of TECs per device	Average TEC speed (rpm)	Max. diameter (m)	Max. device swept area (m^2)	Max. array swept area (m^2)
SIMEC Atlantis Energy	30	1	7.5	26	531	15,930
Andritz Hydro Hammerfest	30	1	7.5	26	531	15,930
Verdant Power	25	3	22	10	235	5,875
QED Naval SubHub	10	3	Assume as Verdant	Assume as Verdant	Assume as Verdant	Assume as Verdant
Nova Innovation	100	1	22	10	78.5	7,850
Sabella	30	1	7.5	15	176.7	5,301

4.3.1.4. Buoyant and Mid-Water Column Devices (Category 2)

62. **Table 4-4** provides a review of parameters for the example tidal technologies outlined in **Table 4-2**, in order to define the worst-case scenario for buoyant and mid-water column device types in terms of TEC parameters, numbers of devices and swept area. A range of capacities are provided for each device type and the maximum number of devices per subzone is based on the smallest capacity from each range as a factor of the largest subzone capacity (30 MW).

Table 4-4 Buoyant and Mid-Water Column Device Parameters (Worst-Case Highlighted in Blue)

Device Type	Number of devices (in a 30 MW array)	Number of TECs per device	Average TEC speed (rpm)	Max. diameter (m)	Max. device swept area (m^2)	Max. array swept area (m^2)
Generic mid water platform with Tocardo TEC	20	5	18	10	392.8	7,857

4.3.1.5. Floating / Surface Emergent Devices (Category 3)

63. **Table 4-5** provides a review of parameters for the example tidal technologies outlined in **Table 4-2**, in order to define the worst-case scenario for floating device types in terms of TEC parameters, numbers of devices and swept area. A range of capacities are provided for each device type and the maximum number of devices per subzone is based on the smallest capacity from each range as a factor of the largest subzone capacity (30 MW).

Table 4-5 Floating / Surface Emergent Device Parameters (Worst-Case Highlighted in Blue)

Device Type	Number of devices (in a 30 MW array)	Number of TECs per device	Average TEC speed (rpm)	Max. diameter (m)	Max. device swept area (m^2)	Max. array swept area (m^2)
Orbital Marine Power and Magallanes	15 (8*)	2	8.71	25	982.1	14,732

Device Type	Number of devices (in a 30 MW array)	Number of TECs per device	Average TEC speed (rpm)	Max. diameter (m)	Max. device swept area (m^2)	Max. array swept area (m^2)
Tocardo (TFS)	20	5	18	10	392.8	7,857
Instream	50**	2	13.6	5	19.92	996
Aquantis	30 (15*)	1	10.1	27m	572.7	17,183

* Values in brackets for Orbital / Magallanes and Aquantis assume a future tidal device with improved TEC efficiency to give up to 4 MW installed capacity per device.

** Values for Instream type device are for a 10 MW array.

4.3.1.6. Corrosion Protection and Antifoulants

64. The majority of devices will utilise some form of corrosion protection system; those proposed are broadly similar to those adopted within other marine industries. These may include systems such as offshore grade protective paint systems, impressed current systems and sacrificial anodes.

65. Structures will typically be painted with modified epoxy or acrylic based abrasion-resistant paints suitable for subsea and splash zone, plus similar primer. Individual devices are each expected to use between 500 and 1,200 litres of paint. All protective coatings and paints used will be suitable for use in the marine environment and, where necessary, approved by the Health and Safety Executive.

66. Impressed Current System (ICS) or sacrificial anodes are both commonly used on ships and subsea structures and may form part of the tidal devices deployed by the Project. Sacrificial anodes are commonly used to supplement the ICS as a back-up or located on parts of the structure where ICS cannot be used. The anodes are standard products for offshore structures, which are welded onto the steel structures and consist of aluminium (98 to 96%) and zinc. The number and size of anodes will vary dependent on device design.

67. Antifoulants may be applied in areas of tidal devices considered particularly susceptible to the build-up of marine growth, for example TECs (rotors and nacelle) and heat exchangers, to ensure devices maintain optimum performance.

68. The majority of antifouling paints produced and available for use in the UK are copper-based, in which the main biocide is cuprous oxide, the natural form of copper. Some antifouling paints contain a less potent form of copper (cuprous thiocyanate) and can be referred to as ‘copper free’ paints. The paints may also contain other biocides in smaller quantities. The use of antifouling paints will be limited to areas of specific need by tenants.

69. A teflon based antifoulant (such as Intersleek 900) has also been commonly used on tidal devices. Intersleek 900 is a non-leaching antifoulant that works by physically preventing species’ attachment as opposed to having biocidal activity.

70. Antifoulant products are generally installed before the first deployment of an array and may be reapplied as required during maintenance activities. A decision on what presents the Best Practicable Environmental Option (BPEO) will be made for each deployment, in compliance with a review of the parameters of each array deployment for compliance with the PDE. The requirements for antifouling may vary between categories of tidal devices.

71. In summary, the following worst-case scenario footprints for the MDZ will be used in the impact assessment:

- Use of sacrificial anodes to each tidal device deployed; and
- Use of copper based anti-fouling paints.

4.3.1.7. Summary of Worst Case Tidal Energy Convertor Parameters

72. Where relevant, technical chapters (**Chapters 7** to **Chapter 26**) of this ES will identify which device type presents the worst-case scenario for their specific receptors. **Table 4-6** below details the worst-case scenario for TEC parameters and device numbers within a 30 MW array, and these values are considered to be within the PDE of this EIA.

Table 4-6 Worst Case Scenario based on Full 240 MW Deployment (Worst-Case Highlighted in Blue)

Parameter	Seabed Mounted Sub-Surface Devices (Category 1)	Buoyant and Mid-Water Column Devices (Category 2)	Floating / Surface Emergent Devices (Category 3)
TEC diameter	26 m	10 m	27 m
TEC speed	22 rpm	18 rpm	18 rpm
30 MW array swept area	15,930 m^2	7,857 m^2	17,183 m^2
Number of devices in a 30 MW array	100	20	50*

* Values for Instream type device are for a 10 MW array, with no deployment of this technology at greater scale within the PDE. This represents the greatest number of floating devices.

4.3.2. Foundation Systems

73. There are two types of foundation systems proposed for use by developers within the MDZ, seabed mounted and anchored (mooring) systems. Within both types there are various options which could be adopted.

74. Anchored devices may be either surface floating or mid water column and buoyant. Seabed mounted foundations in the PDE include Gravity Based Structures (GBS) (including tri-frames), multi-piled structures (including tripods and quadrapod) and monopiles.

75. The worst or 'extreme case' values for foundations and anchors presented below are based on different scenarios of deployment across the site. Each scenario is based on the maximum number of devices that represented a 'worst-case' for potential receptors, whilst assuming no more than 30 MW of any one specific technology. The figures have been calculated based on 30 MW of a technology that represented the 'worst-case' impact, followed by 30 MW of the technology with the second 'worst-case' impact, 30 MW of third 'worst-case' impact and so on until the full potential across the site is reached. It is important to note that more than 30 MW of

any of the device type examples could be deployed in multiple arrays, however, the total worst case calculated will not be exceeded.

76. The values for each technology are based on those provided by developers during a developer consultation exercise and captured in a FEED report commissioned to form the basis for the PDE for the Project (**Appendix 4-1, Volume III**).

4.3.2.1. Gravity Based Structures

77. For some of the tidal devices and infrastructure that may be deployed at the MDZ, the preferred foundation concept is a GBS. GBS utilise the submerged mass of a structure to resist environmental and operational loading on the device and maintain its stability. GBS may be used as foundations or anchors for all three categories of tidal devices included within the PDE, as well as for project infrastructure such as hubs.

78. The footprint (the element of the foundation in direct contact with the seabed) of GBS, proposed within the MDZ would typically be very small (<10 m^2) for each tidal device, with some GBS using 'feet' that focus the weight of the foundation on a small area of seabed. The weight of the foundations can sometimes cause the feet to penetrate the seabed (by up to 0.5 m). The use of feet minimises requirements for seabed levelling as well as also reducing the surface area of the foundation that is in direct contact with the seabed.

79. In a few limited cases some clearing (or grouting) of the seabed might be necessary below a GBS if a sufficiently level area could not otherwise be found. However, this is not anticipated to be widespread.

80. For a 240 MW capacity deployment of tidal devices and supporting infrastructure (such as hubs) using only GBS for foundations and anchors, the total (worst-case) footprint would equate to 74,790 m^2 [3]. The additional seabed footprint (m^2) for navigation and environmental monitoring equipment moorings as well as other project components such as cable protection is defined in **Table 4-24**.

4.3.2.2. Pin Pile Drilled Foundations

81. For some of the tidal devices and infrastructure that may be deployed at the MDZ, the preferred foundation concept is a tripod or quadropod structure typically using three or four drilled pin piles.

82. Due to the hard substrate (bedrock) in the MDZ, drilling will be required to install piled foundations (pin piles or monopiles). For each pin pile a socket is drilled into the seabed,

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[3] Worst-case GBS footprint based on 240MW deployment achieved using 590 tidal devices with the largest foundation footprints and 120 hubs to maximise footprint, as follows: 120 devices @ 4x36m^2 each; 120 devices @ 2x60m^2 each; 15 devices @ 4x78m^2 each; 20 devices @ 2x78m^2 each; 15 devices @ 4x78m^2 each; 150 devices @ 1x9m^2 each); 30 devices @ 4x78m^2 each; 120 devices @ 1x36m^2 each; 60 electrical hubs @ 4x40m^2 each; and 60 electrical hubs @ 1x100m^2 each.

typically between 1.0 to 2.5 m in diameter and the pin pile is inserted into the socket. The pin pile is then grouted or swaged in place to secure it into the seabed. Some piles will be self-drilling, others will require an annulus to be drilled, of sufficient size to accommodate the pile. This will create spoil arisings from the drilling process.

83. In some cases, screw piles may be used; these are steel piles with helical steel plates welded to the pile shaft in accordance with the ground conditions. Screw piles are wound into the seabed much like a screw into wood, using (temporary) rotary hydraulic equipment. The pile diameters and thus drill arisings are broadly similar to drilled pin piles.

84. For a 240 MW capacity deployment of tidal devices and supporting infrastructure (such as hubs) using only piled foundations the worst-case scenario is total footprint on the seabed would be 5,889 m^2 [4]. The worst-case seabed footprint for piled foundations is significantly less than worst-case seabed footprint for GBS; therefore, GBS will be used as worst-case footprint for impact assessment of seabed impacts.

85. Drill arisings are produced during pin pile installation, with up to 117,780 m^3 [5] generated for the 5,889 m^2 footprint detailed earlier in this section. Disposal of this material would be *in-situ,* directly to the surrounding sea bed. The duration for each will be between two and three days.

86. A total of 1,490 drills will be required for the worst-case outlined above, taking up to 3,990 drilling days to achieve[6].

87. For repowering, an additional 50 % of drilling arisings, footprint and drilling time has been assessed.

4.3.2.3. Monopile Foundations

88. The use of monopiles falls within the PDE, with potential to be used within the MDZ to house electrical hub infrastructure. If they are required, then in a similar way to pin pile foundations, monopiles will be inserted into sockets which have been previously drilled into the seabed and the monopiles then grouted in place. The PDE assumes monopiles which extend up to 18 m above sea surface at LAT may be used. Eight such monopiles (one for each potential subzone within the MDZ) might be deployed, each of 6 m diameter giving a significant internal space for array connection infrastructure.

89. For eight monopiles used to house surface-piercing electrical hubs, the worst-case footprint for monopiles is 226.2 m^2. The worst case seabed footprint value of 74,790 m^2 already includes

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[4] Worst-case pin pile footprint based on 240MW deployment achieved using 290 tidal devices and 120 hubs to maximise the footprint: 80 devices @ 4 x drills of 2.6m diameter (21m^2) each device; 120 devices @4 drills of 1.2m dimeter (4.5m^2) per device; and 90 devices @ 3 drills of 2.6m diameter (15.9m^2) per device; then 60 large hubs @ 3 drills of 2.6m diameter (15.9m^2) per hub; and 60 small hubs @ 4 drills of 2.6m diameter (21m^2) per hub. Total number of drills 1,490.
[5] Assumes 5,889m^2 footprint of piles and 20m depth of drilling
[6] Total of 1,490 drills, 1.2m diameter drill taking 2 days each, and all other drills taking 3 days each.

hubs assumed to be mounted on GBS foundations. Therefore, this figure of 226.2 m^2 is not additional seabed footprint.

4.3.2.4. Mooring Systems

90. A number of tidal devices utilise a buoyant support structure on which to mount the TECs. These can be held in a fully submerged and mid water column position (**Table 4-2**, Category 2 devices) or have a partially surface emergent support structure (**Table 4-2**, Category 3 devices).

91. Floating tidal devices, typically using catenary moorings are considered in this PDE, with each tidal device requiring four GBS, to which catenary mooring chains are attached. At any time, a portion of the mooring chains will lay upon the seabed and a portion will be suspended. The suspended weight of chains between the GBS and the tidal device keeps the device in position by maintaining a dynamic tension. The amount of chain suspended at any time is adjusted by the movement of the tidal device in response to the tidal state, wider surface conditions, and in particular to wave climate.

92. **Plate 4-5** illustrates the potential use of catenary moorings for one of the floating tidal devices included within the PDE and is representative of catenary moorings generally for floating devices.

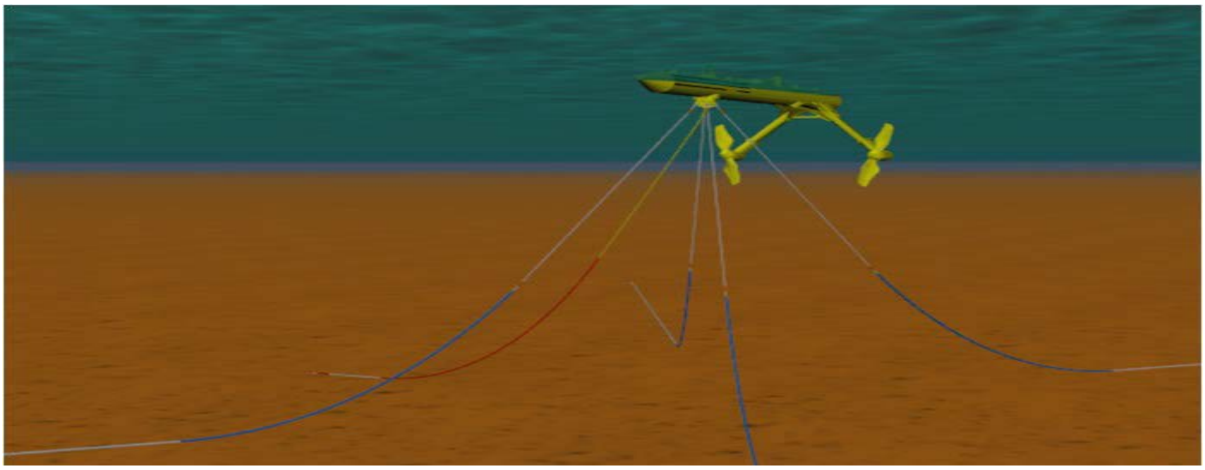

Plate 4-5 Example of Catenary Mooring System (Source: Orbital Marine Power)

93. Buoyant mid-water column devices will typically use a tension mooring system, with the buoyancy of the submerged tidal device holding mooring cables between the tidal device and GBS in constant tension. Such a system does not have to be able to manage surface weather conditions and is subject to less movement than catenary systems, with constant tension maintained on mooring cables as the buoyant tidal device 'seeks' to reach the surface and the moorings restrain it. All cable between tidal device and GBS is in tension and no cable is in contact with the seabed.

94. **Plate 4-6** illustrates and compares catenary and tension moorings.

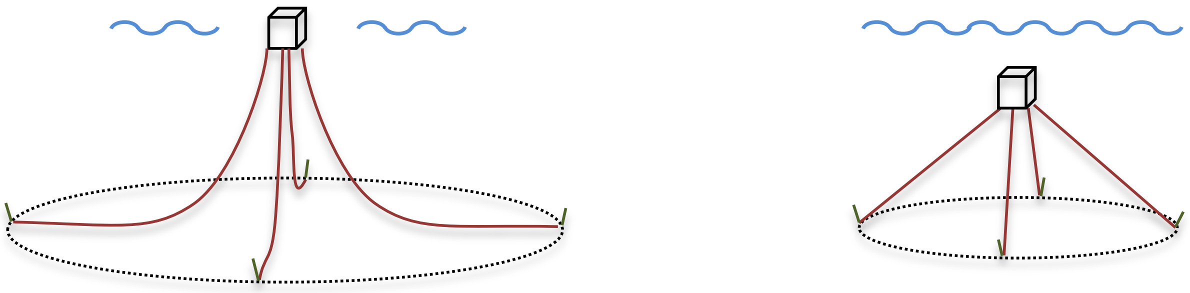

Plate 4-6 Schematic of a Catenary (Left) and a Tension (Right) Based Mooring System

95. The use of catenary moorings for floating / surface emergent tidal devices, leads to a 'Catenary Swept Area' (an area that could be subject to chain drag) where a portion of the mooring chain between a tidal device and a GBS is in contact with the seabed at any point in time. Chains within a catenary mooring system may ‘sweep’ a portion of seabed as the tidal device moves within a window in response to external forces (wind, wave and tides). In these instances, the swept area may be significantly greater than the footprint of the gravity anchors themselves. This effect does not apply to tension moorings as the cables in tension lines do not drag on the seabed.

96. Based on a deployment to 240 MW capacity using only tidal devices that may use catenary mooring systems, the total Catenary Swept Area across the entire MDZ could be up to 2,055,000 m^2 [7].

4.3.2.5. Summary of Worst Case Foundation Parameters

97. A combination of GBS footprint and the use of catenary mooring is the worst-case scenario for seabed footprint of a mooring / foundation system. The worst-case scenario for seabed impact is based on the full 240 MW capacity being installed using 30 MW arrays of tidal devices, using gravity-based foundation systems, with GBS anchor blocks used for floating and mid water devices.

98. The footprint associated with the alternative foundation method of pin-piling device foundations, plus the footprint of associated drill arisings produced by this method are less than the footprint of gravity base foundations. If such foundations are used, their potential seabed footprint impact is considered to be included within that of GBS foundations.

99. Where relevant, technical chapters (**Chapters 7** to **Chapter 26**) of this ES will identify which foundation type presents the worst-case scenario for each receptor. Any devices/arrays with

[7] Worst-case catenary footprint based on 240MW deployment achieved using 410 tidal devices of types which may use catenary moorings to maximise the potential seabed footprint as follows: 30 tidal devices each with catenary swept area of 9,500m^2 each (large devices); 140 devices having swept area of 7,500m^2 each (medium scale devices) floating devices; and 240 tidal devices having swept area of 3,000m^2 each (small scale devices). All catenary footprint measured using CAD to calculate using maximum excursion criteria.

foundation footprints or drill arisings that fall within the worst-case scenarios outlined in **Table 4-7** are considered to be within the PDE of this EIA.

Table 4-7 Worst Case Scenario based on Full 240 MW Deployment

Parameter	Value
Total GBS footprint	74,790 m^2
Catenary or anchor / mooring swept area	2,055,000 m^2
Drilled pin pile foundations	5,889 m^2
Drilled socket arisings	117,780 m^3

4.3.3. Superstructures and Floating or Surface Emergent Elements

100. The MDZ may incorporate floating or surface emergent structures, visible above the sea surface, such as:

- Floating tidal devices up to a maximum of 130 devices;
- Hubs (up to 93 floating hubs or up to eight seabed mounted surface emergent hubs);
- Environmental monitoring buoys (up to 5); and
- Communication and navigational buoys (up to 60 in total) (see **Section 4.3.6**).

101. In terms of maximum dimensions of tidal devices, some of the large rotor diameter floating devices could have lengths of up to 72 m, while other devices, whilst shorter (up to 22 m length), are also wider, with maximum widths of up to 30 m.

102. The supporting structure of tidal devices deployed in the MDZ will not emerge more than 6.5 m above the sea surface at LAT.

103. Electrical hubs may be within surface emergent piled structures which may extend up to 18 m above the sea surface at LAT. The electrical equipment would be housed within the pile.

104. Indicative array layouts used for assessment purposes are detailed further in **Section 4.3.4**. The following summary outlines the number and type of surface emergent devices which could be present across the MDZ and therefore within the PDE of this EIA, with reference to embedded mitigation contained in both Table 4-1 and **Figure 4-1 (Volume II)**:

- Deployment of visually prominent floating / surface emergent devices in the south of the MDZ, to take account of potential for visual impacts. The potential for deployment of floating / surface emergent tidal devices, which are not visually prominent, in more northern parts of the MDZ will be kept under review on a case by case basis with regulators to allow for ongoing development of technology and innovation;
- The worst-case height above sea level[8] for any tidal device will be 6.5 m; and
- The worst-case height above LAT is 18 m for up to eight surface-piercing hub structures.

[8] Note that for a floating / surface emergent tidal device, the device will rise and fall with the tide

4.3.4. Array Layout

4.3.4.1. General

105. The layout of the tidal devices and associated infrastructure (inter-array cables, hubs etc.), will be dependent on the tidal resources across the MDZ as well as the bathymetry and water depths, which the tidal devices require to operate. Therefore, final layout and configuration of visible and fully sub surface elements of the project cannot be predicted. However, based on current understanding of separation distances between certain devices, indicative project layouts can be anticipated and some examples, for illustration purposes only, have been provided (see **Section 4.3.4.4**).

106. Floating devices, which rely on catenary of anchor chains or tension of mooring cables to maintain position will have some movement during changes in tidal conditions, however, this is within the surface area defined by the extent of their anchors or foundations.

4.3.4.2. Device and Array Spacing

107. Array layouts will be identified post consent, following a berth selection and allocation process. Over the life of the Project, layouts will evolve at each new array deployment, or during repowering, when tidal devices within existing arrays may be replaced , or full arrays replaced with new arrays deployed at new locations. The shape of the array layout will depend on the physical requirements of the specific tidal devices deployed. The final detailed device locations will be developed based on further site investigation works conducted post-consent to determine detailed construction constraints. These details will be communicated to the Welsh Government and NRW pre-deployment via a process of site management connected to the discharge of consent conditions.

108. Seabed mounted devices may have a spacing of 50 to 100 m between centres of devices perpendicular to the flow and 100 to 250 m parallel to the flow. Such spacings may need to be modified to allow for seabed conditions, and this could alter spacings considerably, resulting in larger spacings.

109. The maximum case in terms of spacing would be floating tidal devices sharing moorings. Such devices may require up to 150 m between structure centres perpendicular to the flow and 250 m parallel to the flow.

110. Each device could move by up to 80 m (±40 m) in the direction parallel to the flow and 60 m (±30 m) in the direction perpendicular to the flow.

4.3.4.3. Potential Array Surface Area

111. A potential maximum surface area taken up by arrays for the Project has been calculated. The maximum surface area includes the space occupied by tidal devices (including TEC, supporting structures and foundations or anchors), as well as separation spaces between tidal devices. In other words, the surface area of a tidal device or array of tidal devices is greater than the seabed footprint as it includes the full area occupied by the tidal device(s) plus appropriate separation spaces between tidal devices. Surface area values for potential arrays have been derived via

Computer Aided Drawings (CAD) of layout parameters for a series of 30 MW arrays, combined to achieve a full 240 MW deployment scenario.

112. In order to identify a worst case for potential surface area for a deployment to 240 MW, the surface area associated with 30 MW arrays of a range of tidal device technologies were compared via CAD. The surface areas of the eight arrays thus identified were then summed to derive a maximum potential surface area for a 240 MW deployment. The value derived in this manner is 12,459,500 m^2 (12.5 km^2) for a full 240 MW capacity project – see **Table 4-8**.

Table 4-8 Assumptions used for worst-case surface area

Array No.	Device Category	Device Type	Max. Surface Area
1	Fully submerged seabed mounted device	QED Naval	1,838,600 m^2
2		Nova	1,241,800 m^2
3	Buoyant mid water device	SME PLAT-O	2,159,800 m^2
4	Surface emergent device	Magallanes	1,155,100 m^2
5		Orbital	1,155,100 m2
6		Aquantis	1,773,200 m2
7		Instream	2,070,400 m2
8		Tocardo UFS	1,065,500 m2
TOTAL			**12,459,500 m^2**

113. **Table 4-9** outlines the likely worst-case spacing and device areas based on indicative layouts. These parameters are therefore within the PDE of this EIA.

Table 4-9 Worst-Case Spacing Parameters for Devices within the MDZ

Device Category	Spacing between tidal device centres		Maximum extent of surface movement	
	Perpendicular to flow	Parallel to flow	Perpendicular to flow	Parallel to flow
Fully submerged seabed mounted device	50 to 100 m	100 to 250 m	NA	NA
Surface emergent and buoyant mid water device	50 to 200 m	120 to 500 m	60 (±30 m)	80 (±40 m)

4.3.4.4. Indicative Layout for Assessment

4.3.4.4.1. Indicative Layout for SLVIA and Shipping and Navigation

114. The worst-case parameters presented so far within this Chapter will be sufficient to inform the majority of the assessments undertaken during the EIA. For most receptors, deployment scenarios will remain within the levels of worst-case scenarios identified and no further definition is required.

115. However, for receptors such as shipping and navigation (**Chapter 15, Shipping and Navigation**), and Seascape and Landscape Visual Impact Assessment (SLVIA) (**Chapter 24, Seascape and Landscape Visual Impact Assessment**), the assessments undertaken require consideration of the location of arrays within the MDZ. For this purpose, an indicative layout, taking account of consultation with regulators and consultees has been derived.

116. **Figure 4-2 (Volume II)** shows an indicative surface emergent only layout taking into account the following considerations:

- Intention to manage the deployment of visually prominent devices as detailed in **Section 4.2.6** and summarised as:
  - Deployment of visually prominent devices focused on subzones 4 to 8;
  - Future deployment in subzones 1 to 3 under review on a case by case basis with regulators;
- Measures to manage shipping and navigation issues, summarised as:
  - Preference for the deployment of seabed mounted or buoyant mid water tidal devices in subzones 1 to 3, to maintain under keel clearance appropriate to vessels using those parts of the MDZ;
  - Maintenance of an area inshore of surface emergent arrays deployed in the MDZ of a minimum width of 1 km from shore and with a minimum UKC of 8 m;

117. The technologies used for illustration in the indicative array scenario assessed for SLVIA include up to 130 visually prominent surface emergent devices within subzones 4 to 8, as follows:

- 60 MW of large dual TEC tidal devices (30 devices);
- 30 MW of large spar buoy single TEC tidal devices (30 devices);
- 10 MW of multiple vertical axis TEC tidal devices (50 devices) and
- 30 MW of multiple TEC tidal devices (20 devices).

118. Under this indicative scenario, non-visually prominent surface emergent devices, seabed mounted devices or buoyant midwater devices would be deployed in other zones (1 to 3), subject to the requirements of other constraints, such as navigation.

4.3.4.4.2. Indicative Layout for Marine Mammals and Ornithology Assessments

119. In order to illustrate a potential full deployment to 240 MW and inform the assessment of potential impacts on seabirds and marine mammals (**Chapter 11, Marine Ornithology** and **Chapter 12, Marine Mammals**), the indicative surface emergent tidal device layout shown in **Figure 4-2** (**Volume II**) was used as the starting point for an indicative full deployment to 240 MW.

120. The indicative array of surface emergent outlined in **Figure 4-2** (**Volume II**), shows an indicative deployment of surface emergent tidal devices to 130 MW, with potential sub surface deployments not shown. **Figure 4-3** (**Volume II**) and **Figure 4-4** (**Volume II**) show the surface emergent indicative layout used to inform the SLVIA (**Figure 4-2, Volume II**) with the addition of a further 110 MW of non-surface emergent tidal devices, including seabed mounted and buoyant mid water devices. Two potential indicative layouts are shown, illustrated with the following technologies deployed in each:

- 35 MW of buoyant mid-water platform multiple TEC tidal devices (23 devices);
- 15 MW of small seabed mounted single TEC tidal devices (50 devices);

- 30 MW of seabed mounted multiple TEC tidal devices (25 devices); and
- 30 MW of large seabed mounted single TEC tidal devices (30 devices).

4.3.5. Offshore Electrical Infrastructure and Cabling

4.3.5.1. Export Cables

121. Up to nine export cables will be installed between the MDZ and the landfall. These subsea export cables are required to connect the tidal devices/arrays to the Landfall Substation, where the power is subsequently exported to the local distribution network via the Grid Connection Substation. The export cable corridor is shown in **Figure 1-1** (**Volume II**).

122. The size of the cables will be dependent on a number of factors. The required conductor size will be primarily determined by the necessary current carrying capacity which is influenced by transmission voltage, installation conditions (e.g. buried, in a duct etc), ambient temperature, phase spacing and arrangement, as well as the proximity of other cables.

123. Medium Voltage (MV) subsea power cables of the type used for offshore projects are generally built up with three single-cores (three phases), with a cross-section of between 50 to 500 mm^2, surrounded by filling material and covered by armouring, in addition to Low Voltage (LV) cables and multiple optical fibre elements for control and communications.

124. Cable armour is typically made of one layer of round 5 to 6 mm thick steel wire armour. Alternatively, flat strands may be used though these may not offer as much force protection. Where cable protection is a particular concern or where the integrity of the cable under pulling stresses is a concern, a second layer or more of armour may be added.

125. Burial will be difficult, or impossible, to achieve across much of the MDZ and the export cable corridor. An armoured cable will provide additional protection where suitable burial and protection cannot be achieved by other means or risk is perceived to be present. Due to the hard and rocky nature of the seabed, it is expected that the majority of the cables will be free laid with strategic protection (rock bags, concrete mattresses or split-pipe) at locations along the length. The main purpose of this cable protection will be to secure the cable to the seabed sufficiently to manage movement, without the need to protect all laid cable.

126. Armour will delay the onset of faults due to abrasion and less serious impacts, as well as increasing cable strength against pulling forces. This will improve cable survivability where it is exposed to mobile seabed material, currents and wave action, and, where it is potentially exposed (or part exposed) to bottom fishing activity. Armour will also assist with protection from anchor damage; however, heavy strikes will still likely result in failures.

127. The key parameters of the export cables are shown in **Table 4-10**. These parameters are therefore within the PDE of this EIA.

Table 4-10 Key Parameters of the Export Cables

Parameter	Value
Export cable diameter	Up to 120 mm
Cable diameter with split pipe cable protection	Up to 170 mm

Parameter	Value
Individual cable route lengths from each subzone	Between 1.2 and 6 km
Individual rock bags or concrete mattresses	Up to 270 (with a seabed footprint of up to 18 m^2 each) = 4,860 m^2
Total seabed footprint (nine cables plus cable protection systems and rock bags/mattresses)	11,745 m^2 [9]

128. More detailed cable route investigations will be required pre-installation (post-consent) to identify exact routes to shore. These studies will take account of the following criteria:

- Minimum spacing requirements to avoid derating of the cables and to ease laying operations and subsequent access;
- Avoiding key ecological (reef) features to minimise impacts on the seabed ecology and reduce physical risks to the export cable, in particular:
  - Avoid or minimise crossing of slopes beyond 10° which pose risks of cable movement and damage when surface laid
  - Avoid crossing scarps, ridges, scour lines or other areas where there are rapid variations in bathymetry which could lead to damage of the cables if laid across such a feature
  - Using appropriate cable protection to avoid cable moving around on the seabed; and
- Following a direction which runs parallel to the flood and ebb tidal current flows to maximise lateral stability of the cable on the seafloor.

129. Seabed morphology data collected via a project-specific geophysical survey during summer 2018 (Partrac, 2018) identified a significant sandwave feature, an estimated 27,258 m^2, located in the northern half of the MDZ and export cable corridor. Cables will be installed over this feature, potentially with jet trenching, and an as-laid survey will be undertaken to identify any areas where the cable is in suspension, followed by targeted remedial work at that time. If remedial work is required, the sand wave could be reduced using a mass flow excavator or dredger.

130. There is limited sediment in the nearshore sections within ‘Abraham’s Bosom’ where burial may be feasible via jet trenching. Feasibility will be confirmed by pre-installation geotechnical site investigations informing detailed design, however, sediment depth is limited and surface laying of cable, with cable protection is expected.

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[9] Export cable length: 40.5 km: Diameter of split pipe: 170 mm: Area (40,500 m x 0.17 m = 6,885 m^2
Number of rock bags: 120: Footprint area of rock bags: 18 m^2 (4.8 m diameter): Area of all rock bags 270 x 18 m^2 = 4,860 m^2
Total seabed footprint export cable + protection (6,885+4,860) = 11,745 m^2

4.3.5.2. Inter-Array Cables

131. Inter-array cables will be laid between tidal devices; an electrical hub may be used or multiple devices may be connected in a ‘daisy-chain’ format. Tenants would be expected to install their own inter-array cabling where more than one device is being deployed within a subzone, and to connect their project to the export cable at its termination point.

132. The total length of inter-array cabling would be dependent on the array layout within each of the berths, dictated by geotechnical and bathymetric considerations (among others). The final length and layout of inter-array cabling will be determined by tenants prior to installation of their respective devices. The maximum inter-array cable length for the site is based on the maximum number of berths (eight). As per the export cables, for certain parts of the site, additional cable protection may be required to secure the cable to seabed at strategic points and prevent movement.

133. The key parameters of the array cables are shown in **Table 4-11**. These parameters are therefore within the PDE of this EIA.

Table 4-11 Key Parameters of the Array Cables

Parameter	Value
Number of individual cables (full 240 MW capacity)	Up to 740
Cable length	Up to 2.5 km per cable (majority will be less than 1 km)
Total length of array cables	Up to 204.5 km
Total seabed footprint (up to 204.5 km of array cables plus protection, plus rock bags on max 100m intervals)	30,040 m^2.

4.3.5.3. Offshore Cable Tails

134. Up to nine export cables connecting the landfall substation to the offshore arrays will be installed. These may be installed as follows:

- As a continuous export cable from landfall substation; or
- As a cable tail installed from the landfall substation each up to 620 m long to a location several hundred metres offshore. Each ‘tail’ would be terminated in the near shore of the export cable corridor, shortly after the ‘break out’ of planned HDD. As arrays are deployed, they would then connect through an export cable to the cable tail via a junction box or joint.

135. If HDD is not feasible, the proposed alternative method is to trench across the foreshore region. An excavator will create up to nine separate shallow trenches between 480 m to 740 m long (or installed within a single trench if possible) between the landfall and the transition pits, including the intertidal. If trenching is not possible, then cables will be surface laid and secured using concrete mattress and or rock bags. Quantities of rock bags or concrete mattresses for the export cable route, including the intertidal area, are included in Table 4-10. It is anticipated that at least double armoured cables of up to 300 mm^2 cross section may be used; resulting in a diameter of 120 mm.

4.3.5.4. Hubs

136. Hubs would typically connect and aggregate power from a number of individual devices. Hubs may be 'passive', with a busbar joining multiple tidal devices together; or 'active', containing a transformer, switchgear and possible control equipment (convertors).

137. Seabed mounted hubs are likely to be largely cylindrical structures, between 2 and 6 m in diameter, up to 10 m long. They may also have 'external' sealed transformers that would fit into a similar footprint. Height of the structure off the seabed is likely to be approximately 5 to 8 m. Keel clearance will depend on the water depth and the type of hub, with a minimum of 20 m UKC at all locations with seabed mounted hubs.

138. Some hubs may be on a surface emergent structure; a small jacket or monopile structure (2 to 6 m diameter monopile, up to 18 m above the sea surface at LAT). The electrical equipment will be within a larger diameter pile.

139. It is estimated up to 120 separate electrical hubs may be required to aggregate output from multiple devices. The following scenarios are anticipated:

- Up to 120 seabed mounted hubs, fully submerged; or
- Up to 93 floating surface emergent hubs; or
- Up to eight seabed mounted, surface emergent hubs.

4.3.5.5. Summary of Cabling Offshore and Electrical Infrastructure Parameters

140. The worst-case scenario for the cabling and electrical infrastructure to be used in the impact assessment, is presented in **Table 4-12**.

Table 4-12 Worst-case Scenario for Cabling and Electrical Infrastructure

Parameter	Value
Export Cables	
Number of export cables (including cable tails, if required)	9
Total length of export cables	40.5 km
Maximum length of individual export cables	6 km
Minimum length of individual export cables	1.2 km
Footprint of export cables and split-pipe protection	6,885 m^2 (4,860 m^2 cable + 2,205 m^2 split-pipe protection)
Footprint of additional cable protection (rock bags)	4,860 m^2
Footprint of export cables, split-pipe protection and rock bags	**11,745 m^2**
Inter-Array Cables	
Number of inter-array cables	740
Total length of inter-array cables	204.5 km
Maximum length of individual array cable	2.5 km
Footprint of inter-array cables, split-pipe protection and rock bags	**30,040 m^2**

4.3.6. Navigation and Monitoring Equipment

141. The MDZ will be marked by navigation buoys. The exact location, number and nature of the marking and navigation buoys will be determined through consultation with Trinity House (TH), the Maritime and Coastguard Agency (MCA) and navigation stakeholders. Buoys will be provided in accordance with International Association of Lighthouse Authorities (IALA) standards.

142. As a minimum, the northerly, easterly, southerly and westerly boundaries of the MDZ will need to be marked with the appropriate IALA cardinal mark. There may be additional cardinal markers or special mark buoys required, particularly along the northern and southern boundaries of each array. The exact requirements for marking will be confirmed by appropriate regulators and applied via consent condition and their discharge.

143. Cardinal buoys will be required to have flashing white lights with a visibility of not less than 5 nautical miles (nm). Special Mark buoys to have flashing yellow lights with a visibility of not less than 5 nm. Buoys may be required to have automatic acoustic signals that are triggered in low visibility.

144. Substantial yellow colouring is the worst-case in terms of the appearance of any surface-emergent elements of the PDE, in compliance with IALA guideline O-139 Section 2.4.1 2F. Tidal devices will be lit at night in conformance with guidance from TH and IALA. Fully submerged devices and electrical hubs may have a marker buoy to assist with access, communications and retrieval.

145. There may be a requirement for some floating and seabed mounted environmental monitoring platforms to be deployed throughout the MDZ.

146. A number of Acoustic Doppler Current Profilers (ADCPs) will also be deployed across the site to measure current flow speeds and directions. Each ADCP is expected to be a seabed mounted unit, deployed in a stainless-steel seabed frame.

147. The layout options considered may include combinations of surface emergent and fully submerged devices. As such appropriate consideration will be required to ensure that the method and type of marking are appropriate for the device type and infrastructure.

148. The key parameters of the navigation and monitoring equipment are shown in **Table 4-13.** These parameters are therefore within the PDE of this EIA.

Table 4-13 Worst-case Scenario for Navigation and Monitoring Equipment

Parameter	Value
Number of navigation buoys	Four
Dimensions of navigation buoys	Up to 3 m, with a focal plane height (position of light) of 6 m
Number of marker buoys	Each fully submerged seabed mounted or mid-water buoyant device
Dimensions of marker buoys	Up to 1.2 m, with a focal plane height of 1.5 m
Number of environmental monitoring buoys	Five

Parameter	Value
Dimensions of environmental monitoring platforms	Up to 3.6 m above sea level
Number of ADCPs	Up to 40
Diameter of ADCP	Approximately 1.5 m
Footprint of individual ADCP (and total across MDZ)	7 m^2 (378m^2)
Number of IALA cardinal marks	Four
Dimensions of IALA cardinal marks	Up to 3 m, with a focal plane height of 6 m
Seabed footprint of anchors	Concrete weight up to 2 m in diameter, with a chain catenary in contact with the seabed of up to 30 m
Visibility of fully emergent/floating devices	Coloured yellow above water and with navigation lights

4.4. ONSHORE INFRASTRUCTURE

149. The boundary for the ODA is provided in **Figure 1-2** (**Volume II**). The Landfall Substation is within land currently farmed by Ty-Mawr farm, in the area of Holy Island known as Penrhos Feilw. From the Landfall Substation location, the majority of the onshore cable route follows the minor road network to towards the A55 and Holyhead to Bangor rail line.

150. The cable will be routed via trenching to the Switchgear Building and be subsequently routed via trenching, with a trenchless crossing under the A55 and rail line, to the Grid Connection Substation.

151. The key components of the onshore works associated with the Project are detailed in this Section, in the following order:

- Cable landfall;
- Landfall Substation;
- Onshore cable corridor;
- Switchgear Building; and
- Grid Connection Substation.

4.4.1. Cable Landfall

152. Landfall will be located within the bay on the western coast of Holy Island known as Abraham's Bosom. There are two main methods which could be used for cable installation at landfall:

- HDD; or
- Open cut trenching.

153. HDD is the preferred method to achieve landfall. If HDD is not feasible, the proposed alternative method is to trench across the foreshore region. An excavator will create up to nine separate shallow trenches between 480 m to 740 m long (or installed within a single trench if possible) between landfall and transition pits. This will be followed by installation and pinning of ducting and/or subsea cable within the trench across the cliff top and fore shore, with a split-pipe used to carry cabling down the cliff face. If trenching is not possible in the foreshore, then cables will be surface laid and secured using concrete mattress and or rock bags. Quantities of rock bags

or concrete mattresses for the export cable route, including the intertidal area, are included in **Table 4-10**.

4.4.1.1. HDD Compound and Transition Pits

154. As noted earlier, HDD is the preferred method of cable installation. The proposed route to the HDD exit point measures approximately 0.55 km in length, from Abrahams Bosom in the north, passing under South Stack Road, beneath a campsite and into Ty-Mawr farm field. The route and other works will be accessed by a temporary track.

155. The transition pit and HDD drilling rig compound will be located in Ty-Mawr farm field, immediately south-west of the existing farm buildings. There will be one transition pit, up to 15 m x 85 m x 1.5 m deep, equating to a footprint of 1,275 m^2, excavated volume 1,912.5 m^3 in addition to trenching excavation or HDD cutting volumes. All transition pits will be buried upon completion of the works and covered by a depth of approximately 200 mm topsoil (recovered from excavated materials) and seeded with grass mix. The final volume is subject to confirmation of geology and drill geometry.

156. Material excavated will be re-used on site if possible. If it cannot be re-used it will be removed from site for appropriate re-use elsewhere.

157. Within the transition pit, each of the nine submarine cables may be jointed and transitioned to 9 sets of separate onshore cables. Each of the 9 sets of onshore cables will then require between 2 and 8 ducts depending on the specific requirements of the tidal energy devices. The maximum case of 8 ducts comprise, 3 x HV, 1 x fibre optic, 1 x LV and a spare, 1 x Extra Low Voltage and a spare. The minimum case of 2 comprise a single, multi-core HV cable and a fibre optic. This gives a maximum case of 72 ducts and a minimum case of 18 ducts.

158. The cable route from transition pit to the Landfall Substation may be up to 0.4 km in length and will be trenched. Up to nine draw pits may be required within that route to allow for changes in direction of the trench. Each draw pit will be approximately 2 m x 2 m x 1.5 m deep, subject to final detailed design.

159. A precast concrete box culvert will be installed beneath the Ty-Mawr Access Road to allow the onshore cable ducts to pass through to the Landfall Substation whilst minimising disruption to the existing access.

160. Within the HDD compound, plant (i.e. generator, drilling rig) will be present to support HDD operations. The HDD compound will be bounded by a 3.5 m high acoustic demountable fence located around the equipment and a 2 m high solid hoarding fence built around the compound boundary.

4.4.1.2. Landfall Trench/Surface Laying Option

161. As discussed above, should HDD not be feasible, an alternative approach would be open cut trenching. This would involve cutting shallow trenches across the beach and pinning and/or ducting the subsea cable, within a split-pipe to the cliff face. Should trenching not be possible, then cables will be surface laid, with cables crossing the intertidal area requiring protection using

rock bags or concrete mattresses. From the cliff top, cables will be buried in trenches that cross the fields and South Stack Road to the transition pits and onwards to the landfall substation.

162. Up to nine shallow trenches (slots within the cliff face) would be created using a rock cutter and then the cables would be 'surface laid' over the cliff using a split pipe or J-tube. A J-tube type solution is essentially very similar to the split pipe, or duct approach. In this way, cable ducts will be fixed to the cliff face. The J tubes would extend above the top of the cliffs and then the cables would emerge before being buried across the fields to the transition pits. As much as possible the pipes would be marshalled to a common location and brought down the cliff in as small an area as possible. Up to 500 mm separation between J-tube centres is proposed. The total width of grouped J-tubes would be up to 30 m.

163. Depending on the geology of the foreshore, an individual trench width up to 600 mm, or a single trench with all nine cables laid within it of up to 10 m width and 0.5 to 1.2 m deep will be constructed using open cut trenching. Alternatively, split pipes could also be used in the foreshore region, and the cables surface laid and protected, should trenching not be feasible.

164. A temporary working corridor width of 30 m is assumed for the foreshore and cliff works.

4.4.1.3. Temporary Works

165. It is expected that up to one temporary access track to the transition pit or to a temporary construction compound will be required during the construction phase.

166. To create the temporary works areas and access track, it is anticipated that 0.15 m of topsoil will be stripped back, stockpiled and protected during storage whilst the construction works progress. This will be reinstated, so there will be no waste topsoil arising from this activity. It has been assumed that 0.3 m of hardstanding (permeable gravel aggregate underlain by geotextile) will be placed over each area during construction. A layer of tarmac may also be placed over the temporary works areas that will use/store heavy machinery/equipment. Any surface vegetation removed as part of excavation works will be separately stockpiled and sent for recovery at a composting or an anaerobic digestion facility.

4.4.1.4. Summary of Landfall Installation Parameters

167. The requirements for installation of the landfall by HDD and trenching are presented in **Table 4-14.**

Table 4-14 Construction Parameters for Installation of the Landfall by HDD and Trenching Methods

HDD Installation (preferred)	Trenching (worst-case)
Up to nine cable tails.	Up to nine cable tails.
Up to nine separate drills; each up to 550 m long, nominally 450 mm diameter.	Up to nine separate shallow trenches (slots within the cliff face).
Separation of 10 m between HDD entry points.	Trenches between 480 m and 740 m long from transition pit to intertidal.
Separation of 20 m between HDD exit points.	Individual trench widths of up to 600 mm. Or a single trench with all nine cables laid within it of approximately 10 m width and 0.5 to 1.2 m deep.

HDD Installation (preferred)	Trenching (worst-case)
Total drill cuttings volume could be up to 900 m^3 (total amount for all nine drills).	Duct or split pipe over 370 to 550 m of each cable, up to 350 mm external diameter.
Trenching works from transition pit to Landfall Substation.	Up to 500 mm separation between J-tube centres.
Transition pit up to 15 m x 85 m x 1.5 m deep, equating to a footprint of 1,275 m^2, excavated volume 1,912.5 m^3.	Total width of grouped J-tubes would be up to 30 m.
Up to 9 draw pits of 2 m x 2 m x 1.5 m deep equating to a footprint of 36 m^2, excavated volume 54 m^3.	Total material removed from site could be approximately 8,880 m^3 [10]; with the majority of material replaced to backfill the trench after the ducts / cables were installed. Worst case assumption all material removed in onshore or offshore dependent on receptor.
HDD compound will be bounded by a 3.5 m high acoustic demountable fence located around the equipment and a 2 m high solid hoarding fence.	Cables crossing the intertidal area may also require protection using rock bags or concrete mattresses or equivalent methods.
Temporary works area up to 120 m by 70 m (total area for HDD rig, site office and equipment plus laydown area).	Temporary works area up to 100 m by 50 m (for site office and equipment plus laydown area). A temporary working corridor width of 30 m.
From transition pit to Landfall Substation, each of the 9 onshore cables will require between 2 and 8 ducts depending on the specific requirements of the tidal energy devices. The maximum case of 8 ducts comprise, 3 x HV, 1 x fibre optic, 1 x LV and a spare, 1 x Extra Low Voltage and a spare. The minimum case of 2 comprise a single, multi-core HV cable and a fibre optic. This gives a maximum case of 72 ducts and a minimum case of 18 ducts.	From transition pit to Landfall Substation, each of the 9 onshore cables will require between 2 and 8 ducts depending on the specific requirements of the tidal energy devices. The maximum case of 8 ducts comprise, 3 x HV, 1 x fibre optic, 1 x LV and a spare, 1 x Extra Low Voltage and a spare. The minimum case of 2 comprise a single, multi-core HV cable and a fibre optic. This gives a maximum case of 72 ducts and a minimum case of 18 ducts.

168. There are currently two HDD scenarios to installing the export and onshore cables that may be possible:

- **Scenario 1:** HDD boreholes, onshore cable ducts and infrastructure are installed and subsequently pull through export and onshore cables. This work would take place during the construction phase.
- **Scenario 2:** HDD boreholes, onshore cable ducts and infrastructure are installed during the construction phase. Each developer will pull through their export and onshore cables and therefore these operations will be staggered during the service life of the facility.

169. Scenario 1 represents the worst-case scenario for cumulative noise, visual and disturbance impacts and therefore is assessed as such within the relevant ES chapters.

4.4.2. Landfall Substation

170. The landfall substation will house the connection between the offshore export cables and the onshore cable to the grid connection substation. The landfall substation will be positioned within

[10] Based on calculation of trenches of 740 m length, 10 m width and 1.2 m depth

a single field adjacent to South Stack Road to the west of Tŷ-Mawr Farm. It will comprise three separate buildings of differing footprints, all up to approximately 7 m high. There would also be a separate transformer compound and external working areas and parking. The layout also comprises a facility for electric vehicle charging.

171. The site comprises a fenced compound approximately 80 m by 80 m and contains three buildings: the first 62 m by 22.5 m by 7 m high (or equivalent area); second to 28 m by 10 m by 7 m high (or equivalent area) and the third to 8 m by 8 m by 7 m high. The third building is within a substation compound to 28 m by 36 m by 7 m high (or equivalent area). The estimated total footprint of the landfall substation compound is 6,400 m^2.

172. An indicative site layout for the Landfall Substation is provided in **Plate 4-7**, which may be subject to further refinement.

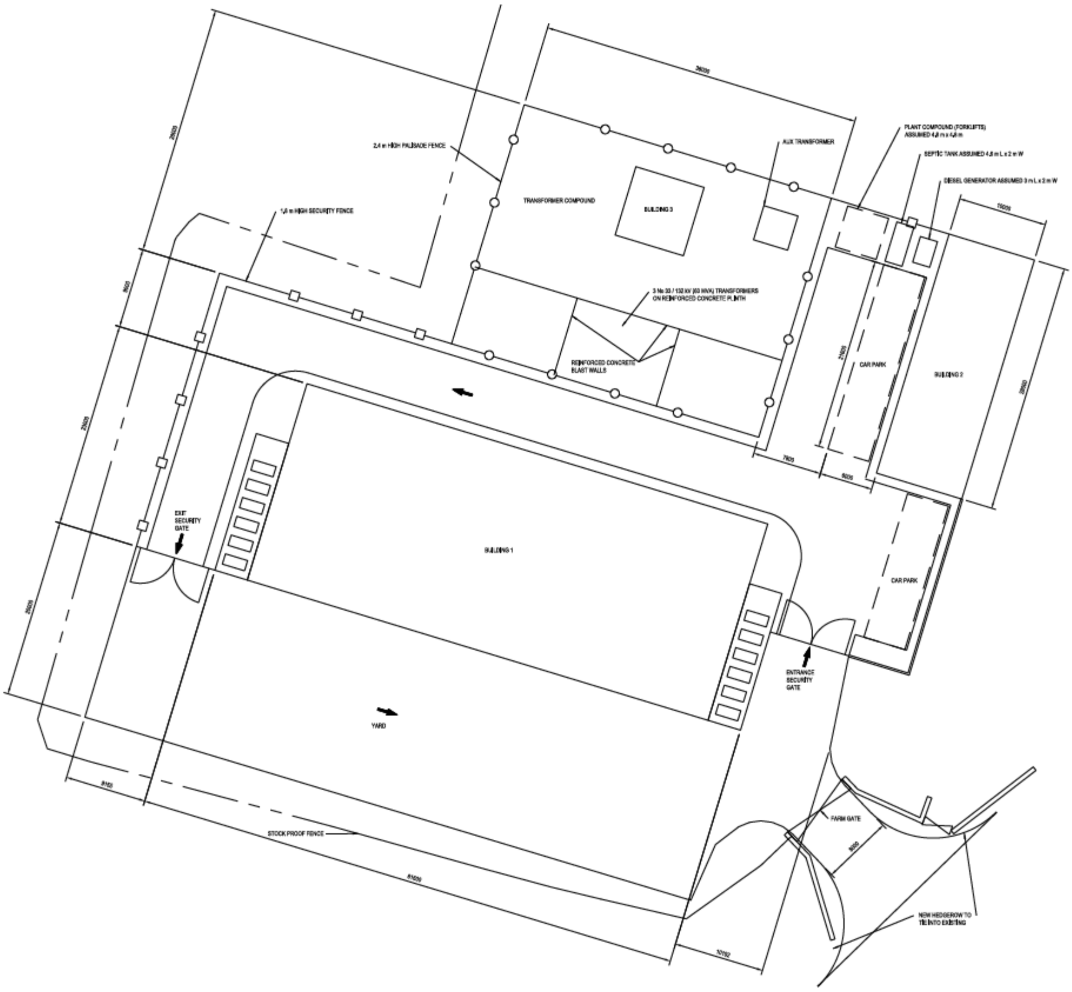

Plate 4-7 Indicative Site Layout – Landfall Substation

173. The main building will contain up to nine electrical plant rooms for developers to contain step-up transformers. The building will also support external (within a dedicated enclosure) Cooling/Ventilation systems. The buildings will be of a mainly steel portal frame construction with a pitched roof. The walls will be clad in preformed steel and, if necessary, timber batons. The walls of the flanking cooler compounds will be clad with ventilation louvres.

174. The landfall substation is positioned within a recessive location in the landscape, within a valley, and uses the landform to help integrate the substation into the landscape. The landfall substation will be cut into the valley side rather than building a platform out from the valley slope. There will be a retaining structure (to reduce the amount of cut) along the western and northern edges of this landfall substation site, assumed to be constructed of stone filled gabions, possibly combined with underlying rock. Approximately 13,900 m^3 will be cut in to the landscape and a fill of approximately 130 m^3.

175. There will be a temporary construction compound and laydown area with a footprint of 50 m by 100 m, or the equivalent area, located to the south west of the landfall substation.

176. Permanent access is proposed to the landfall substation location during construction and operation.

4.4.3. Onshore Cable Corridor

4.4.3.1. Onshore Corridor Overview

177. The onshore cable route will feature up to two 132 kV cable circuits. Each circuit would consist of three power cables plus a fibre optic cable. This results in up to six power cables and two fibre optic cables in total, each of up to 110 mm diameter cable for each circuit (up to six in total).

178. The onshore cable route will be of up to 8.1 km total route length, dependent on final detailed route design, with the cables trenched into the local road network so much as is practicable, given constraints in road width and services already within the road. It is assumed, based on Design Manual for Roads and Bridges (Highways Agency, 2019), that the profile of the trench comprises 0.3 m porous asphalt, 0.3 m base course and the remaining 1.1 m is road base. However, it is acknowledged that some more rural roads are less likely to have as comprehensive a make-up.

179. There are two trench types as shown in **Table 4-15**, one from the Landfall Substation to Switchgear Building and one from the Switchgear Building to the Grid Connection Substation.

Table 4-15 Cable Route Trench Parameters

Cable route parameter	Landfall Substation to Switchgear Building	Switchgear Building to Grid Connection Substation
Circuit	132 kV	33 kV
Trench depth	1620 mm	1620 mm
Trench width	1400 mm	2000 mm
Length	6675 m	1420 m
Joint bays (No.)	18	2
Joint bay chamber depth	1.65 m	1.65 m
Joint bay chamber width	2 m	3 m
Joint bay chamber length	12.5 m	5 m
Draw pits (to be fully reinstated following works) (No.)	35	7
Draw pit depth	1.65 m	1.65 m

Cable route parameter	Landfall Substation to Switchgear Building	Switchgear Building to Grid Connection Substation
Draw pit width	3 m	5 m
Draw pit length	8 m	8 m

180. Where road width is insufficient, the road verge and adjacent field areas may be utilised, within a maximum work corridor width of 30 m.

181. Approximately 20 m x 7 m of hardstanding will be required around each joint bay to provide enough space for the cable pulling works. This area may require use of field areas adjacent to the road.

182. A length of cable installation by HDD will be required to cross the railway line and A55 at the Grid End location. The transition pits will be located either side of the A55 and railway line and in line with the proposed Grid Connection Substation. The two transition pits (exit and entry pits) will be 80 m x 15 m x 1.5 m deep. The final location will be determined within detailed design.

4.4.4. Switchgear Building

183. The infrastructure at Parc Cybi will consist of a 33 kV switchboard room and metering room. The existing road will be used to access this location, during both construction and operation of the switch. The Switchgear Building would comprise a single building up to 9.4 m x 5 m, with a maximum height of 4 m. It would be positioned to the north east of the existing substation within the Parc Cybi employment site (as described in Isle of Anglesey Local Development Plan, 2017), separated from this existing infrastructure by part of the internal road layout. The footprint of the Switchgear Building is 38 m^2, with a temporary construction compound of up to 30 m x 20 m. An indicative site layout for the Switchgear Building is provided in **Plate 4-8**, which may be subject to further refinement.

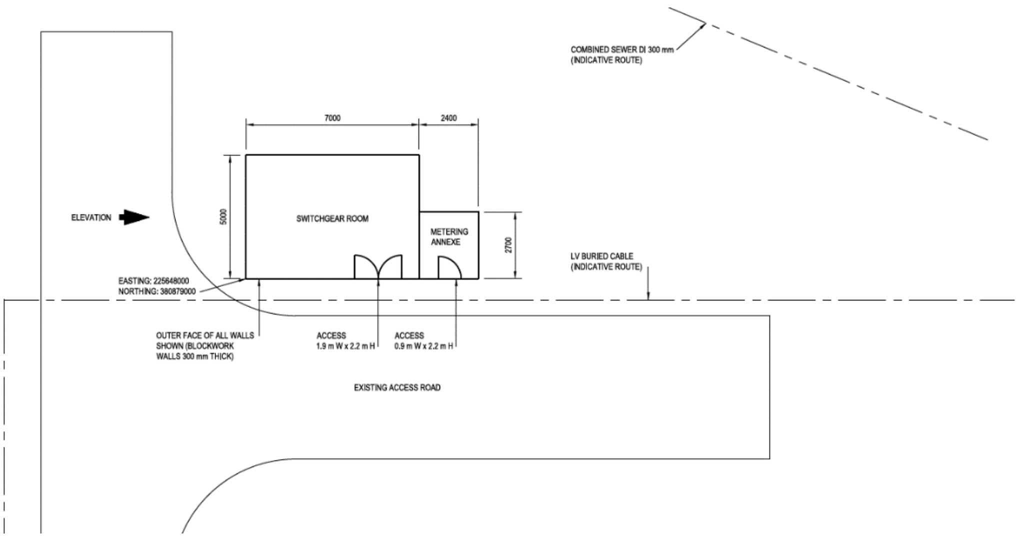

Plate 4-8 Indicative Site Layout – Switchgear Building

4.4.5. Grid Connection Substation

184. A substation will be required to achieve connection at the grid connection point. The Grid Connection Substation will be located within the land that forms part of the former Anglesey Aluminium works to the north east of Holy Island, south east of Holyhead, now known as Orthios. Connection to existing electricity network will be through existing infrastructure.

185. The existing road to the Orthios site will be used to access this location, during both construction and operation.

186. The Grid Connection Substation will contain up to seven energy storage systems each with two sets of inverters, HVAC units and transformers. There will be up to three substation buildings, (two 132 kV substations and one 33 kV) and one static synchronous compensator (STATCOM) building. The compound will also contain external air-cooled reactors and cooling units.

187. The Grid Connection Substation will have an overall footprint of up to 104 m x 62 m. It would contain external plant and equipment, together with four buildings. The maximum height of the proposed structures within the Grid Connection Substation will be 9 m. An indicative site layout for the Grid Connection Substation is provided in **Plate 4-9**, which may be subject to further refinement. An indicative location for the Grid Connection Substation is shown in **Figure 1-2** (**Volume II**) and throughout supporting figures to the technical chapters. However, note that this is indicatively only and will be refined upon detailed design.

188. A temporary construction compound and laydown area will also be created, up to 50 m x 100 m, or equivalent area.

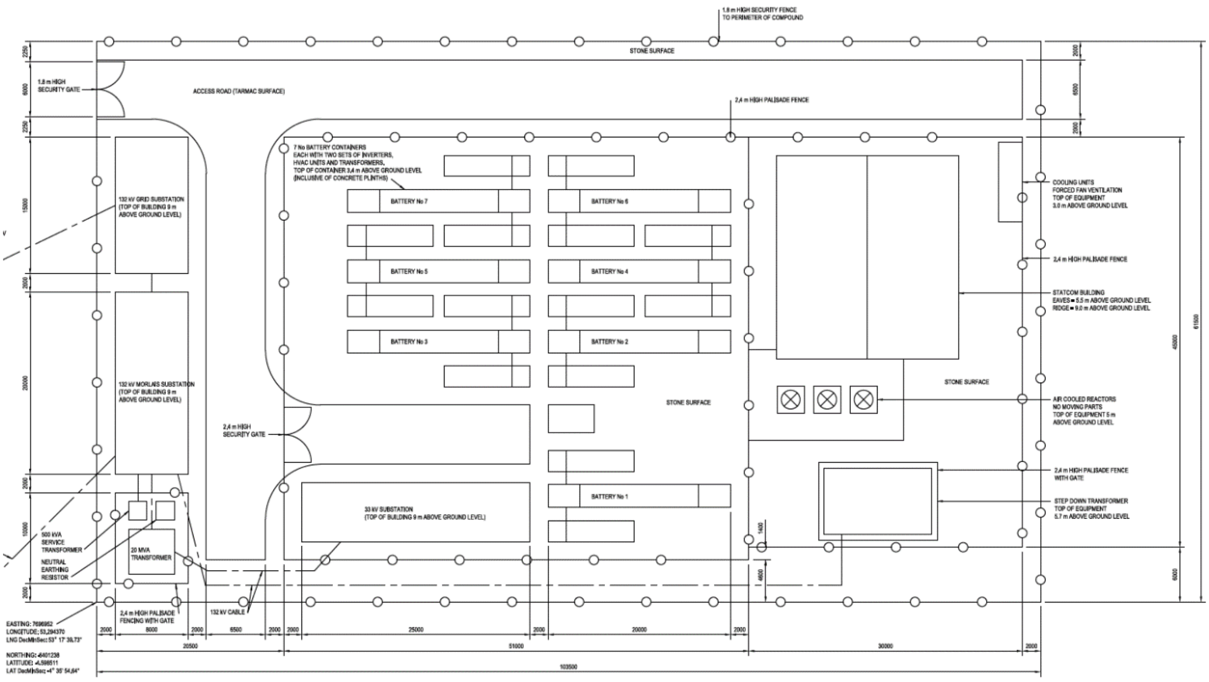

Plate 4-9 Indicative Site Layout – Grid Connection Substation

4.4.6. General Building Parameters

189. The parameters bulleted below are relevant to the infrastructure within the ODA, including the Landfall Substation, Switchgear Building and Grid Connection Substation:

- Appearance of the buildings;
- Lighting;
- Screening structures;
- Access;
- Foundations;
- Building materials; and
- Drainage.

4.4.6.1. Appearance

190. The preferred appearance of the Landfall Substation is for agricultural (shed-like) buildings (which will house indoor equipment), which will allow at least partial mitigation of noise and visual impacts of outdoor equipment. The buildings will be steel portal frame structures with pitched roofs and can be clad in timber or a profiled metal cladding. Differently, the Grid Connection Substation and Switchgear Building are located within the context of buildings that are comparable in form and function. It is anticipated that the proposed the buildings would be constructed using materials that are similar to those located in the immediate surroundings i.e. within the Orthios and Parc Cybi sites.

191. The buildings may feature low level ventilation louvers to bring in cooler outdoor air, and high-level exhaust cowls with ducted axial fans. These ventilation features would be visible from outside the building.

192. Distinct cooler compounds are to be steel structures with ventilation louver cladding to bring in cooler outdoor air. The cooler compounds are anticipated to abut with the buildings and will be visible from outside the building.

193. The perimeter will be protected by a weld steel fence. The design of the fence shall be such that it blends in with the local environment as far as possible. The perimeter fencing would be a minimum of 1.8 m tall.

194. Outdoor equipment may be placed outside in the external compound at the Landfall Substation and the Grid Connection Substation. Reinforced concrete blast walls will provide a protective barrier between adjacent transformers and enclosure whilst palisade fencing can be installed around the perimeter of the external compound to provide security. The palisade fencing will be installed hidden from view within the substation perimeter fence. The palisade fencing would be at minimum 2.4 m tall.

4.4.6.2. Lighting

195. A minimum of 110 lux (lx) directed lighting will be required around the entry to the Landfall Substation and Grid Connection Substation, which will be turned on when needed, and may be equipped with motion sensors. Adequate lighting will be provided for any outdoor electrical plant areas in the form of compound floodlighting to facilitate any inspection or maintenance of electrical equipment at night. This would normally provide 10 lx along access paths and around major items of electrical plant. This may require columns to fix lighting to although electrical

clearances will be followed to eliminate the possibility of a column falling across electrical equipment.

4.4.6.3. Access

196. Access and egress to each site will be on a 24 hour and seven days per week basis. It is anticipated that access will be via secure key pad and automatic gate.

197. Specific areas of the road network may need works to assist with turning radius or weight distribution for transport of low loader vehicles.

4.4.6.4. Foundations

198. Each item of outdoor and indoor electrical and non-electrical equipment will have a concrete slab foundation. Strip and pad foundations will be utilised if possible.

199. It may be necessary to utilise a piled foundation solution, using pre-cast concrete piles or similar, if warranted, depending on the underlying geological conditions (to be determined by the civils contractor) and the outcome of post-consent, pre-construction archaeological evaluations. The transformer foundations will be bunded to contain any risk of oil leakage from the transformer or any other oil-filled plant.

4.4.6.5. Building Materials

200. The interior of the Landfall Substation building, an agricultural shed type structure, will have fire barrier walls made of dry wall cladding. The main transformer room for the agricultural shed will have firewalls constructed out of concrete or concrete blocks. Other rooms may similarly utilise blockwork construction including the switchgear, battery and auxiliary power rooms.

201. It is anticipated that the proposed Grid Connection Substation and Switchgear Building would be constructed using materials that are similar to those located in the immediate surroundings i.e. within the Orthios and Parc Cybi sites.

4.4.6.6. Surfaces

202. Hard standing will be in the form of hard core or tarmac surfaces on the access roads within the Landfall Substation and the Grid Connection Substation. This pertains to the 5 m to 7 m wide perimeter access road, additional access areas around transformers and reactors, building entrances, and the main substation entrance and car park.

203. Footpaths or pavement in and out of the grid connection substation building and areas commonly accessed may be of poured concrete instead of hard core or tarmac.

204. Outdoor areas within the Landfall Substation and Grid Connection Substation compounds will have a layer of crushed rock or gravel approximately 80 mm to 150 mm thick. This will be everywhere inside of the substations' perimeters with the exception of the access roads, protruding equipment foundations, and buildings.

4.4.6.7. Drainage Systems

205. Generally, the aim will be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

- Priority Level 1: Surface water runoff is collected for use;
- Priority Level 2: Surface water runoff is infiltrated to ground;
- Priority Level 3: Surface water runoff is discharged to a surface water body;
- Priority Level 4: Surface water runoff is discharged to a surface water sewer, highway drain or another drainage system; or
- Priority Level 5: Surface water runoff is discharged to a combined sewer.

206. Guidance indicates that Priority Level 1 is the preferred (highest priority) and 4 and 5 should only be used in exceptional circumstances.

207. A Surface Water Drainage Strategy will be developed according to the principles of the Sustainable Drainage Systems (SuDS) hierarchy and in line with S1 Surface water runoff destination, as set out in the Statutory Standards for sustainable drainage systems.

208. The foul drainage system is to take wastewater from personnel areas and connect into a local septic tank with an overflow into a local infiltration trench. The surface water system collects run off from buildings and roads run through oil interceptors and discharged using bund pumps, so all contaminants are removed from the water. The drainage system will be designed to handle the worst-case water situation and with consideration of flood risk. The surface water may connect into a sewer system, discharge into a local watercourse if possible, septic tank, or be discharged into a soakaway system constructed nearby.

209. An oil interceptor may be required to be installed to protect the surface water system from pollution. Such an interceptor capacity should be adequate to the area intercepted by the substation surface water drainage system.

4.5. CONSTRUCTION METHODOLOGY

4.5.1. Offshore

4.5.1.1. Device Installation

210. Due to the wide range of possible device types that may be installed within the MDZ, it is not possible to specify the exact installation methodology that will be adopted. The consultation process with potential developers has been used to inform the likely foundation and device installation methods that may be used at the site.

211. A number of installation method could be adopted, including those below:

- Installation of foundations and support structures, then lower, ballast or pull the TEC(s) down onto the foundation;
- Installation of foundation, support structures and TEC as a complete unit from a heavy lift (dynamic positioning or moored barge) or bespoke vessel;

- Installation of foundation, support structures and TEC as a complete unit towed to site and then ballasted into position (seabed or mid water column); and
- Floating and mid water buoyant systems will be towed to site and while on the surface attached to pre-installed anchors and mooring lines / cables. Mid water buoyant devices will then be winched below the surface via mooring / anchor lines.

212. Piled foundations would mainly be installed by a moored barge or Dynamic Positioning (DP) vessel with sufficient cranage (250 t to 400 t). Monopile and pin-piles will be installed through remote drilling using a subsea rig controlled from a DP vessel (up to three days per large pile drilled, or 1.5 days for pin-piles).

213. TECs and supporting structures would then be installed separately using a DP vessel (potentially the same as for the foundation installation) or a multicat vessel.

214. A moored barge may be suitable for some installations. Such a barge would be approximately 100 m x 30 m and have four to eight 100 tonne gravity blocks (5 m by 5 m) or drag anchors (3 m x 5 m) with some anchor chain catenary, estimated at 400 m to 500 m length on seabed and 1 m diameter. A typical mooring spread would consist of moorings on a 'radius' from the vessel centre of between 500 m and 800 m. Overall 'footprint' of mooring spread would be a rectangle of approximately 500 m to 1,400 m x 850 m to 1,600 m. This type of vessel will require one or two small support vessels (30 m x 22 m) to assist with positioning and anchor deployment.

215. A DP vessel would be of a similar size to the barge (155 m x 30 m) but would not disturb the seabed and may not require any tugs.

4.5.1.2. Cable Installation

216. After HDD drilling, diver operations will be required to fit a seal/cap to the offshore end of each of the ducts. This would be carried out by a small dive support vessel/multicat and will take approximately five days to complete.

217. Before export cable laying, diver operations will again be required to open the ducts and install pick-up lines for the cable laying vessel. If the HDD end is in an area of sediment, it may need to be exposed which will require diver excavation. This would also be carried out by a small dive support vessel/multicat and take approximately five days.

218. Export cables will be installed using specialist cable installation vessel, barge or multi-cat. Where a cable tail is used, the vessel will pick-up the cable ends, connect the cables, and lay towards the tidal array. Where cable tail is not used, then the cable will be continuous from HDD to the array. Connection to device arrays could include daisy-chained devices as well as connection via single and multiple hubs (submerged and surface emergent).

219. Post cable installation, if the HDD is to be bentonite filled then the offshore end will need to be vented which will require further diver operations. This would also be carried out by a small dive support vessel / multicat and take approximately five days.

220. Following surface cable laying, cable protection systems, either concrete mattress or rock bags will be installed. Sediment within the MDZ is limited, however, burial of the cable in the first

1 km to 2 km may be attempted with multiple passes of a jet trenching Remotely Operated Vehicle (ROV), or possibly diver burial techniques over shorter lengths in the shallow water.

221. Installation of export and array cables could require a medium sized cable installation vessel (up to 140 m long and 6 m draft), plus barge (could be up to 130 m long x 30 m wide) for installation of rock bags / mattresses (30 m long x 12 m wide), with a small additional support vessel for each.

222. It is anticipated that there will be a safety zone of 500 m around all installation vessels.

223. The cable vessels will be mobilised directly from the manufacturing / supply port; likely to be Hartlepool, Norway, Italy or Germany for cables. Installation support ports are likely to be Holyhead, Mostyn, Liverpool or Birkenhead; although ports further afield may be used by some developers.

4.5.1.3. Cable Tail Installation

224. If cable tails are installed this will be undertaken by a cable vessel, barge or multicat (up to 140 m long and 6 m draft), plus small support vessel(s). The cable installation vessel is likely to be on site up to ten days; cable protection installation vessels may be on site for up to two days.

4.5.2. Onshore

4.5.2.1. Onshore Cable Route

225. Trenching for the onshore cables will be undertaken using a large excavator to dig up the ground along the route. Rock breakers will also be required along some sections.

226. Where the route goes through fields the trench will be backfilled with sand and/or stabilised material to a depth of approximately 150 mm above the top of the cables. The material originally removed from the trench will be replaced on top of the stabilised material. Finally, the trench will be topped up with a minimum of 150 mm of topsoil and the land restored as close as possible to its original condition. The cable will be buried to a depth of approximately 1 m, from the surface to the top of the ducts. Up to 30 m working width will be required for plant access, lay down of equipment, top soil, spoil and trench shoring along the cable route.

227. Cable installation within a road or a verge will follow the methodology of cable installation in a field. However, due to the restricted environment, installation activities will need to be sequenced and material will need to be removed from the site or kept off site until required. A trench will be cut through the road surface and excavated. Once the trench is prepared, the cables or ducts will be laid, and the road reinstated. A working area of approximately 6m width would suffice for installation in a single lane road.

228. The onshore cables will cross the A55 and the railway line within an area opposite the Grid Connection Substation. The HDD rig will either be positioned within the footprint of the Grid Connection Substation or on the opposite side of the A55/railway. The route will be perpendicular to the A55 but the exact location of the entry/exit pits will be refined during detailed design. Up to two crossings, each involving six drills, will be required with a drill length of

approximately 150 m. Two site areas will be prepared for each HDD crossing; the drill rig site where the HDD enters the ground, and the exit point on the other side of the crossing.

229. When crossing underground services, it is likely that the cable trenches will pass underneath existing services, unless the service is extremely deep. This will be determined through further surveys.

4.6. CONSTRUCTION SCHEDULE

230. An overview of the indicative Project construction schedule is shown in **Table 4-16**. This is based on the assumption of project consent in March 2021 and on the preferred option of HDD construction methods at the landfall. Further detail on the offshore and onshore timescales are provided in **Section 4.6.1** and **Section 4.6.2**, respectively.

Table 4-16 Indicative Morlais Construction Programme

Task Name	Start	Finish
Grid Connection Substation		
Construction	January 2022	October 2022
Onshore Cable Route		
Transition Pit installation	September 2022	December 2022
HDD works mobilisation and preparation	November 2021	June 2022
Onshore Cable Construction	March 2022	April 2023
Landfall Substation and Switchgear Building		
Preparation works	November 2021	December 2021
Construction works	February 2022	October 2022
Electrical Installation	July 2022	December 2022
Cable Connection	November 2022	January 2023
Offshore Infrastructure		
Installation of infrastructure within the MDZ and ECC	January 2023	December 2023

4.6.1. Offshore

231. Offshore works (for installation of tidal devices and associated cabling and infrastructure) would be phased over a period of several years, taking up to 15 days per device or hub and up to 1.5 day for each inter-array cable, and up to 20 days for each export cable plus up to 12 days each for cable protection. For the main installation phase of tidal devices and associated electrical hub infrastructure, the typical time for complete installations is between three and 15 days per device, including foundation.

232. For the full 240 MW capacity scenario, the worst-case scenario in terms of installation period would involve all devices requiring pin-piled anchors requiring multiple drilling operations. These could take between 4 and 15 days per device. Therefore, total time on site installing developer devices (and hubs) could be up to 4,306 days.

233. For the export cable installation, it is anticipated that each of the nine export cables would take up to 20 days installation (total of 180 days). For array cable installation, installation could take up to 1.5 days per cable. For the maximum number of 740 array cables, this amounts to

1,110 days of array cable installation. Cable tail installation may take up to 20 days in total for 9 tails.

234. Durations for key elements of offshore construction are provided in **Table 4-17** below. It is important to note that many of the activities detailed may occur concurrently.

Table 4-17 Morlais Installation Durations

Activity	Predicted number of vessels on site	Indicative number of days vessels on site			Proportion of time vessels on site per year
		Over 10 year construction	Per year	Per year per sub-zone	
Cable tail installation	3 vessels (1 x cable tail installation vessel; 1 x cable tail installation support vessel; and 1 x dive support vessel)	200 days (assumes single operation of up to 15 days with 5 days extra for protection)	20 days	N/A (works in nearshore area not sub-zones)	5.48 %
Export cable installation	2 vessels (1 x cable installation vessel; and 1 x support vessel)	180 days (assumes 9 blocks of 20 days over 10yr period)	20 days (worst-case assumes that one 20 day block of activity occurs per year, for 9yrs of the 10yr build-out period)	Each 20 day block of export cable installation per year predicted to be spread across each of the 8 sub-zones	5.48 %
Export cable protection installation	3 vessels (1 x cable tail installation vessel; 1 x cable tail installation support vessel; and 1 x dive support vessel)	108 days (assumes 9 x blocks of 12 days following each block of export cable installation)	12 days (worst-case assumes that one 12 day block of activity occurs per year, for 9 yrs. of the 10yr build-out period)	Each 12 day block of export cable protection installation per year predicted to be spread across each of the 8 sub-zones	3.29 %
Inter-array cable Installation	2 vessels (1 x cable installation vessel; and 1 x support vessel)	1,110 days (assumes a 10 year period build out of all 8 arrays, and no more than 2 arrays built in parallel at any time)	111 days	Up to 13.75 days	30.14 %
Hub installation	2 vessels (1 x hub installation vessel; and 1 x support vessel)	1,800 days (assumes 15 days per hub for 120 hubs)	180 days	22.5 days (assumes total hub installation vessel days will be spread equally across the 8 sub-zones)	49.32 %

Activity	Predicted number of vessels on site	Indicative number of days vessels on site			Proportion of time vessels on site per year
		Over 10 year construction	Per year	Per year per sub-zone	
Tidal device installation	2 vessels (1 x construction vessel; plus 1 support vessel) Or 4 vessels (2 x construction vessel; plus 2 support vessel)	4,306 days	431 days	54 days (assumes total tidal device installation vessel days will be spread across the 8 sub-zones)	100 % & 18 % (assumes 1 x construction vessel plus 1 support vessel on sites every day; plus for 18 % of year assumes 2 x construction vessel plus 2 support vessels on site)

4.6.2. Onshore

235. A build out schedule for the onshore and landfall infrastructure of 24 months is planned (assuming all works can be carried out in parallel, not sequentially). The schedule would consist of the following:

- HDD at landfall lasting up to ten months;
- Substations (Landfall Substation and Grid Connection Substation) and Switchgear Building totalling 24 months duration. The work would mainly be running in parallel, with some activities staggered or phased. This includes:
  - Year 1: enabling works and civils
  - Year 2: electrical fit out and commissioning;
- Onshore cable circuit installation (including HDD for any crossings) lasting up to 18 months.

236. Working hours are expected to be:

- 24 hours per day and seven days per week for HDD and offshore cable tail installation; and
- Daylight only and six days per week for all other works.

237. This is summarised below in **Table 4-18**.

Table 4-18 Summary Table for Onshore Construction Schedule Parameters

Parameter	Value
HDD Schedule	10 months Working 24 hours per day and seven days per week
Substations schedule (Landfall and Grid Connection Substation)	24 months Daylight only / six days per week
Offshore cable tail schedule	Three months Working 24 hours per day and seven days per week
Onshore cable circuit schedule	Up to 18 months Daylight only / six days per week

4.6.2.1. Summary of Installation Works

238. Enabling works at the Grid Connection Substation, the Switchgear Building and the Landfall Substation may include:

- Surveying and measurement of sites, including pre-construction archaeology and ecological surveys and mitigation;
- Reinforcement or alteration of access roads;
- Creation of construction compounds (temporary laydown/construction areas and site office);
- Provision of electricity supply and other services to site;
- Construction of temporary security and site fencing;

- Tree and scrub clearance; and
- Foundation excavation.

239. Works at the Landfall Substation site may entail

- HDD between the transition pits and offshore HDD ‘break out’;
- Possible alternative method if HDD not feasible consisting of cutting of trenches with excavator / rock cutter and installation of marine cables from transition pit to shallow subtidal, including installation and pinning of ducting and cable to cliff face using split-pipe;
- Construction of transition pits to joint marine and non-marine cables;
- Installation (pulling in) of subsea cable tails; and
- Cable installation via trenching between transition pits and the Landfall Substation;

240. The following ancillary works may be undertaken in association with construction of the Landfall Substation and Grid Connection Substation building and outdoor compounds and the construction of the Switchgear Building;

- Creation of parking areas;
- Construction of foundations for buildings and plant;
- Construction of cable basements or cable pits;
- Possible construction / installation of screening and/or landscaping measures, including embankments and/or stone walls;
- Installation of transformers, switchgear and other electrical infrastructure within both substations;
- Termination of cables and wiring of electrical systems;
- Installation and termination of communications;
- Testing and commissioning activity; and
- Reinstate access roads/public rights of way and affected ground.

241. The following activities may be associated with the cable route trenching works;

- Construction of joint pits every 200 m to 900 m;
- HDD to enable crossings of watercourses and roads; and
- Reinstatement of access roads, public rights of way and affected ground.

4.6.2.2. Traffic and Staff

242. To understand the likely numbers of employees and Heavy Goods Vehicles (HGVs) that would be required for the onshore construction works, B&V have been commissioned to provide industry expertise and to develop the methodologies and quantities that underpin the traffic demand assumptions for the Project.

243. The construction workforce would consist primarily of specialist workers who travel to work on similar projects throughout the UK. To supplement this, local workers would be used where

possible, subject to required skills being available. The peak number of construction employees required has been estimated at up to 70 per day, further details regarding the likely split between the various construction activities is provided within **Table 4-19**.

244. **Table 4-19** also provides a summary of the forecast HGV movements for the respective construction activities. The numbers presented represent the peak periods for each construction activity. Further details of the traffic demand and derivation are provided within **Chapter 23, Traffic and Transport**.

Table 4-19 Vehicle Trips and Staffing Requirements for Onshore Construction Works

Activities	Peak two-way * daily HGV movements	Peak two-way * LGV ** movements	Peak all vehicle movements (two-way *)
Cable installation	6	24	30
Landfall substation and HDD	20	64	84
Inland substation and HDD	20	52	72
Total	**46**	**140**	**186**
Notes			
*	*A two-way movement represents the inbound (laden trip from source/home) and the outbound trip (back to source/home). For example, 20 two-way HGV movements comprise 10 laden trips from source and 10 outbound unladen trips back to source.*		
**	*LGV (Light Goods Vehicles) includes a range of vehicles, such as cars, vans, pickups, etc.*		

245. It is proposed that vehicles associated with the Landfall Substation, landfall HDD works and cable installation activities would first travel to the site compound at the Landfall Substation. From this point, vehicles associated with the cable installation would then travel onwards to their respective work fronts. Vehicles associated with the Grid Connection Substation and HDD works across the A55 would travel direct to these sites.

246. Upon completion of the construction there would additional vehicle movements to the Landfall Substation associated with installation of tenant equipment and periodic maintenance.

247. B&V have identified that during installation of tenant equipment within the landfall substation up to 30 employees would be required to travel to the Landfall Substation (60 two-way movements). In addition, up to four HGV deliveries per day (eight two-way movements) would be required.

248. Upon completion of the construction and developer equipment installation, there will be a requirement for periodic maintenance at the Landfall Substation and Grid Connection Substation. This is likely to result in a peak of 10 employees (20 two-way movements) per day.

249. To facilitate the safe access and egress from the public highways to the Landfall Substation and landfall HDD, a new access would be provided from South Stack Road. This access would be constructed prior to the commencement of construction and remain in place post construction for maintenance traffic.

250. The Grid Connection Substation would be accessed from existing accesses from the A5 London Road. Full details of the access requirements are contained within **Chapter 23, Traffic and Transport**.

4.6.2.3. Noise Emissions

251. A non-exhaustive list is included below in **Table 4-20** for plant creating notable noise in relation to the onshore works. All plant listed is relevant to construction.

Table 4-20 Noise Emission Figures for Onshore Construction Plant

Vehicle / plant	BS5228 Reference	LwA dB(A)	On time Correction	Comments
Tracked Excavator	C2.17	103.9	75 %	Will be used at all points of the works
Backhoe Loader	C2.8	95.8	75 %	Used at substations
Bulldozer	C2.11	106.9	75 %	Will be used at all points of the works
Dumper	C2.32	101.9	75 %	Will be used at all points of the works
Mobile Crane	C4.38	106.2	75 %	Used at substations
Cement Mixer Truck (Discharging)	C4.18	103.1	50 %	May be used at transition pits and substations
Truck Mounted Concrete Pump and Boom Arm	C4.32	105.8	50 %	Used along cable route and at substations
Dump Truck	C2.30	107.0	75 %	May be used along cable routes and at substations
Generator	89.4	89.4	100 %	May be used at all points of the works
Water Pump	C2.45	93.1	75 %	May be needed at various locations depending on ground water conditions
Lorry	C4.53	104.9	20 %	Will be used at all points of the works
Asphalt spreader and road roller*	C5.33	103.6	75 %	Used along cable route and at substations
Backhoe Loader	95.8	96	50 %	May be used along cable routes and at substations
HDD Drilling Rig	105.0	105.0	75 %	Likely needed at landfall and the A55/Railway crossing along at the Grid Connection Substation
Conveyor Drive Unit	C10.22	97.2	100 %	May be used along cable routes and at substations
Field Conveyor (Rollers)	C10.23	80.5	100 %	May be used along cable routes and at substations

4.7. OPERATION AND MAINTENANCE

4.7.1. Tidal Devices

252. Developers are expected to visit each tidal device up to 15 times annually for both planned and unplanned maintenance activities. Many developers plan to undertake at least monthly routine inspection / maintenance using small vessels. A worst-case scenario of one five-hour visit to each device on site per month may be foreseeable.

253. During maintenance activities a safety zone will apply around the O&M vessels. Offshore maintenance activities should be made available through Notices to Mariners.

254. Typical maintenance jobs may include: diagnostic tests, oil changes and lubrication, replacement of control cards and sensors, removal of biofouling, overhaul or replacement of systems (gearboxes, generators, switchgear etc.). Major operations such as retrieval and repair following structural failures would require similar vessels and procedures as installation works.

255. Maintenance procedures vary with device types with some tidal technologies having built in mechanisms to raise the devices to the water surface minimising the requirement for large maintenance vessels. Examples are as follows:

- TEC buoyant nacelle (remotely) released to surface and towed by a multicat or workboat to maintenance port. All work will be carried out onshore;
- Device designed for minimal interventions and high reliability (most critical systems are off the device), no gearbox or lubrication systems. TEC nacelle lifted with bespoke lifting frame via guide chains or similar. TEC disconnected from cable and taken to shore for work;
- Each TEC nacelle can be independently lifted from / lowered onto a seabed frame using a DP vessel or crane barge with moderate lifting capacity. Work on TECs will be carried out onshore. Lifting operations would typically take only a few hours each;
- Floating devices are designed so that it can be accessed at sea so that a large proportion of the maintenance can be carried out without removing the TEC from its moorings. These devices can, however, be towed by a small vessel to a nearby port for any major maintenance works; and
- Surface emergent, floating platforms are designed to be stable enough to carry out all but the largest of maintenance operations at sea. Access can be gained for some operations through surface emergent elements (transformers, control equipment etc.). Platform is raised (through variable buoyancy) for access to TEC. These can then be separately removed to shore for major work as necessary. Vessels for O&M would mainly be a workboat or multicat. For removal of tidal devices, a large multicat or possibly offshore DP vessel may be required.

256. For electrical hubs, requirements will vary depending on supplier and nature of the hub. Likely to require access several times a year. For fully submerged systems, the hub and foundation would either be lifted in its entirety or a buoyant hub may be remotely released and accessed by a much smaller vessel on the surface. Surface emergent hubs could be access using smaller

vessels on site and/ or be towed to shore for more major operations. A wide variety of DP vessels, heavy lift vessel, multicat, workboats and ROVs may be used.

4.7.2. Export Cables

257. It is expected that once installed, the ongoing offshore operations for the export cables will be limited to inspection (through survey) and maintenance of the cables and ancillaries.

258. The inspection regime for the offshore cables is expected to consist of annual inspections for the first two or three years reducing to every two years thereafter depending on the results of the initial surveys.

259. The inspections will be performed by an offshore survey vessel (including the use of an ROV) to assess the cables for any signs of damage or movement that has resulted in/from a free span. In the event of any cable movement to a position of concern, corrective action will either involve a (larger) work-class ROV to move that portion of the cable to a more stable location and/or the use of additional rock bags to lay over / under the cable in its new position.

260. As well as the scheduled maintenance operations it may be necessary to repair a subsea cable in the event of a failure or break. The most common cause of damage to a cable in offshore projects is from fishing trawl gear or anchor impact.

261. Repair of a cable will necessitate a vessel with suitable lifting and cable jointing equipment. The following process will be undertaken in this event:

    - Isolation of the requisite cable(s);
    - Location of the fault from onshore using suitable electrical techniques;
    - Location and assessment of the fault offshore using an offshore survey vessel (including the use of an ROV);
    - Cutting the cable subsea adjacent to the break on an area of ‘good cable’;
    - Lift the good end of the cable, check this part of the cable is undamaged;
    - Once check is satisfactory, buoy off good end and return to water;
    - Lift the damaged section of the cable, cut out any damaged length;
    - Splice on spare cable length;
    - Return to previously buoyed off end and joint to spare cable;
    - Return cable to the seabed;
    - Complete testing from onshore; and
    - Re-energise system.

262. It is anticipated that up to ten major cable repairs (five days each) may be required throughout the project life. It is assumed that up to 750 m of cable will be subject to repair works per event (From a total of 7,500 m). These will involve the same type of seabed disturbance and potential exclusion of other marine users due to the presence of cable repair vessel, as experienced via

the main cable installation phase. However, any such disturbance will be much more temporally and spatially limited.

263. Annual maintenance of navigational buoys and any environmental monitoring equipment will also be required. These works will be undertaken using a workboat with small crane. The buoys or ADCP frames will be lifted onto the vessel from which appropriate maintenance can be carried out, this will include cleaning to remove marine growth, bulb replacement for buoys; diagnostic tests and battery replacement for ADCPs.

4.8. REPOWERING

264. The Project is a tidal technology demonstration project and it is anticipated that the tidal devices/arrays may be replaced several times within the 37-year project life.

265. A repowering of a device/array is defined as the end of a berth/array demonstration cycle, at which time the TECs, device foundations, support structures, electrical hubs, tenant monitoring equipment, and inter-array cabling may be removed, in line with procedures adopted during decommissioning (see **Section 4.9**). Once the developer owned assets listed above have been removed, the Project will then have capacity for ‘repowering’ when tidal devices within existing arrays may be replaced at the same berth, or full arrays may be replaced with new arrays deployed at a new location.

266. Once all the tenant’s infrastructure has been removed, the specifications of any new array would be reviewed by regulators against the consented PDE following an agreed consent management regime. Construction of new devices will be undertaken in accordance with the construction procedures for device foundations, support structures, TECs, electrical hubs, tenant monitoring equipment, and inter-array cabling outlined in **Section 4.5**.

267. Export cables, export cable protection, navigational markers and onshore infrastructure will remain in place for the life of the Project.

268. The repowering process differs from O&M activities where, for example, the TEC may be removed for maintenance, whilst the other infrastructure (e.g. foundations) would remain *in situ*.

269. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50% of the tenants will undertake repowering, i.e. for 50 % of the tenants, their infrastructure will be removed and replaced (potentially with different infrastructure by a different tenant). For the other 50 % of tenants, their infrastructure will remain over the lifetime of the project.

270. In terms of impact assessment parameters, the repowering process has been defined as per below:

- Initial temporary seabed disturbance via deployment of barge anchors to <u>remove</u> foundations, TEC’s, hubs, inter-array cables and monitoring equipment for 50 % of the Tenants (berths);

- Further temporary seabed disturbance via re-installation (repowering) of foundations, TEC's, hubs, inter-array cables and monitoring equipment for the same 50 % of Tenants (berths); and
- Additional permanent habitat loss (over and above that via initial construction phase), due to placement of re-installed (repowered) foundations/TECs in different areas to where originally installed.

271. The quantified values for this activity are presented below in **Table 4-22**.

4.9. DECOMMISSIONING

272. Although contractual details have not been finalised, decommissioning of individual devices and arrays will be the responsibility of the individual tenants. However, Menter Môn holds ultimate responsibility for decommissioning of the Project, and the decommissioning of general infrastructure will be the direct responsibility of Menter Môn.

273. Offshore decommissioning methodologies would vary considerably between devices but would be expected to be similar to the construction phase in reverse. For the purpose of this ES, it is assumed that offshore cables are required to be removed as this represents the worst-case scenario in terms of impacts.

274. At the end of the intended Project lifetime of 37 years, the Project is likely to be decommissioned or re-powered. The decommissioning phase is expected to be as below, for the purposes of the ES:

- Cables will be re-used, preserved *in situ* or removed. Removal is considered as the worst-case scenario;
- Cable protection material will be left *in situ* on the sea bed, assuming that it causes no unacceptable impacts or hazards;
- Gravity base foundations (including gravity anchors) may be left *in situ* while piles would be cut to an acceptable seabed level;
- All other components of the tidal devices (i.e. TECs, superstructure and support structure) will be removed;
- Any electrical hubs will be removed; and
- Navigation buoys and site monitoring equipment and their foundations / moorings will be removed for re-use.

275. At this stage, decommissioning of onshore electrical infrastructure is expected to consist primarily of removal of the onshore substation. Any cables that might be laid on the surface within the onshore Development Area would be terminated and it left *in situ*. All structures laid upon the cliff face and foreshore will be removed upon decommissioning, any buried cables will remain *in situ*.

276. For the purposes of the EIA, the PDE will include a worst-case scenario for the decommissioning against which the assessment of impacts will be undertaken.

4.10. PROJECT DESIGN ENVELOPE SUMMARY

277. This section summarises the PDE and provides an overview of the worst-case scenarios of the key components of the project description which are taken forward in impact assessments.

278. **Table 4-21** to **Table 4-28** summarise the PDE.

Table 4-21 Generic Project Parameters

Parameter	Maximum value
MDZ area	35 km^2
ECC area	4.75 km^2
ODA area	1 km^2
OfDA area (MDZ plus ECC)	39.75 km^2
Intertidal area	0.0151 km^2
Project life	37 years
Project installed capacity	240 MW
Tidal Energy Converters	1,648
Number of Export cables	9
Total length export cables	40.5 km
Number of Inter-array cables	740
Total length inter-array cables	204.5 km
HDD ducts	9
Transition pits or bays	9
Export cables and export cable tails	9
Landfall substation	1
Switchgear building	1
Grid Substation	1

Table 4-22 Worst-Case Number of Tidal Devices for Each Device Type

Tidal Device Type	Number of devices
Floating / Surface emergent	Up to 130*
Buoyant mid-water and/or seabed mounted fully submerged	Up to 490
TOTAL	**Up to 620 ****
* Worst case scenario for surface emergent devices detailed in paragraphs 104 and 117, as well as Chapter 25 SLVIA. ** See paragraphs 36 and 60.	

Table 4-23 Tidal devices and TECs worst-case parameters[11]

Parameter	Maximum value
TEC output	4 MW [12]
TEC diameter	27 m
TEC average speed	22 rpm
Height above sea level (for floating device)	6.5 m
Length	72 m
Width	30 m
Device spacings within arrays	See **Table 4-9**

Table 4-24 Hubs and buoys worst case parameters[13]

Parameter	Maximum value
Number of hubs	120
Height of hubs above LAT	18 m
Navigation (including IALA Cardinal marks) and marker buoys	60
IALA Cardinal Marks	4
ADCPs	40
Monitoring buoys (in addition to Navigation and marker buoys	5

Table 4-25 Worst-Case Foundation, Mooring and Footprint Parameters (Operational (Repowering) phase)

Parameter	Construction Phase	Repowering
Maximum seabed footprint of devices	74,790 m^2	37,395 m^2
Export Cable Footprint (cables and protection systems + rock bags)	11,745 m^2	NA
Array Cable Footprint (cables and protection systems + rock bags every 100m)	30,040 m^2	15,020 m^2
Landfall trench for nine landfall cables	7,400 m^2	NA
Maximum footprint cable tails	120 m^2	NA
Maximum footprint of 40 ADCPs	280 m^2	NA
Footprint of eight seabed mounted environmental monitoring units	112 m^2	66 m^2
Footprint of 60 Navigation and Marker Buoy moorings	540 m^2	NA

[11] This table is drawn from review of parameters of multiple tidal devices and TECS, to identify the worst case or maximum value for each parameter. It does not refer to one single device example.
[12] 4 MW anticipates improvements of design and efficiency of tidal technologies over the time of the project to allow for a greater installed capacity per device, with all other maximum PDE values unchanged, and up to the maximum installed capacity of the Project of 240MW.
[13] This table is drawn from review of parameters of monopile, floating and seabed hubs to identify the worst case or maximum value for each parameter. It does not refer to one single hub type example.

Parameter	Construction Phase	Repowering
Footprint of five sea level environmental monitoring buoy moorings	45 m^2	22.5 m^2
Swept area from Catenary	2,055,000 m^2	NA
Drilled pin pile foundations	5,889 m^2	2,944.5 m^2
Drilled socket arisings	117,780 m^3	58,890 m^3
Drilling footprint	5,889 m^2	2,944.5 m^2
Drilling time	3,990 days	1,995 days

Table 4-26 Worst-Case Parameters for Temporary Seabed Disturbance (Construction, O&M (Repowering) and Decommissioning phases)

Parameter	Entire Site	Comment
Construction Phase:		
Post-lay cable management	27,259 m^2	Area of sandwave field where post-lay works with Mass-Flow Excavator (MFE) may be required if surface laid cable shows areas of suspended cable.
Deployment of anchor blocks by barges during cable installation	100,240 m^2	Temporary disturbance arising from mooring footprints. Up to eight 25 m^2 (5 m by 5 m) anchor blocks for a single barge equal to a total footprint per anchor deployment of 200 m^2. Assumed that these types of anchor barges generally deploy a spread every 500 m. So, for every 500 m of cable installation a footprint of 200 m^2 of temp seabed disturbance occurs (via the anchor blocks). Total cable length = 250.6 km (Exports: 40.5 km Inter-Arrays: 203.5 km Cable Tails: 5.6 km) So, assuming the footprint of 200 m^2 every 0.5 km, or 400 m^2 every 1 km, and assuming all cables are installed using anchor barges, temporary disturbance impact equal to 100,240 m^2 (0.10 km^2).
Deployment of anchor blocks by barges during tidal device installation	248,000 m^2	Max. no of devices set at 620 x small (0.2 kW devices) Assumed that deployment of each device requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2)

Parameter	Entire Site	Comment
		Therefore, total temporary seabed disturbance = 620 x 400 m^2 = 248,000 m^2
Deployment of anchor blocks by barges during hub installation	48,000 m^2	Maximum number of seabed mounted hubs is set at 120. Assumed that deployment of each hub requires two anchor deployments from barge (equal to 400 m^2). Therefore, total temporary seabed disturbance is equal to 48,000 m^2.
Construction Phase TOTAL	**423,499 m^2 (0.42 km^2)**	
Operational Phase:		
50 % of tenants' infrastructure (Foundations; TEC's; hubs' array cables; monitoring equipment) removed and replaced with new (different) tenant infrastructure	377,400 m^2	Initial <u>removal</u> of tenant infrastructure from 50 % of berths • 50 % of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 • 50 % of anchor block value of tidal device installation = 124,000 m^2 • 50 % of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2 Subsequent <u>re-installation (re-powering)</u> of tenant infrastructure from 50 % of berths • 50 % of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 • 50 % of anchor block value of tidal device installation = 124,000 m^2 • 50 % of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2
Cable repairs	3,000 m^2	Up to 10 major cable repairs (five days each) may be required throughout the project life (assumed that cables will be surface-laid). It is assumed that up to 750 m of cable will be subject to repair works per event (7,500 m in total).

Parameter	Entire Site	Comment
		Anchor deployments at of 400 m^2 temp seabed disturbance per 1 km of cable works is equal to 3,000 m^2.
Operational Phase TOTAL	**380,400 m^2 (0.38 km^2)**	
Decommissioning Phase:		
Decommissioning Phase	Same worst-case as per construction phase due to same activities needed to remove infrastructure.	
Decommissioning Phase TOTAL	**423,499 m^2 (0.42 km^2)**	

Table 4-27 Maximum Weight of Offshore Infrastructure Deployed

Infrastructure	Weight
Steel	193,333 tonnes
Concrete	466,667 tonnes
TOTAL	**660,000 tonnes**

Table 4-28 Worst-Case Onshore Infrastructure

Parameter	Value
Landfall Substation	
Fenced compound	80 m by 80 m or equivalent area.
Buildings	Building A: 62 m by 22.5 m (or equivalent area) x 7 m high Building B: 28 m by 10 m (or equivalent area) x 7 m high Building C: 8 m by 8 m (or equivalent area) x 7 m high Building C is within a plant compound: 28 m x 36 m (or equivalent area) x 7 m high.
Temporary construction compound	50 m x 100 m or equivalent area.
Substation perimeter fencing	Weld steel 1.8 m tall.
Palisade fencing	Hidden within perimeter fence 2.4 m tall.
Access / egress	Via new entrance South Stack Road.
Surfaces	Hard standing 5 m to 7 m wide on access roads and access within substation. Outdoor areas other than hard standing crushed rock 80 mm to 150 mm deep.
Foundations	Concrete slab foundations. Slip and slab if possible. Alternative piled solution if ground conditions require.
Cut and fill volumes	Approximately 13,900 m^3 cut and approximately 130m^3 fill.
Drainage	Foul drainage to septic tank. Surface water via oil interceptors (as required) to water course, septic tank or soakaway.
Lighting	110 lx directed lighting. Lit only as needed. Motion sensor activated.
Other	Facility for electric vehicle charging.
Switchgear Building	
Fenced compound	N/A
Building	Single building up to 9.4 m x 5 m, with a maximum height of 4 m.

Parameter	Value	
Temporary construction compound	30m x 20 m or equivalent area.	
Palisade fencing	N/A	
Access / egress	Access via the existing road to Parc Cybi employment site	
Surfaces	N/A	
Foundations	Concrete slab foundations. Slip and slab if possible. Alternative piled solution if ground conditions require.	
Drainage	Surface water via oil interceptors (as required) to water course, local sewerage, or soakaway.	
Lighting	110 lx directed lighting. Lit only as needed. Motion sensor activated.	
Grid Connection Substation		
Fenced compound	104 m x 62 m or equivalent area.	
Buildings	Buildings and plant to maximum height of 9 m.	
Temporary construction compound	50 m x 100 m or equivalent area.	
Palisade fencing	2.4 m height palisade fencing.	
Access / egress	Access via existing road to Orthios site.	
Surfaces	Hard standing 5 m to 7 m wide on access roads and access within substation. Outdoor areas other than hard standing crushed rock 80 to 150 mm deep.	
Foundations	Concrete slab foundations. Slip and slab if possible. Alternative piled solution if ground conditions require.	
Drainage	Foul drainage to local sewerage network, or to septic tank. Surface water via oil interceptors (as required) to water course, local sewerage, or soakaway.	
Lighting	110 lx directed lighting. Lit only as needed. Motion sensor activated.	
Onshore cables		
Cables from transition pit to Landfall substation	From transition pit to Landfall Substation, each of the 9 onshore cables will require up to 8 ducts depending on the specific requirements of the tidal energy devices. The maximum case of 8 ducts comprises, 3 x HV, 1 x fibre optic, 1 x LV and a spare, 1 x Extra Low Voltage and a spare. The minimum case of 2 comprise a single, multi-core HV cable and a fibre optic. This gives a maximum case of 72 ducts.	
Cables from Landfall Substation to Grid Substation	Six power cables and two fibre optic cables. Each to a maximum 110 mm diameter.	
Cable route length	Up to 8.1 km, depending on route finalisation	
Installation method	Cables will be laid in ducts installed into trenches. Trenches will be laid into the road and adjacent verge / field area areas.	
Trench parameters (per section)	Landfall Substation to Grid Connection Substation	Switchgear Building to Grid Connection Substation
Circuit	132 kV	33 kV
Trench depth	1620 mm	1620 mm
Trench width	1400 mm	2000 mm
Length	6675 m	1420 m

Parameter	Value	
Joint pits (No.)	18	2
Joint pits chamber depth	1.65 m	1.65 m
Joint pits chamber width	2 m	3 m
Joint pits chamber length	12.5 m	5 m
Draw pits (to be fully reinstated following works) (No.)	35	7
Draw pit depth	1.65 m	1.65 m
Draw pit width	3 m	5 m
Draw pit length	8 m	8 m
Hard standing	20 m x 7 m hardstanding at each joint bay.	

4.11. SUMMARY

279. The Project details for the MDZ described in this chapter have been considered by for the parameters relevant to each receptor. **Chapters 7** to **26** outline the worst-case scenario for each relevant receptor and this is used as the basis for assessing the impacts. By assessing the worst-case scenario per receptor, it is deemed that this provides the maximum potential impact for assessment.

5. REFERENCES

Isle of Anglesey County Council (2017). Joint Local Development Plan (Anglesey and Gwynedd). https://www.anglesey.gov.uk/en/Residents/Planning-building-control-and-conservation/Planning-policy/Joint-Local-Development-Plan-Anglesey-and-Gwynedd/Joint-Local-Development-Plan-Anglesey-and-Gwynedd.aspx

Morlais Project
Environmental Statement

Chapter 5: EIA Methodology

Volume I

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GLOSSARY OF ABBREVIATIONS

CIA	Cumulative Impact Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
EIA	Environmental Impact Assessment
ES	Environmental Statement
HRA	Habitats Regulations Assessment
IEMA	Institute of Environmental Management and Assessment
IoACC	Isle of Anglesey County Council
MHCLG	Ministry for Housing, Communities and Local Government
MMO	Marine Management Organisation
NRW	Natural Resources Wales
PDE	Project Design Envelope
TWAO	Transport and Works Act Order
UK	United Kingdom
WG	Welsh Government

5. EIA METHODOLOGY

5.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) describes the Environmental Impact Assessment (EIA) process and the methodology used throughout the ES assessment chapters for the Morlais Project (the Project).

2. The purpose of the EIA is to inform the decision-maker, stakeholders and all interested parties of any significant environmental issues that may result from the Project during its construction, operation and (where relevant) decommissioning. The EIA provides an independent assessment of the Project to enable interested parties to understand such potential impacts before making decisions on whether consent for the Project should be granted.

3. This section sets out the approach for the assessment of impacts which has been adopted within this ES. In summary, this chapter presents:

    - Details of the guidance followed throughout the EIA;
    - A summary of the EIA process;
    - The approach adopted to define the baseline environment (specific details are provided for each environmental topic considered in the relevant chapter);
    - The generic approach taken to assess potential impacts, including the evaluation of significance (where a different approach has been adopted for a specific topic, this is set out in the relevant chapter);
    - The generic approach taken to the derivation of mitigation measures and the assessment of residual impacts; and
    - The approach taken to the assessment of potential cumulative impacts.

4. This chapter provides an overview of the generic approach taken to impact assessment across all EIA topics. It should be noted that topic specific methodology is covered in each technical chapter (**Chapters 7 to 26**) as the exact methodology for the receptors of each topic need to be relevant to those receptors (e.g. in terms of definitions of sensitivity or magnitude of effect).

5.2. EIA GUIDANCE

5. As discussed in **Chapter 2, Policy and Legislation**, the legislative framework for EIA is set by Directive 97/11/EC (“the EIA Directive”). This Directive has been transposed into UK law through a number of regulations applicable to different categories of development, which require an EIA to be undertaken to support the consent application.

6. The following consents are required for the Project:

    - A Marine Licence under the Marine and Coastal Access Act 2009;
    - A Transport and Works Act Order under the Transport and Works Act 1992.

7. The requirement to comply with the EIA Directive is transposed into law by amendments to the Transport and Works Act 1992 and Transport and Works (Applications and Objections

Procedure) (England and Wales) Rules 2006 and the Marine Works (EIA) (Amendment) Regulations 2017. The Project also falls under the Marine and Coastal and Access Act (2009).

8. For applications under the Transport and Works Act 1992, including deemed planning permission, the consenting body will be the Welsh Government, while for Marine Licenses under the Marine Coastal and Access Act (2009), Natural Resources Wales (NRW) are the licensing body.

9. This EIA has been undertaken in accordance with the requirements of the above regulations and has taken into account key policies, legislation, guidance and advice, including but not limited to the following:

- Ministry for Housing, Communities and Local Government (MHCLG) “Guidance: Environmental Impact Assessment” (2017);
- Chartered Institute of Ecology and Environmental Management (CIEEM) “Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine” (2018);
- Institute of Environmental Management & Assessment (IEMA) “Guidelines for Environmental Impact Assessment” (2017);
- Planning Policy Wales (2018);
- Draft Welsh National Marine Plan (2017); and
- The Wildlife and Countryside Act 1981.

10. It is noted that this list of guidance is not exhaustive and the relevant guidance adopted for the assessment of each environmental parameter is described in the relevant topic chapter.

5.3. THE EIA PROCESS

5.3.1. Process Overview

11. EIA is a systematic process, which identifies the potential effects of proposed works and how these translate into impacts upon the receiving environment. This process includes an assessment of the likely significance of any potential impacts and the identification of a range of suitable mitigation options and management measures. The EIA process is designed to be as transparent as possible incorporating an ongoing consultation process with statutory and non-statutory consultees. The EIA process has a number of distinct stages as follows:

- **Scoping** – a formal process requesting an opinion on the Project from statutory consultees, coordinated by the Welsh Government (WG). The scoping process also identifies the existing environmental data present and the key issues at the site, thereby identifying any additional studies that are required for their assessment;
- **Baseline studies** – undertaken to identify the current status of the receiving environment and to identify the requirement to carry out further desk and field studies;
- **Project definition** – development of the project details under a Rochdale Envelope or Project Design Envelope (see **Chapter 4, Project Description** for more information on

project definition and **Chapter 2, Policy and Legislation** for more information on the Rochdale Envelope approach);

- **Assessment of impacts** – the assessment of the significance of the potential impacts related to the Project, as well as the proposed mitigation and the resulting residual impacts;
- **Environmental reporting** – compilation of the ES and the supporting documentation (e.g. appendices and technical reports); and
- **Submission and consenting** – the submission of the ES, information to support a Habitats Regulations Assessment (HRA), and the appropriate consent applications. These documents go through a determination process with the appropriate consenting body.

12. The EIA is based on the expert judgement of technical specialists, following an appraisal of the parameters included in the Rochdale or Project Design Envelope (PDE) as described in **Chapter 4, Project Description**. The process is outlined in **Table 5-1**.

Table 5-1 Stages of the ES Preparation

Stage	Task	Aim/Objective	Work/Output (Examples)
EIA	Consultation – throughout EIA process	Consult with statutory and non-statutory organisations	Local knowledge and information
	Primary Data Collection	To identify the baseline/ existing environment	Background data including existing literature and specialist studies
	Specialist Studies	To further investigate those environmental parameters which may be subject to potentially significant effects	Specialist reports (e.g. hydrodynamic modelling and archaeological assessment)
	Impact Assessment	To evaluate the baseline environment in terms of sensitivity To evaluate and predict the impact (i.e. magnitude) upon the baseline To assess the resultant effects of the above impacts (i.e. determine significance)	Series of significant adverse and beneficial impacts
	Mitigation Measures and Monitoring Requirements	To identify appropriate and practicable mitigation measures and enhancement measures and outline any recommended monitoring.	The provision of solutions to avoid offset or reduce adverse impacts (e.g. sensitive scheduling to avoid noise and traffic impacts) Feedback into the design process, as applicable.
	Draft ES	Production of the ES in accordance with EIA guidance	ES
	Finalise ES	Submission of the ES to WG	ES

13. EIA is a tool for systematically identifying, examining and assessing the impacts and effects of the construction, operational and, if applicable, decommissioning phases of the proposed scheme on the environment. The process of identifying and assessing the environmental impacts of the proposed Project is iterative, running in parallel with the project design. Where any of the potential impacts are identified as being significantly adverse then, where possible,

the design will be altered to mitigate these impacts. Consultation is ongoing throughout the EIA process and contributes to the identification of both impacts and associated mitigation measures.

14. The formal reporting mechanism for an EIA is the ES. In accordance with regulations, the ES should include such information as is reasonably required to assess the likely significant environmental effects of the proposed scheme and which the applicant can reasonably be required to compile. **Table 5-2** summarises the information requirements and where these can be found within the ES.

Table 5-2 Information Requirements of an ES

Information Required for Inclusion in the ES	Reference within the ES
▪ A description of the Project and of the regulated activity, including in particular: ▪ A description of the location of the Project and the regulated activity; ▪ A description of the physical characteristics of the whole Project and regulated activity, including where relevant, requisite demolition works, and the land-use requirements during the construction and operational phases; ▪ A description of the main characteristics of the operational phase of the Project and the regulated activity (in particular any production process); ▪ An estimate, by type and quantity, of expected residues and emissions resulting from the operation of the proposed Project and the regulated activity.	**Chapter 4, Project Description**
▪ A description of the reasonable alternatives.	**Chapter 3, Site Selection and Consideration of Alternatives**
▪ A description of the relevant aspects of the current state of the environment (baseline scenario).	**Chapters 7 to 26**
▪ A description of the factors likely to be significantly affected by the Project and the regulated activity: population, human health, biodiversity, land, soil, water, air, climate, material assets, cultural heritage, including architectural and archaeological aspects, and landscape.	**Chapters 7 to 26**
▪ A description of the likely significant effects of the Project and the regulated activity on the environment.	**Chapters 7 to 26**
▪ The description of the likely significant effects on the factors must cover the direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the Project and the regulated activity. This description must take into account the environmental protection objectives established at Union or member State level which are relevant to the Project and the regulated activity.	**Chapters 7 to 26**
▪ A description of the forecasting methods or evidence used to identify and assess the significant effects on the environment including details of	**Chapters 7 to 26**

Information Required for Inclusion in the ES	Reference within the ES
difficulties encountered compiling the required information and the main uncertainties involved.	
▪ A description of the measures envisaged to avoid, prevent, reduce or if possible offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements.	**Chapters 7 to 26,** Outline Construction Environment Management Plan (**Document MOR/RHDHV/DOC/0073**) and Outline Environment Mitigation and Monitoring Plan (**Document MOR/RHDHV/DOC/0072**)
▪ A description of the expected significant adverse effects of the Project and the regulated activity on the environment deriving from the vulnerability of the Project and the regulated activity to risks of major accidents or disasters which are relevant to the Project and the regulated activity concerned.	**Chapters 7 to 26**
▪ A non-technical summary.	**Non-Technical Summary**
▪ A reference list detailing the sources used for the descriptions and assessments included in the report.	**Chapters 7 to 26**

15. The approach adopted in the EIA process for the Project is summarised in the following sections. It should be noted that these stages are not necessarily consecutive and may overlap. For example, iterative design changes may be made in light of emerging findings of the EIA process to prevent or reduce the significance of a potential impact. This would then require re-assessment of the potential impact, potentially informed by further survey work to adequately describe the baseline environment.

5.3.2. Screening

16. An inception meeting regarding the Project's proposed consenting route was undertaken with the Planning Inspectorate and the Welsh Government on 15th March 2018 at which the need for EIA to support consent applications was confirmed and appropriate consenting requirements for the Project were agreed. Following discussions within this meeting, Menter Môn is seeking to consent via the following legislative mechanisms:

- Transport and Works Act 1992 because the Project has the potential to interfere with rights of navigation in waters up to the limits of the territorial sea); and
- Marine and Coastal Access Act 2009 as the Project will involve the placement of materials on and above the seabed.

17. A detailed summary of the legal framework for the Project is provided in **Section 2, Policy and Legislation**.

5.3.3. Scoping

18. The purpose of the scoping process is to identify the principal environmental issues at the earliest possible stage of the development process through responses from the regulators and their consultees. This assists in the appropriate targeting of the assessment studies and the

identification of which elements of the Project have the potential to cause significant environmental impacts.

19. The consultation process may identify mitigation measures and, where practicable, take account of the view of consultees to alter the project design, thereby avoiding or reducing any environmental or human impacts. Menter Môn regards the consultation process as being important to the success of the Project and have therefore undertaken a significant amount of public and stakeholder engagement, as well as additional consultation with statutory consultees beyond the scoping and submission processes. The consultation undertaken and key topics covered are detailed in **Chapter 6, Consultation**.

20. Regulation 8 of the Transport and Works (Applications and Objections Procedure) (England and Wales) Rules 2006 outlines that before submitting an application in relation to works for which an EIA is or may be required, the applicant may request in writing to the Secretary of State his opinion as to the information to be provided in the ES (a scoping opinion).

21. Two earlier scoping reports have previously been submitted to NRW, the Marine Management Organisation (MMO) and the IoACC; however, these are now superseded as a result of further development in the project design concept. The proposed installed capacity of the Project has been increased in response to industry demand, and the Project is now seeking consent for an array of up to 240 MW capacity and associated supporting infrastructure.

22. As a result, a third Scoping Report (superseding previous Scoping Reports) was produced by Royal HaskoningDHV on behalf of Menter Môn and submitted to the Welsh Government, with a request for screening and scoping opinion, by Menter Môn on 6th April 2018.

23. A version of the Scoping Report was also sent to NRW with a request for Scoping Opinion to inform an EIA as required under The Marine Works (Environmental Impact Assessment) Regulations 2007, as amended by The Marine Works (Environmental Impact Assessment) (Amendment) Regulations 2017.

24. RHDHV and MarineSpace have ensured the ES clearly demonstrates how the comments received from the regulators and their statutory consultees for both key consents (Transport and Works Act Order (TWAO) and Marine Licence) are addressed. This is done via a ‘signposting’ table outlining the scoping response received and the location within the ES where the comment is addressed.

25. Each technical chapter (**Chapters 7 to 26**) outlines the key issues pertinent to that issue which have been identified through the scoping process.

5.3.4. Environmental Statement

5.3.4.1. Environmental Baseline

26. The term ‘baseline environment’ is used to describe the nature, scale, condition, and other relevant information to provide a detailed description of a given environmental receptor that falls within the scope of the ES.

27. Characterisation (a description) of the baseline environment has been undertaken in order to determine the baseline conditions in the area covered by the Project and relevant study areas. This has been undertaken following the steps below. These steps are also detailed further within each assessment chapter, where relevant:

- Definition of study areas for each receptor, based on the relevant characteristics of the receptor;
- Review of available information;
- Review of likely or potential impacts that might be expected to arise from the Project;
- Review of whether sufficient information is available to make EIA judgements with sufficient confidence;
- If further data is required, ensure data are gathered, targeted and directed at filling key data gaps; and
- Review further data to ensure sufficient information is available to make EIA judgements with sufficient confidence.

28. Within this ES, the description of the baseline environment consists of the following aspects:

- the spatial location and extent of the environmental features or receptors;
- a description of the environmental features or receptors and their character;
- the context of the environmental features or receptors in terms of rarity, function, and population at the local, regional and national level;
- the sensitivity of the environmental features or receptors in relation to physical, chemical or biological changes; and
- the value of the environmental features or receptors (e.g. designated status).

29. A wide range of information has been gathered and activities undertaken to define the baseline environment and likely receptors. These data sources are detailed in each chapter and include, but are not limited to the following:

- Desk-based review of existing published data;
- Data provided by consultees; and
- Field survey and site investigation information.

30. The results of the environmental baseline studies are outlined in **Chapters 7** to **26** of this ES.

5.3.4.2. Project Design Envelope

31. An essential element of any EIA is defining the project description against which impacts will be assessed. Due to the nature of the Project and the evolving nature of the tidal energy sector, full details of the proposed Project are not available at the time of the application. Therefore, the project description and methods upon which this application for consent is based, fall within a range of defined criteria. This Project Design Envelope approach, often referred to as a 'Rochdale Envelope', allows a degree of flexibility in determining the final specific Project details,

while still meeting the requirements of the EIA process. This approach is outlined in more detail in **Chapter 2, Policy and Legislation.**

32. The approach defines a series of realistic maximum extents and magnitudes for the description of a development, so that a realistic 'worst case scenario' is assessed. **Chapter 4, Project Description** sets out the parameters of the Project which form the basis of the ES. Each technical chapter (**Chapters 7** to **26**) provides an outline of the relevant worst case for that receptor. Post consent, a detailed design of the scheme can vary within that envelope, without rendering the EIA inadequate. By adopting this approach, the ES can conclude that the environmental impact of the Project will be no greater than that set out in the ES and may actually be less.

5.3.4.3. Impact Assessment

33. The approach to making balanced assessments for the Project has been guided by Royal HaskoningDHV, MarineSpace and technical specialists using available data, new data, experience and expert judgement. In order to provide a consistent framework and system of common tools and terminology, a matrix approach has been used to frame and present the judgements made.

34. This section sets out the assigned definitions that are used in the assessment process for a number of topics considered in the ES. For each topic of the EIA, the most relevant and latest guidance or best practice has been used and therefore definitions of sensitivity and magnitude of impact are tailored to each receptor. A description of the approach taken to the specific impact assessment for each environmental receptor is provided (in each relevant chapter) so that it is clear to the reader how impacts have been defined, particularly where such an approach differs to that described within this section.

35. The impact assessment considers the potential for impacts during the construction, operation and maintenance, and decommissioning phases of the Project.

36. EIA provides an assessment of the impacts on sensitive receptors as a result of the effects of a development upon the environment. The terms 'effects' and 'impacts' have, in the past, been used interchangeably, but they are in fact different and one drives the other. Effects are physical changes in the environment that are set in motion as a consequence of a particular development or activity. Effects do not impact all receptors, as some receptors are not always sensitive to them.

37. Effects are measurable physical changes in the prevailing environment (e.g. volume, time and area) arising from construction and operation activities. Effects can be classified as primary (e.g. the physical presence of a built element of the development) or secondary (e.g. increase in erosion due to a change in the rate of discharge of surface water). Impacts consider the possible changes in potentially sensitive receptors as a result of an effect.

38. Impacts can be classified as follows:

- Direct impacts: these may arise from impacts associated with the construction, operation and maintenance, or decommissioning of the Project;
- Indirect impacts: these may be experienced by a receptor that is removed (e.g. in space or time) from the direct impact (e.g. noise impacts upon fish which are a prey resource for fish or mammals).
- Inter-relationships between impacts; or
- Cumulative impacts: these may occur as a result of the Project in conjunction with other existing or planned projects within the study area for each receptor.

39. The EIA framework used herein is based on the ‘source-pathway-receptor’ conceptual model process used to provide a systematic and auditable approach to understanding the potential for effects to arise, the spatial extents of the effect-receptor interactions, impact pathways, and potential impact significance. The conceptual ‘source-pathway-receptor’ model is effective in the identification of potential effects and the means by which these can manifest themselves on the receiving environment and its sensitive receptors.

40. The term ‘source’ describes the origin of potential effects (e.g. construction activities) and the term ‘pathway’ describes the means (e.g. through air, water, or ground) by which the effect reaches the receiving sensitive ‘receptor’ (e.g. terrestrial habitats, archaeology and human receptors). If the source, pathway or receptor is absent, no linkage exists and thus there will be no potential for an impact to manifest.

41. For each effect, the assessment identifies receptors within the study area that are sensitive to that effect and implements a systematic approach to understand the impact pathways and the level of impacts on given receptors. The process considers the following:

- The sensitivity of a receptor to the effect;
- The probability that an effect-receptor interaction will occur;
- The magnitude of the effect;
- The determination and (where possible) qualification of the level of impact on a receptor, considering the probability that the effect-receptor interaction will occur, the spatial and temporal extents of the interaction and the significance of the resulting impact; and
- The level of certainty at all stages.

5.3.4.3.1. Receptor Sensitivity

42. All receptors will exhibit a degree of sensitivity to the changes brought about by the Project and defining receptor ‘sensitivity’ as part of the definition of the baseline environment helps to ensure that the subsequent assessment is transparent and robust. The characterisation of the existing environment helps to determine the receptor sensitivity in order to assess the potential impacts upon it.

43. The ability of a receptor to adapt to change, tolerate, and/or recover from potential impacts is key in assessing its sensitivity to the impact under consideration. For ecological receptors, tolerance could relate to short term changes in the physical environment; for human environment receptors, tolerance could relate to impacts upon socio-economics or health impacts. The time required for recovery is an important consideration in determining receptor sensitivity.

44. The overall receptor sensitivity is determined by considering a combination of value, adaptability, tolerance and recoverability. This is achieved through applying known research and information on the status and sensitivity of the feature under consideration coupled with professional judgement and past experience.

45. In summary, the sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected, and is defined by the following factors:

- Vulnerability: whether a particular effect has the ability to impact a receptor;
- Adaptability: the degree to which a receptor can avoid or adapt to an effect;
- Tolerance: the ability of a receptor to accommodate temporary or permanent change without a significant adverse effect;
- Recoverability: the temporal scale over, and extent to, which a receptor will recover following an effect; and
- Value: a measure of the receptor's conservation importance, rarity and worth (see **Section 5.3.4.3.2**).

46. In order to define the sensitivity of a receptor, the guidelines presented in **Table 5-3** have been adopted in this ES.

Table 5-3 Definitions of the Sensitivity Levels for Environmental Receptors

Sensitivity	Description
High	Individual receptor has very limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Medium	Individual receptor has limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Low	Individual receptor has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact.
Negligible	Individual receptor is generally tolerant to and can accommodate or recover from the anticipated impact.

47. It should be noted that the sensitivity criterion is a composite one; combining value (see **Section 5.3.4.3.2**) with sensitivity. In some instances, the inherent value of a receptor is recognised by means of designation, and the 'value' element of the composite criterion recognises and gives weight in the assessment to that designation. However, irrespective of the recognised value, all receptors will exhibit a greater or lesser degree of sensitivity to the potential changes brought about by the proposed scheme. It should be noted that the assessment of sensitivity is a matter of judgement applied by professional experts based on the receptors within the relevant study area.

48. Sensitivity to potential impacts is considered for each species, using available evidence including published data sources. The conclusions reached regarding the sensitivity of receptors have been presented in the baseline sections of each technical chapter (**Chapters 7 to 26**).

5.3.4.3.2. Receptor Value

49. Receptor value considers whether, for example, the receptor is rare, has protected or threatened status, has importance at a local, regional, national or international scale, and in the case of biological receptors whether the receptor has a key role in the ecosystem function.

50. The 'value' of a receptor forms an important element within the assessment, for instance, if the receptor is a protected species or has an economic value its value may be greater than otherwise.

51. It is important to understand that high value and sensitivity are not necessarily linked within a particular impact. A receptor could be of high value (e.g. an Annex II species), but have a low or negligible sensitivity to an effect. Similarly, low value does not equate to low sensitivity and is judged on a receptor by receptor basis. The value of the feature or receptor is a function of a range of factors (e.g. biodiversity value, social/community value and economic value).

52. Value will be considered, where relevant, as a modifier for the sensitivity assigned to the receptor, based on expert judgement. **Table 5-4** provides definitions for the value afforded to a receptor based on its legislative importance.

Table 5-4 Definitions of the Value Levels

Value	Definition
High	Internationally or nationally important. Internationally protected species that are listed as a qualifying interest feature of an internationally protected site (i.e. Annex II protected species designated feature of a European designated site) and protected species (including EPS) that are not qualifying features of a European designated site.
Medium	Regionally important or internationally rare. Protected species that are not qualifying features of a European designated site, but are recognised as a Biodiversity Action Plan (BAP) priority species either alone or under a grouped action plan, and are listed on the local action plan relating to the marine mammal study area.
Low	Locally important or nationally rare. Protected species that are not qualifying features of a European designated site and are occasionally recorded within the study area in low numbers compared to other regions.
Negligible	Not considered to be particularly important or rare Species that are not qualifying features of a European designated site and are never or infrequently recorded within the study area in very low numbers compared to other regions.

53. In addition to legislative factors, a range of other characteristics will be considered in the categorisation of importance, for example:

- Species or sub-species that are rare or uncommon, either internationally, nationally or more locally, including those that may be seasonally transient;
- Endemic species or locally distinct sub-populations of a species;
- Size of habitat or species population;

- Species in decline;
- Species rich assemblages;
- Large populations of species or concentrations of species considered uncommon or threatened in a wider context; and
- Species on the edge of their range, particularly where their distribution is changing as a result of global trends and climate change.

54. The value or potential value of a receptor or feature can be determined within a defined geographical context, for example, the following hierarchy to describe value is recommended by the Chartered Institute of Ecology and Environmental Management (CIEEM) (2016) with respect to ecological receptors:

- International and European;
- National;
- Regional;
- Metropolitan, County, vice-county or other local authority-wide area; and
- Local (e.g. assessment within a district or borough context or within a ‘zone of influence’).

55. Value is considered for each receptor, using available evidence including published data sources. The conclusions reached regarding the value of receptors have been presented in the baseline sections of each technical chapter (**Chapters 7 to 26**).

5.3.4.3.3. The Magnitude of Effect

56. In order to predict the significance of an impact, it is fundamental to establish the magnitude and probability of an impact occurring through a consideration of (CIEEM, 2018):

- Scale or spatial extent: the area over which an effect occurs (small scale to large scale or a few individuals to most of the population);
- Duration: the time for which the effect occurs (short term to long term);
- Likelihood of impact occurring;
- Frequency: how often the effect occurs;
- Nature of change relative to the baseline: positive or negative; and
- Reversibility: the degree of change relative to existing environmental conditions.

57. The categorisation of some of these elements is not always appropriate or required, and may rely on expert opinion.

58. The categorisation of duration for topics considered within this ES is presented in **Table 5-5**.

Table 5-5 Definitions of Temporal Scale of Magnitude

Temporal Scale	Definition
Permanent	Impacts continuing indefinitely beyond the span of one human generation (taken as approximately 25 years), except where there is likely to be substantial improvement after this period.
Long term	Approximately 15 - 25 years or longer (refer to above).
Medium term	Approximately 5 - 15 years.
Short term	Up to approximately 5 years.

59. In order to help define impact magnitude, the criteria presented in **Table 5-6** have been adopted for the purposes of this EIA. While **Table 5-6** provides guidelines of a generic nature, it should be noted that more specific guidelines in relation to impact magnitude have been adopted for topics (i.e. marine ornithology and marine mammals), where considered necessary.

Table 5-6 Generic Guidelines used in the Determination of Magnitude of Effect

Magnitude	Description
Very high	Loss of resource and/or integrity of the resource; severe damage to key characteristics, features or elements (adverse). Permanent / irreplaceable change, which is certain to occur. Large scale improvement of resource or attribute quality; extensive restoration or enhancement (beneficial).
High	Loss of resource, but not affecting integrity of the resource; partial loss of or damage to key characteristics, features or elements (adverse). Permanent / irreplaceable change, which is likely to occur. Improvement to, or addition of, key characteristics, features or elements of the resource; improvement of attribute quality (beneficial).
Medium	Minor loss of, or alteration to, one (maybe more) key characteristics, features or elements; measurable change in attributes, quality or vulnerability (adverse). Long-term though reversible change, which is likely to occur. Minor improvement to, or addition of, one (maybe more) key characteristics, features or elements of the resource; minor improvement to attribute quality (beneficial).
Low	Very minor loss of, or alteration to, one (maybe more) key characteristics, features or elements; noticeable change in attributes, quality or vulnerability (adverse). Short- to medium-term though reversible change, which could possibly occur. Very minor improvement to, or addition of, one (maybe more) key characteristic, feature or element; very minor improvement to attribute quality (beneficial).
Very low	Temporary or intermittent very minor loss of, or alteration to, one (maybe more) characteristic, feature or element; possible change in attributes, quality or vulnerability (adverse). Short-term, intermittent and reversible change, which is unlikely to occur. Possible very minor improvement to, or addition of, one (maybe more) characteristic, feature or element; possible improvement to attribute quality (beneficial).

5.3.4.3.4. Impact Significance

60. Subsequent to establishing the sensitivity and magnitude, the impact significance is predicted by using quantitative or qualitative criteria, as appropriate, to ensure a robust assessment. The significance of the potential impacts is assessed on the scale, degree or intensity of disturbance to the baseline conditions. Four levels of magnitude are used: high; medium; low; or negligible, as defined in **Table 5-6**.

61. Impact statements carry a degree of subjectivity, as they are based on expert judgement regarding the effect-receptor interaction that occurs and on available data. As such, impact statements should be qualified appropriately. Where possible the matrix presented in **Table 5-7** has been used to aid assessment of impact significance, combined with the application of expert judgement, to facilitate a consistent approach throughout the EIA. However, for each topic within the EIA, best practice methodology (based on the latest available guidance) has been followed and hence, when more appropriate, an alternative approach to the use of a matrix may be used.

62. By combining the magnitude of the impact and the sensitivity of the receptor in a matrix (see **Table 5-7**), the final significance of the impact (prior to the implementation of mitigation measures) can be obtained.

63. Definitions of impact significance are provided in **Table 5-8**. In the context of EIA, 'significant impacts' are taken to be those of moderate or major significance (as defined in **Table 5-8** below); albeit that appropriate mitigation, where available, should be sought for all impacts. Whilst minor impacts would not be deemed to be significant in their own right, they may contribute to significant impacts through inter-relationships or cumulative impacts.

Table 5-7 Impact Assessment Matrix

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Table 5-8 Impact Significance Definitions

Value	Definition
Major	Very large or large change in receptor, either adverse or beneficial, which are important at a population (national or international) level because they contribute to achieving national or regional objectives, or, expected to result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate or large change in receptor, which may to be important considerations at national or regional population level. Potential to result in exceedance of statutory objectives and / or breaches of legislation.
Minor	Small change in receptor, which may be raised as local issues but are unlikely to be important at a regional population level.
Negligible	No discernible change in receptor.

64. It should be noted that any residual impact (the impact after the implementation of mitigation; see **Section 5.3.4.6** below) which remains at the level of 'moderate' or 'major' is regarded by the EIA Regulations as being significant.

65. It should also be reiterated that, although this section sets out the overall approach adopted for this EIA, individual chapters may take their own approach where industry standard methodologies are appropriate or another approach has been agreed with the relevant regulator. Where a different approach is taken, this is explained in the relevant methodology section.

5.3.4.4. Confidence

66. Once an assessment of a potential impact has been made, it is necessary to assign a confidence value to the assessment to assist in the understanding of the judgement. This is undertaken on a simple scale of high-medium-low, where high confidence assessments are made on the basis of robust evidence, with lower confidence assessments being based, for example, on extrapolation and use of proxies.

5.3.4.5. Mitigation Measures

67. Where an impact assessment identifies that an aspect of the Project is likely to give rise to significant environmental impacts, mitigation measures have been proposed, in order to avoid impacts or reduce them to acceptable levels.

68. For the purposes of the EIA, two types of mitigation have been defined:

- Embedded mitigation: mitigation measures that are identified and adopted as part of the evolution of the project design, and are included and assessed in the EIA; and
- Additional mitigation: mitigation measures that are identified during the EIA process specifically to reduce or eliminate any predicted significant impacts.

69. It is important to note that the mitigation measures applied should be proportionate to the scale of the impact predicted. Appropriate mitigation measures have been discussed and agreed, where possible, with the relevant regulatory authorities and stakeholders. Whilst mitigation for minor or negligible impacts may not be specifically defined as a matter of course, industry standard or 'embedded' mitigation often applies in these cases (and is set out herein). It is also recognised that minor and negligible impacts could become significant when considered cumulatively with other pressures on a receptor and, in this event, mitigation may be required.

70. All mitigation associated with the Project is identified and described in more detail in the relevant chapters of the ES (**Chapters 7 to 26**).

5.3.4.6. Residual Impacts

71. Where further mitigation measures are identified, the significance of the residual environmental impact (i.e. the post-mitigation impact) has been re-assessed and residual impacts described.

72. Where no mitigation measure is proposed, a discussion explains why the impact cannot be reduced.

5.3.4.7. Monitoring

73. Appropriate mitigation measures have been identified and recommended in this ES where the EIA process has identified an adverse impact and mitigation is available (see **Section 5.3.4.5** above). In some cases, in order to ensure that the mitigation measures are successful or where there is significant uncertainty with respect to important receptors, monitoring may be appropriate.

74. Monitoring programmes are most commonly required during and shortly after construction, but can also be prior to and during operations. The nature of any monitoring is dependent on the nature of the effect or mitigation measure under inspection and is discussed within the relevant chapters of the ES (**Chapters 7 to 26**). An Outline Construction Environment Management Plan (**Document MOR/RHDHV/DOC/0073**) and Outline Environment Mitigation and Monitoring Plan (**Document MOR/RHDHV/DOC/0072**) are also provided in support of the TWAO and Marine Licence applications for the Project.

5.3.5. Cumulative Impact Assessment

5.3.5.1. Impact Inter-Relationships

75. Council Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the EIA Directive) states (in Annex III) that an ES should include "*A description of the aspects of the environment likely to be significantly affected by the proposed project, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter-relationship between the above factors*".

76. This ES has given due consideration to the potential for different residual impacts to have a combined impact on key sensitive receptors. For example, a landscape and visual effect and noise impact may cumulatively impact on a receptor.

77. The objective is to identify where the accumulation of impacts on a single receptor, and the relationship between those impacts, potentially gives rise to a need for additional mitigation.

78. Inter-relationships have been assessed within the relevant sections of the topic chapters of the ES.

5.3.5.2. Cumulative Impacts

79. Cumulative Impact Assessment (CIA) is undertaken as part of each technical chapter impact assessment. In line with IEMA's Guidelines for EIA (2004), cumulative impacts are defined as: "…the impacts on the environment which result from incremental impacts of the action when added to other past, present and reasonably foreseeable future actions …".

80. There is no legislation that outlines how CIAs should be undertaken. However, the EIA and Habitats Directives and their associated regulations require the consideration of direct impacts and any indirect, secondary and cumulative effects of a project. Schedule 4, of Regulation 17 (3), of the Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017 states that the CIA should consider: "*the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources*".

81. Guidance on cumulative effects assessment is provided in a number of good practice documents (e.g. RenewableUK, 2013). This guidance is not prescriptive, but rather suggests various approaches which may be used, depending on their suitability to the Project (for example the use of matrices, expert opinion, consultation, spatial analysis and carrying capacity analysis).

82. A tiered approach has been adopted for the Project, based upon the following definitions:

- Site-specific (or within-development) cumulative impacts - different effects associated with the proposed scheme have the potential to interact and, together, influence common receptors. Where applicable, these inter-relationships are considered in the ES and HRA.
- Wider cumulative impacts which are the combined impacts (additive or interactive) that may occur between the proposed facilities, and any other relevant development(s) for which information is publicly available.

83. With respect to 'past' projects, a useful ground rule in CIA is that the environmental impacts of schemes that have been completed should be included within the environmental baseline; as such, these impacts will be taken into account in the EIA process and, generally, can be excluded from the scope of CIA. Where projects are already in existence they are therefore deemed to be part of the existing environment, contributing to the baseline conditions and are therefore not considered to provide a further cumulative impact. However, the environmental impacts of recently completed projects may not be fully manifested and, therefore, the potential impacts of such projects should be taken into account in the CIA.

84. The study area for the CIA varies depending on the range and characteristics of the receptor as well as the extent of impacts associated with the Project and therefore each technical chapter provides information on the relevant foreseeable projects for consideration in the CIA.

5.3.5.3. Assumptions and Limitations

85. The EIA process also requires that an ES is prepared by competent experts. This ES has been compiled by Royal HaskoningDHV and MarineSpace. Royal HaskoningDHV is the UK's leading EIA consultant, successfully leading the EIA and consent process for over 10GW of UK offshore wind projects, including six successful DCO applications, as well as successfully completing the EIA and consenting three significant tidal stream projects, the world's first commercial tidal turbine deployment (SeaGen), the world's first tidal array (Sound of Islay) and the world's first commercial demonstration project (PTEC). MarineSpace is a specialist marine consultancy and has supported a range of projects including providing consultancy support to Tidal Energy Limited (TEL) on its Ramsey and St David's Head projects and consenting support to Tidal Lagoon Power Ltd (TLP) in developing the Adaptive Environmental Management Plan (AEMP) for the Swansea Bay Tidal Lagoon project.

86. Royal HaskoningDHV is a corporate member of the Institute of Environmental Management & Assessment (IEMA) (number 0001189) and also a Corporate Registered Assessor for EIA under IEMA's voluntary EIA Quality Mark scheme, through which EIA activity is independently reviewed, on an annual basis, to ensure it delivers excellence in areas including EIA management, team capabilities, regulatory compliance, content, presentation, and improving practice.

87. All Royal HaskoningDHV's lead authors are senior and chartered professionals with a significant track record in undertaking technical assessment and EIA in their discipline. The team undertaking the EIA for the Project is comprised of a dedicated core team of EIA professionals who take the lead role in the co-ordination and management of the EIA and the preparation of

the ES. The core team is then supported by a wider team of technical specialists taking responsibility of the data collection, data analysis and technical impact assessment.

88. Some of the technical assessment and associated ES chapters are undertaken by specialist consultancies outside Royal HaskoningDHV. These include Shipping and Navigation, Landscape and Visual and Socio-economics. All specialist consultants have been selected by Menter Môn based on stringent quality checks.

89. The EIA process requires an ES to provide an indication of any difficulties (technical deficiencies or lack of know-how) encountered during the assessment process. Any such assumptions or limitations are identified within the relevant topic chapter, where relevant.

90. The information provided by third parties, including publicly available information and databases, is correct at the time of publication. The EIA has been subject to the following limitations:

- Existing environmental conditions have been assumed to be accurate at the time of the physical surveys; however, due to the dynamic nature of the environment, conditions may change during the various phases of the development; and
- The assessment of cumulative impacts has been reliant on the availability of accurate information on the proposed developments that may act in combination with the one outlined within this ES.

5.4. SUMMARY

91. This chapter outlines the approach that has been used to frame and present the expert judgements used in assessing the potential impacts during the construction, operation and decommissioning of the Project.

92. For each topic of the EIA, the most relevant and latest guidance and/or best practice has been used. Therefore, where appropriate, the approach to each impact assessment (including definitions of sensitivity and magnitude of impact) is tailored to each receptor as detailed in **Chapters 7 to 26**.

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Morlais Project
Environmental Statement

Chapter 6: Consultation

Volume I

Applicant: Menter Môn Morlais Limited

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GLOSSARY OF ABBREVIATIONS

CRM	Collision Risk Model
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ERM	Encounter Rate Model
ES	Environmental Statement
FEED	Front End Engineering Design
FLO	Fisheries Liaison Officer
GAFLAG	Gwynedd and Anglesey Fisheries Local Action Group
GAPS	Gwynedd Archaeological Planning Service
HRA	Habitats Regulations Assessment
IFCA	Association of Inshore Fisheries and Conservation Authorities
IoACC	Isle of Anglesey County Council
MCA	Maritime and Coastguard Agency
MMO	Marine Management Organisation
MoD	Ministry of Defence
NGO	Non-Governmental Organisation
NRA	Navigation Risk Assessment
NRW	Natural Resources Wales
NWFCL	North Wales Fishermen's Co-operative Limited
ODA	Onshore Development Area
PHA	Preliminary Hazard Analysis
PID	Public Information Day
PINS	Planning Inspectorate
PR	Public Relations
PVA	Population Viability Analysis
RCAHMW	Royal Commission on the Ancient and Historical Monuments of Wales
RNLI	Royal National Lifeboat Institution
RSPB	Royal Society for the Protection of Birds
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SLVIA	Seascape, Landscape and Visual Impact Assessment
SMRU	Sea Mammal Research Unit
SNCB	Statutory Nature Conservation Body
SoCG	Statement of Common Ground
SSSI	Site of Special Scientific Interest
TWAO	Transport and Works Act Order
TWG	Technical Working Group
UK	United Kingdom
WEFO	Welsh European Funding Office

WFA	Welsh Fishermen's Association
ZTV	Zone of Theoretical Visibility

6. CONSULTATION

6.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) presents and summarises the project wide consultation undertaken relating to the Environmental Impact Assessment (EIA) for the Morlais Project (the Project). Within each technical chapter, all specific, relevant stakeholder consultations are also presented in further detail.

2. Menter Môn has developed a Consultation Report (**Document MOR/RHDHV/DOC/0066, Consultation Report**) which sets out the pre-application engagement and consultation undertaken in relation to the Project, including statutory and non-statutory interests. The ES and Consultation Report will accompany the Transport and Works Act Order (TWAO) and Marine Licence applications.

6.2. POLICY AND LEGISLATION

3. The Transport and Works (Applications and Objections Procedure) (England and Wales) Rules 2006 specifically required that the TWAO application be accompanied by "*a report summarising the consultations that have been undertaken, including confirmation that the applicant has consulted all those named in column (2) of the tables in Schedules 5 and 6 to these Rules where authority is sought for works or other matters described in column (1) of those tables*".

4. Consultation in relation to the EIA must also include statutory consultation (i.e. scoping and consultation undertaken in accordance with the Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017, and the Marine Works (Environmental Impact Assessment) (Amendment) Regulations 2017 (herein collectively known as 'the EIA Regulations'), and non-statutory consultation (i.e. consultation not required by the Regulations but undertaken to support the EIA process). Non-statutory consultation includes further engagement with relevant statutory bodies, and engagement/consultation with other organisations that have a relevant science-based interest.

5. Schedules 5 and 6 of the Procedure Rules primarily relate to the consultation required once the application has been made; however, Menter Môn has chosen to front-load engagement and consultation to maintain open engagement with the public, statutory consultees and other stakeholders throughout the pre-application process in order to optimise communications and information sharing, and to inform the EIA process.

   Drawing upon experience of other consenting regimes that have procedures to obligate developers to undertake pre-application engagement and consultation, such as the Development Consent Order (DCO) process under the Planning Act 2008, Menter Môn applied a technical working group and "statement of common ground" approach to management of selected key environmental issues for the EIA process, in particular with respect of the TWAO application, but also in support of wider EIA consultation requirements and the Marine Licence.

6.3. GENERAL APPROACH TO CONSULTATION

6. Menter Môn recognises that effective and meaningful consultation is an integral part of its development activities and is committed to ensuring an open and transparent approach to engagement and consultation with stakeholders.

7. Early engagement of local communities, local authorities and statutory consultees aims to bring about the following shared benefits:

- To allow the public to influence how the Project is developed and how it is integrated in the community by providing the Morlais development team with feedback on potential options;
- To help local people and stakeholders understand better what the Project means for them;
- To obtain important information about the economic, social and environmental impacts of the Project – helping Morlais to identify unsuitable Project options as early as possible;
- To enable potential mitigating measures to be considered and, where appropriate, built into the Project before the application is submitted; and
- To identify new ways in which the Project could support wider strategic and/or local objectives.

8. Public engagement and consultation was undertaken to engage with user groups, communities and individuals potentially affected by the Project. These groups were provided with Project details, an explanation of the EIA process and an overview of studies and surveys being undertaken. This process provided the framework for expression of opinions, information sharing and stakeholder feedback. A summary of public engagement and consultation is set out in the Consultation Report (**Document MOR/RHDHV/DOC/0066, Consultation Report**).

9. The purpose of early EIA stakeholder consultation on the Project is to enable discussion of the proposals and potential impacts with stakeholders and to seek feedback so that comments can inform proposals, including the EIA and Front End Engineering Design (FEED) process.

6.4. APPROACH TO EIA CONSULTATION

6.4.1. Background

10. Two scoping reports were previously submitted to Natural Resources Wales (NRW), the Marine Management Organisation (MMO) and the Isle of Anglesey County Council (IoACC) in support of earlier (lower capacity) versions of the Project. However, the proposed installed capacity of the Project has since been increased and the Project is now seeking consent for up to 240 MW capacity. A further request for scoping opinion was therefore submitted to the Welsh Government and NRW in April 2018, which supersedes the earlier scoping reports.

11. The Welsh Government and NRW provided a detailed scoping opinion, which has been the starting point for consultation on the Project. Consultation with the Welsh Government and NRW has been ongoing throughout the EIA to discuss developments in the Project, scope and design

parameters, and to agree methodologies and approaches used for environmental surveys and assessments during the EIA process.

12. Royal HaskoningDHV and MarineSpace have led consultation with statutory consultees and regulators for the TWAO and the Marine Licence during the EIA process. Statutory consultation has been undertaken, with focus on Welsh Government – Planning Section; NRW; and IoACC. In addition, although not a statutory body, the Royal Society for the Protection of Birds (RSPB) as a key landowner has been included in consultation undertaken by Royal HaskoningDHV and MarineSpace.

13. Royal HaskoningDHV and MarineSpace led all technical EIA consultation, including leading on communications with Cadw, IoACC, NRW (in its capacity as a Statutory Nature Conservation Body (SNCB)) and RSPB, as well as fisheries stakeholders. Although not required as statutory documents under Schedule 5 and 6 of the Transport and Works (Applications and Objections Procedure) (England and Wales) Rules 2006, Menter Môn is submitting Statements of Common Ground (SoCG) on key technical issues; marine mammals, marine ornithology and seascape, landscape and visual impact assessment (SLVIA).

14. Royal HaskoningDHV also led on consultation with the following non-statutory conservation stakeholders: North Wales Wildlife Trust; Gwynedd Archaeological Trust; UK Whale and Dolphin Conservation Trust; and Marine Conservation Society.

15. Navigation and shipping consultation, including recreational interests, was led by the Navigation Risk Assessment (NRA) Consultants, Marico Marine, with review by RHDHV and MarineSpace.

16. Community engagement and other non-statutory consultation was undertaken by Menter Môn with support from the appointed Public Relations (PR) Company, Ateb. The focus of this engagement and consultation was to increase awareness of the Project, share information and invite comments. In addition to promoting the Project and sharing information on the proposals, two series of public information days (PIDs) were held. Further information on community engagement and other non-statutory consultation is included within the Consultation Report (**Document MOR/RHDHV/DOC/0066, Consultation Report**).

6.4.2. EIA Scoping Opinion

17. Scoping responses were received from NRW and the Welsh Government and have been taken into account within the EIA (**Chapters 7** to **26**). Direct responses to the Welsh Government as part of this process were received from Cadw, MMO and NRW, in its capacity as a SNCB. The formal scoping responses from NRW and the Welsh Government are provided in **Appendix 6.1** (**Volume III**).

18. Following receipt of the Scoping Opinion, Menter Môn undertook a series of preliminary meetings to discuss the Project further with key EIA stakeholders.

19. Menter Môn has reviewed consultation responses received and in light of the feedback, has made a number of key decisions in relation to the project design and site selection which are outlined in **Chapter 2, Project Description** and **Chapter 3, Site Selection and Consideration of Alternatives**, respectively.

6.4.3. Technical Working Groups and Statements of Common Ground

6.4.3.1. Technical Working Groups

20. Menter Môn also assembled Technical Working Groups (TWG) to discuss key topic areas. TWGs are a way to discuss the methods used for data collections and analysis, use of the data itself, assessment methods, and results. These can then be brought to bear on mitigation and management of impacts, and in particular adaptive management approaches which may be adopted to address impact pathway or receptor sensitivity or receptor vulnerability unknowns. The aim is to undertake a process of review, discussion and where possible, agreement, in a 'face to face' environment where the aim is to air and resolve disagreements or agree approaches which will allow this to be achieved.

21. Three TWGs were established to enable technical discussions with experts from relevant stakeholders, as follows:

- Marine Mammals;
- Ornithology; and
- SLVIA.

22. The main participants of the TWGs were technical experts mainly drawn from NRW and, for landscape matters, from IoACC. Three meetings were held for each TWG pre-application (**Table 6-1**). The groups may meet post application as appropriate and as directed by the regulator to resolve remaining issues. A clear agenda was agreed for each meeting detailing the issues to be discussed, the questions set out to answer and the aim of the process.

Table 6-1 Technical Working Group Meeting Details

Topic	Date	Attendees	Agenda

Marine Mammals First TWG Meeting	27th November 2018	NRW, Menter Môn, Royal HaskoningDHV	▪ Project background (recap)
			▪ Review of project design envelope
			▪ Species, density estimates, reference populations and management units
			  ▪ Scale of assessment
			▪ Approach to Collision Risk Model (CRM)/Encounter Rate Model (ERM)
			  ▪ Species parameters and dive profiles
			  ▪ Appropriate avoidance rates
			▪ Use of population modelling
			  ▪ iPCoD
			▪ Approach to assessment / potential impacts
			▪ Cumulative assessment
			▪ Phased deployment

Marine Mammals Second TWG Meeting	19th February 2019	NRW, Menter Môn, Royal HaskoningDHV	▪ Overview of tidal device design envelope ▪ Tidal device parameters ▪ Collision risk models: ERM and CRM ▪ Environmental parameters: water depth and current speed

Topic	Date	Attendees	Agenda
			▪ Marine mammal species: density estimates and reference populations ▪ Marine mammal parameters: body length and width; dive profiles and parameters ▪ Avoidance rates
Marine Mammals Third TWG Meeting	10th May 2019	NRW, Menter Môn, Royal HaskoningDHV	▪ Summary of density estimates and reference populations for species and Special Areas of Conservation (SACs) used in the assessments. ▪ Overview of assessments for ES and Habitats Regulations Assessment (HRA), including underwater noise, disturbance, barrier effects, changes in prey / habitat loss and collision risk. ▪ PCoD – update. ▪ Proposed approach to monitoring and mitigation.

Ornithology First TWG Meeting	13th December 2018	NRW, Menter Môn, Royal HaskoningDHV	▪ Project background (recap)
			▪ Review of project design envelope
			▪ Species, conservation sites and populations to be included
			▪ Appropriate spatial scale for assessment
			▪ Review species parameters and vulnerability by species/group:
			  ▪ Above water
			  ▪ Submerged
			  ▪ Foraging distances
			▪ Approach to CRM/ERM
			  ▪ Appropriate avoidance rates
			▪ Potential Biological Removal
			▪ Approach to assessment / potential impacts
			▪ Cumulative assessment
			▪ Summary

Ornithology Second TWG Meeting	19th February 2019	NRW, Menter Môn, Royal HaskoningDHV	▪ Overview of CRM and ERM: ▪ Methods, limitations, interpretation, role in EIA ▪ Device parameters and overview of modelling scenarios ▪ Bird input parameters (densities and diving behaviour) and sources of information ▪ Avoidance rates: what might be appropriate and why? ▪ Presentation and review of preliminary results ▪ Plans for future work

Topic	Date	Attendees	Agenda
			▪ Obtaining feedback on work already undertaken and planned
Ornithology Third TWG Meeting	3rd May 2019	NRW, Menter Môn, Royal HaskoningDHV	▪ Outstanding points and queries raised in first and second TWG meetings ▪ Progress update on Marine Ornithology EIA, including ERM/CRM and Population Viability Analysis (PVA) for Holy Island Coast Site of Special Scientific Interest (SSSI) ▪ Progress update on Marine Ornithology HRA ▪ Progress update on Terrestrial Ornithology EIA - chough

SLVIA First TWG Meeting	30th October 2018	NRW, IoACC, Menter Môn, Royal HaskoningDHV	▪ Project background (recap)
			▪ Review of Project Design Envelope
			▪ Baseline data collection
			▪ Assessment methodology
			▪ Night time lighting assessment
			▪ Offshore Zone of Theoretical Visibility (ZTV) parameters and proposed viewpoints
			▪ Onshore ZTV parameters (including proposed viewpoints)
			    ▪ Grid connection substation
			    ▪ Landfall substation
			▪ Cumulative assessment

SLVIA Second TWG Meeting	12th March 2019	NRW, IoACC, Menter Môn, Royal HaskoningDHV	▪ Project background (recap) ▪ Review of Project Design Envelope ▪ Offshore Project Design Envelope: Draft Layout ▪ Draft Visualisations ▪ Viewpoint assessment (update) ▪ Night time lighting assessment (update) ▪ Navigation Lighting update ▪ Onshore Design Review ▪ Landfall substation ▪ Grid connection substation ▪ Mitigation – colour guide
SLVIA Third TWG Meeting	17th April 2019	NRW, IoACC, Menter Môn, Royal HaskoningDHV	▪ Review of Project Design Envelope (offshore elements) ▪ Mitigated design envelope - careful consideration of NRW/IACC comments ▪ Draft visualisations ▪ Assessment scope update (viewpoint selection and night time photography) ▪ Landfall substation ▪ Scheme design work undertaken following second TWG

Topic	Date	Attendees	Agenda
			▪ Draft visualisations ▪ Assessment scope considerations (viewpoint selection) ▪ Grid substations ▪ Scheme proposals ▪ Assessment scope considerations (viewpoint selection)

6.4.3.2. Statements of Common Ground

23. The main mechanism for capturing the works undertaken and agreed positions reached within each of the TWGs is through the development of SoCG: living documents that capture the work, and agreed positions achieved by each group. Menter Môn has endeavoured to agree SoCG on key technical issues relating to those topic areas in order to aid the Welsh Government and NRW in understanding where there is substantial agreement with stakeholders and where additional management measures and mitigation may be required.

24. The SoCG were developed over the course of the consenting programme as follows:

- A series of TWG meetings were held with the key parties relevant to the issue under discussion, in most instances this was the NRW technical experts, with the IoACC as appropriate (**Table 6-1**);
- A record was kept of the TWG meetings through meeting minutes. The meeting minutes detail the key questions discussed, areas of disagreement and areas of agreement;
- The meeting minutes allow each meeting to build upon the previous discussions sequentially and provide the source material for the SoCG, a report detailing the status of the discussions held, including the areas of agreement and of disagreement.

25. The SoCGs have been used to support the assessment undertaken during the EIA and will form the basis of any post application discussions required by the regulator, from a continuation of technical meetings through to potential preparation for a public inquiry.

26. The purpose of the SoCGs is to demonstrate the process followed to support the application, the agreement reached between parties and where disagreement still lies. They will support the inquiry stage of the consent process and demonstrate to the inspector the measures taken to reach application.

27. SoCGs have been produced for Marine Mammals (**Appendix 6.2, Volume III**), Marine Ornithology (**Appendix 6.3, Volume III**) and SLVIA (**Appendix 6.4, Volume III**). It should be noted that the SoCGs are live documents and will be updated following the continuation of TWGs post application, where required.

6.4.4. Other Consultation Meetings on TWAO and Marine Licence Applications

6.4.4.1. Commercial Fisheries

28. MarineSpace led this aspect of consultation on behalf of RHDHV, in liaison with Menter Môn and Ateb. The focus of consultation was on relevant organisations and vessel operators, including:

- Welsh Fishermen's Association (WFA);
- North Wales Fishermen's Co-operative Limited (NWFCL);
- Gwynedd and Anglesey Fisheries Local Action Group (GAFLAG); and
- Anglesey vessel owners and relevant operators operating locally to the project site.

29. Information was gathered on the following aspects of fisheries use of the Project area:

- Current and historical fishing activity;
- Spatial patterns of fishing activity;
- Temporal patterns of fishing activity;
- Relative importance and economics of fishing grounds;
- Onward market chain;
- Potential opportunities to provide support to the Project (supply chain); and
- Concerns and perceptions about the Project.

30. A summary of the above consultation is provided in **Table 6-2**.

6.4.4.2. Shipping and Navigation

31. Menter Môn's appointed Shipping and Navigation Risk consultants, Marico Marine, mapped navigation stakeholders and statutory consultees during the production of a Preliminary Hazard Analysis (PHA). Marico Marine met with the MCA to discuss the project and obtain their feedback on the proposed scope of work for the NRA, to ensure all potential issues are covered. The PHA report was issued to relevant navigational stakeholders for comment.

32. Winter and summer (14 day) marine traffic surveys were undertaken in 2017 and the collected data were used in the development of a NRA (**Appendix 15.1, Volume III**). A third winter survey was undertaken in April 2019 and informed the NRA. As part of the NRA, Marico Marine met with key shipping and navigational stakeholders. Meetings with the following organisations or their representatives were held during this process:

- Maritime and Coastguard Agency (MCA);
- Chamber of Shipping;
- Trinity House;
- WFA;
- Holyhead Harbour Master;

- Royal Yachting Association (RYA);
- Royal National Lifeboat Institution (RNLI);
- Irish Ferries;
- Stena Line; and
- Local Recreational Clubs.

33. The same stakeholders were invited to participate in the Hazard Review Workshop, where hazards and associated impacts are identified and reviewed.

34. A summary of the above consultation is provided in **Table 6-2**.

6.4.4.3. Ministry of Defence

35. Consultation has also been undertaken with the Ministry of Defence (MoD) to understand the previous and/or current use of the site and any potential issues. The aim of this consultation was to confirm that there is no actual use of these areas or identify significant issues and agree solutions/mitigation as appropriate.

36. This consultation was carried out via the EIA Scoping process, with the MoD being issued the various versions of the EIA Scoping Report between 2015 and 2018. Responses were received from the MoD and incorporated into the EIA process.

6.4.4.4. Environmental Interest Groups and Non-Governmental Organisations (NGOs)

37. Environmental groups have been contacted by email or telephone, providing a brief overview of the project and the timescales for the application. The Consultation Report also provides details of those groups invited to PIDs for the Project (**Document MOR/RHDHV/DOC/0066, Consultation Report**).

38. Feedback from each group at the PIDs is incorporated into the Consultation Report (**Document MOR/RHDHV/DOC/0066, Consultation Report**) and used in the relevant receptor impact assessments, as well as being outlined in the ES.

6.4.4.5. Public Engagement

39. Menter Môn has engaged with a diverse range of stakeholders and user groups regarding the proposed Project through a number of processes since 2015.

40. During the pre-application stage, Menter Môn engaged with relevant local authorities, landowners, community councils and other local stakeholders, in order to raise awareness of the Project, the proposals, to outline the consenting process and to highlight opportunities to input. The process of engagement and consultation with the community and other stakeholders is set out in the Consultation Report (**Document MOR/RHDHV/DOC/0066, Consultation Report**).

41. Menter Môn undertook engagement with local communities and user groups with support from Ateb, RHDHV and MarineSpace. Local communities and user groups identified for consultation were as follows:

- Community and Town Councils within/adjacent to the Project area;
- Local business owners;
- Tourism sector contacts; and
- Recreational groups (sailing, diving and recreational fishing).

42. The key elements of consultation undertaken are as follows:

- Drop in exhibitions held at locations within and adjacent to the Onshore Development Area, at which project information was made be available, and the project team was available to meet the public, answer questions, and discuss the project;
  - First PID held on the 19th March 2019; and
  - Second PID held over three sessions on 11th, 12th and 17th June 2019.
- Community engagement events and briefings with Community and Town Councillors;
- Recreation group meetings as appropriate;
- Newsletters distributed throughout the onshore project area. These newsletters were distributed prior to each PID event; in March and June;
- Leafleting relevant communities to ‘capture’ hard to reach groups; and
- Provision of a dedicated project website; and
- Publicity and awareness raising though media outlets, with focus on printed press, but potentially including radio and television if opportunities present.

43. Further information is set out in the Consultation Report (**Document MOR/RHDHV/DOC/0066, Consultation Report**)

6.4.4.6. Landowner Engagement

44. Consultation has been undertaken directly with landowners and interested parties including tenants, occupiers and other parties with land rights. Engagement with individual land owners within or adjacent to the proposed development was managed directly by Menter Môn, with support from their appointed Land Agent.

45. Menter Môn has engaged with landowners regarding survey access, through consultation meetings and during the land referencing process. Letters were sent to all potentially affected parties offering to meet to discuss the project proposals.

46. In addition, Menter Môn’s land agents have contacted the affected landowners. A number of onshore cable route change suggestions have been put forward by those affected by the onshore development area (ODA). Menter Môn have been able to incorporate a number of those suggestions into the final design of the Project.

47. Further information on these discussions have been considered within **Chapter 3, Site Selection and Consideration of Alternatives** where relevant and the Consultation Report (**Document MOR/RHDHV/DOC/0066, Consultation Report**).

6.4.5. Summary of EIA Consultation

48. A summary of the statutory and non-statutory consultation undertaken for the Project is provided in **Table 6-2.** Note that the RSPB and SEACAMS are included here although their roles are not statutory, because of their science-based approach and availability of data to support the EIA process. A full list of non-statutory communication undertaken, such as with recreational groups, is presented within the Consultation Report (**Document MOR/RHDHV/DOC/0066, Consultation Report**).

49. In addition to the consultation activities presented below, Menter Môn met with the Planning Inspectorate and IoACC's Planning Officer on a regular basis throughout the development of the Project, to provide updates and to seek advice on subjects including the site selection process, approach to the EIA and drafting the application documents.

Table 6-2 Overview of Statutory and Non-Statutory Consultation Made to Date

Date	Consultee	Topic	Format	Content	Considerations to ES
24/08/2015	SEACAMS	Marine Mammals	Meeting	Introduction to Project and view on mammal data requirements for consent.	Feedback built into the EIA approach for **Chapter 12, Marine Mammals**.
24/05/2016	NRW	Project Introduction / Update	Meeting	Discussion of planning performance agreement and Project timescales.	Informed consenting strategy discussions for production of 2017 scoping report.
16/06/2016	Sea Mammal Research Unit (SMRU) & NRW	Project Design Envelope	Meeting	Project Design Envelope.	Feedback built into the 2017 Scoping Report.
17/06/2016	RSPB	Ornithology	Meeting	Project introduction, overview and status, RSPB local interest and concerns.	Feedback built into the EIA approach for **Chapter 11, Marine Ornithology**.
28/07/2016	SEACAMS & NRW	Marine Mammals	Meeting	Discussion around marine mammal survey data.	Feedback built into the EIA approach for **Chapter 12, Marine Mammals**.
24/05/2017	NRW	Project Introduction / Update	Meeting	Project update, summary of survey work undertaken to date.	No substantive feedback.
26/05/2017	RSPB	Ornithology	Meeting	Project update, summary of survey work undertaken to date.	No substantive feedback.
29/09/2017	NRW	Ornithology	Meeting	Update on progress with bird surveys, discussion regarding further survey effort.	Feedback built into the EIA approach for **Chapter 11, Marine Ornithology**.

Date	Consultee	Topic	Format	Content	Considerations to ES
13/12/2017	RSPB	Ornithology	Meeting	Update on progress with bird surveys.	Feedback built into the EIA approach for **Chapter 11, Marine Ornithology**.
09/01/2018	NRW	Consenting Strategy	Meeting	Project and consenting strategy update.	Informed consenting strategy decisions and requirements for submission of 2018 Scoping Report under DCO process.
17/01/2018	NRW & Welsh Government	Consenting Strategy	Meeting	Project update / discussion around consenting strategy.	Informed consenting strategy decisions and requirements for submission of 2018 Scoping Report under DCO process.
19/01/2018	Welsh European Funding Office (WEFO) & Welsh Government	Consenting Strategy	Meeting	Project update / discussion around consenting strategy.	Informed consenting strategy decisions and requirements for submission of 2018 Scoping Report under DCO process.
24/01/2018	RSPB	Ornithology	Meeting	Project Update.	No substantive feedback.
13/02/2018	IoACC	Onshore Ecology	Meeting	Discussion regarding the draft scope of works for the Extended Phase 1 Habitat Survey and proposed approach to Phase 2 surveys.	Feedback built into the EIA approach for **Chapter 19, Onshore Ecology**.
13/03/2018	IoACC	Onshore Ecology	Meeting	Discussion regarding the draft ecological survey methodology.	Feedback built into the EIA approach for **Chapter 19, Onshore Ecology**.
15/03/2018	Planning Inspectorate (PINS) & Welsh Government	Consenting Strategy	Meeting	Project inception meeting.	WG highlighted that if the DCO application was not accepted before the 1 April 2019, any Screening or Scoping Opinion issued by the Secretary of State would not carry any legal weight and the process would need to be carried out (in whole or in part) afresh by WG on behalf of the Welsh Ministers. WG advised that it would be possible for the Applicant to seek consent using a Transport and Works Act Order. This informed the consenting strategy of the Project.

Date	Consultee	Topic	Format	Content	Considerations to ES
23/05/2018	IoACC	Onshore Ecology	Meeting	Discussion regarding proposed approach to great crested newt Phase 2 survey.	Feedback built into the EIA approach for **Chapter 19, Onshore Ecology**.
24/05/2018	IoACC	Project Introduction / Update	Meeting	Introduction to the revised project description and an explanation of the scoping process undertaken. Discussion of planned approach to technical consultation with IoACC. Discussion of planned engagement with councillors / council and community / town council.	No substantive feedback.
24/05/2018	SEACAMS	Marine Mammals	Meeting	Meeting to hear findings of marine mammal studies undertaken to date by SEACAMS. Presentation of density and behavioural studies to date. Outline of other study streams and opportunities with SEACAMS. Discussion regarding contributions to works.	Feedback built into the EIA approach for **Chapter 12, Marine Mammals**.
07/06/2018	IoACC	Project Introduction / Update	Meeting	Project presentation for the Anglesey Councillors.	No substantive feedback.
21/06/2018	NRW	Project Introduction / Update	Meeting	Project briefing and consultation planning.	No substantive feedback.
21/06/2018	NWFCL, Bangor Mussel Producers, Lleyn and District Inshore Fishermen's Association, Lleyn Fishermen's Association, Lleyn Pot	Commercial Fisheries	Email	Provided an update on the project, including notification of survey work, PIDs and project-specific FLO appointment.	No substantive feedback.

Date	Consultee	Topic	Format	Content	Considerations to ES
	Fishermen's Association & WFA				
12/07/2018	Welsh Government & UK Highways	Traffic and Transport	Meeting	Discussion of a potential A55 crossing.	Concerns raised on proposed onshore cable route, informed FEED and project design envelope (**Chapter 3, Site Selection and Consideration of Alternatives** and **Chapter 4, Project Description**).
16/08/2018	Welsh Government	Project Introduction / Update	Meeting	Project briefing and consultation planning.	No substantive feedback.
19/09/2018	NRW	Project Design Envelope	Meeting	Discussion of Project Design Envelope and approach to EIA.	Feedback built into the project description, ES, FEED and EIA approach (**Chapter 3, Site Selection and Consideration of Alternatives** and **Chapter 4, Project Description**).
19/09/2018	Valley Community Council	Project Introduction / Update	Meeting	Project update.	No substantive feedback.
25/09/2018	Trearddur Bay Community Council	Project Introduction / Update	Meeting	Project update.	No substantive feedback.
26/09/2018	Chamber of Shipping	Project Introduction / Update	Meeting	Project introduction	The importance of maintaining a line of orientation across MDZ was discussed, which fed into FEED and offshore project design envelope (**Chapter 4, Project Description** and **Chapter 15, Shipping and Navigation**).
08/10/2018	Holyhead Town Council	Project Introduction / Update	Meeting	Project update.	No substantive feedback.
11/10/2018	Design Commission for Wales	Project Design Envelope	Meeting	Design review.	Feedback built into **Chapter 4, Project Description** and **Chapter 24, Seascape, Landscape and Visual Impact Assessment**

Date	Consultee	Topic	Format	Content	Considerations to ES
15/10/2018	Network Rail	Traffic and Transport	Meeting	Project rail crossing options.	Discussions informed FEED and project design envelope (**Chapter 3, Site Selection and Consideration of Alternatives** and **Chapter 4, Project Description**).
17/10/2018	MCA	Shipping and Navigation	Meeting	Phase 1 consultation meeting as per NRA process.	Informed Navigation Risk Assessment and **Chapter 15, Shipping and Navigation**.
25/10/2018	Chamber of Shipping	Shipping and Navigation	Meeting	Phase 1 consultation meeting as per NRA process.	Informed Navigation Risk Assessment and **Chapter 15, Shipping and Navigation**.
30/10/2018	IoACC & NRW	SLVIA	Meeting	First SLVIA TWG Meeting (see **Table 6-1**).	Feedback built into **Chapter 24, Seascape, Landscape and Visual Impact Assessment**.
31/10/2018	Trinity House	Shipping and Navigation	Meeting	Phase 1 consultation meeting as per NRA process.	Informed Navigation Risk Assessment and **Chapter 15, Shipping and Navigation**.
05/11/2018	WFA	Commercial Fisheries	Meeting	Project update, discussion on project design and impacts on fisheries.	Feedback built into **Chapter 14, Commercial Fisheries**.
19/11/2018	WFA	Shipping and Navigation	Meeting	Meeting formed part of the formal NRA process being undertaken by Marico Marine. Input from WFA on fishing activity in/around MDZ and discussion on potential risks to inform the NRA.	Informed Navigation Risk Assessment and **Chapter 15, Shipping and Navigation**.
20/11/2018	Trearddur Bay Sailing Club, RNLI, Anglesey Water Sport & Anglesey School of Yachting	Shipping and Navigation	Meeting	Meeting formed part of the formal NRA process being undertaken by Marico Marine. Input from various stakeholders on marine activities in/around MDZ and discussion on potential risks to inform the NRA.	Informed Navigation Risk Assessment and **Chapter 15, Shipping and Navigation**.

Date	Consultee	Topic	Format	Content	Considerations to ES
20/11/2018	Holyhead Harbour Master Office	Shipping and Navigation	Meeting	Meeting formed part of the formal NRA process being undertaken by Marico Marine. Input from various stakeholders on marine activities in/around MDZ and discussion on potential risks to inform the NRA.	Informed Navigation Risk Assessment and **Chapter 15, Shipping and Navigation**.
20/11/2018	Stena Line	Shipping and Navigation	Meeting	Meeting formed part of the formal NRA process being undertaken by Marico Marine. Input from Stena Line re: ferry operations in/around MDZ and discussion on potential risks to inform the NRA.	Informed Navigation Risk Assessment and **Chapter 15, Shipping and Navigation**.
21/11/2018	Irish Ferries	Shipping and Navigation	Meeting	Meeting formed part of the formal NRA process being undertaken by Marico Marine. Input from Irish Ferries re: ferry operations in/around MDZ and discussion on potential risks to inform the NRA.	Informed Navigation Risk Assessment and **Chapter 15, Shipping and Navigation**.
21/11/2018	RNLI	Shipping and Navigation	Meeting	Meeting formed part of the formal NRA process being undertaken by Marico Marine. Input from RNLI re: SAR operations in/around MDZ and discussion on potential risks to inform the NRA.	Informed Navigation Risk Assessment and **Chapter 15, Shipping and Navigation**.
23/11/2018	NWFCL, Bangor Mussel Producers, Lleyn and District Inshore Fishermen's Association, Lleyn Fishermen's Association, Lleyn Pot Fishermen's Association & WFA	Commercial Fisheries	Email	Provided a Project update and requested specific information on fishing activity and potential impacts.	No substantive feedback.

Date	Consultee	Topic	Format	Content	Considerations to ES
27/11/2018	NRW	Marine Mammals	Meeting	First Marine Mammals TWG Meeting (see **Table 6-1**).	Feedback built into **Chapter 12, Marine Mammals** and **HRA**.
03/12/2018	NWFCL, Bangor Mussel Producers, Lleyn and District Inshore Fishermen's Association, Lleyn Fishermen's Association, Lleyn Pot Fishermen's Association & WFA	Commercial Fisheries	Email	Follow-up mail to 23/11/18 mail.	No substantive feedback.
06/12/2018	Design Commission for Wales	Project Design Envelope	Meeting	Design Review.	Feedback built into **Chapter 4, Project Description** and **Chapter 24, Seascape, Landscape and Visual Impact Assessment**.
13/12/2018	NRW	Ornithology	Meeting	First Ornithology TWG Meeting (see **Table 6-1**).	Feedback built into **Chapter 11, Onshore Ornithology** and **HRA**.
19/12/2018	NWFCL, Bangor Mussel Producers, Lleyn and District Inshore Fishermen's Association, Lleyn Fishermen's Association, Lleyn Pot Fishermen's Association & WFA	Commercial Fisheries	Email	Request for meetings in January 2019 to gather information/discuss issues.	No substantive feedback.
04/02/2019	WFA NWFCL	Commercial Fisheries	Email	Confirmation from WFA and NWFCL that no members had taken the opportunity to arrange/attend proposed meetings.	No substantive feedback.

Date	Consultee	Topic	Format	Content	Considerations to ES
19/02/2019	NRW	Ornithology	Meeting	Second Ornithology TWG Meeting (see **Table 6-1**).	Feedback built into **Chapter 11, Onshore Ornithology** and **HRA**.
19/02/2019	NRW	Marine Mammals	Meeting	Second Marine Mammals TWG Meeting (see **Table 6-1**).	Feedback built into **Chapter 12, Marine Mammals** and **HRA**.
27/02/2019	NRW	Water Resources and Flood Risk	Information Request	Preliminary opinion requested - free pre-application advice received regarding flood risk management.	Feedback built into **Chapter 17, Water Resources and Flood Risk** and **Appendix 17.1 Flood Consequence Assessment**.
12/03/2019	IoACC & NRW	SLVIA	Meeting	Second SLVIA TWG Meeting (see **Table 6-1**).	Feedback built into **Chapter 24, Seascape, Landscape and Visual Impact Assessment**.
13/03/2019	NWFCL, Bangor Mussel Producers, Lleyn and District Inshore Fishermen's Association, Lleyn Fishermen's Association, Lleyn Pot Fishermen's Association & WFA	Commercial Fisheries	Email	Notification of March PID.	No substantive feedback.
19/03/2019	IoACC & NRW	SLVIA	Meeting	Teleconference to discuss suitability of siting for landfall substation.	Feedback built into **Chapter 4, Project Description** and **Chapter 24, Seascape, Landscape and Visual Impact Assessment**.
26/03/2019	NRW	Water Resources and Flood Risk	Information Request	Updated preliminary opinion requested following red line boundary update - updated pre-application advice received.	Feedback built into **Chapter 17, Water Resources and Flood Risk** and **Appendix 17.1 Flood Consequence Assessment**.
26/03/2019	IoACC	Noise and Vibration	Information Request	Requested advice on survey and assessment methodology	Feedback built into **Chapter 21, Noise and Vibration**.

Date	Consultee	Topic	Format	Content	Considerations to ES
				approach - Approval of construction and operational assessment methodologies received including recommendations for data collection along cable corridor onshore, however, overall acceptance of survey.	
28/03/2019	Gwynedd Archaeological Planning Service (GAPS)	Onshore Archaeology	Meeting	Dewi Jones at IoACC provided contact details as the council's lead advisor for archaeology. Provided GAPS with project overview, details of assessment and mitigation measures.	Feedback built into **Chapter 20, Onshore Archaeology and Cultural Heritage**.
10/04/2019	IoACC	Air Quality	Information Request	Requested advice on assessment methodology – agreed that construction phase vessel and road traffic emissions could be scoped out. Also agreed that dust deposition monitoring is not strictly necessary. Also provided baseline information.	Feedback built into **Chapter 22, Air Quality**.
17/04/2019	IoACC & NRW	SLVIA	Meeting	Third SLVIA TWG Meeting (see **Table 6-1**).	Feedback built into **Chapter 24, Seascape, Landscape and Visual Impact Assessment**.
17/04/2019	IoACC	Water Resources and Flood Risk	Information Request	Private water supplies - details of the onshore development area was sent to IoACC and a search was undertaken within 2.5 km of the boundary. Response issued.	Feedback built into **Chapter 17, Water Resources and Flood Risk** and **Appendix 17.1 Flood Consequence Assessment**.
17/04/2019	RSPB	Ornithology	Meeting	Project update.	No substantive feedback.

Date	Consultee	Topic	Format	Content	Considerations to ES
03/05/2019	NRW	Ornithology	Meeting	Third Ornithology TWG Meeting (see **Table 6-1**).	Feedback built into **Chapter 11, Onshore Ornithology** and **HRA**.
10/05/2019	NRW	Marine Mammals	Meeting	Third Marine Mammals TWG Meeting (see **Table 6-1**).	Feedback built into **Chapter 12, Marine Mammals** and **HRA**.
13/05/2019	Welsh Government & UK Highways	Traffic and Transport	Meeting	Project road crossing options.	Discussions informed FEED and project design envelope (**Chapter 3, Site Selection and Consideration of Alternatives** and **Chapter 4, Project Description**).
09/05/2019	Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW)	Marine Archaeology	Email	Update on key findings of marine archaeological assessment.	Feedback built into **Chapter 13, Offshore Archaeology and Cultural Heritage**.
16/05/2019	IoACC	Traffic and Transport	Information Request	Project update.	Feedback built into **Chapter 23, Traffic and Transport**.
22/05/2019	NWFCL, Bangor Mussel Producers, Lleyn and District Inshore Fishermen's Association, Lleyn Fishermen's Association, Lleyn Pot Fishermen's Association & WFA	Commercial Fisheries	Email	Notification of June PID.	No substantive feedback.
28/05/2019	NRW	SLVIA	Information Request	Draft SLVIA SoCG sent to NRW for comment.	Feedback checked against **Chapter 24, Seascape, Landscape and Visual Impact Assessment**.
28/05/2019	IoACC	SLVIA	Information Request	Draft SLVIA SoCG sent to IoACC for comment.	Feedback checked against **Chapter 24, Seascape, Landscape and Visual Impact Assessment**.

Date	Consultee	Topic	Format	Content	Considerations to ES
28/05/2019	NRW	Ornithology	Information Request	Draft Ornithology SoCG sent to NRW for comment.	Feedback checked against **Chapter 11, Onshore Ornithology**.
31/05/2019	RSPB	Ornithology	Meeting	Project update and to provide an overview of the outcomes of the EIA to date.	Feedback built into **Chapter 11, Onshore Ornithology** and **Chapter 19, Onshore Ecology**.
12/06/2019	NRW	Marine Mammals	Information Request	Draft Marine Mammals SoCG sent to NRW for comment.	Feedback checked against **Chapter 12, Marine Mammals**.
18/06/2019	Network Rail	Traffic and Transport	Meeting	Project rail crossing options.	Discussions informed FEED and project design envelope (**Chapter 3, Site Selection and Consideration of Alternatives** and **Chapter 4, Project Description**).
04/07/19	IoACC	Traffic and Transport	Meeting	Provided a summary of the findings of the traffic and transport assessment.	No substantive feedback.

6.5. CONCLUSIONS

50. Menter Môn conducted a comprehensive and transparent pre-application consultation in relation to the EIA process, with a wide range of stakeholders. The aim of the consultation process was to meet and exceed the requirements of the TWA 1992 and EIA Regulations. To this end it has taken into account relevant advice and guidance published by the Planning Inspectorate, Welsh Government and relevant United Kingdom (UK) Government departments.

51. EIA stakeholders have been engaged in the development process from an early stage. Menter Môn acknowledge and appreciate their involvement and corresponding influence on the design of the Project (as outlined in **Chapter 3, Site Selection and Consideration of Alternatives**) and the EIA.

52. Consultation responses have been carefully documented and considered in the ongoing project development work. Responses which are considered relevant to this ES and the regard Menter Môn has had to them are included in each technical chapter of the ES and in the Consultation Report (**Document MOR/RHDHV/DOC/0066, Consultation Report**).

Morlais Project
Environmental Statement

Chapter 7: Metocean Conditions and Coastal Processes

Volume I

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-007

Chapter 7: Metocean Conditions and Coastal Processes

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GLOSSARY OF ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
AONB	Area of Outstanding Natural Beauty
ATM	Anglesey Turbidity Maximum
CEMP	Construction Environmental Management Plan
CD	Chart Datum
CPA	Coast Protection Act
ES	Environmental Statement
FEPA	Food and Environmental Protection Act
GBS	Gravity Base Structure
HDD	Horizontal Directional Drilling
JLDP	Joint Local Development Plan
MCAA	Marine and Coastal Access Act
MCZ	Marine Conservation Zone
MDZ	Morlais Demonstration Zone
MPS	Marine Policy Statement
NRW	Natural Resources Wales
OfDA	Offshore Development Area
PDE	Project Design Envelope
PDZ	Policy Development Zones
RCP	Representative Concentration Pathway
SAC	Special Area of Conservation
SMP	Shoreline Management Plan
SPA	Special Protection Area
S-P-R	Source-Pathway-Receptor
SSSI	Site of Special Scientific Interest
TAN	Technical Advice Note
TWAO	Transport and Works Act Order
UAV	Unmanned Aerial Vehicle
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
WNMP	Welsh National Marine Plan

GLOSSARY OF TERMINOLOGY

Astronomical tide	The predicted tide levels and character that would result from the gravitational effects of the earth, sun and moon without any atmospheric influences
Bathymetry	Topography of the sea bed
Beach	A deposit of non-cohesive sediment (e.g. sand, gravel) situated on the interface between dry land and the sea (or other large expanse of water) and actively ‘worked’ by present-day hydrodynamic processes (i.e. waves, tides and currents) and sometimes by winds

Bedforms	Features on the seabed (e.g. sand waves, ripples) resulting from the movement of sediment over it
Bedforms	Features on the seabed (e.g. sand waves, ripples) resulting from the movement of sediment over it
Climate change	A change in global or regional climate patterns. Within this chapter this usually relates to any long-term trend in mean sea level, wave height, wind speed etc, due to climate change
Closure depth	The depth that represents the 'seaward limit of significant depth change', but is not an absolute boundary across which there is no cross-shore sediment transport
Coastal processes	Collective term covering the action of natural forces on the shoreline and nearshore seabed
Crest	Highest point on a bedform or wave
Current	Flow of water generated by a variety of forcing mechanisms (e.g. waves, tides, wind)
Ebb tide	The falling tide, immediately following the period of high water and preceding the period of low water
Erosion	Wearing away of the land or seabed by natural forces (e.g. wind, waves, currents, chemical weathering)
Flood tide	The rising tide, immediately following the period of low water and preceding the period of high water
Glacial diamicton	Poorly sorted or non-sorted sediments of glacial origin
Gravel	Loose, rounded fragments of rock larger than sand but smaller than cobbles. Sediment larger than 2mm (as classified by the Wentworth scale used in sedimentology)
Habitat	The environment of an organism and the place where it is usually found
High water	Maximum level reached by the rising tide
Intertidal	Area on a shore that lies between Lowest Astronomical Tide (LAT) and Highest Astronomical Tide (HAT)
Longshore currents	The movement of currents parallel to the shore
Low water	The minimum height reached by the falling tide
Mean sea level	The average level of the sea surface over a defined period (usually a year or longer), taking account of all tidal effects and surge events
Megaripples	Bedforms with a wavelength of 0.6 to 10.0m and a height of 0.1 to 1.0m. These features are smaller than sand waves but larger than ripples
Metocean	The syllabic abbreviation of meteorology and oceanography
Neap tide	A tide that occurs when the tide-generating forces of the sun and moon are acting at right angles to each other, so the tidal range is lower than average
Nearshore	The zone which extends from the swash zone to the position marking the start of the offshore zone (~20m)

Numerical modelling	Refers to the analysis of coastal processes using computational models
Offshore	Area to seaward of nearshore in which the transport of sediment is not caused by wave activity
Quaternary Period	The last 2 million years of earth history incorporating the Pleistocene ice ages and the post-glacial (Holocene) Period
Sand	Sediment particles, mainly of quartz with a diameter of between 0.063mm and 2mm. Sand is generally classified as fine, medium or coarse
Sand wave	Bedforms with wavelengths of 10 to 100m, with amplitudes of 1 to 10m
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations as a result of the flow of water.
Sea level	Generally refers to 'still water level' (excluding wave influences) averaged over a period of time such that periodic changes in level (e.g. due to the tides) are averaged out
Sea-level rise	The general term given to the upward trend in mean sea level resulting from a combination of local or regional geological movements and global climate change
Sediment	Particulate matter derived from rock, minerals or bioclastic matter
Sediment transport	The movement of a mass of sediment by the forces of currents and waves
Shallow water	Commonly, water of such depth that surface waves are noticeably affected by bottom topography. It is customary to consider water of depths less than half the surface wave length as shallow water
Shore platform	A platform of exposed rock or cohesive sediment exposed within the intertidal and subtidal zones
Significant wave height	The average height of the highest of one third of the waves in a given sea state
Spring tide	A tide that occurs when the tide-generating forces of the sun and moon are acting in the same directions, so the tidal range is higher than average
Storm surge	A rise in water level on the open coast due to the action of wind stress as well as atmospheric pressure on the sea surface
Surge	Changes in water level as a result of meteorological forcing (wind, high or low barometric pressure) causing a difference between the recorded water level and the astronomical tide predicted using harmonic analysis
Suspended sediment	The sediment moving in suspension in a fluid kept up by the upward components of the turbulent currents or by the colloidal suspension
Swell waves	Wind-generated waves that have travelled out of their generating area. Swell characteristically exhibits a

	more regular and longer period and has flatter crests than waves within their fetch
Tidal current	The alternating horizontal movement of water associated with the rise and fall of the tide
Tidal range	Difference in height between high and low water levels at a point
Tide	The periodic rise and fall of the water that results from the gravitational attraction of the moon and sun acting upon the rotating earth
Wave climate	Average condition of the waves at a given place over a period of years, as shown by height, period, direction etc.
Wave height	The vertical distance between the crest and the trough
Wavelength	The horizontal distance between consecutive bedform crests

7. METOCEAN CONDITIONS AND COASTAL PROCESSES

7.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) describes the metocean conditions and coastal processes of the Morlais Project (the Project).

2. The Project is being developed by Menter Môn Morlais Ltd. (Menter Môn) and will have a tidal generating capacity of up to 240 MW within the Morlais Demonstration Zone (MDZ).

3. The development of the Project will provide a consented tidal technology demonstration zone, specifically designed for the installation and commercial demonstration of multiple arrays of tidal energy devices. The Project will include communal infrastructure for tidal technology developers which provides a shared route to the cable landfall point via nine export cables, an onshore landfall substation, and an onshore electrical cable route to the existing electricity network via a grid connection substation (see **Chapter 4, Project Description**).

4. This chapter provides a summary description of key aspects relating to existing metocean conditions and coastal processes followed by an assessment of the magnitude and significance of the effects on the baseline conditions resulting from the construction, operation, repowering and decommissioning of the Project, as well as those effects resulting from cumulative interactions with other existing or planned projects.

5. This chapter of the ES was written by Royal HaskoningDHV metocean and coastal processes specialists and incorporates metocean data collected by Partrac (2014)[1], benthic survey data collected by Ocean Ecology (2018) and geophysical data collected by Partrac (2018), as well as numerical modelling outputs from HR Wallingford (2017, 2019). The assessment process has been informed by the following:

   - Interpretation of survey data specifically collected for the Project including bathymetry, sub-sea bed geology, sea bed sediments and metocean conditions;
   - Consideration of the existing evidence base regarding the effects of Project infrastructure on the physical and sedimentary environments;
   - Discussion and agreement with key stakeholders; and
   - Application of expert-based assessment and judgement by Royal HaskoningDHV.

6. The Project will install multiple technology types within the MDZ, and so the consent application is based on a Project Design Envelope (PDE), determined through knowledge of existing technology and the direction of future developments. Hence, the potential effects on metocean conditions and coastal processes have been assessed conservatively using realistic 'worst-case' scenarios for the Project.

[1] Provided courtesy of OpenHydro

7.2. RELEVANT GUIDANCE AND POLICY

7. This section outlines the relevant national and regional policy and guidance and industry guidance which has be used to support the compilation of this Metocean and Coastal Processes Chapter.

8. An overview of the relevant legislative context for the Project is provided in **Chapter 2, Policy and Legislation**.

7.2.1. Policy Statements

7.2.1.1. National Policy Statements

9. The Project is seeking consent for a Transport and Works Act Order from the Welsh Ministers and a Marine Licence from Natural Resources Wales (NRW). Although this Project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP), therefore guidance relevant to NSIPs is considered appropriate to use for this Project. Guidance that is relevant to assessing impacts for NSIPs is set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to metocean conditions and coastal processes include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3), July 2011 (DECC, 2011b).

10. Details of specific policies within EN-1 and EN-3 used to inform this assessment are provided in **Table 7-1** below. The specific assessment requirements for metocean conditions and coastal processes are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 7-1 NPS EN-1 and EN-3 Assessment Requirements Relevant to Metocean Conditions and Coastal Processes

NPS Requirement	NPS Reference	ES Reference
'Where relevant, applicants should undertake coastal geomorphological and sediment transfer modelling to predict and understand impacts and help identify relevant mitigating or compensatory measures'	NPS EN-1 Section 5.5, paragraph 5.5.6	Modelling has been used to assess the baseline hydrodynamic regime and the impacts from the Project on the baseline hydrodynamic regime. A description of this modelling process is provided in **Appendix 7.1** (**Volume III**). Given the nature of the baseline environment (**Section 7.6**), it was deemed appropriate that the baseline sediment regime (including suspended sediment) has been defined based upon existing literature, previous similar

NPS Requirement	NPS Reference	ES Reference
		projects, geophysical and benthic survey and expert interpretation.
'The ES should include an assessment of the effects on the coast. In particular, applicants should assess: ▪ The impact of the proposed project on coastal processes and geomorphology, including by taking account of potential impacts from climate change. If the development will have an impact on coastal processes the applicant must demonstrate how the impacts will be managed to minimise adverse impacts on other parts of the coast. ▪ The vulnerability of the proposed development to coastal change, taking account of climate change, during the project's operational life and any decommissioning period.'	NPS EN-1 Section 5.5, paragraph 5.5.7	See **Section 7.7.5**, **7.7.6** and **7.7.7**
'The applicant should be particularly careful to identify any effects of physical changes on the integrity and special features of Marine Conservation Zones, candidate marine Special Areas of Conservation (SACs), coastal SACs and candidate coastal SACs, coastal Special Protection Areas (SPAs) and potential SCIs and Sites of Special Scientific Interest (SSSI).'	NPS EN-1 Section 5.5, paragraph 5.5.9	See **Section 7.7** and **7.7.1**
The assessment should include predictions of the physical effect that will result from the construction and operation of the required infrastructure and include effects such as the scouring that may result from the proposed development.	NPS EN-3 Section 2.6, paragraph 2.6.194	See **Section 7.7.5** and **7.7.6**
Mitigation measures which the IPC should expect the applicants to have considered include the burying of cables to a necessary depth and using scour protection techniques around offshore structures to prevent scour effects around them. Applicants should consult the statutory consultees on appropriate mitigation.	NPS EN-3 Section 2.6, paragraph 2.6.197	See **Section 7.7.3** and **94**

7.2.1.2. Marine Policy Statement

11. The Marine Policy Statement (MPS) adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made in order to enable sustainable development. The MPS sets out a vision of having 'clean, healthy, safe, productive and biologically diverse oceans and seas' by supporting the development of Marine Plans. It also sets out the framework for environmental, social and economic considerations that need to be considered in marine planning. Regarding the topics covered by this chapter the key reference is in **Table 7-2**.

7.2.1.3. Welsh National Marine Plan

12. By adopting the MPS, the Welsh Government committed to the requirement to introduce Marine Plans for Wales.

13. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the Welsh National Marine Plan (WNMP). The Plan is being developed in accordance with the Marine and Coastal Access Act (MCAA) 2009, the MPS and the Maritime Spatial Planning Directive, a draft version has been issued for consultation (discussed further in **Chapter 2, Policy and Legislation**).

14. Objective 10 of the WNMP, “to maintain and enhance the resilience of marine ecosystems and the benefits they provide in order to meet the needs of present and future generations”, is of relevance to this chapter as this covers policies and commitments on the wider ecosystem, as set out in the MPS including those to do with the Marine Strategy Framework Directive and the Water Framework Directive, as well as other environmental, social and economic considerations.

15. The draft WNMP makes reference to the policies shown in **Table 7-2**which are particularly relevant to the Project.

7.2.1.4. Planning Policy Wales

16. Planning policy for Wales is set out in the document Planning Policy Wales (Welsh Government, 2016). The planning policy document outlines the Welsh Government’s approach to facilitating the delivery of the aims set out in Energy Wales: A Low Carbon Transition (Welsh Government, 2012b), as well as UK wide and European renewable energy targets, including obligations under the Renewable Energy Directive (2009/28/EC). The relevant points within the policy relating to metocean and coastal processes are outlined in **Table 7-2**.

17. The following Planning Policy Technical Advice Note (TAN) has been reviewed within this chapter of the Morlais ES:

- TAN 14: Coastal Planning.

7.2.2. Regional Plans

7.2.2.1. Anglesey and Gwynedd Joint Local Development Plan

18. Development of the Project will support those objectives of the 2017 Anglesey and Gwynedd JLDP, aimed at promoting the development of renewable or low carbon energy technologies. The Project will prioritise maximising opportunities for local communities directly via employment and indirectly via the establishment of a local supply chain.

19. Of the policies contained in the JLDP, those presented in **Table 7-2** are considered to be of relevance to the proposed development.

7.2.2.2. Shoreline Management Plan

20. A Shoreline Management Plan (SMP) provides a large-scale assessment of the risks associated with coastal evolution and presents a policy framework to address these risks to people and the developed, historic and natural environment in a sustainable manner. In doing so, an SMP is a high-level document that forms an important part of the Department for Environment, Food and Rural Affairs (Defra) strategy for flood and coastal defence (Defra, 2001).

21. The SMP is a non-statutory policy document for coastal defence management planning. It takes account of other existing planning initiatives and legislative requirements and is intended to inform wider strategic planning. The shoreline of Wales is divided into a number of Policy Development Zones (PDZ). The coastal area of the Project lies within PDZ17 – Holy Island and West Anglesey (Twyn y Parc to Twyn Cliperau).

7.2.3. Policy Summary

22. The relevant nation National and Regional policy requirements relevant to the Morlais Metocean and Coastal Processes ES chapter is shown in **Table 7-2**.

Table 7-2 National and Regional Policy Requirements Relevant to Metocean and Coastal Processes

Policy Description	Reference	ES Reference
MPS		
Marine plan authorities should not consider development which may affect areas at high risk and probability of coastal change unless the impacts upon it can be managed. Marine plan authorities should seek to minimise and mitigate any geomorphological changes that an activity or development will have on coastal processes, including sediment movement.	Section 2.6.8.6	The potential impacts on coastal processes associated with the construction, operation and decommissioning of the Project is assessed in **Section 7.7.7**, **7.7.8** and **7.7.9**.
Draft WNMP		
Proposals should demonstrate how they are resilient to coastal change and flooding over their lifetime.	SOC_08: Resilience to coastal change and flooding	Coastal change has been considered when assessing potential impacts and effects, see **Section 7.6.6**.
Proposals are encouraged that: ▪ Demonstrate that they have no significant adverse impact upon coastal processes; ▪ Minimise the risk of coastal change and flooding; and ▪ Align with the relevant Shoreline Management Plan	SOC_09: Effects on coastal change and flooding	The potential impacts on coastal processes associated with the construction, operation and decommissioning of the Project is assessed in **Section 7.7.7**, **7.7.8** and **7.7.9**. The Project will not affect the Shoreline Management Plan and allowance has been made for natural erosion (including allowances for climate change) during the project design. Embedded mitigation to minimise potential impacts at the coast of cable installation and operation are described in **Section 7.7.3**.

Policy Description	Reference	ES Reference
Proposals should demonstrate that they have considered the impacts of climate change and have incorporated appropriate adaption measures, taking into account Climate Change Risk Assessments for Wales.	SOC_11: Resilience to climate change	Climate change impacts have been considered when assessing potential impacts and effects, see **Section 7.6.6**.
Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: ▪ a) Avoid adverse effects; and/or ▪ b) Minimise effects where they cannot be avoided; and/or ▪ c) Mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01: Cumulative effects	Cumulative and in-combination impacts of the Project have been considered in **Section 7.7.8** and **Chapter 26, Cumulative and In-Combination Effects**.
Planning Policy Wales		
As part of understanding the characteristics of coastlines it should be recognised that sea level rise, storm surge, wave action and changes in coastal morphology and sediment supply can lead to both direct and indirect effects at the coast. Uncertainty is further exacerbated by the effects of climate change.	Section 6.5.14	Climate change impacts have been considered when assessing potential construction, operation and decommissioning phase impacts and effects, see **Section 7.6.6**.
It is not appropriate for development in one location to unacceptably add to the impacts of physical change to the coast in another location.	Section 6.5.15	Cumulative and in-combination impacts of the Project have been considered in **Section 7.7.8** and **Chapter 26, Cumulative and In-Combination Effects**.
SMPs will influence whether development itself can be justified or how it should be designed.	Section 6.5.17	The Project will not affect the Shoreline Management Plan and allowance has been made for natural erosion (including allowances for climate change) during the project design.
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
Within the coastal areas that are protected as a Heritage Coast an emphasis will be placed on protecting and promoting the natural beauty of the coast, facilitating access for the public and public appreciation, maintaining the environmental quality of the waterfronts and promoting sustainable types of social and economic development.	AMG 4: Coastal Protection	Holyhead Mountain Heritage Coast has been considered when assessing potential impacts during the construction, operation and decommissioning of the Project.
All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations,	ADN 3: Other Renewable Energy and Low Carbon Technologies	Impacts on Holy Island Coast SSSI/SAC, Anglesey AONB and Holyhead Mountain Heritage coast have been assessed in **Section 7.7** and mitigation proposed in **Sections 7.7.3** and **7.7.4**

Policy Description	Reference	ES Reference
including, where appropriate, their settings are conserved or enhanced.		
The Councils will manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline, and proposals that have a significant adverse effect on them will be refused unless the need for and benefits of the development in that location clearly outweighs the value of the site or area and national policy protection for that site and area in question.	PS 19: Conserving and Where Appropriate Enhancing the Natural Environment	Please see **Chapter 19, Onshore Ecology**; **Chapter 24, Seascape, Landscape and Visual Impact Assessment**, **Chapter 25, Socioeconomics, Tourism and Recreation**
Proposals that are likely to cause direct or indirect significant harm to Local Nature Reserves (LNR), Wildlife Sites (WS) 1 or regionally important geological / geomorphologic sites (RIGS) must have overriding economic and social benefit and not cause unacceptable harm	AMG 6: Protecting Sites of Regional or Local Significance	See **Section 7.7.7, 7.7.8** and **7.7.9** for the impact assessment results.
Wellbeing of Future Generations (Wales) Act 2015		
A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).	A resilient Wales	See **Section 7.7.7, 7.7.8** and **7.7.9** for the impact assessment results.

7.2.4. Industry Guidance

23. Industry guidance on the generic requirements, including spatial and temporal scales, for metocean and coastal processes studies associated with tidal array developments is provided in several documents (some of which are specifically written for offshore wind farms but are also of relevance here):

- Metocean Procedures Guide for Offshore Renewables (IMarEST, 2018);
- Offshore wind farms: guidance note for Environmental Impact Assessment in respect of Food and Environmental Protection Act (FEPA) and Coast Protection Act (CPA) requirements: Version 2 (Cefas, 2004);
- Coastal Process Modelling for Offshore Wind farm Environmental Impact Assessment (COWRIE, 2009);
- Review of Cabling Techniques and Environmental Effects applicable to the Offshore Wind Farm Industry (BERR, 2008);
- General advice on assessing potential impacts of and mitigation for human activities on Marine Conservation Zone (MCZ) features, using existing regulation and legislation (JNCC and Natural England, 2011); and
- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Cefas, 2011).

7.3. CONSULTATION

24. Consultation is an important part of the Transport and Works Act Order (TWAO) application process. To date, consultation regarding metocean conditions and coastal processes has been conducted through the Scoping Opinion for the Scoping Report (Royal HaskoningDHV, 2018). The Scoping responses received are summarised in **Table 7-3**.

Table 7-3 Scoping Opinion Responses

Consultee	Comment	Response/where addressed in the ES
Planning Inspectorate	Reduced energy in tidal currents from energy removed by tidal devices. Paragraph 11.2.2.1 of the Scoping Report requests to scope this matter out on the basis that previous studies for other projects such as Perpetuus Tidal Energy Centre and SeaGen have found little evidence of significant changes to tidal strength downstream of devices and have predicted no significant impacts on coastal processes. Whilst this is noted, the Perpetuus Tidal Energy Centre is a 30MW development and it is not accepted that the findings of such previous studies are directly applicable to the Proposed Works, which is 240MW and is seeking a wide project design envelope. In addition, the request to scope this matter out is contradicted by Table 7-1 of the Scoping Report which states that removal of tidal energy from the environment may result in increased sedimentation downstream of TEC devices and that significance of impact is unknown. It is therefore not agreed that this matter can be scoped out of the ES. The ES should assess potential hydrodynamic impacts from the presence of offshore infrastructure.	The potential impacts on the baseline hydrodynamic conditions from the presence of offshore infrastructure are assessed in **Section 7.7.8**.
Planning Inspectorate	Changes to wave climate from submerged and surface piercing infrastructure. The Applicant states that EIA and monitoring studies from other surface piercing technologies, namely offshore wind, have found no evidence to suggest that surface piercing devices significantly alter wave climate or strength inshore of project areas. No specific studies have been referenced and it is unclear if such studies conducted for different technology types will be applicable to the Proposed Works' tidal technologies, which may include substantially different structures to wind turbines. On the basis of the information provided at this stage, it is not agreed this matter can be scoped out of the ES. The ES should assess potential hydrodynamic impacts from the presence of offshore infrastructure.	The potential impacts on the baseline wave climate from the presence of offshore infrastructure are assessed in **Section 7.7.8**.
Planning Inspectorate	The Scoping Report provides limited detail on how the baseline will be characterised. The Applicant should make efforts to discuss and agree the approach to baseline characterisation with NRW. The proposed coastal process conceptual modelling should inform the need of any further field surveys e.g. bathymetric and/ or geophysical investigations. Sediment samples should also be taken in sediment laden seabed areas to determine sediment type,	The data sources used to inform the conceptual understanding of the baseline environment are listed in **Section 7.5.2**. The baseline environment is described in **Section 7.6**.

Consultee	Comment	Response/where addressed in the ES
	composition and sediment volume that could potentially be suspended through the cable trenching activities. Topographical data from the landfall location should be provided to inform any impacts on the beach profile and sediment morphology from cable landfall.	
Planning Inspectorate	The Scoping Report has not detailed how the potential impacts will be assessed. The methodology must be detailed in the ES. It is considered that modelling will be required to predict the anticipated increase in suspended sediment from the Proposed Works. The ES should include details of the parameter inputs to the model and provide an explanation/justification of any worst-case scenario that has been assumed.	The methodology used for the assessment of potential impacts is described in **Section 7.4.1**. Modelling has been used to assess the baseline hydrodynamic regime and the impacts from the Project on the baseline hydrodynamic regime. A description of this modelling process is provided in **Appendix 7.1** (**Volume III**). Given the nature of the baseline environment (**Section 7.6**), it was deemed appropriate that the baseline sediment regime (including suspended sediment) has been defined based upon existing literature, previous similar projects, geophysical and benthic survey and expert interpretation.
Planning Inspectorate	The Scoping Report notes the potential for *Sabellaria alveolata* and *Modiolus modiolus* reef to be present in the offshore scoping area. The Applicant should take into account NRW's response (see Appendix 1 of this Scoping Opinion) stating that several areas of *Sabellaria alveolata* have developed into *Sabellaria* reef. Any likely significant effects on *Sabellaria* reef should be assessed within the ES. The ES should consider potential direct impacts from construction and also the potential impacts from maintenance activities on reef that may colonise the cables during the operational phase.	The potential impacts on Sabellaria reef as a result of the construction, operation and decommissioning phase of the Project are considered in **Chapter 9, Benthic and Intertidal Ecology.**
Planning Inspectorate	It is understood that the type and locations of TEC devices within the offshore area will not be determined by the time of application. As such, the ES should consider a worst-case scenario of habitat loss. When assessing the potential impacts from loss of habitat, the ES should also give consideration to habitat loss resulting from the introduction of any scour and cable protection.	Worst-case scenarios of habitat loss as a result of the construction, operation and decommissioning phase of the Project are considered in **Chapter 9, Benthic and Intertidal Ecology.**
Planning Inspectorate	Potential impacts due to change in sediment regime are included in Table 8-4. However, Table 8-2 identifies potential impacts to benthic ecology interest features of designated marine and coastal sites due to changes in	The likely significant effects on intertidal and subtidal benthic ecology from changes to physical

Consultee	Comment	Response/where addressed in the ES
	coastal processes, sedimentology and hydrodynamic regime in Table 8-2. The ES should assess the likely significant effects on intertidal and subtidal benthic ecology from changes to physical process (e.g. alteration to flow conditions, waves regime and sediment transport pathways).	processes as a result of the construction, operation and decommissioning phase of the Project are considered in **Chapter 9, Benthic and Intertidal Ecology.**
Planning Inspectorate	The ES should assess the likely significant effects from increased turbidity on larvae of fish and shellfish species.	The likely significant effects from increased turbidity on larvae of fish and shellfish species as a result of the construction, operation and decommissioning phase of the Project are considered in **Chapter 10, Fish and Shellfish Ecology.**
Natural Resources Wales	Zone of influence and impact pathway descriptions have not been provided in sufficient detail for scrutiny in the EIA scoping report. We are therefore unable to confirm whether we agree with the impact zone of influence or impact pathways. This presents implications for the advice that can currently be provided with respect to designated sites, cumulative impacts and activities to be scoped out. It is not known at present what devices will be deployed in the demonstration zone area etc therefore it will be important that the zone of influence identifies the maximum environmental impact based on realistic worst-case scenarios. The baseline evidence used to determine the zone of influence will need to be clearly stated in the ES.	The zone of influence approach originally envisaged has subsequently been replaced by hydrodynamic modelling to assess the impacts on the hydrodynamic regime in a quantifiable and rigorous manner.
Natural Resources Wales	Little information is currently provided in the EIA scoping report with regard to cable protection requirements. It is not defined at present where and how much cable protection will be required if the export cables are surface laid on exposed bedrock and protected by rock armour or concrete mattresses. Cable protection could include permanent rock armour protection on the seabed potentially altering current flows near the seabed, inducing sediment scour and potentially altering sediment transport pathways near the coast. Worst-case scenarios for cable protection will need to be assessed in the ES.	The worst-case scenario for cable protection is described in **Section 7.7.6**. The effects of cable protection on baseline conditions are described in **Section 7.7.8**.
Natural Resources Wales	The baseline characterisation work proposed within the EIA scoping report is limited. Clarification is required regarding how the applicant intends to describe the site selection process for the tidal energy devices and grid connection route if detailed hydrodynamic, bathymetric and geophysical investigations are not carried out to provide the necessary baseline evidence. We advise that the applicant should use accurate bathymetry and geophysical survey data of the demonstration zone to inform their decision on the export cable route pathways through the proposed demonstration zone. Sediment samples should also be taken in sediment laden seabed areas to determine sediment type, composition and sediment volume that could potentially be suspended through the cable trenching activities.	The baseline characterisation has been informed by geophysical, subtidal grab sample, intertidal and metocean surveys, as described in **Section 7.5.2**.

Consultee	Comment	Response/where addressed in the ES
Natural Resources Wales	The EIA scoping report suggests that the applicant will not be conducting hydrodynamic investigations of the demonstration zone area. If that is the case, we seek clarification regarding how the applicant intends to assess potential hydrodynamic impacts from the presence of the offshore infrastructure that they are responsible for (i.e. offshore hub, inter array and export cables and associated cable protection) and the tidal energy devices themselves.	In recognition of this comment, hydrodynamic investigations have been undertaken using numerical modelling techniques and geomorphological interpretation of the results to assess the impacts of the Project on the baseline hydrodynamic regime. Description of this numerical modelling process is provided in **Appendix 7.1** (**Volume III**).
Natural Resources Wales	Potential impacts on metocean conditions and coastal processes only includes impacts during the operational phase of the proposed development (see table 7.1). The other phases of the project life (construction and decommissioning) should also be considered within the ES. For example, during the construction phase there could be impacts caused by the cable laying activities, such as alteration to the seabed morphology caused by presence of rock armour protection on the seabed. This could have a significant impact on coastal processes if located across an active sediment transport pathway. There could also be a potential for sediment scour downstream of the structure and alteration of flow near the seabed.	The impact assessment covers not only the construction phase but also the operation and decommissioning phases, as described in **Section 7.7.8** and **7.7.9**.
Natural Resources Wales	Table 7-1 describes the potential impact ‘increased suspended sediment from reduced water energy’. It is unclear how reduced water energy will increase suspended sediment concentrations. Reduced water energy may increase sedimentation of suspended material; is this what is meant?	Noted, further clarification is provided in the assessment of Operational Impacts (**Section 7.7.6**).
Natural Resources Wales	Again, it is unclear how potential impacts relating to metocean conditions and sediment transport, and coastal processes be assessed for impact significance in the EIA without conducting hydrodynamic modelling studies pre and post tidal array/cable installation (see Table 7-1). Without physically measuring or modelling the change in the energy potential downstream of the devices and alteration to the wave directions under different wave conditions, it may not be possible to determine significance and magnitude of impact on the coastal processes.	Modelling has been used to assess the impacts on the hydrodynamic regime and description of this modelling process is provided in **Appendix 7.1** (**Volume III**).
Natural Resources Wales	With reference to Table 7-1 we recommend that consideration should be given in the ES to the alteration of the near bed currents and sediment transport pathways caused by rock armour protection on the seabed, not just the tidal energy devices.	The effects of cable protection have been considered in **Section 7.7.8**.
Natural Resources Wales	Regarding ‘EIA baseline characterisation’ NRW welcome the inclusion of a conceptual model to describe the hydrodynamic and coastal process. A coastal processes conceptual model is a useful way to identify where there are gaps in existing baseline evidence which may then inform the requirement for further metocean data collection through field surveys. At the scoping stage, metocean and	The data sources used to inform the conceptual understanding of the baseline environment are listed in **Section 7.5.2**.

Consultee	Comment	Response/where addressed in the ES
	coastal processes field data collection should not be ruled out (see section 7.1.3).	The baseline environment is described in **Section 7.6**.
Natural Resources Wales	We advise that hydrodynamic modelling to inform the EIA impact assessment should also not be ruled out at the scoping stage until it is confirmed that there is enough baseline evidence to qualify and quantify the EIA impact assessment process for hydrodynamics, sediment transport and coastal processes.	Modelling has been used to assess the impacts on the hydrodynamic regime and description of this modelling process is provided in **Appendix 7.1** (**Volume III**).
Natural Resources Wales	It is recommended that the coastal processes baseline characterisation needs to also include topographical data at the landfall location which may be used to inform any potential impacts on the beach profile and sediment morphology arising from the cable landfall of the export cable from offshore to onshore and the construction of a transition pit.	Morphological and sedimentary characteristics at the landfall have been addressed in **Section 7.6.10**.Geology and Coastal Processes at the Landfall
Natural Resources Wales	Further information is required regarding how the potential impacts to the physical processes caused by the deployment of multiple tidal energy devices will be qualitatively and quantitatively assessed using a non-numerical approach i.e. development of a conceptual model. The physical processes impact assessment is an important assessment as any alteration to the flow conditions, waves regime and sediment transport pathways caused by the presence of the tidal devices and the associated infrastructure will potentially impact on the intertidal and subtidal benthic ecology, water quality and coastal morphodynamics. This in turn could then affect the integrity of the protected sites designated under the Habitats directive and affect the ecological status defined under the Water Framework Directive.	Modelling has been used to assess the impacts on the hydrodynamic regime and description of this modelling process is provided in **Appendix 7.1** (**Volume III**). Hydrodynamic impacts have then been interpreted from the modelling results. Expert assessment has been used elsewhere (e.g. effects on wave regime and sediment transport regime).
Natural Resources Wales	We disagree that the offshore physical processes associated with reduced energy in tidal currents from energy removed by tidal devices should be scoped out from the EIA. It is not clear at this stage what devices will be deployed within the demonstration zone. PTEC are potentially generating 30MW of power whilst the demonstration zone will potentially be generating 240 MW of power. The scale of both projects is very different and ruling out the effects caused by a reduction in energy based on the findings of a much smaller project is not acceptable at this stage.	The potential impacts on the baseline hydrodynamic conditions from the presence of offshore infrastructure are assessed in **Section 7.7.8**. This impacts assessment is informed by numerical modelling which is described in **Appendix 7.1** (**Volume III**).
Natural Resources Wales	There has been no inclusion of tidal current data in the demonstration zone which shows the magnitude and direction of flow over the zone to substantiate the assumption that the suspended sediments would rapidly disperse. We agree that in fast flowing currents, dispersion of suspended sediments could occur rapidly and the potential for smothering would be reduced as a result (see table 7.2). However, there is no baseline evidence presented in the metocean section that supports this assessment of impact. We advise that further evidence is presented to show the magnitude and direction of the tidal currents in the nearshore and intertidal areas which are often much smaller than those experienced offshore, and	The baseline hydrodynamic conditions are assessed in **Section 7.6**. These have been informed by numerical modelling which is described in **Appendix 7.1** (**Volume III**).

Consultee	Comment	Response/where addressed in the ES
	which may not be enough to promote rapid dispersion of suspended sediments and potential contaminants released through trenching activities over this zone.	
Natural Resources Wales	Extreme sea levels can be obtained for this coastline for a range of probability flood events including that of climate change allowances. These extreme sea levels would allow for surge conditions but not wave action. To obtain the levels a request may be made to our data distribution team.	Extreme sea levels are described as part of the baseline environment in **Section 7.6**.
Natural Resources Wales	We welcome the acknowledgement of potential impacts to benthic ecology interest features of designated marine and coastal sites due to changes in coastal processes, sedimentology and hydrodynamic regime in table 8.2. We note, however, that only potential impacts due to change in sediment regime are included in table 8.4 Potential impacts on benthic ecology. We wish to draw the applicant's attention to our comments relating to coastal process aspects of the EIA Scoping Report. Specifically, we would welcome clarity on how the potential impacts to the physical processes caused by the deployment of multiple tidal energy devices and associated infrastructure will be adequately assessed using a nonnumerical (conceptual model) approach, and how this will be applied in the context of potential impacts to intertidal and subtidal benthic ecology, water quality and coastal morphodynamics arising due to physical process impacts (alteration to flow conditions, waves regime and sediment transport pathways).	See **Section 7.7.5** and **Section 7.7.6** for operational impacts. The following chapters have utilised this information to inform the impact assessment sections of those chapters; **Chapter 8, Marine Water and Sediment Quality**, **Chapter 9, Benthic and Intertidal Ecology** as suggested.
Natural Resources Wales	We note that the Offshore Scoping Zone now includes the sea area between the demonstration zone and the shore. Additional multibeam / acoustic survey and benthic ground-truthing will be needed in this area to inform the benthic impact assessment associated with the export cable route from the Lease Area if not already available.	The marine geophysical survey covers all areas of the MDZ, shown in **Figure 7-1** (**Volume II**).

7.4. ASSESSMENT METHODOLOGY

25. To meet the requirements of the guidance documents described in **Section 7.2**, the assessment approach has adopted the following stages:

- Review of existing relevant data and information;
- Acquisition of additional project-specific data to fill any gaps (including additional numerical modelling of effects on the tidal regime);
- Formulation of a conceptual understanding of baseline conditions;
- Consultation and agreement with the regulators regarding proposed assessment approaches;
- Determination of the worst-case scenarios;
- Consideration of embedded mitigation measures; and
- Assessment of effects using data analysis, numerical modelling outputs, and expert-based judgements by Royal HaskoningDHV.

7.4.1. Impact Assessment Methodology

26. As described in **Chapter 5, EIA Methodology**, the assessment of effects on metocean conditions and coastal processes is predicated on a Source-Pathway-Receptor (S-P-R) conceptual model, whereby the source is the initiator event, the pathway is the link between the source and the receptor impacted by the effect, and the receptor is the receiving entity.

27. An example of the S-P-R conceptual model is provided by cable installation which disturbs sediment on the sea bed (source). This sediment is then transported by tidal currents until it settles back to the sea bed (pathway). The deposited sediment could change the composition and elevation of the sea bed (receptor).

28. Consideration of the potential effects of the Project on the metocean conditions and coastal processes is carried out over the following spatial scales:

- Near-field: the area within the immediate vicinity (tens or hundreds of metres) of the Project and along the offshore cable corridor; and
- Far-field: the wider area that might also be affected indirectly by the Project (e.g. due to disruption of waves, tidal currents or sediment pathways).

29. Four main phases of development are considered, in conjunction with the present-day baseline, over the life-cycle of the Project. These are:

- Construction phase;
- Operation and maintenance phase;
- Repowering phase and
- Decommissioning phase.

30. A repowering of a device/array is defined as the end of a berth/array demonstration cycle, at which time the device, device foundations, support structures, electrical hubs, tenant monitoring equipment, and inter-array cabling will be removed, in line with procedures adopted during decommissioning. Once all developer owned assets listed above have been removed, the Project will then have capacity for ‘repowering’ the berth would then be available for ‘repowering’ where new devices may be installed to utilise the vacated berth, or be installed at a new berth for further demonstration.

31. For the purposes of this chapter, the effects and impacts of repowering are considered to be the same as assessed for construction and decommissioning.

32. For the effects on metocean conditions and coastal processes, the assessment follows two approaches. The first type of assessment is impacts on metocean conditions and coastal processes whereby several discrete direct receptors are identified. These include certain morphological features with inherent value, such as:

- Offshore sand ridges / sandbanks – these morphological features play an important role in influencing the baseline tidal, wave and sediment transport regimes; and
- Beaches and sea cliffs - these shoreline morphological features play an important natural coastal defence role at the coast and are features which form part of the

designated sites of Holy Island Coast Site of Special Scientific Interest (SSSI)/Special Area of Conservation (SAC), Anglesey Area of Outstanding Natural Beauty (AONB) and Holyhead Mountain Heritage Coast.

33. The impact assessment incorporates a combination of the sensitivity of the receptor, its value (if applicable) and the magnitude of the change to determine a significance of impact. **Chapter 5, EIA Methodology** provides an overview of this approach to the assessment of impacts.

34. In addition to identifiable receptors, the second type of assessment covers changes to metocean conditions and coastal processes which in themselves are not necessarily impacts to which significance can be ascribed. Rather, these changes (such as a change in the wave climate, a change in the tidal regime or a change in suspended sediment concentrations) represent effects which may manifest themselves as impacts upon other receptors, most notably marine sediment and water quality, benthic ecology, and fish and shellfish ecology (e.g. in terms of increased suspended sediment concentrations, or erosion or smothering of habitats on the sea bed).

35. Hence, the two approaches to the assessment of metocean conditions and coastal processes are:

- Situations where potential impacts can be defined as directly affecting receptors which possess their own intrinsic morphological value. In this case, the significance of the impact is based on an assessment of the sensitivity of the receptor and magnitude of effect at the receptor location, taking into the near-field or far-field nature of the effect from the receptor. An impact significance matrix is used as a guide to determine the impact significance; and
- Situations where effects (or changes) in the baseline metocean conditions and coastal processes may occur which could manifest as impacts upon receptors other than metocean conditions and coastal processes. In this case, the magnitude of effect is determined in a similar manner to the first assessment method but the significance of impacts on other receptors is made within the relevant chapters of the ES pertaining to those receptors.

7.4.1.1. Sensitivity, Value and Magnitude

36. The sensitivity of a receptor is dependent upon its:

- *Tolerance* to an effect (the extent to which the receptor is adversely affected by an effect);
- *Adaptability* (the ability of the receptor to avoid adverse impacts that would otherwise arise from an effect); and
- *Recoverability* (a measure of a receptor’s ability to return to a state at, or close to, that which existed before the effect caused a change).

37. In addition, a value component may also be considered when assessing a receptor. This ascribes whether the receptor is rare, protected or threatened.

38. The magnitude of an effect is dependent upon its:

- Scale (i.e. size, extent or intensity);
- Duration;
- Frequency of occurrence; and
- Reversibility (i.e. the capability of the environment to return to a condition equivalent to the baseline after the effect ceases).

39. The sensitivity and value of discrete morphological receptors and the magnitude of effect are assessed using expert judgement and described with a standard semantic scale. Definitions for each term are provided in **Table 7-4**, **Table 7-5** and **Table 7-6**. These expert judgements of receptor sensitivity, value and magnitude of effect are guided by the conceptual understanding of baseline conditions.

Table 7-4 Definitions of Sensitivity Levels for a Morphological Receptor

Sensitivity	Definition
High	Tolerance: Receptor has very limited tolerance of effect. Adaptability: Receptor unable to adapt to effect. Recoverability: Receptor unable to recover resulting in permanent or long-term (greater than ten years) change.
Medium	Tolerance: Receptor has limited tolerance of effect. Adaptability: Receptor has limited ability to adapt to effect. Recoverability: Receptor able to recover to an acceptable status over the medium term (5-10 years).
Low	Tolerance: Receptor has some tolerance of effect. Adaptability: Receptor has some ability to adapt to effect. Recoverability: Receptor able to recover to an acceptable status over the short term (1-5 years).
Negligible	Tolerance: Receptor generally tolerant of effect. Adaptability: Receptor can completely adapt to effect with no detectable changes. Recoverability: Receptor able to recover to an acceptable status near instantaneously (less than one year).

Table 7-5 Definitions of the Different Value Levels for a Morphological Receptor

Value	Definition
High	Value: Receptor is designated and/or of national or international importance for marine geology, oceanography and physical processes. Likely to be rare with minimal potential for substitution. May also be of significant wider-scale, functional or strategic importance.
Medium	Value: Receptor is not designated but is of local to regional importance for marine geology, oceanography and physical processes.
Low	Value: Receptor is not designated but is of local importance for marine geology, oceanography and physical processes.
Negligible	Value: Receptor is not designated and is not deemed of importance for marine geology, oceanography and physical processes.

Table 7-6 Definitions of Magnitude of Effect Levels for Metocean Conditions and Coastal Processes

Magnitude	Definition
High	Scale: A change which would extend beyond the natural variations in background conditions. Duration: Change persists for more than ten years. Frequency: The effect would always occur. Reversibility: The effect is irreversible.
Medium	Scale: A change which would be noticeable from monitoring but remains within the range of natural variations in background conditions. Duration: Change persists for 5-10 years. Frequency: The effect would occur regularly but not all the time. Reversibility: The effect is very slowly reversible (5-10 years).
Low	Scale: A change which would barely be noticeable from monitoring and is small compared to natural variations in background conditions. Duration: Change persists for 1-5 years. Frequency: The effect would occur occasionally but not all the time. Reversibility: The effect is slowly reversible (1-5 years).
Negligible	Scale: A change which would not be noticeable from monitoring and is extremely small compared to natural variations in background conditions. Duration: Change persists for less than one year. Frequency: The effect would occur highly infrequently. Reversibility: The effect is quickly reversible (less than one year).

7.4.1.2. Impact Significance

40. Following the identification of receptor sensitivity and value, and magnitude of effect, it is possible to determine the significance of the impact. A matrix is presented in **Table 7-7** as a framework to guide how a judgement of the significance is determined.

Table 7-7 Impact Significance Matrix

		Negative Magnitude				**Beneficial Magnitude**			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

41. Through use of the matrix shown in **Table 7-7,** an assessment of the significance of an impact can be made in accordance with the definitions in **Table 7-8**.

Table 7-8 Impact Significance Definitions

Impact Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation.

Impact Significance	Definition
Moderate	Intermediate change in receptor condition, which is likely to be an important consideration at a local level.
Minor	Small change in receptor condition, which may be raised as a local issue but is unlikely to be important in the decision-making process.
Negligible	No discernible change in receptor condition.

42. For the purposes of this ES, 'major' and 'moderate' impacts are deemed to be significant (in EIA terms). In addition, whilst 'minor' impacts may not be significant, it is important to distinguish these from other non-significant (negligible) impacts as they may contribute to significant impacts cumulatively.

7.4.1.3. Cumulative Impact Assessment

43. Cumulative impacts are assessed through consideration of the extent of influence of changes to metocean conditions and coastal processes arising from the Project alone and those arising from the Project cumulatively or in combination with other developments including the Deep Green (DG) Holyhead Deep Project Phase 1 (0.5) and DG Holyhead Deep Array Project.

7.5. SCOPE

7.5.1. Study Area

44. The MDZ is in the eastern Irish Sea, encompassing a sea bed area of approximately 35 km^2 and an export cable corridor of 4.75 km^2 (plus an intertidal area of 0.01 km^2), totalling an area of 39.76 km^2 for the Offshore Development Area (OfDA). Its nearest point is located approximately 0.5 km from the west coast of Anglesey. Offshore cables connect Project across an offshore cable corridor to the east of the MDZ and then to the landfall near Penrhos Feilw (**Figure 1-1, Volume II**).

7.5.2. Data Sources

45. Information to support this chapter of the ES has come from several sources (**Table 7-9**).

Table 7-9 Data Sources

Data	Year	Coverage	Confidence	Notes
Geophysical Survey	2018	MDZ, buffer zone and Abraham's Bosom	High	High-resolution sea bed bathymetry, seabed texture and morphological features, and shallow geology using multibeam echosounder, side-scan sonar, and boomer (Partrac, 2018).
Subtidal Grab Sample Survey	2018	MDZ and buffer zone	High	Drop-down camera and five grab samples at selected suitable sites (Ocean Ecology, 2018).
Intertidal Survey	2018	Abraham's Bosom	High	Unmanned Aerial Vehicle (UAV) survey and intertidal walkover (Ocean Ecology, 2018).
Metocean Survey	2014	MDZ	High	Bottom-mounted Acoustic Doppler Current Profilers (ADCP) deployed for a continuous 40-day period in November and December 2014 at two locations.

46. A geophysical survey of the MDZ (plus a 1 km buffer zone to the -10 m Chart Datum (CD) contour around it) was completed between 22nd April 2018 and 19th May 2018 (Partrac, 2018) (**Table 7-9**). Survey lines were completed at 125 m spacing for most of the site with a bearing of 24 ° (tidal flow direction) (**Figure 7-1, Volume II**).

47. In the nearshore zone, the line spacing was decreased to between 30 m and 50 m. Where vessel safety allowed, the survey was extended up to the -5 m CD contour, along the western coast, except for within the bay approaching the landfall known as Abraham's Bosom. The shallow water in this bay was mapped to the 0 m CD contour or as far inshore as possible without compromising vessel safety. Five cross lines were completed at suitable locations to 'tie together' the main lines.

48. Ocean Ecology (2018) also completed an intertidal survey around the proposed cable landfall in Abraham's Bosom (**Table 7-9**) (**Figure 7-2, Volume II**). The area was flown on 30th August 2018 at low spring tide using a UAV to capture high-resolution aerial imagery that was subsequently used to create an ortho-mosaic map of key habitats (**Figure 7-2, Volume II**). The remote sensing was followed by an intertidal walkover survey on 14th September 2018.

Table 7-10 Location of Grab Samples and Drop-Down Camera Stills (Ocean Ecology, 2018) (corresponding to Figure 7-2, Volume II)

Location	Grab Samples	Drop-down Camera
Demonstration Zone	Location 41	Location 33
Buffer Zone	Locations 15 and 20	Location 6
Abraham's Bosom	Location 42	Location 3

49. A metocean survey was undertaken between November and December 2014 by Partrac and provided to Mentor Môn (courtesy of OpenHydro). This involved the deployment of ADCPs at two locations in the MDZ. Site 1 was in approximately 37 m water depth and Site 2 in approximately 35 m water depth. Water level and tidal current velocity were measured over a continuous 40-day period, covering three spring tides and two neap tides.

50. In addition to the new data collection, a range of information sources is available, including:

- Marine Renewable Atlas (BERR, 2008);
- National Tide and Sea Level Facility (British Oceanographic Data Centre);
- Extreme sea levels database (Environment Agency, 2015);
- United Kingdom Hydrographic Office (UKHO) tidal diamonds;
- National Oceanographic Laboratory Class A tide gauges;
- United Kingdom Climate Projections 2018 (UKCP18);
- British Geological Survey 1:250,000 sea bed sediment mapping; and
- Admiralty Charts and United Kingdom Hydrographic Office survey data.

7.6. EXISTING ENVIRONMENT

7.6.1. Bathymetry

51. Water depths across the MDZ and export cable corridor vary between approximately -2 m CD at the landfall and 72 m CD in the northwest part of the MDZ (**Figure 7-1, Volume II**) (Partrac, 2018). The average depth across the MDZ is approximately 40 m.

52. Most of the sea bed comprises large areas of outcropping bedrock with minimal relief above surrounding bed levels (**Figure 7-3, Volume II**). Secondary bathymetric features include a large, generally symmetric, sand ridge north of South Stack which extends to the northwest for approximately 1 km (within the offshore cable corridor) (**Plate 7-1**). The crest of the ridge is about 8 m to 10 m higher than the surrounding sea bed. Several smaller ridges oriented parallel to the main ridge occur to its north-northeast.

53. Within Abraham's Bosom (a bay towards the landfall), the bathymetry is smoother, representing the surface of an area of sediment on top of the bedrock, bounded by rock outcrops to the north and south.

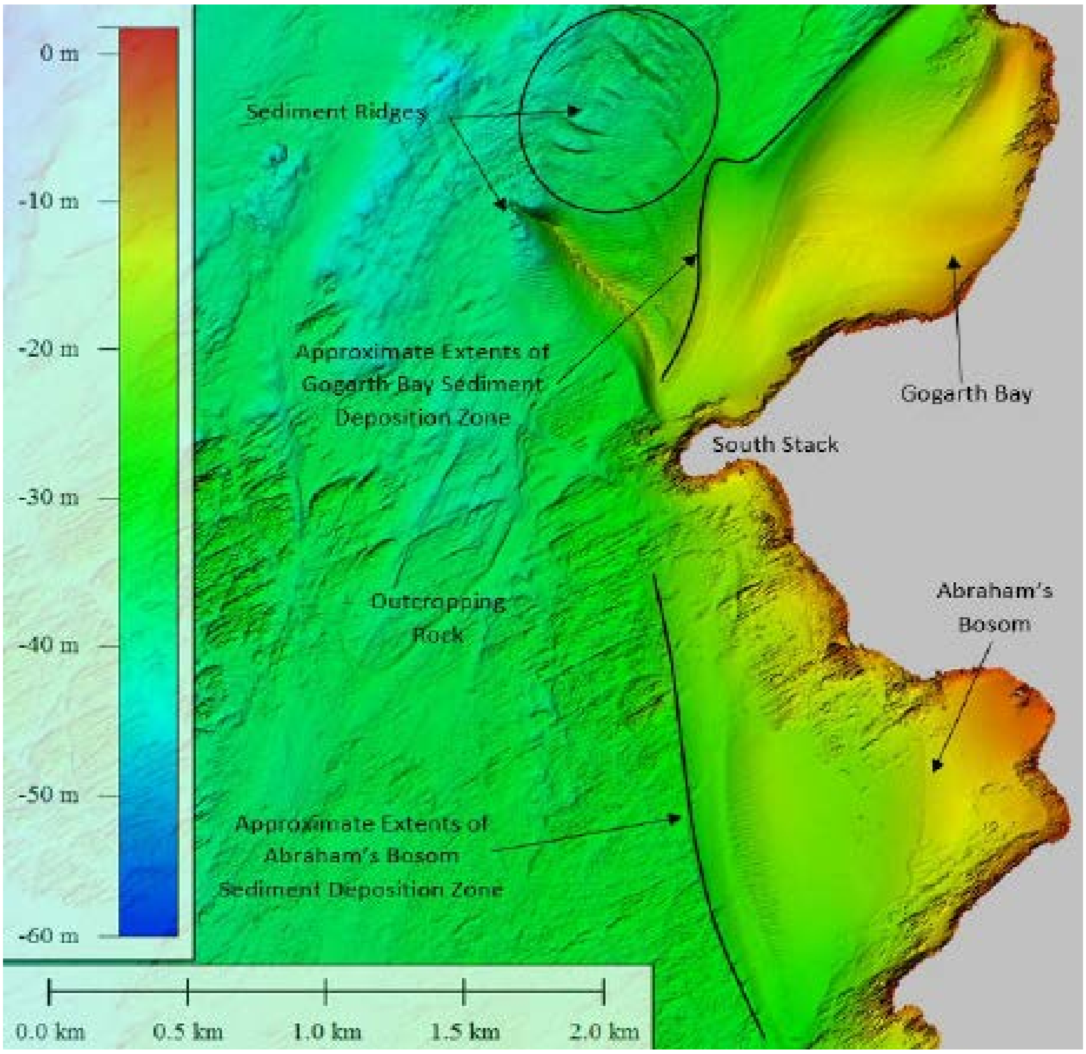

Plate 7-1 Bathymetric Features Close to Shore Within the Offshore Cable Corridor (Partrac, 2018)

54. At a more local scale the sea bed is uneven due to the presence of bedforms of various sizes. Megaripples occur close to Abraham’s Bosom within the offshore cable corridor. They are up to 0.6 m high, up to 12.8 m wavelength, with crests oriented approximately west-east, indicative of north-south tidal currents (**Plate 7-2**). Larger fields of megaripples occur in the south and southwest parts of the MDZ, where they are up to 0.6 m high, up to 12.9 m wavelength, with crests oriented approximately west-east.

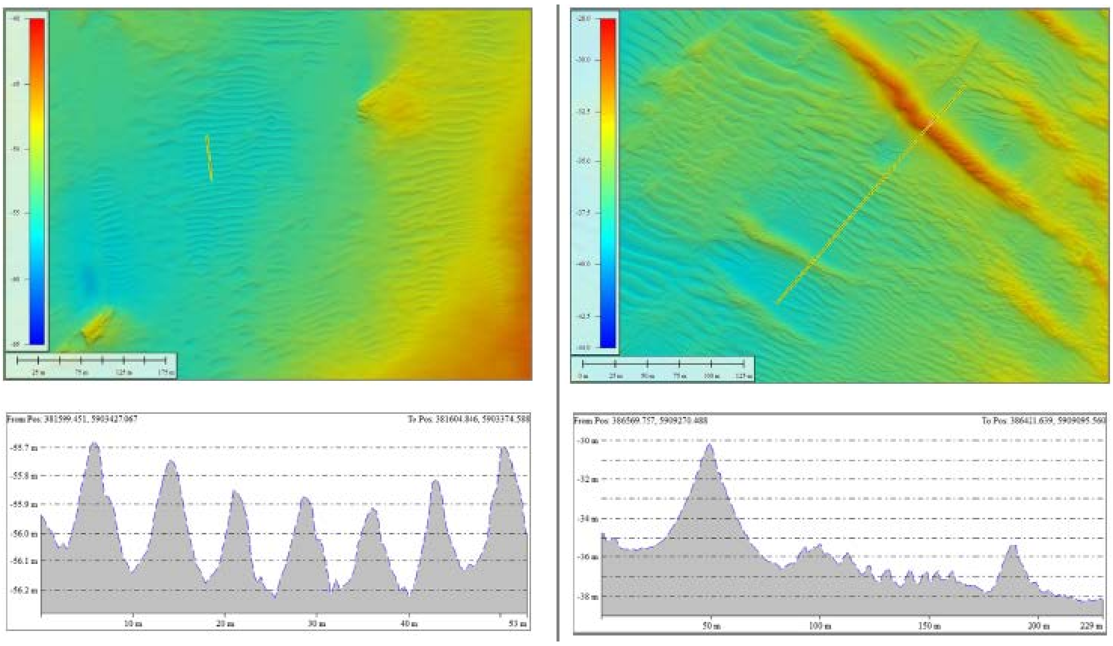

Plate 7-2 Examples of Megaripples in Deeper (left) and Shallower (right) Water

7.6.2. Offshore Geology

55. The geology of the MDZ is dominated by bedrock at, or very close to, the surface, which was not differentiated by Partrac (2018). However, it was postulated that it forms part of the Mona Complex that is exposed across Anglesey, and Holy Island specifically. The bedrock is covered with a sediment veneer composed of gravel and boulders ranging in size from 0.2 m to 1.5 m.

56. Across the west and southwest parts of the MDZ, the bedrock surface dips beneath the sea bed and is covered by undifferentiated ‘overburden’ (possibly glacial diamicton), up to 29 m thick in the southwest and up to 14 m in the west (**Plate 7-3**). Towards the shoreline and approaching Abraham’s Bosom bay, bedrock is overlain by up to 7 m of sediment and then 2 – 4 m of sediment within the bay itself (likely to be mainly sand) (**Plate 7-4**).

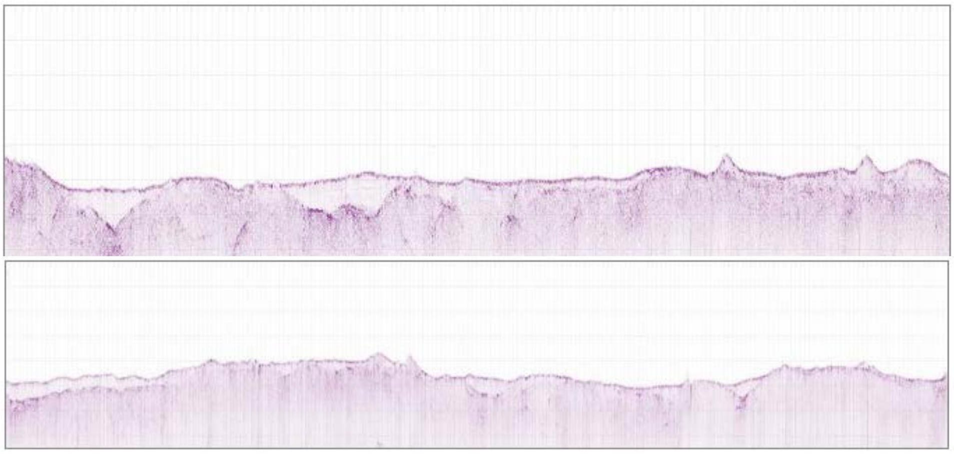

Plate 7-3 Example North-South Aligned Western MDZ and Buffer Zone Sub-Bottom Profiles Showing Overburden on Top of Bedrock (Partrac, 2018)

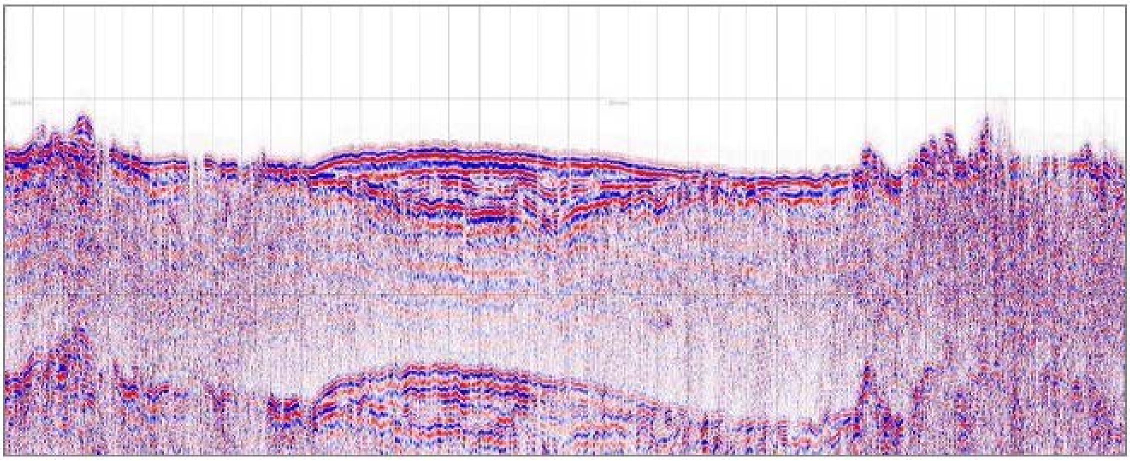

Plate 7-4 Example South (left of the image) to North (right of the image) Sub-Bottom Profile Across the Entrance to Abraham's Bosom Showing Deposition on Top of Bedrock (Partrac, 2018)

7.6.3. Tidal Water Levels

57. Tidal water levels within the MDZ are characterised by the ADCP surveys from Sites 1 and 2 in **Figure 7-4** (**Volume II**) which describe a typical spring tidal range of around 4.5 m and a typical neap tidal range of around 3.0 m (**Plate 7-5**).

58. Tidal water levels at the landfall are best represented by tidal data from the standard port of Holyhead, which are shown in **Table 7-11**. This shows a typical spring tidal range of around 4.9 m and a typical neap tidal range of around 2.4 m.

Table 7-11 Tidal Levels at Holyhead (source: Admiralty Tide Tables 2019)

Parameter	Water Level (m CD)	Water Level (m ODN)
Lowest astronomical tide (LAT)	0.00	-3.05
Mean low water springs (MLWS)	0.70	-2.35
Mean low water neaps (MLWN)	2.00	-1.05
Mean sea level (MSL)	3.30	0.25

Parameter	Water Level (m CD)	Water Level (m ODN)
Mean high water neaps (MHWN)	4.40	1.35
Mean high water springs (MHWS)	5.60	2.55
Highest astronomical tide (HAT)	6.30	3.25

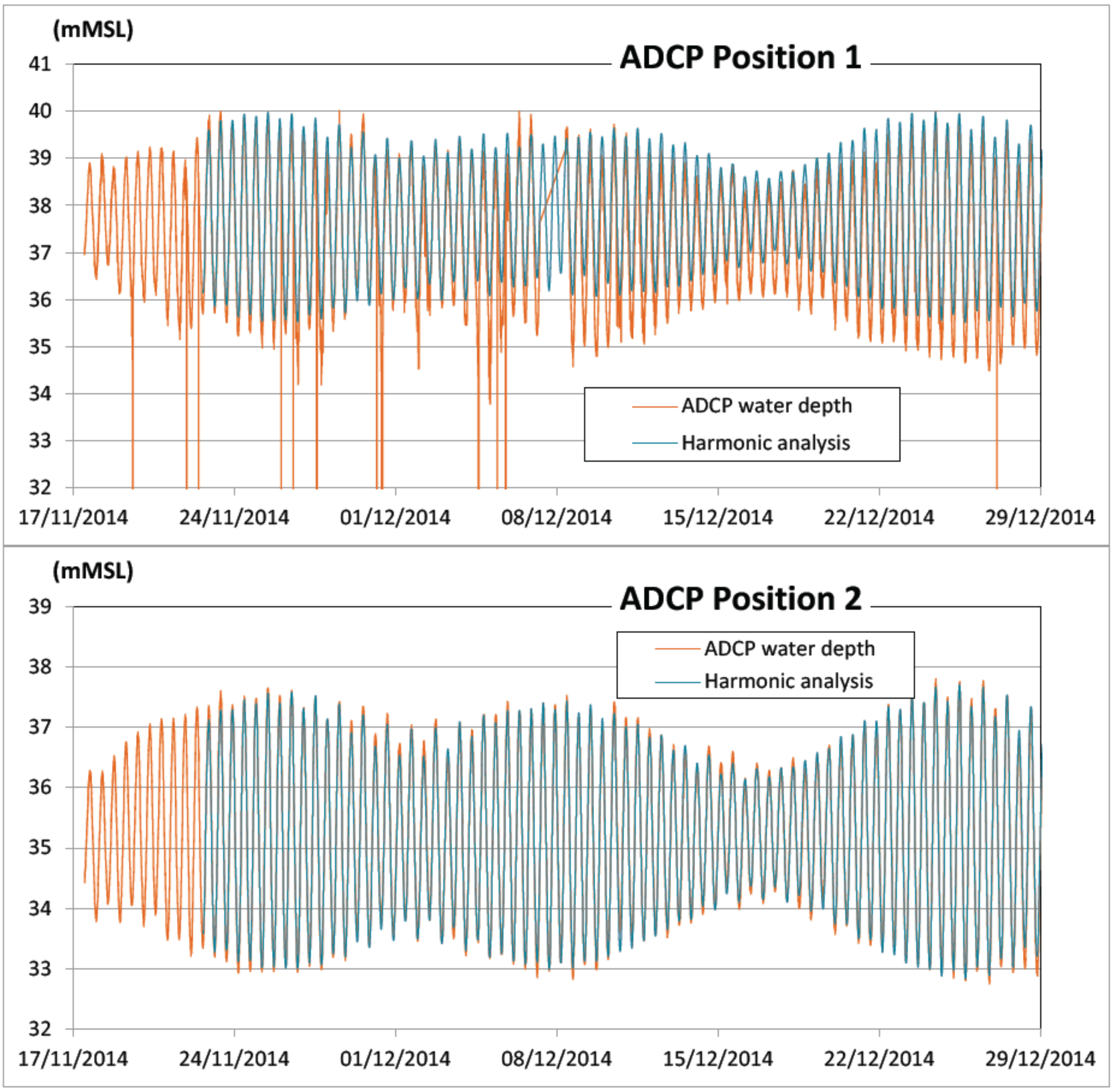

Plate 7-5 Tidal Levels at Sites 1 and 2 within the MDZ (source: HR Wallingford 2017)

7.6.3.1. Storm Surge

59. The tidal water levels described above are astronomically driven and thus are regular and predictable, but these can be elevated or supressed by meteorological events, such as storms and surges. **Table 7-12** presents the extreme sea levels that can be attained at Holyhead for different return period events due to these surge effects. The tidal currents can also become enhanced by positive storm surges, and these effects are implicit within measured tidal current data in the following section.

Table 7-12 Extreme Sea Levels at Holyhead (source: McMillan *et al.*, 2011)

Return Period of Surge Event	Level (m CD)	Level (m ODN)
1 in 1 year	0.31	3.36

Return Period of Surge Event	Level (m CD)	Level (m ODN)
1 in 10 years	0.56	3.61
1 in 50 years	0.72	3.77
1 in 100 years	0.78	3.83
1 in 200 years	0.84	3.89

7.6.4. Tidal Currents

60. Tidal currents within part of the MDZ are characterised by the ADCP surveys from Sites 1 and 2 (**Table 7-13**). These data show that current velocities at the measurement locations are slightly lower towards the sea bed due to bed-friction, but all values recorded exhibit very high baseline current speeds.

Table 7-13 Peak Tidal Currents at Sites 1 and 2 within the MDZ (source: OpenHydro, 2015)

Height above sea bed	Peak Velocities on a Mean Spring Tide Site 1 (m/s)	Peak Velocities on a Mean Spring Tide Site 2 (m/s)
10 m	2.71	2.64
15 m	2.84	2.79
20 m	2.92	2.90

61. The current roses shown in **Figure 7-4** (**Volume II**) **Plate 7-2** indicate that at both Sites 1 and 2, the baseline current velocities are strongly aligned from just east of south to north-northwest. However, further north in the MDZ, the tidal currents flow around Holy Island (to the north on a flooding tide and to the south on an ebbing tide) along a more south-north and then (with progression north) south-southwest-north-northeast axis.

62. Tidal current speeds and directions were predicted by the baseline numerical modelling undertaken by HR Wallingford (2017). **Figure 7-5** (**Volume II**) shows the peak depth-averaged flow velocities for a mean spring tide. Peak speeds are generally faster through the eastern parts of the subzones, reaching around 2.6 – 2.8 m/s in most areas, apart from the northernmost and southernmost subzones. The highest velocities within the MDZ are recorded just off Holy Island (4.0 m/s). For the western parts of the subzones, peak speeds are lower, reaching around 2.2 – 2.6 m/s.

7.6.5. Waves

63. Given the semi-enclosed nature of the Irish Sea, most oceanic swell waves are prevented from reaching the Anglesey coastline through St George’s Channel and from the north due to the shelter provided by the Isle of Man. As a result, waves arriving at the Anglesey coastline are predominantly wind generated within the Irish Sea (Royal HaskoningDHV, 2011). The fetch between Ireland and Wales is generally less than 100 km, limiting the height that waves can grow from the west. The largest fetch originates from a southwest direction, where the fetch can reach thousands of kilometres into the Atlantic Ocean.

64. Wave exposure at Holy Island is extremely variable owing to the range of coastline orientations. Most of the Anglesey coast is west facing and dominant offshore waves arrive as swell waves travelling up the Irish Sea from the south-southwest and southwest. Exposure to waves

increases towards Holy Island due to decreasing shelter provided by the Llyn Peninsula. Towards the north of the Anglesey coast, offshore waves arrive predominantly from the west and occasionally from the north to northeast.

65. The wave regime was characterised using data obtained from the Met Office at three locations northwest of the MDZ (**Figure 7-6, Volume II**). Results show the dominant offshore wave direction for all three locations is south-southwest to southwest. The wave rose from the most western point offshore (A) also shows waves from a northerly and southerly direction occurring relatively frequently. Moving eastward (B and C), these waves become less frequent due to the shelter provided by Wales to the south and the Isle of Man to the north.

66. Annual mean significant wave height (SWH) for the area is 1.26 – 1.50 m, ranging from 0.76 – 1.00 m in the summer to 1.51 – 1.75 m in the winter (ABPmer, 2008).

7.6.6. Climate Change

67. Historical data show that the global temperature has risen significantly due to anthropogenic influences since the beginning of the 20th century, and predictions are for an accelerated rise, the magnitude of which is dependent on the magnitude of future emissions of greenhouse gases and aerosols.

68. As a result of future global warming, sea-level is predicted to rise at accelerated rates. The latest available science of projected sea-level rise is available from the UK Climate Projections 2018 (UKCP18). **Table 7-14** presents projections of sea level rise to 2050 (relative to 2018) under three Representative Concentration Pathways (RCPs) (Met Office, 2018).

Table 7-14 Sea level Rise Projections to 2050 with 5th, 50th and 95th Percentile Confidence Intervals (Met Office, 2018)

Representative Concentration Pathway (RCP)	Year	UKCP18 projected increase in sea level (m relative to 2018 values)		
		5th percentile	50th percentile	95th percentile
RCP 2.6	2050	0.071	0.117	0.180
RCP 4.5	2050	0.084	0.132	0.201
RCP 8.5	2050	0.108	0.168	0.246

69. As the indicative design life of the Project is 37 years, and both onshore and offshore infrastructure is set far enough from the coast, the projected increases in sea level to 2050 will not change significantly through the design life of the Project.

70. Climate change will also affect extreme sea levels. **Table 7-15** presents projections of sea level rise to 2050 (relative to 2018) under three RCPs (Met Office, 2018).

71. Different methods were used for analysis of present-day extreme water levels and future projections under UKCP18, and the former is currently being updated by the Environment Agency with a scheduled release for the update in 2019. It is notable that the three projections of future extreme sea levels do not show marked increases relative to each other and the effects over the life of the development are modest and can be adequately accounted for in design.

Table 7-15 Extreme Sea Levels at Holyhead (source: McMillan *et al.*, 2011)

	Extreme Sea Level (mODN)			
Return Period of Surge Event	**Present Day (2018(**	**2050 (RCP2.6) (50 percentile)**	**2050 (RCP4.5) (50 percentile)**	**2050 (RCP8.5) (50 percentile)**
1 in 1 year	3.36	3.48	3.50	3.53
1 in 10 years	3.61	3.74	3.75	3.79
1 in 50 years	3.77	3.91	3.92	3.96
1 in 100 years	3.83	3.99	4.00	4.03
1 in 200 years	3.89	4.06	4.07	4.11

73. With respect to waves, climate projections from UKCP18 indicate that at Holyhead mean significant wave heights will decrease under all but one modelled scenario by between 0 – 20 % by 2100 (although under one scenario they could increase by up to 30 %). Annual maximum wave heights at Holyhead could increase or decrease by up to 20 % by 2100 depending on modelled scenario (Palmer *et al*., 2018). These results demonstrate the uncertainty inherent in projecting changes in future wave climate associated with climate change.

7.6.7. Sea Bed Sediment Distribution

7.6.7.1. MDZ

74. Partrac (2018) used side-scan sonar to provide a general overview of the sea bed sediment distribution across the MDZ. Throughout most of the northern, central and eastern parts of the MDZ the sea bed is dominated by outcropping bedrock with thin patches of sandy gravel, whereas the deeper western part comprises relatively uniform gravel or gravelly sand.

75. Only one sea bed sediment sample (location 41) was recovered from the MDZ, on its eastern boundary, northwest of South Stack (Ocean Ecology, 2018). Two samples were collected in the buffer zone, one north of South Stack (location 15) and one to the south of the MDZ (location 20). The particle size characteristics of these three samples are presented in **Plate 7-6** and **Table 7-16**. The dominant sediment type in sample 41 is gravel (73 %) with 27 % sand, with a median particle size of about 3.8 mm. In samples 15 and 20, the dominant component is sand (89-93 %) with a median particle size of 0.63 mm and 0.75 mm (both coarse sand).

Table 7-16 Particle Size Characteristics of Sea Bed Sediment Samples in the MDZ and Buffer Zone. Data from Ocean Ecology (2018)

Station	Gravel (%)	Sand (%)	Mud (%)	d_{50} (mm)
41	73	27	0	3.8
15	9	89	2	0.63
20	7	93	0	0.75

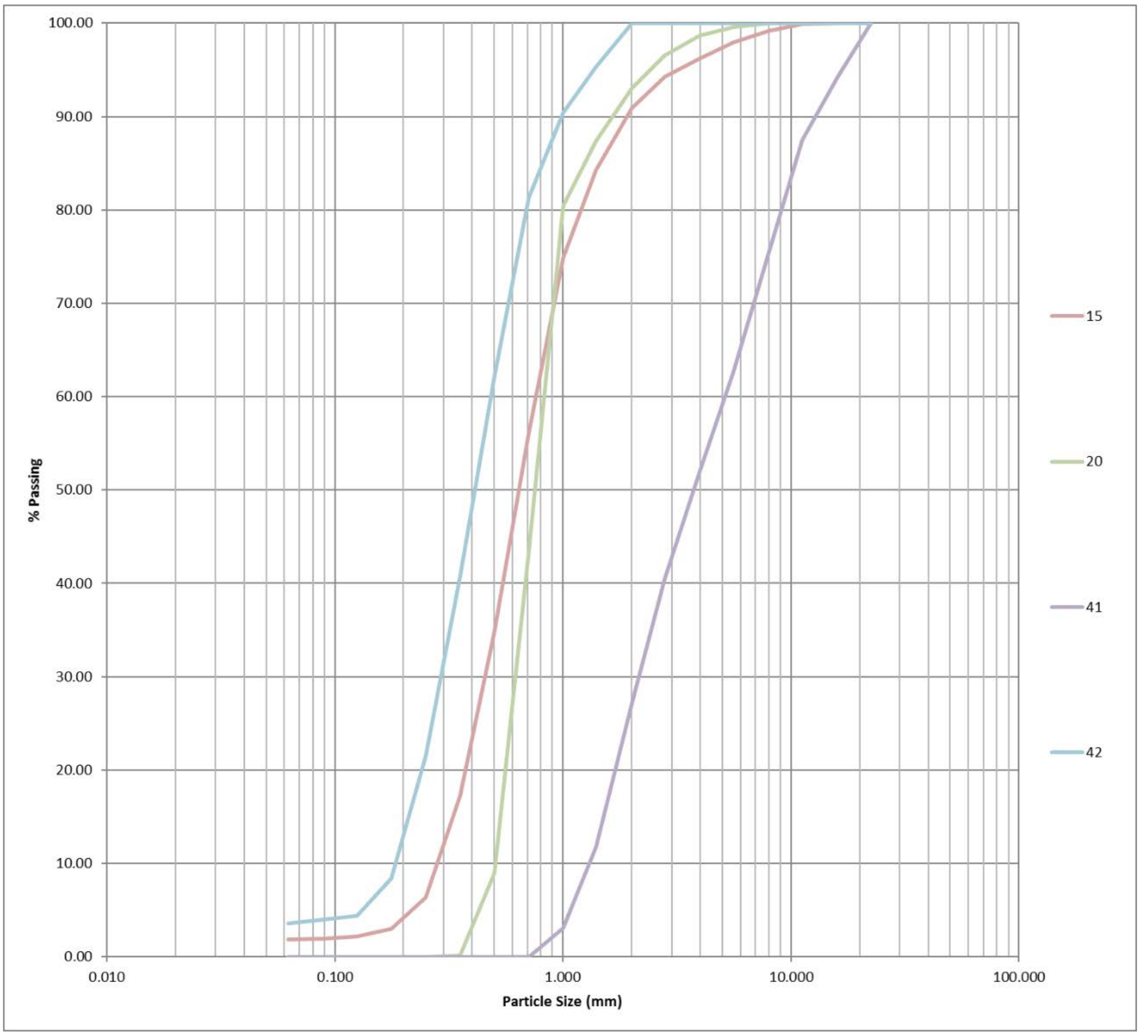

Plate 7-6 Cumulative Particle Size Distribution Curves for the Four Seabed Sediment Samples. Data from Ocean Ecology (2018)

7.6.7.2. Export Cable Corridor

76. One sample (42) was collected along the landward part of the offshore cable corridor in Abraham's Bosom (Ocean Ecology, 2018). The particle size characteristics of this sample is presented in **Plate 7-6** and **Table 7-17**. The dominant sediment size is sand (96 %) with a median particle size of about 0.41 mm (medium sand). This sample falls within the Abraham's Bosom sediment deposition zone identified by Partrac (2018) (**Plate 7-1**).

Table 7-17 Particle Size Characteristics of the Sea Bed Sediment Sample in the Offshore Cable Corridor. Data from Ocean Ecology (2018)

Station	Gravel (%)	Sand (%)	Mud (%)	d_{50} (mm)
42	0	96	4	0.41

7.6.8. Bedload Sediment Transport

77. Sediment transport pathways within the MDZ and across the offshore cable corridor have been analysed using the orientation and asymmetry of bedforms. The orientation of sand ridges and megaripples indicate that gross sediment transport is to the north and south to the south of South Stack and then bends to the northeast and southwest to the north of South Stack. The

size and shape of the bedforms makes it difficult to determine a long-term net transport direction as they are generally symmetric and change their geometry on different states of the tide (Partrac, 2018).

78. Previous studies show that regional sediment transport is north to northeast (BGS, 2005). Littoral drift is very weak because of shoaling within bays and diffraction around headlands along the Anglesey coastline and so sediment is contained within pockets between headlands (Royal HaskoningDHV, 2011). If longshore currents exist, they usually decrease as they transport sediment towards one side of the bay, as the beach rotates to face incoming waves (Royal HaskoningDHV, 2011).

7.6.9. Suspended Sediment Transport

79. Measurements of suspended sediment concentration were carried out generally across the Irish Sea during June and November 1997, and April and September 1998 at a total of 85 stations. Overall, suspended sediment concentrations were between 2.55 and 23 mg/l over the period (**Table 7-18**), although concentrations varied seasonally (Bowers *et al*., 2002).

Table 7-18 Concentration of Total Suspended Solids (mg/l) in the Irish Sea 1997 - 1998

	Min	Max	Mean
June 1997, 16 stations	3.73	14.18	6.57
November 1997, 17 stations	2.55	20.38	9.82
April 1998, 26 stations	3.30	23.00	10.27
September 1998, 26 stations	2.76	17.18	5.70

80. More specific to the sea bed off Anglesey, several authors have described an Anglesey Turbidity Maximum (ATM) based on observations from space (Simpson and Brown, 1987; Weeks and Simpson, 1991; Bowers *et al*., 1998) and ships (Mitchelson, 1984; Weeks, 1989, Bowers *et al*., 2002). This is an isolated area of enhanced turbidity that is geographically fixed and present all year, although more strongly marked in winter.

81. The position of the maximum coincides with the area of high tidal currents off the northwest coast of Anglesey and its continued presence has been described as “a puzzle” (Bowers *et al*., 2005). Indeed, the phenomenon is not easy reproduced by models and there is no obvious source of sediment, since the local (and surrounding) sea bed is largely comprised of bare rock with occasional boulders. Despite being defined by authors as a “turbidity maximum”, it is only defined in this context because suspended sediment concentrations are of the order of 2 – 3 times those of the surrounding sea bed (i.e. it is a maximum *relative* to surrounding areas). In *absolute* terms, suspended sediment concentrations remain very low, reaching about 5 mg/l in summer and 10 – 15 mg/l in winter. Beyond the ATM, background suspended sediment concentrations are about 3 – 4 mg/l (Ellis *et al*., 2008).

7.6.10. Geology and Coastal Processes at the Landfall

82. The geology of the landfall comprises steep cliffs and shore platforms composed of bedded turbiditic sandstones and mudstones of the Cambrian-Ordovician South Stack Formation (of the Holy Island Group) overlain by a thin layer Quaternary diamicton (**Plate 7-7**). The bay is studded

with very small pocket beaches in enclosed sub-bays composed of shingle and occasional areas of sand (Ocean Ecology, 2018) (**Plate 7-8**).

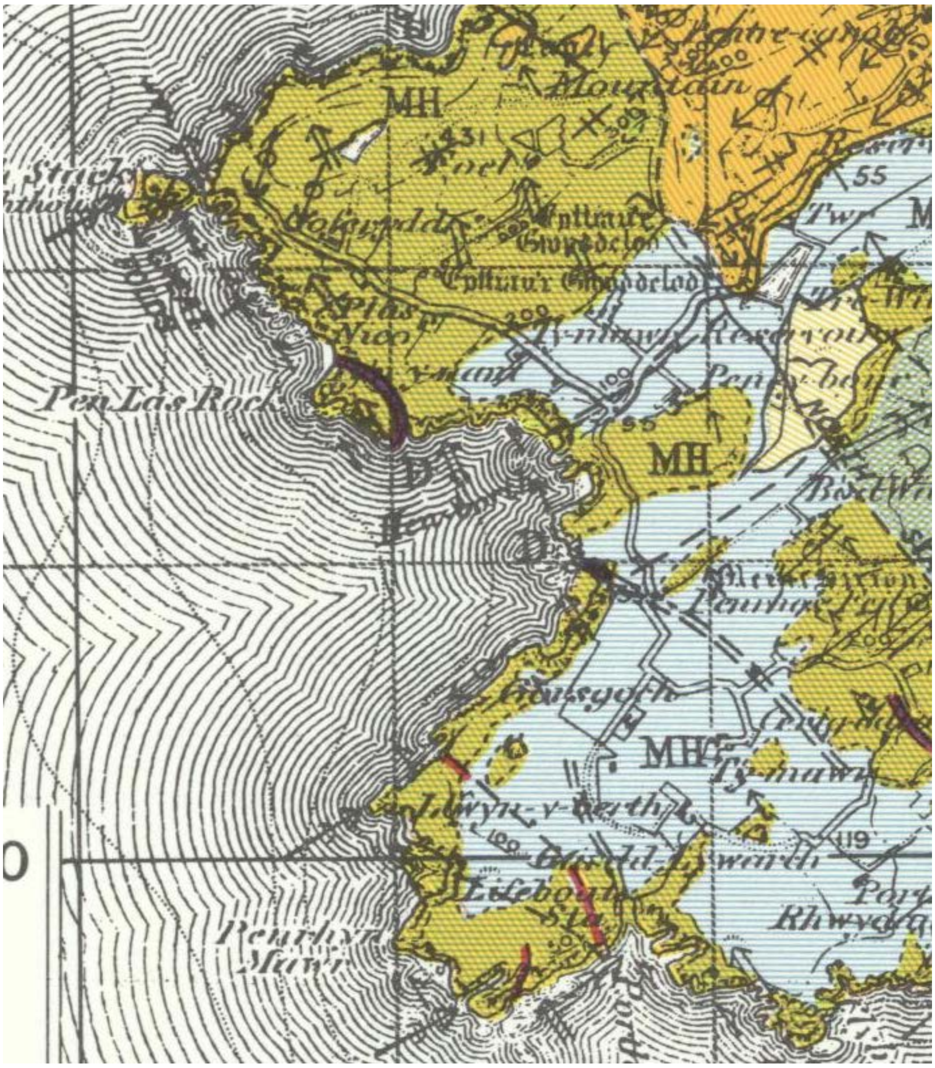

Plate 7-7 Bedrock and Quaternary Geology of the Landfall (British Geological Survey, 1974)

Plate 7-8 Photos of the cable landfall point at Abraham's Bosom (Partrac, 2018)

83. Although the west coast of Holy Island is exposed to significant wave action from the southwest, the strength of the cliffs (Cambrian-Ordovician rocks) at the landfall means that they are subject to only minor erosion.

7.7. POTENTIAL IMPACTS AND EFFECTS

7.7.1. Impact Receptors

84. The principal receptors with respect to metocean conditions and coastal processes are those features with an inherent geological or geomorphological value or function which may potentially be affected by the Project. Protected sites that could be potentially impacted by the Project include national SSSIs which underpin international SACs and Special Protection Areas (SPAs) along the coast of Holy Island. The Holy Island coast is also a Heritage Coast and part of the larger Anglesey AONB. No marine designations are within the boundaries of the Project or within a metocean or coastal processes impact pathway.

85. The potential impacts on metocean conditions and coastal processes are considered for three receptors. The specific features defined within these receptors as requiring assessment are listed in **Table 7-19** and shown in **Figure 7-7** (**Volume II**).

Table 7-19 Metocean and Coastal Processes Receptors Relevant to the Project

Receptor (Plate 7-1)	Extent of coverage	Description of features	Distance from the Project
Holy Island Coast SSSI / SAC	Holyhead West Breakwater to Cymyran Bay	Vegetated sea cliffs	Designation covers cable landfall point
Anglesey AONB	Holyhead Mountain to Cymyran Bay	Cliffs, coves and gravel beaches	Designation covers cable landfall point
Holyhead Mountain Heritage Coast	Holyhead Mountain to Cymyran Bay	Cliffs, coves and gravel beaches	Designation covers cable landfall point

86. This section assesses the significance of potential impacts on the wave and/or current and/or sediment transport regimes on the receptor groups.

7.7.1.1. Holy Island Coast SSSI / SAC

87. The west coast of Holy Island including the landfall is composed of rock cliffs which support important examples of coastal cliff heathland vegetation. In addition to maritime heath, there are extensive maritime cliff-crevice and grassland communities.

7.7.1.2. Anglesey AONB

88. The main features of the Anglesey AONB are undeveloped cliffs (including North and South Stack) alternating with coves and gravel beaches (many within Abraham's Bosom bay and the landfall).

7.7.1.3. Holyhead Mountain Heritage Coast

89. The AONB designation is supported by the non-statutory designation of the Holyhead Mountain Heritage Coast.

7.7.2. Effects

90. In addition to the receptor groups listed in **Table 7-19** there are other potential changes (effects) to metocean conditions and coastal processes associated with the Project which may manifest themselves as impacts upon a wider grouping of receptors. These include marine sediment and water quality, benthic and intertidal ecology, fish and shellfish ecology, offshore archaeology and commercial fisheries.

91. In respect of these effects, the assessment only defines the magnitude of change in metocean conditions or coastal processes. The assessments of the significance of impacts arising from these effects or changes on other receptors are made within the relevant chapters of this ES pertaining directly to those receptor types (**Chapter 8, Marine Water and Sediment Quality**, **Chapter 9, Benthic and Intertidal Ecology**, **Chapter 10, Fish and Shellfish Ecology**, **Chapter 13, Offshore Archaeology** and **Chapter 14, Commercial Fisheries**).

7.7.3. Mitigation Measures

7.7.3.1. Embedded Mitigation

92. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the Project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process.

93. A range of different information sources has been considered as part of embedding mitigation into the design of the Project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

94. The embedded mitigation relevant to metocean conditions and coastal processes includes;

- Devices within the MDZ will be spaced appropriately to minimise the energy loss between adjacent rows. This also has the added advantage of causing least potential impact on the baseline tidal current regime.
- So far as other constraints (for example, Chapter 24, Chapter Seascape, Landscape and Visual Impact Assessment) allow, devices within the MDZ are most likely to be placed towards the eastern part of the MDZ, where the baseline tidal currents are higher. This means that any suspended sediment effects will be more rapidly and more widely dispersed than if devices were to be placed towards the west of the MDZ.

7.7.3.2. Additional Mitigation Measures

95. An outline Construction Environmental Management Plan (CEMP) (**Document MOR/RHDHV/DOC/0073**) and outline Pollution Prevention and Management Plan (PPMP) (**MOR/RHDHV/DOC/0077**) will be submitted with the TWAO application and Marine Licence application. The development of the detailed design will refine the worst-case impacts assessed in this EIA. It is recognised that construction mitigation is an important element in the management and verification of the actual Project impacts. The outline CEMP and PPMP would be agreed with NRW prior to construction works commencing.

7.7.4. Worst-Case Scenarios

96. The offshore project area consists of the offshore cable corridor with landfall at Penrhos Feilw and the Project within the MDZ. Their detailed designs (including numbers of devices, layout configuration, requirement for scour protection etc.) will not be determined until after the TWAO has been determined. Therefore, realistic worst-case scenarios in terms of potential impacts/effects on metocean conditions and coastal processes are adopted to undertake a precautionary and robust impact assessment. The realistic worst-case scenarios used are described in the sections below.

97. To achieve the maximum 240 MW export capacity, there would be up to 620 devices, supporting up to 1,648 Tidal Energy Convertors (TECS) and up to 740 inter-array cables within the MDZ. This represents the worst case scenario as outlined in **Chapter 4, Project Description**. In addition, numerous electrical hubs that aggregate the power to transmit along the offshore cable are considered as part of the worst-case scenario, as well as navigation marker buoys, environmental monitoring platforms and ADCPs, all of which will also interact with the seabed. The hubs could include a combination of fully submerged sea bed mounted (up to 120), floating (up to 93) and sea bed mounted and surface emergent (up to eight).

98. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50% of the tenants will undertake repowering, i.e. for 50% of the tenants, their infrastructure will be removed and replaced (potentially with different infrastructure by a different tenant). For the other 50% of tenants, their infrastructure will remain over the lifetime of the project.

99. In terms of impact assessment parameters, the repowering process has been defined as per below:

- Initial temporary seabed disturbance via deployment of barge anchors to remove foundations, TEC's, hubs, inter-array cables and monitoring equipment for 50% of the Tenants (berths); and
- Further temporary seabed disturbance via re-installation (repowering) of foundations, TEC's, hubs, inter-array cables and monitoring equipment for the same 50% of Tenants (berths).

100. The export cables and export cable tails would not be removed as part of the repowering phase

101. As the repowering phase will involve both the removal and installation of infrastructure, the types of effects on metocean conditions and coastal processes would be analogous to those identified for the construction and decommissioning phase and therefore is considered within **Section 7.7.5** and **Section 7.7.7**, where relevant. However, note that repowering will occur during the 37-year operation of the Project.

7.7.4.1. Foundations

102. Within the Project, several different types of foundation types for the devices and hubs are being considered, as described in **Chapter 4, Project Description**, these include:

- Monopiles or jacket (on pin piles): the piling method would be dependent on the nature of the sea bed. Although piles can be hammered into soft sea bed types using percussive piling, such an approach is not appropriate in areas of predominantly hard sea bed such as the MDZ. In such locations rock sockets may be pre-drilled and grouted pin piles, or screw piles may be used to anchor the foundation;
- Gravity base structures (GBS): if piling and drilling into hard sea bed types would be technically challenging, there is also the potential for gravity base structures to be used. These would consist of bases (concrete, steel or iron) attached to a jacket foundation, acting as feet on the jacket structure);
- Catenary floating devices: catenary moorings may require up to four gravity anchors. These anchors tend to weigh in the region of 300 tonnes. Mooring lines are attached to the anchors to hold the device support structure in place. Gravity foundations for larger floating platforms may be up to 2000 tonnes in weight, with a footprint of up to 312 m^2; and
- Tension floating devices: a tensile mooring system may be used to reduce movement. These are typically deployed using four anchor points and kept under tension, as opposed to the catenary mooring system which is not held under tension.

103. Due to the high energy dynamic environment of the MDZ, with associated limited superficial sediment cover on the sea bed, it is assumed that the need for scour protection will be minimal.

104. The layout of the tidal devices would be defined post consent but would be based on deployed capacity of up to 240 MW plus hubs. The total number of devices within the MDZ will be dependent on the individual generating capacity of the devices being installed. The site may be divided into eight subzones, with the zones allowing the demarcation of different technology types.

7.7.4.2. Cable Installation

7.7.4.2.1. Inter-Array and Offshore Cables

105. Inter-array cables would link individual devices within an array to a singular point (hubs), where output from all the devices is collected prior to exporting via the offshore cable. Up to 204.5 km of inter-array cables may be installed on the sea bed. Individual inter-array cables would be up to 2.5 km long with a total sea bed footprint of up to 30, 040 m^2 (including rock bag cable protection).

106. Up 40.5 km of offshore cables will be installed, one from each of the tidal arrays in each sub-zone (not including inter-array cables). The location of the offshore cable corridor is shown on **Figure 1-1** (**Volume II)**. Individual offshore cables would be between 1.2 km and 6 km long with a total sea bed footprint of about 11,745 m^2 (including split-pipe cable protection).

7.7.4.2.2. Cable Protection

107. Cables would be free laid with protection at locations along their lengths. For most of their length, no trenching will be required, although it is possible that some post-installation jetting may be needed to bury the cable across the sand wave feature in the northern half of the cable corridor.

108. The following cable protection options may be used and this would be determined during the final design of the Project:

- Rock (bags) placement - the laying of rocks on top of the cable; and
- Concrete mattresses - prefabricated flexible concrete coverings that are laid on top of the cable. The placement of mattresses is slow and as such is only used for short sections of cable.

109. It is assumed on a worst-case scenario that up to 270 individual rock bags or concrete mattresses (18 m^2 each) could be used on the export cables. This is additional to the split-pipe protection referenced in **Section 7.7.4.2.1** above.

7.7.4.2.3. Cable Burial

110. There is a significant sand wave feature located in the northern half of the offshore cable corridor. It is likely that cables will be installed over this after which an as-laid survey would be completed to identify any areas where the cable is in suspension to target any necessary remedial work at that time. The sand wave can be reduced using a mass flow excavator or dredger. The spatial extent of the sandwave covers an estimated 27,258 m^2.

7.7.4.2.4. Boulder Clearance

111. Pre-construction surveys will identify any requirement for boulder clearance within the offshore project area. Boulder clearance would involve localised relocation of boulders which would have no overall impact on metocean and coastal processes and is therefore not considered further.

7.7.4.2.5. Pre-lay Grapnel Run

112. A pre-lay grapnel run would be undertaken to clear any identified debris in advance of each phase of installation. The maximum width of sea bed disturbance along the pre-grapnel run would be 20 m. This is encompassed by the maximum footprint of cable installation works associated with ploughing (30 m disturbance width).

7.7.4.3. Landfall

113. The offshore cable landfall would be at Penrhos Feilw using either Horizontal Directional Drilling (HDD) (preferred) or use of ducts or J-tubes pinned to the cliff and/or laid in a shallow trench or slot.

114. A HDD landfall would comprise the following components:

- Up to nine cable tails each up to 620 m long at the landfall;
- Up to nine separate drills, each up to 550 m long;
- Separation of 20 m between HDD exit points; and
- Total drill cuttings volume of up to 900 m^3 for HDD alone (total amount for all nine drills).

115. A trenched landfall would comprise the following components:

- Up to nine cable tails each up to 620 m long at the landfall;

- Up to nine separate shallow trenches (with slots within the cliff face) from the intertidal zone to the transition pits, each up to 740 m long;
- Individual trench width would be up to 600 mm with approximately 0.5 m separation distances or a single trench approximately 10 m wide and 0.5 m to 1.2 m deep, with all nine cables laid within it;
- Total material removed would be approximately 8,880 m^3. The majority would be replaced to backfill the trench after the ducts / cables have been installed; and
- Duct or split pipe over 370 m to 550 m of each cable, up to 350 mm external diameter.

7.7.4.4. Construction Programme

116. The construction of offshore works (for installation of tidal devices and associated cabling and infrastructure) would be phased over a period of several years, taking up to 15 days per device or hub and up to 1.5 days for each inter-array cable, up to 20 days for each offshore cable, and up to 12 days for each phase of cable protection. Up to nine separate cable laying and protection campaigns are possible. **Table 7-20** provides an indicative construction programme for the Project.

Table 7-20 Worst-Case Project Construction Programme Based on 240 MW Deployment

Indicative Programme	Approximate Duration (per event)	Approximate Duration (full 240 MW capacity)
Foundations and devices (including drilling of up to 3 days per device – maximum of 596 devices[2])	15 days	4,306 days
Hub installation vessel days (per hub – 120 hubs)	15 days	1,800 days
Inter-array cable vessel days (per cable – 740 cables)	1.5 days	1,110 days
Export cables vessel days (per cable – 9 cables)	20 days	180 days
Export cable Protection (per cable – 9 cables)	12 days	108 days

7.7.4.5. Operations and Maintenance

7.7.4.5.1. Devices

117. Regular maintenance of the devices will be required during operation. These works will have minimal impact on metocean conditions and coastal processes. However, the placement of anchors or jack-up vessels during maintenance activity has been considered to provide a comprehensive assessment. A maximum average of two turbine locations per day, visited by a jack-up vessel has been assessed, to cover 15 inspections of each device annually (for both planned and unplanned maintenance activities).

7.7.4.5.2. Cable Repairs

118. It is expected that once installed, the ongoing offshore operations for the offshore cables would be limited to inspection (through survey) and maintenance of the cables and ancillaries. It is

[2] Based on a worst-case installation scenario of a full 240 MW deployment of pin-piled anchors

anticipated that up to ten major cable repairs (five days each) may be required throughout the Project life. It is assumed that up to 750 m of cable would be subject to repair works per event (7,500 m in total). These will involve the same type of sea bed disturbance as experienced during the main cable installation phase. However, any such disturbance would be more temporally and spatially limited. Annual inspections will be carried out for the first three years, reducing to two years thereafter.

119. In most cases a cable failure would lead to the following operation:

- Vessel anchor placement;
- Cutting the cable;
- Lifting the cable ends to the repair vessel;
- Jointing a new segment of cable to the old cable; and
- Lowering the cable (and joints) back to the sea bed.

7.7.4.6. Summary

120. **Table 7-21** describes the relevant worst-case scenarios for metocean conditions and coastal processes.

Table 7-21 Summary of Worst-Case Scenarios for the Project

Impact	Parameter	Worst-case	Rationale
Construction and Repowering			
Changes in suspended sediment concentrations due to foundation installation in the Project	Sediment plume created by foundation installation	Monopiles / jackets with pin piles	Greatest volume of disturbed/released sediment
Changes in sea bed level (morphology) due to deposition during foundation installation in the Project	Sediment deposited from the plume created by foundation installation	Monopiles / jackets with pin piles	Greatest morphological change would be associated with greatest volume of disturbed/released sediment
Changes in suspended sediment concentrations during offshore export cable installation (including nearshore) (construction only)	Sediment plume created by offshore export cable installation	Placement of up to 40.5 km of cable and cable protection at locations along the length, plus post-installation jetting to bury offshore cable across the sand ridge feature in the northern half of the cable corridor	Greatest volume of disturbed/released sediment
Changes in sea bed level due to offshore export cable installation (construction only)	Changes in sea bed level due to deposition from the suspended sediment plume created during offshore export cable installation	Placement of up to 40.5 km of cable and cable protection at locations along the length plus levelling of sand ridge in northern half of the cable corridor	Greatest morphological change

Impact	Parameter	Worst-case	Rationale
Changes in suspended sediment concentrations during inter-array cable installation	Sediment plume created by inter-array cable installation	Placement of up to 204.5 km cable and cable protection at locations along the length	Greatest volume of disturbed/released sediment
Changes in sea bed level due to inter-array cable installation	Sediment deposited from plume created by inter-array cable installation	Placement of up to 204.5 km cable and cable protection at locations along the length	Greatest morphological change would be associated with greatest volume of disturbed/released sediment
Changes in sea bed level (morphology) due to indentations during installation in the Project	Indentations on the sea bed due to the physical presence of installation vessels	Jack-up and anchor footprints	Greatest morphological change would be associated with vessels working around turbines for foundation installation
Operation and Maintenance			
Changes to the tidal regime due to the presence of structures in the Project	Changes to tidal currents created by the presence of devices and hubs	Envelope covering 240 no. 1 MW devices to 620 no. smaller (0.3-0.5 MW) devices	Maximum 240 MW capacity
Changes to the wave regime due to the presence of structures in the Project	Changes to waves created by the presence of devices and hubs	GBS foundations	Of all foundation types being considered, GBS would have the greatest physical blockage effect on the baseline wave regime
Changes to the sediment transport regime due to the presence of structures in the Project	Sediment plume and changes to bedload sediment transport created by the presence of devices and hubs	GBS foundations supporting an envelope covering 240 no. 1 MW devices to 620 no. smaller (0.3-0.5 MW) devices	The greatest changes to the sediment transport regime would be caused by the greatest changes to the tidal regime and/or the greatest changes to the wave regime
Loss of sea bed morphology due to the footprint of structures in the Project	Sea bed morphology	Total footprint of 129,932 m^2	This includes the worst-case scenario of GBS foundations, drill arisings, export cable footprint (cables and protection systems), array cable footprint, additional cable protection material, cable tails, footprint of navigation marker buoys and footprint of ADCP moorings
Morphological and sediment transport effects due to cable protection measures for offshore export cables (including nearshore and at the coastal landfall)	Sea bed morphology and sediment transport along offshore cables	Total footprint of 11,745 m^2 Placement of free laid cable and rock bags and/or concrete mattresses	Greatest footprint from offshore export cables and cable protection

Impact	Parameter	Worst-case	Rationale
Morphological and sediment transport effects due to cable protection measures for inter-array cables	Sea bed morphology and sediment transport along inter-array cables	Total footprint of 30,040 m^2 Placement of free laid cable and rock bags and/or concrete mattresses	Greatest footprint from inter-array cables and cable protection
Changes in sea bed level (morphology) due to maintenance during maintenance in the Project	Cable repairs and maintenance vessel footprints	Turbine maintenance – jack-up and anchor footprints from a maximum two turbine locations visited per day Cable repairs – a maximum of ten cable repairs (five days each)	Greatest morphological change would be associated with vessels working around turbines for foundation maintenance and for repairs of cables
Decommissioning and Repowering			
Changes in suspended sediment concentrations due to device and hub removal	Suspended sediment concentrations	GBS removal	Greatest volume of disturbed/released sediment would be with removal of GBS since monopiles/pin piles would be cut-off at sea bed level
Changes in sea bed level due to device and hub removal	Sea bed morphology	GBS removal	Greatest morphological change would be associated with greatest volume of disturbed/released sediment
Changes in suspended sediment concentrations during offshore export cable removal (including nearshore and at the coastal landfall) (decommissioning only)	Suspended sediment concentrations	Removal of up to 204.5 km of cable and cable protection at locations along the length	Greatest volume of disturbed/released sediment (compared to leaving *in situ*)
Changes in sea bed levels due to removal of the offshore export cables (decommissioning only)	Sea bed morphology	Removal of up to 204.5 km of cable and cable protection at locations along the length	Greatest morphological change would be associated with greatest volume of disturbed/released sediment (compared to leaving *in situ*)
Changes in suspended sediment concentrations during removal of parts of the inter-array cables	Suspended sediment concentrations	Removal of up to 40.5 km of cable and cable protection at locations along the length	Greatest volume of disturbed/released sediment (compared to leaving *in situ*)
Changes in sea bed levels due to removal of parts of the inter-array cables	Sea bed morphology	Removal of up to 40.5 km of cable and cable protection at locations along the length	Greatest morphological change would be associated with greatest volume of disturbed/released sediment (compared to leaving *in situ*)

Impact	Parameter	Worst-case	Rationale
Changes in sea bed level (morphology) due to indentations during decommissioning in the Project	Indentations on the sea bed due to the physical presence of decommissioning vessels	Jack-up and anchor footprints	Greatest morphological change would be associated with vessels working around turbines for foundation removal

7.7.5. Potential Impacts During Construction and Repowering

7.7.5.1. Impact 1: Changes in Suspended Sediment Concentrations During Foundation Installation in the Project

121. During the construction phase there is potential for foundation installation activities within the Project to disturb sediments, either from the sea bed surface or from below the sea bed (depending on foundation type) and release them into the water column as a plume. This will enhance the baseline suspended sediment concentrations in the water column, making it more turbid, until the plume becomes dispersed by tidal current action and the sediments settle once again on the sea bed.

122. The principal causes of disturbance during foundation installation would be:

- Preparatory works for foundation installation, including boulder clearance;
- Placement of bed-mounted GBS foundations on the sea bed;
- Installation of anchor points for floating systems; and
- Pre-drilling of rock sockets for piled foundations (e.g. monopiles or pin piles).

123. Throughout the MDZ, there is a paucity of surface sediment, with tide-swept bedrock prevailing. Where sediment does exist in these areas, it is sparse, and predominantly gravel, cobbles and rock boulders, which are not particle sizes that can be suspended in the water column and therefore will not form part of a sediment plume even if disturbed during construction.

124. Due to the above, any release of sediments from pre-drilling below the sea bed is of greater potential significance. This would be associated with the installation of monopile or pin pile (for jacket) foundations that may be required for the Project. This has been considered as the worst-case scenario for this impact.

125. In practice, the pre-drilling work required for foundations will progress sequentially over time (rather than being instantaneous). Therefore, the realistic worst-case scenario is sediment release from one foundation location at a time. Under this scenario, any plume that is generated would disperse well before the potential exists for its coalescence with plumes from adjacent (or any other) pre-drill locations.

126. The total volume of sediment released from pre-drilling for monopile or pin pile installation would be extremely small (1,020 m^3 per foundation). From experience of other schemes, this is likely to result in peak increases in suspended sediment concentration at the points of release within the Project being only a few mg/l (typically less than 10 mg/l) and peak values at only a short distance from each release point reducing rapidly to less than 1 mg/l. This low (barely measurable) effect is partly due to the low volume of sediment released from drilling at the

location of each release point, and partly because any fine material released would be rapidly dispersed by the strong tidal currents along the axis of tidal flow.

127. The maximum envisaged effect associated with sediment plumes arising from the foundation installation activities will cause only very minor enhancements in suspended sediment concentration (typically less than 1 mg/l a short distance from the release point) over only a small geographical area (a few hundred metres). The effects will be temporary, with a return to very low background concentrations occurring rapidly upon cessation of installation activities (i.e. the effect is temporary only). Other than at the immediate release point, such a change would be immeasurable. Based on this qualitative assessment the likely magnitudes of effect are shown in **Table 7-21**.

Table 7-22 Magnitude of Effects on Suspended Sediment Concentrations During Foundation Installation

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Low	Negligible	Negligible	Negligible	Negligible
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

128. Changes in the suspended sediment concentrations arising from foundation installation do not directly impact on the identified geomorphological receptors *per se* but are important to consider because they inform subsequent assessment of impacts arising from any sediment deposition associated with the plume (see Impact 2, **Section 7.7.5.2**). There is no physical pathway that links the source of the impact to the beaches and sea cliffs before the plume is diminished. Hence, there is **no change** to these identified shoreline geomorphological receptors. There is a direct physical pathway that links the source of the impact to the offshore sand ridge in the north of the MDZ, but plume effects are **negligible** near this sea bed geomorphological receptor.

129. These changes in suspended sediment concentrations arising from foundation installation are also important to consider in the assessment of impacts on marine water quality (see **Chapter 8, Marine Water and Sediment Quality**), benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.5.1.1. Mitigation

130. There is no suggested mitigation.

7.7.5.1.2. Residual Impact

131. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.5.2. Impact 2: Changes in Sea Bed Level (Morphology) Due to Deposition During Foundation Installation in the Project

132. Any sediment that becomes entrained within the plume generated by foundation installation will have the potential to deposit on the sea bed at some distance from its point of release, as it settles through the water column. Similar to Impact 1 (**Section 7.7.5.1**), the greatest potential

effect would arise from the release of sediment into the water column from pre-drilling for monopile installation.

133. Based upon a realistic worst-case of sediment release from a single monopile at a time, the sediment deposition on the sea bed will be extremely small in thickness. From experience of similar schemes, it is envisaged that in the immediate vicinity of the release point, deposition depths of no more than 0.1 m will be observed. These sediments are then highly likely to become re-entrained by currents during the peak velocities of the following tide and transported further away in small concentrations.

134. Further away from the release point, the deposition of sediments would extend over a similar zone of influence to that of the sediment plume (i.e. within a few hundred metres of each release point, following the axis of the tidal current flow), but the thickness of deposits would be extremely small, typically millimetres. In such a highly dynamic tidal area, this would be an immeasurable change.

135. As sediment plumes and sediment deposition will be governed by the axis of the tidal flows, there is limited potential for the sediment deposited from different turbine locations to coalesce and remain on the sea bed in any measurable magnitude within this area of strong tidal currents. Rather, deposited sediments would be very quickly re-suspended and redistributed across a wide area in low (immeasurable) quantities. Based on this qualitative assessment the likely magnitudes of effect are shown in **Table 7-22**.

Table 7-23 Magnitude of Effects On Sea Bed Levels Due to Sediment Deposition Associated with Foundation Installation

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Low	Negligible	Negligible	Negligible	Negligible
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

136. There is no physical pathway that links the source of the impact arising from foundation installation to the beaches and sea cliffs and therefore there is **no change** to these identified shoreline geomorphological receptors. However, there is a direct physical pathway that links the source of the impact arising from foundation installation to the offshore sand ridge in the north of the MDZ, but deposition effects are **negligible** near this sea bed geomorphological receptor.

137. Changes in sea bed level due to sediment deposition arising from foundation installation are also important to consider in the assessment of impacts on benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.5.2.1. Mitigation

138. There is no suggested mitigation.

7.7.5.2.2. Residual Impact

139. The residual impact on the identified shoreline geomorphological receptors (beaches and sea cliffs) remains **no change** and on the identified sea bed geomorphological receptor (offshore sand ridge) remains **negligible**.

7.7.5.3. Impact 3: Changes in Suspended Sediment Concentrations During Offshore Export Cable Installation (including Nearshore and Landfall)

140. During the construction phase only, there is potential for offshore export cable installation activities within the cable corridor (including the nearshore and landfall) to disturb sediments and release them into the water column as a plume. This will enhance the baseline suspended sediment concentrations in the water column, making it more turbid, until the plume becomes dispersed by tidal current action and the sediments settle once again on the sea bed.

141. The principal causes of sediment disturbance during offshore cable installation would be:

- Free-laying of up to 40.5 km of offshore export cable on the sea bed;
- Placement of cable protection (rock bags of concrete mattresses) at specific locations along the cable length; and
- Post-installation jetting to bury offshore cable across the sand ridge feature in the northern half of the cable corridor.

142. The offshore parts of the cable corridor are mostly governed by large areas of outcropping bedrock, with minimal relief and only sparse sediment cover, predominantly gravel, cobbles and rock boulders. However, the northern part of the cable corridor is covered by a sand ridge north of South Stack headland and extending northwest for around 1 km. This is where post-lay jetting may be required to bury the offshore cable, which would cause some sea bed sediment disturbance.

143. Nearer to the landfall, Abraham's Bosom is a bay bounded by rock headlands to the north and south, with a cover of sediment overlying bedrock. The grab sample from this location recovered medium-grained sand. Just offshore of the bay is a patch of megaripples (up to 0.6 m high).

144. The free-laying of cables and the placement of cable protection would not cause plumes along the offshore sections of the cable corridor because the sea bed is characterised by bedrock or, where sparse sediment cover does exist, by sediments with a particle size that cannot be suspended in the water column. In the nearshore, the bedrock is overlain by sand which has the potential to be disturbed by the free-laying of cables and the placement of cable protection. However, any plume arising from these activities would only arise from the force of the cable or protection measures on the sea bed.

145. At the landfall, the worst-case scenario would be open trenching rather than the preferred option of HDD. Under open trenching, up to 7,440 m^3 of sand would be excavated and the majority replaced to backfill the trench, with only a small net loss to the inshore system. Due to these factors, the likely increase in suspended sediment concentration in areas with sand cover nearer to shore (including at the landfall) will remain within the bounds of natural behaviour that are governed by storm waves and surge effects. Furthermore, these effects will be one-off and temporary in duration and are unlikely to be measurable.

146. The principal effect would arise from the post-installation jetting to bury the offshore cable across the sand ridge feature in the northern half of the cable corridor. Under this activity, it is likely that the maximum envisaged effect associated with sediment plumes arising from the jetting will cause only modest (but measurable) increases in suspended sediment concentration locally (typically a few tens of mg/l above background levels). This increase would reduce rapidly with distance from the point of disturbance to a few mg/l over a small geographical area (within a few hundred metres, along the axis of tidal currents). Furthermore, these effects will be one-off and temporary in duration, with a return to the very low background concentrations occurring rapidly upon cessation of installation. Based on this qualitative assessment the likely magnitudes of effect are shown in **Table 7-24**.

147. Changes in the suspended sediment concentration do not directly impact on the identified geomorphological receptors *per se* but are important to consider because they inform subsequent assessment of impacts arising from any sediment deposition associated with the plume (see Construction Impact 4). There is a direct physical pathway that potentially links the source of the impact (arising at the landfall) to the beaches and sea cliffs before the plume is diminished, but plume effects are **negligible** near these geomorphological receptors. There is also a direct physical pathway that potentially links the source of the impact (arising in the offshore part of the cable corridor) to the offshore sand ridge, but plume effects are **low** near this geomorphological receptor.

Table 7-24 Magnitude of Effects on Suspended Sediment Concentrations During Offshore Cable and Cable Protection Installation

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Low (sand ridge) to Negligible (elsewhere)
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

148. These changes in suspended sediment concentration arising from offshore cable installation are also important to consider in the assessment of impacts on marine water quality (see **Chapter 8, Marine Water and Sediment Quality**), benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.5.3.1. Mitigation

149. There is no suggested mitigation.

7.7.5.3.2. Residual Impact

150. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.5.4. Impact 4: Changes in Sea Bed Level Due to Offshore Cable Installation (including Nearshore and Landfall)

151. Any sediment that becomes entrained within the plume generated by offshore cable installation (Impact 3, **Section 7.7.5.3**) during the construction phase only will have the potential to become deposited on the sea bed at some distance from its point of release as it settles through the water column. Similar to the plume effects, the greatest potential depositional effects would be associated with the post-installation jetting to bury the offshore cable across the sand ridge feature in the northern part of the cable corridor. Other depositional effects (e.g. sediment disturbed from the free-laying of cables or the placement of cable protection on the sea bed) will remain within the bounds of natural behaviour that are governed by storm waves and surge effects, with construction phase effects being one-off and temporary in duration, and unlikely to be measurable.

152. From experience of similar schemes, it is envisaged that in the immediate vicinity of the post-lay jetting through the sand ridge, deposition depths of no more than 0.1 m will be observed. These are highly likely to become re-entrained by currents during the peak velocities of the following tide and transported further away in small concentrations.

153. Further away from the immediate vicinity of the post-lay jetting, the deposition of sediments would extend over a similar zone of influence to that of the sediment plume (i.e. within a few hundred metres of each release point, following the axis of the tidal current flow). Within a short distance from the release points the thickness of deposits will be extremely small, typically millimetres. In this highly dynamic tidal area, this is effectively an immeasurable change. Based on this qualitative assessment the likely magnitudes of effect are shown in **Table 7-25**.

Table 7-25 Magnitude of Effects on Sea Bed Levels Due to Sediment Deposition Associated with Offshore Cable and Cable Protection Installation

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Negligible
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

154. There is a direct physical pathway that potentially links the source of the impact (arising at the landfall) to the beaches and sea cliffs, but effects on sea bed and beach levels are **negligible** for these geomorphological receptors. There is also a direct physical pathway that potentially links the source of the impact (arising in the offshore part of the cable corridor) to the offshore sand ridge, but effects on sea bed levels are **negligible** for this geomorphological receptor.

155. Changes in sea bed level due to sediment deposition arising from foundation installation are also important to consider in the assessment of impacts on benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.5.4.1. Mitigation

156. There is no suggested mitigation.

7.7.5.4.2. Residual Impact

157. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.5.5. Impact 5: Changes in Suspended Sediment Concentrations During Inter-Array Cable Installation

158. During the construction phase there is potential for inter-array cable installation activities within the Project to disturb sediments and release them into the water column as a plume. This would enhance the baseline suspended sediment concentrations in the water column, making it more turbid, until the plume becomes dispersed by tidal current action and the sediments settle once again on the sea bed.

159. The principal causes of sediment disturbance during inter-array cable installation would be:

- Free-laying of up to 204.5 km of inter-array cable on the sea bed; and
- Placement of cable protection (rock bags of concrete mattresses) at specific locations along the cable length.

160. The substrate across the Project is mostly large areas of outcropping bedrock, with minimal relief and only sparse sediment cover, predominantly gravel, cobbles and rock boulders. Only in the south and southwest of the Project does the sea bed have any sediment that could potentially be affected by inter-array cable or cable protection installation, where megaripples are present with heights up to 0.6 m.

161. The free-laying of inter-array cables and the placement of cable protection would not cause plumes to be created in most areas of the Project because these areas are characterised by bedrock or, where sparse sediment cover does exist, by sediments which have particle sizes that cannot be suspended in the water column. In the areas with megaripples, plumes may locally and temporarily arise from these activities, but only due to the impact force of the cable or protection measures on the sea bed. Hence, the likely increases in suspended sediment concentration in areas with megaripples would remain within the bounds of natural behaviour that are governed by storm waves and surge effects. Furthermore, these construction-related effects will be one-off and temporary in duration and are unlikely to be measurable. Based on this qualitative assessment the likely magnitudes of effect are shown in **Table 7-26**.

Table 7-26 Magnitude of Effects on Suspended Sediment Concentrations During Inter-Array Cable and Cable Protection Installation

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

162. Changes in the suspended sediment concentrations do not directly impact on the identified geomorphological receptors *per se* but are important to consider because they inform subsequent assessment of impacts arising from any sediment deposition associated with the plume (Impact 6, **Section 7.7.5.6**). There is no direct physical pathway that potentially links the source of the impact to the beaches and sea cliffs before the plume is diminished, and so there

is **no change** in these shoreline geomorphological receptors. There is a direct physical pathway that potentially links the source of the impact (arising in parts of the Project) to the offshore sand ridge, but plume effects are **negligible** near this geomorphological receptor.

163. These changes in suspended sediment concentration arising from inter-array cable installation are also important to consider in the assessment of impacts on marine water quality (see **Chapter 8, Marine Water and Sediment Quality**), benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.5.5.1. Mitigation

164. There is no suggested mitigation.

7.7.5.5.2. Residual Impact

165. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.5.6. Impact 6: Changes in Sea Bed Level Due to Inter-Array Cable Installation

166. Any sediment that becomes entrained within a plume generated by inter-array cable installation or placement of cable protection (Impact 5, **Section 7.7.5.5**) will have the potential to become deposited on the sea bed at some distance from its point of release as it settles through the water column. However, these depositional effects will remain within the bounds of natural behaviour, with construction phase effects being one-off and temporary in duration and unlikely to be measurable.

167. The deposition of sediments arising from plumes associated with inter-array cable installation or cable protection would likely be immeasurable. Based on this qualitative assessment the likely magnitudes of effect are shown in **Table 7-27**.

Table 7-27 Magnitude of Effects on Sea Bed Levels Due to Sediment Deposition Associated with Inter-Array Cable and Cable Protection Installation

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

168. There is no physical pathway that links the source of the impact arising from inter-array cable installation to the beaches and sea cliffs and therefore there is **no change** to these identified shoreline geomorphological receptors. However, there is a direct physical pathway that potentially links the source of the impact (arising in the offshore part of the cable corridor) to the offshore sand ridge, but effects on sea bed levels are **negligible** for this geomorphological receptor.

169. Changes in sea bed level due to sediment deposition arising from inter-array installation are also important to consider in the assessment of impacts on benthic and intertidal ecology (see

Chapter 9, Benthic and Intertidal Ecology), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.5.6.1. Mitigation

170. There is no suggested mitigation.

7.7.5.6.2. Residual Impact

171. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.5.7. Construction Impact 7: Changes in Sea Bed Level Due to Indentations During Installation in the Project

172. During the construction phase, specialist vessels will be used for installation activities. While these are present at the site, their jack-up legs or anchors will exert influences in the form of scars or indentations on the sea bed morphology.

173. Due to the predominance of exposed bedrock on the sea bed, with occasional gravel cobbles and boulders, the legs / anchors of the vessels will not cause significant effects. In areas where a sand ridge is present (in the north of the Project) or where megaripples are present (in the south and southwest of the Project), there will be local effects on the sand surface. However, due to the high tidal energy environment across these areas, any depressions are likely to become rapidly re-worked after the legs / anchors are removed. Furthermore, at each location these effects will be highly localised, one-off and temporary in duration. Based on this qualitative assessment the likely magnitudes of effect are shown in **Table 7-28**.

Table 7-28 Magnitude of Effects on Sea Bed Levels Due to Indentations During Installation

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
Far-field	No effect	Negligible	Negligible	Negligible	Negligible

174. There are no areas where the legs / anchors of vessels are likely to affect the beaches and cliffs and therefore there is **no change** in the shoreline geomorphological receptors. Changes in sea bed level due to indentations during installation activities are **negligible** for the sea bed geomorphological receptor.

175. Changes in sea bed level due to indentations during installation are also important to consider in the assessment of impacts on benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.5.7.1. Mitigation

176. There is no suggested mitigation.

7.7.5.7.2. Residual Impact

177. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.6. Potential Impacts During Operation

7.7.6.1. Impact 1: Changes to the Tidal Regime Due to Presence of Structures in the Project

178. Once installed within the MDZ, tidal devices have the intention of affecting the baseline tidal regime due to the extraction of energy from the tidal currents. This will result in the formation of wakes within the hydrodynamic current flow arising from each tidal device within the Project. The overall effect will be to (mainly) pacify the existing tidal regime downstream of the tidal devices, when compared to the pre-existing (baseline) situation, recognising that the location of this wake will change along the axis of tidal flow depending on the stage of the tide. Wake effects have been visually observed at the water surface on previous tidal device deployments (e.g. SeaGen deployment in Strangford Lough, Northern Ireland). There could also be some (less significant) local increases in current speed between the wakes of adjacent tidal devices and/or around some of the foundations or support structures within the site.

179. The changes caused by the tidal devices and their foundations or support structures could lead to a modification of the tidal regime downstream of an individual tidal device (device scale), downstream of a sub-zone occupied by a small array of tidal devices (near-field scale) or across the whole demonstration site and beyond (far-field scale).

180. To investigate this issue, numerical modelling has been used to determine the changes in the baseline tidal regime arising from the worst-case scenario. The modelling was undertaken principally to assess the effects of tidal energy resource extraction on the levels of resource available to adjacent projects within the MDZ. The results are also of direct relevance to this chapter of the ES in terms of the effects on the baseline tidal regime within the demonstration site, across surrounding sea bed areas and at the adjacent shoreline.

181. A very high resolution 2D finite element model was set-up, calibrated and run to simulate the effects on the baseline tidal regime. The modelling considered ‘generic turbine rotor characteristics’ as follows:

- 20 rotor diameter turbines
- 4.5D spacings (along e-w alignment)
- Mid-depth in water column
- Each device rated 595kW electrical power

182. This rating of device yielded four scenarios, using the indicative subzones shown in **Figure 4-4** (**Volume II**):

- Scenario 1 – 60 MW total capacity, with a total of 102 turbines within the MDZ (17 no. turbines installed in each of subzones 2 – 6 and 8);
- Scenario 2 – 120 MW total capacity, with a total of 204 turbines within the MDZ (34 no. turbines installed in each of subzones 2 – 6 and 8);

- Scenario 3 – 180 MW total capacity, with a total of 306 turbines within the MDZ (51 no. turbines installed in each of subzones 2 – 6 and 8); and
- Scenario 4 – 240 MW total capacity, with a total of 408 turbines[3] within the MDZ (17 no. turbines installed in each of subzones 1 – 8) (**Plate 7-9**).

183. As this is a demonstration site with a wide Project Design Envelope, there will potentially be a vast number of different (presently unknown) layouts, types and ratings of device in reality selected from within the Project Description. It is not possible or proportionate to model each and every permutation, so instead the modelling approach was to assess the effects from an indicative array, to provide insight into potential scale of effects from various scales of deployment. It used a generic exemplar that was considered to be representative of extent and magnitude effects on physical processes.

184. If in reality a larger number of devices (up to 620) was used than has been modelled, then those devices will be of smaller rating and therefore of smaller physical size. Thus, they would each have a smaller individual effect than has been modelled, so the array-scale effects from the modelled scenario would likely be conservative.

185. For deployment of arrays, the MDZ may be spilt into a series of subzones, with the zones allowing the demarcation of different technology types. Eight indicative subzones within the MDZ are shown in **Plate 7-9**, however, these indicative zones may be modified to meet the requirements of tenants and regulators.

186. Since the precise configuration, type and characteristics of the tidal devices to be deployed within each sub-zone of the MDZ will not be known until a later date, generic turbine characteristics, dimensions, power curves and thrust curves were used in the assessments, together with a specific configuration of the multiple arrays of tidal stream devices within the MDZ focused on optimising deployments within locations of greatest baseline tidal current flows. This involved simulation of effects from devices with 20 m rotor diameters, placed at 4.5D spacings (east to west within each row) and located at mid-depth in the water column. Successive rows were spaced 333 m apart with turbines staggered by 2.25D in an east-west direction between rows. The model was run for a 44-day simulation period covering a complete lunar cycle. Further details of the numerical modelling set-up, calibration and runs are provided in **Appendix 7.1** (**Volume III**).

187. Results from the modelling of all four scenarios show that the greatest changes in baseline tidal currents occur at the peak of the flood flow or the peak of the ebb flow, with changes being greater on a mean spring tide than on a mean neap tide.

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[3] *Even though worst-case no. of TECs stated in earlier sections was 620, the max. total of 408 TEC's used in Scenario 4 were worst-case for this specific assessment. The modelling used an indicative array, to provide insight into potential scale of effects from various scales of deployment. It used a generic exemplar that was considered to be potentially most impactful representative of effects on physical processes. Development of the project description continued after the modelling.*

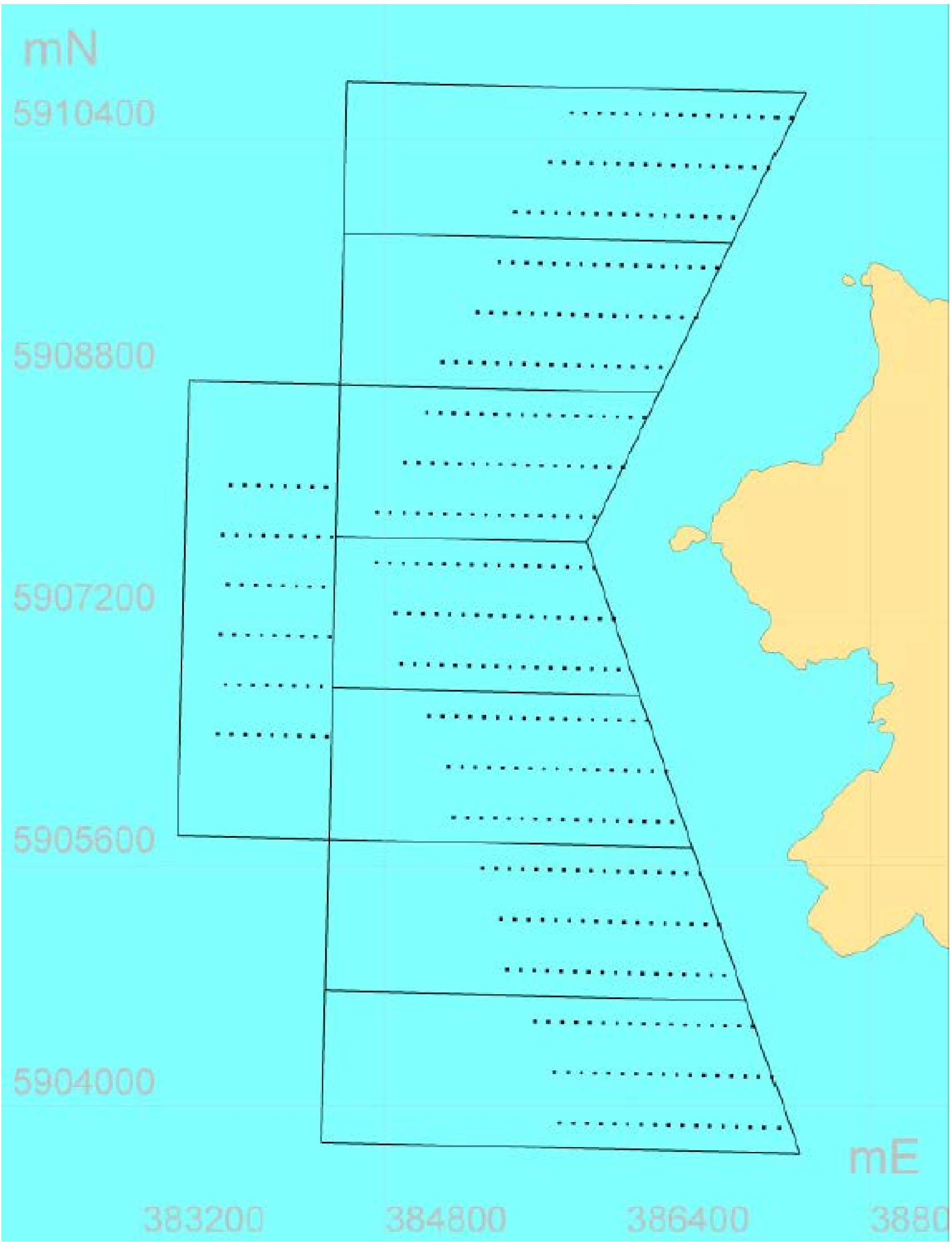

Plate 7-9 Arrays of Tidal Devices Across All Eight Subzones of the MDZ for the 240MW Worst Case Model Run

7.7.6.1.1. Scenario 1 (60 MW Capacity, 102 Turbines) - Peak Flood Flow on a Mean Spring Tide

188. **Figure 7-8 (Volume II**) shows that reductions of up to 0.3 – 0.4 m/s in baseline current speeds are predicted locally across small areas in the easternmost parts of subzones 1, 2 and 3 within the MDZ under peak flood flow on a mean spring tide. However, typically the reductions are in the range 0.1 – 0.3 m/s within around two-thirds of subzones 1 and 2 (entire central and eastern parts) and a smaller area within sub-zone 3 (typically in part of the eastern side). The changes in baseline tidal regime extend beyond the northern limits of the MDZ, following the axis of the baseline tidal currents as they flow northeast around Holy Island.

189. The remainder of subzones 1 and 2 (i.e. western parts) show no change in baseline conditions. Elsewhere, the wakes (with reductions in flow typically of 0.1 – 0.2 m/s) are locally focused around individual turbines within subzones 3 (western and central parts), 4, 5, 6 and 8, with no change in sub-zone 7 (which has no turbines present under this scenario).

7.7.6.1.2. Scenario 1 (60 MW Capacity, 102 Turbines) - Peak Ebb Flow on a Mean Spring Tide

190. **Figure 7-9** (**Volume II**) shows predicted reductions of up to 0.2 – 0.3 m/s in baseline current speeds across the central parts of subzones 6 and 7 under peak ebb flow on a mean spring tide. However, typically the reductions are in the range 0.1 – 0.2 m/s across large portions of subzones 4, 5, 6, 7 and 8, with changes in baseline tidal regime of this magnitude also extending beyond the southern limit of the MDZ, following the axis of the baseline tidal currents as they flow towards the south-southeast.

191. More confined wakes (with reductions in flow of 0.1 – 0.2 m/s) are predicted in subzones 2 and 3 with no change in sub-zone 1 (which has no turbines present under this scenario).

7.7.6.1.3. Scenario 2 (120 MW Capacity, 204 Turbines) - Peak Flood Flow on a Mean Spring Tide

192. **Figure 7-10 (Volume II**) shows that reductions of up to 0.6 – 0.7 m/s in baseline current speeds are predicted locally within subzones 1 and 2. However, more typically the peak changes in the eastern half of these subzones, and extending a small distance into sub-zone 3, are in the range 0.4 – 0.6 m/s. Reductions of up to 0.5 m/s also extend beyond the northern limits of the MDZ, following the axis of the baseline tidal currents towards the northeast.

193. Over the central parts of subzones 1 and 2 and the eastern part of sub-zone 3, the reductions are typically in the range 0.1 – 0.4 m/s with this zone of effect also extending beyond the northern limits of the MDZ, towards the northeast around Holy Island and approaching closer to shore off the north coast of Holy Island.

194. The central parts of subzones 3, 4 and 5 and the central northern segment of sub-zone 8 have reductions in flow of 0.1 – 0.2 m/s. In sub-zone 6, the wakes are confined to individual devices (with local reductions up to 0.1 – 0.2 m/s) whilst there is no change in sub-zone 7 (which has no turbines present under this scenario).

7.7.6.1.4. Scenario 2 (120 MW Capacity, 204 Turbines) - Peak Ebb Flow on a Mean Spring Tide

195. **Figure 7-11 (Volume II**) shows that reductions of up to 0.5 – 0.6 m/s in baseline current speeds are predicted locally across the central part of sub-zone 6. However, typically the peak reductions across the central parts of subzones 5, 6 and 7, extending slightly south of the southern limit of the MDZ, are in the range 0.4 – 0.5 m/s. Changes in tidal currents of around 0.1 – 0.3 m/s are also experienced offshore from Abraham’s Bosom.

196. Large parts of subzones 2, 3 and 8, as well as most of subzones 4, 5, 6 and 7 show reductions in baseline flow of 0.1 – 0.4 m/s. A zone of effect of this magnitude also extends south of the southern boundary of the MDZ by up to 5 km.

197. Sub-zone 1 (which has no turbines present under this scenario) is predicted to show no change in baseline conditions.

7.7.6.1.5. Scenario 3 (180 MW Capacity, 306 Turbines) - Peak Flood Flow on a Mean Spring Tide

198. **Figure 7-12** (**Volume II**) shows that reductions in baseline tidal currents of up to 0.8 m/s are predicted to occur across the eastern side of sub-zone 1 (and a small part of sub-zone 2), with reductions up to 0.6 m/s common throughout the central and eastern parts of subzones 1 and 2 and the eastern part of sub-zone 3. Effects of this magnitude also extend around 1 km to the northeast of the northern boundary of the MDZ, before diminishing to reductions of around between 0.1 – 0.4 m/s for a further 3.5 km to the northeast along the axis of baseline flood flows. Changes in tidal currents of around 0.1 – 0.3 m/s are also experienced closer to shore off the north coast of Holy Island.

199. Elsewhere within the MDZ, the reductions are typically in the range 0.1 – 0.4 m/s throughout significant areas of indicative subzones 3, 4, 5, 6 and the northern parts of 8.

200. Sub-zone 7 (which has no turbines present under this scenario) is predicted to show no change in baseline conditions.

7.7.6.1.6. Scenario 3 (180 MW Capacity, 306 Turbines) - Peak Ebb Flow on a Mean Spring Tide

201. **Figure 7-13** (**Volume II**) shows that peak reductions in baseline tidal currents of up to 0.8 m/s occur only locally, within sub-zone 6, but reductions between 0.4 – 0.7 m/s are predicted more commonly throughout the central and eastern parts of subzones 4 (part), 5, 6 and 7. Effects of this magnitude also extend around 750 m to the southeast of the southern boundary of the MDZ, before diminishing to reductions of around between 0.1 – 0.4 m/s for a further approximately 3.5 km to the southeast along the axis of baseline flood flows. Changes in tidal currents of around 0.1 – 0.4 m/s are also predicted offshore from Abraham’s Bosom.

202. Elsewhere within the MDZ, the reductions in current velocity are typically in the range 0.1 – 0.4 m/s throughout significant areas of subzones 2 and 3, and the western parts of subzones 4, 5, 6 and 7, as well as the southern and central parts of sub-zone 8.

203. Sub-zone 1 (which has no turbines present under this scenario) shows no change in baseline conditions.

7.7.6.1.7. Scenario 4 (240 MW Capacity, 408 Turbines) - Peak Flood Flow on a Mean Spring Tide

204. **Figure 7-14** (**Volume II**) shows that reductions in baseline tidal currents of up to 0.8 m/s are predicted to occur across the entire eastern side of sub-zone 1 (and a small part of the sub-zone 2), extending around 1 km to the northeast of the northern boundary of the MDZ.

205. Elsewhere, predicted peak reductions in current velocity are 0.6 – 0.7 m/s across much of sub-zone 2, reducing to 0.5 – 0.6 m/s across much of sub-zone 3 and part of sub-zone 4, and reducing further to 0.4 – 0.5 m/s across central parts of sub-zone 5. The zone of effect of this magnitude beyond the northern limit if the MDZ extends for a distance of about 3 km northeast of the northern boundary. Changes in tidal currents of around 0.1 – 0.4 m/s are also predicted approaching closer to shore off the north coast of Holy Island.

206. The wake effects are also observed across central and eastern parts of subzones 6 and 7, the northern central part of sub-zone 8, and extending 2.5 km to the northeast of the MDZ, but at a lower magnitude of change, typically 0.1 – 0.4 m/s.

7.7.6.1.8. Scenario 4 (240 MW Capacity, 408 Turbines) - Peak Ebb Flow on a Mean Spring Tide

207. **Figure 7-15** (**Volume II**) shows that predicted peak reductions in baseline tidal currents of up to 0.8 m/s occur only locally, within subzones 6 and 7, but reductions between 0.4 – 0.7 m/s are predicted more commonly throughout the central and eastern parts of subzones 4, 5, 6 and 7. Effects of this predicted magnitude also extend around 1 km to the southeast of the southern boundary of the MDZ, before diminishing to reductions of around 0.1 – 0.2 m/s for a further 4 km to the south-southeast along the axis of baseline flood flows. Changes in tidal currents of around 0.1 – 0.3 m/s are also predicted offshore from Abraham's Bosom.

208. Elsewhere within the MDZ, the predicted reductions are typically 0.1 – 0.4 m/s throughout significant areas of subzones 2 and 3, and westernmost parts of subzones 4, 5, 6 and 7, as well as the southern and central parts of sub-zone 8.

209. Sub-zone 1 (which does have turbines present under this scenario) shows predicted reductions of up to 0.1 – 0.3 m/s, over only a small area.

7.7.6.1.9. Summary

210. Overall, the modelling results show that there is a predicted increase in the effect on baseline tidal conditions with increasing capacity of the arrays within the subzones of the MDZ. The effects occur: (i) local to individual devices; (ii) from one array to another array within the MDZ; and (iii) from the MDZ to surrounding areas of sea bed.

211. The zone of influence of effect tends to follow the axes of baseline tidal flows, extending northeast beyond the MDZ on a flood tide and south-southeast beyond the MDZ on an ebb tide.

212. However, in even the worst-cases, the magnitude of reduction in tidal current flow (up to 0.8 m/s) results in a residual current flow of high speeds, because the baseline flow conditions in these most affected areas are typically greater than 2 m/s.

213. Based on the qualitative and quantitative modelling assessments the likely magnitudes of effect are shown in **Table 7-29**.

Table 7-29 Magnitude of Effects on Tidal Regime Due to the Presence of Structures in the Project

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Device	Medium	High	Medium	Negligible	Medium
Near-field	Low - Medium	High	Medium	Negligible	Low - Medium
Far-field	Negligible	High	Medium	Negligible	Negligible

214. Changes in the tidal regime do not directly impact on the identified geomorphological receptors *per se* but are important to consider because they inform subsequent assessment of effects arising from any changes to sediment erosion or deposition associated with the changes in tidal regime (see Operational Impact 3).

215. As there is no physical pathway that links the source of the impact to the beaches and sea cliffs before the wake effect on the tidal velocities is back to baseline, there is **no change** to these identified shoreline geomorphological receptors. There is a direct physical pathway that links the source of the impact to the offshore sand ridge in the north of the MDZ, and the magnitude of changes in the tidal regime are **low - medium** near this sea bed geomorphological receptor.

7.7.6.1.10. Mitigation

216. There is no recommended further mitigation.

7.7.6.1.11. Residual Impact

217. The magnitude of change in tidal regime at the shoreline receptor remains **no change** and at the sea bed receptor remains at **low – medium** change.

7.7.6.2. Impact 2: Changes to the Wave Regime Due to Presence of Structures in the Project

218. Once installed within the MDZ, tidal devices and their associated foundations or support structures will have the potential to affect the baseline wave regime. This would be most notable for devices with foundations/support structures that occupy the greatest height within the water column and present the greatest cross-sectional area as a solid mass, causing the greatest potential for blockage.

219. The changes caused by the tidal devices and their foundations or support structures could lead to a modification of the wave regime downstream of an individual tidal device and its foundation or support structure (device scale), downstream of a sub-zone occupied by a small array of tidal devices (near-field scale) or across the whole demonstration site and beyond (far-field scale). To further investigate this issue, experience from the offshore wind farm industry is drawn upon.

220. For monopiles, wave theory exists which relates the pile diameter (D) to the wavelength (L) of the incident waves. Diffraction effects become important when $D/L \geq 0.2$. Using wavelengths typical of the demonstration site, which is often characterised by long period Atlantic swell, wave diffraction is not envisaged to be induced at the MDZ by a monopile foundation. This confirms that effects on the wave regime from a monopile would be confined to local scale reflections and blockage, and that the wave trains will regroup and return to baseline values within a short distance from each foundation.

221. For GBS, which are likely to represent the worst-case foundation type due to their occupation of a greater cross sectional area within the water column, there is a strong evidence base which demonstrates that the changes in the wave regime due to the presence of foundation structures (even under a worst-case scenario of the largest diameter GBS considered by the offshore wind farm industry to date), are relatively small in magnitude (typically less than 10 % of baseline wave heights in close proximity to each wind turbine, reducing with greater distance from each turbine). Effects are localised in spatial extent, extending as a shadow zone typically up to several tens of kilometres from the site along the axis of wave approach, but with low magnitudes (only a few percent change across this wider area). This is confirmed by a review of modelling studies from over 30 offshore wind farms in the UK and European waters (Seagreen 2012), existing guidance documents (ETSU 2000; ETSU 2002; Lambkin *et al*. 2009), published research (Ohl *et al*. 2001) and post-installation monitoring (Cefas 2005).

222. Based on the above assessment the likely magnitudes of effect are shown in **Table 7-30**.

Table 7-30 Magnitude of Effects on Wave Regime Due to the Presence of Structures in the Project

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Device	Medium	High	Medium	Negligible	Medium
Near-field	Low	High	Medium	Negligible	Low
Far-field	Negligible	High	Medium	Negligible	Negligible

223. Changes in the wave regime do not directly impact on the identified geomorphological receptors *per se* but are important to consider because they inform subsequent assessment of effects arising from any changes to sediment erosion or deposition associated with the changes in wave regime (see Impact 3, **Section 7.7.6.3**).

224. As there is no physical pathway that links the source of the impact to the beaches and sea cliffs before the shadow effect on the wave regime is diminished, there is **no change** to these identified shoreline geomorphological receptors. There is a direct physical pathway that links the source of the impact to the offshore sand ridge in the north of the MDZ, and the magnitude of changes in the wave regime are **low** near this sea bed geomorphological receptor.

7.7.6.2.1. Mitigation

225. There is no recommended further mitigation.

7.7.6.2.2. Residual Impact

226. The magnitude of change in wave regime at the shoreline receptor remains **no change** and at the sea bed receptor remains at **low – medium** change.

7.7.6.3. Impact 3: Changes to the Sediment Transport Regime Due to Presence of Structures in the Project

227. Changes in the sediment transport regime will arise as either: (i) an indirect effect, consequent upon changes in the tidal and/or wave regimes caused by tidal devices and their foundations; or (ii) a direct effect due to blockage of (bedload) sediment transport by the foundations of tidal devices or electrical hubs on the sea bed within the Project.

228. As the magnitude of impacts on the tidal regime (Impact 1, **Section 7.7.6.1**) and wave regime (Impact 2, **Section 7.7.6.2**) are negligible across the far-field, then the associated knock-on effects on sediment transport will also be negligible across the far-field.

229. At a device scale, the worst-case for potential blockage of (bedload) sediment transport by foundations is associated with the use of GBS for all devices deployed in a 240 MW array. Under the worst case seabed footprint deployment scenario detailed in **Chapter 4, Project Description**, there could, potentially, be up to 590 devices plus 120 hubs, all deploying GBS, with a seabed footprint of up to 74,790 m^2 within the MDZ.

230. However, at the demonstration site there is little mobile sediment available for bedload transport. This is because the sea bed has been swept to bedrock (with or without a gravel, cobble, boulder

lag) by strong tidal currents. Given this dominant process, the potential for interruption or disturbance of sediment transport by the foundations and electrical hubs is limited. The greatest potential effect will arise in the immediate vicinity of the sand ridge in the north of the MDZ and the area of megaripples in the south and southwest of the MDZ. However, it is unlikely that any project infrastructure will present such an obstacle to sediment transport locally that far-reaching effects will become manifest.

231. Based on the above assessment the likely magnitude of effects are shown in **Table 7-31**.

Table 7-31 Magnitude of Effects on Sediment Transport Regime Due to Presence of Structures in the Project

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Device	Low	High	Medium	Negligible	Low
Near-field	Negligible	High	Medium	Negligible	Negligible
Far-field	Negligible	High	Medium	Negligible	Negligible

232. There is no physical pathway that links the source of the impact (indirectly caused by changes to the tidal and/or wave regimes) to the beaches and sea cliffs and therefore there is **no change** to these identified shoreline geomorphological receptors. However, there is a physical pathway that links the source of the impact arising from local (device location) changes to the tidal and/or wave regimes and direct placement of foundations in the vicinity of the offshore sand ridge in the north of the MDZ. Reductions in tidal velocities of the order expected are relatively small in relation to the very high baseline tidal flows (within a defined zone of influence) and would not result in changes to the existing erosion or deposition patterns of sediment since the critical thresholds for deposition of sediments of different grain particle sizes will still not be crossed. Consequently, these effects on the sediment transport regime are **low** at the location of the device, and **negligible** further afield.

7.7.6.3.1. Mitigation

233. There is no recommended further mitigation.

7.7.6.3.2. Residual Impact

234. The magnitude of effect on the sediment transport regime at the shoreline receptor remains **no change** and at the sea bed receptor remains at **low** (at the location of a foundation) and **negligible** elsewhere.

7.7.6.4. Impact 4: Increases in Suspended Sediment Concentrations Due to Sea Bed Scour Induced by the Project

235. The greatest potential sea bed scour effect will be associated with changes in the flow regimes around the foundations of devices as the flow bifurcates around the obstruction provided by each foundation. Where the sea bed is comprised of bare bedrock or where this is covered with boulders, cobbles or gravels there is unlikely to be any change in suspended sediment concentrations. If devices are placed in areas of the MDZ characterised by sands (e.g. southwest section and in the vicinity of the sand ridge in the north) there is potential for locally accelerated flows around foundations to increase suspended sediment concentrations, but since flows in these areas are very high in the baseline conditions, this will not be a major

exacerbation of the issue. Given the nature of the sea bed morphology, comprised mostly of exposed bedrock, the potential for adverse effects of this nature is extremely limited.

236. Based on the above assessment the likely magnitude of effects is shown in **Table 7-32**.

Table 7-32 Magnitude of Effects on Suspended Sediment Concentrations Due to Sea Bed Scour Induced by the Project

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field (direct footprint)	Low	High	Medium	Negligible	Low
Far-field	No change	No change	No change	No change	No change

237. There is no physical pathway that links the source of the impact to the beaches and sea cliffs and therefore there is **no change** to these identified shoreline geomorphological receptors.

238. However, there is a physical pathway that links the source of the impact to the offshore sand ridge in the north of the MDZ, but effects are **low** at the location of each device placed across this feature.

7.7.6.4.1. Mitigation

239. There is no recommended further mitigation.

7.7.6.4.2. Residual Impact

240. The magnitude of effect on suspended sediment concentrations at the shoreline receptor remains **no change** and at the sea bed receptor remains **low** (at the location of a foundation placed on the sand ridge or sand covered bedrock), with **no change** elsewhere (areas dominated by coarser material).

7.7.6.5. Impact 5: Loss of Sea Bed Morphology Due to Footprint of Structures in the Project

241. The physical presence of foundations, support structures, mooring anchors and chains, surface-laid cables and cable protection works on the sea bed will affect the existing morphology.

242. In the case of the static infrastructure, there will be a footprint imposed on the sea bed that will directly cover the morphology. In the case of the moorings, an area of the sea bed morphology will be 'swept' by the drag of the catenary chain.

243. Given the nature of the sea bed morphology, comprised mostly of exposed bedrock, the potential for adverse effects is limited.

244. Based on the above assessment the likely magnitude of effects are shown in **Table 7-33**.

Table 7-33 Magnitude of Effects on Sea Bed Morphology Due to Footprint of Structures in the Project

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field (direct footprint)	Low	High	Medium	Negligible	Low
Far-field	No change	No change	No change	No change	No change

245. There is no physical pathway that links the source of the impact to the beaches and sea cliffs and therefore there is **no change** to these identified shoreline geomorphological receptors.

246. However, there is a physical pathway that links the source of the impact to the offshore sand ridge in the north of the MDZ, but effects are **low** at the location of each device placed across this feature, and **there is no change** beyond the direct footprint.

7.7.6.5.1. Mitigation

247. There is no recommended further mitigation.

7.7.6.5.2. Residual Impact

248. The magnitude of effect on the sediment transport regime at the shoreline receptor remains **no change** and at the sea bed receptor remains **low** (at the location of a foundation placed on the sand ridge), with **no change** elsewhere.

7.7.6.6. Impact 6: Changes to the Morphology and Sediment Transport Regime Due to Offshore Cable and Cable Protection (including Nearshore and Landfall)

249. Changes in the morphology and sediment regime will potentially arise as a direct result of blockage of (bedload) sediment transport by the surface-laid offshore cables and cable protection works on the sea bed.

250. Surface-laid offshore cables, together with any cable protection works, will present an obstacle to bedload sediment transport up to a short height off the sea bed. If bedload transport processes are active, then it would be expected that a ‘ramp’ of sediment would rapidly form against the obstruction and transport process would then occur across the ramp. Such processes are observed across pipelines on the sea bed in areas of active sediment transport. If sediment transport processes are not active, then the presence of the offshore cable and cable protection present no concern in respect of this impact.

251. Across much of the offshore cable corridor, there is little mobile sediment available for bedload transport. This is because the sea bed has generally been swept to bedrock by strong tidal currents. There are exceptions to this in the northern part of the cable corridor, where a sand ridge is present, and closer to shore in Abraham’s Bosom, where sand overlies bedrock. However, the Project infrastructure at the shoreline or within the shallow nearshore that is inshore of the ‘closure depth’ of the active beach profile, will not present an obstruction to bedload sediment transport because the cable will be buried here (by HDD or trenching).

252. Based on the above qualitative assessment the likely magnitude of effects are shown in **Table 7-34**.

Table 7-34 Magnitude of Effects on Morphology and Sediment Transport Regime Due to Offshore Cable and Cable Protection

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Negligible	High	Medium	Negligible	Negligible
Far-field	Negligible	High	Medium	Negligible	Negligible

253. There is no physical pathway that links the source of the impact (either indirectly caused by changes to the tidal and/or wave regimes, or directly due to cables or cable protection) to the beaches and sea cliffs and therefore there is **no change** to these identified shoreline geomorphological receptors.

254. However, there is a physical pathway that links the source of the impact arising from near-field changes to the tidal and/or wave regimes and direct placement of offshore cables and cable protection near the offshore sand ridge in the north of the MDZ, but effects are **negligible**.

7.7.6.6.1. Mitigation

255. There is no recommended further mitigation.

7.7.6.6.2. Residual Impact

256. The magnitude of effect on the sediment transport regime at the shoreline receptor remains **no change** and at the sea bed receptor remains **negligible**.

7.7.6.7. Impact 7: Changes to the Morphology and Sediment Transport Regime Due to Inter-Array Cable and Cable Protection

257. Changes in the morphology and sediment regime will potentially arise as a direct result of blockage of (bedload) sediment transport by the surface-laid inter-array cables and cable protection works on the sea bed.

258. Surface-laid inter-array cables, together with any cable protection works, will present an obstacle to bedload sediment transport up to a short height off the sea bed. If bedload transport processes are active, then it would be expected that a ‘ramp’ of sediment would rapidly form against the obstruction and transport process would then occur across the ramp. Such processes are observed across pipelines on the sea bed in areas of active sediment transport. If sediment transport processes are not active, then the presence of the offshore cable and cable protection presents no concern in respect of this impact.

259. Across much of the MDZ (where the inter-array cables will be installed), there is little mobile sediment available for bedload transport. This is because the sea bed has generally been swept to bedrock by the strong tidal currents. There are exceptions to this in the northern part of the MDZ where a large sand ridge is present, and in the south and southwest of the MDZ where megaripples occur. It is unlikely that any Project infrastructure will present a significant obstruction to bedload sediment transport in these areas since it will occupy only a short height above the sea bed.

260. Based on the above qualitative assessment the likely magnitude of effects are shown in **Table 7-35**.

Table 7-35 Magnitude of Effects on Morphology and Sediment Transport Regime Due to Inter-Array Cable and Cable Protection

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Negligible	High	Medium	Negligible	Negligible
Far-field	Negligible	High	Medium	Negligible	Negligible

261. There is no physical pathway that links the source of the impact (either indirectly caused by changes to the tidal and/or wave regimes, or directly due to cables or cable protection) to the beaches and sea cliffs and therefore there is **no change** to these identified shoreline geomorphological receptors.

262. However, there is a physical pathway that links the source of the impact arising from near-field changes to the tidal and/or wave regimes and direct placement of inter-array cables and cable protection near the offshore sand ridge in the north of the MDZ, but effects are **negligible**.

7.7.6.7.1. Mitigation

263. There is no recommended further mitigation.

7.7.6.7.2. Residual Impact

264. The magnitude of effect on the sediment transport regime at the shoreline receptor remains **no change** and at the sea bed receptor remains **negligible**.

7.7.6.8. Impact 8: Changes in Sea Bed Level Due to Indentations During Maintenance in the Project

265. During the operational phase, specialist vessels will be used for maintenance activities. While these are present at the site, their jack-up legs or anchors will form scars or indentations on the sea bed.

266. Due to the predominance of exposed bedrock, with occasional gravel, cobbles and boulders, the legs / anchors of the vessels will not cause significant effects. In areas where either a sand ridge is present (in the north of the Project) or where megaripples are present (in the south and southwest of the Project), there will be local effects on the sand surface. However, due to the high tidal energy environment across these areas, any depressions are likely to be re-worked soon after the legs / anchors are removed. Based on this qualitative assessment the likely magnitude of effects are shown in **Table 7-36**.

Table 7-36 Magnitude of Effects on Sea Bed Levels Due to Indentations During Installation

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
Far-field	No effect	Negligible	Negligible	Negligible	Negligible

267. There are no areas where the legs / anchors of vessels are likely to affect the beaches and cliffs and therefore there is **no change** in the shoreline geomorphological receptors. Changes in sea bed level due to indentations during maintenance activities are **negligible** for the sea bed geomorphological receptor.

268. Changes in sea bed level due to indentations during maintenance are also important to consider in the assessment of impacts on benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.6.8.1. Mitigation

269. There is no suggested mitigation.

7.7.6.8.2. Residual Impact

270. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.7. Potential Impacts During Decommissioning and Repowering

7.7.7.1. Impact 1: Changes in Suspended Sediment Concentrations During Device and Hub Removal in the Project

271. During the decommissioning phase the potential for device and hub removal activities within the Project to disturb sediments on the sea bed and release them into the water column as a plume is lower than the effects arising from installation of foundations.

272. This is primarily because the removal activities will cause less direct interference (i.e. no pre-drilling) and the Project substrate is largely characterised by bedrock with little surface sediment other than occasional gravel, cobbles and boulders, which would not form a plume. The only areas with sand are in the north where a sand ridge is identified and in the south and southwest where megaripples are identified in parts of the Project. Based on this qualitative assessment the likely magnitude of effects are shown in **Table 7-37**.

Table 7-37 Magnitude of Effects on Suspended Sediment Concentrations Due to Device and Hub Removal

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

273. Changes in suspended sediment concentration arising from device and hub removal do not directly impact on the identified geomorphological receptors *per se* but are important to consider because they inform subsequent assessment of impacts arising from any sediment deposition associated with the plume (Impact 2, **Section 7.7.7.2**). There is no physical pathway that links the source of the impact to the beaches and sea cliffs before the plume has diminished. Hence, there is **no change** to these identified shoreline geomorphological receptors. There is a direct physical pathway that links the source of the impact to the offshore sand ridge in the north of the MDZ, but plume effects are **negligible** near this sea bed geomorphological receptor.

274. These changes in suspended sediment concentration arising from device and hub removal are also important to consider in the assessment of impacts on marine water quality (see **Chapter 8, Marine Water and Sediment Quality**), benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.7.1.1. Mitigation

275. There is no suggested mitigation.

7.7.7.1.2. Residual Impact

276. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.7.2. Impact 2: Changes in Sea Bed Level (Morphology) due to Device and Hub Removal

277. Any sediment that becomes entrained within the plume generated by device and hub removal will have the potential to be deposited on the sea bed at some distance from its point of release as it settles through the water column. However, such plumes arising from decommissioning activities will be of negligible significance and the tidal currents are strong, encouraging rapid dispersion. Based on this qualitative assessment the likely magnitude of effects are shown in **Table 7-38**.

278. There is no physical pathway that links the source of the impact arising from device and hub removal to the beaches and sea cliffs and therefore there is **no change** to these identified shoreline geomorphological receptors. However, there is a direct physical pathway that links the source of the impact arising from device and hub removal to the offshore sand ridge in the north of the MDZ, but deposition effects are **negligible** in the vicinity of this sea bed geomorphological receptor.

Table 7-38 Magnitude of Effects on Sea Bed Levels Due to Sediment Deposition Arising from Device and Hub Removal

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

279. Changes in sea bed level due to sediment deposition arising from device and hub removal are also important to consider in the assessment of impacts on benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.7.2.1. Mitigation

280. There is no suggested mitigation.

7.7.7.2.2. Residual Impact

281. The residual impact on the identified shoreline geomorphological receptors (beaches and sea cliffs) remains **no change** and on the identified sea bed geomorphological receptor (offshore sand ridge) remains **negligible**.

7.7.7.3. Impact 3: Changes in Suspended Sediment Concentrations Due to Removal of Offshore Cable (including Nearshore and Landfall)

282. During the decommissioning phase there is potential for offshore cable removal activities within the cable corridor (including the nearshore and landfall), during the decommissioning phase only, to disturb sediments and release them into the water column as a plume. This will enhance the baseline suspended sediment concentrations in the water column, making it more turbid, until the plume becomes dispersed by tidal current action and the sediments settle to the sea bed.

283. The offshore sea bed along the cable corridor are mostly governed by large areas of outcropping bedrock, with minimal relief and only sparse sediment cover, predominantly gravel, cobbles and rock boulders. Here, cable removal will create minimal sediment plumes.

284. In the northern part of the cable corridor where the cable has been buried within a sand ridge and nearer to the landfall where there is sand over bedrock, including the presence of some megaripples, removal of the offshore cable will cause effects like those experienced during installation.

285. These effects will be one-off and temporary in duration, with a return to the very low background concentrations occurring rapidly upon cessation of removal. Based on this qualitative assessment the likely magnitude of effects are shown in **Table 7-39**.

Table 7-39 Magnitude of Effects on Suspended Sediment Concentrations Due to Removal of the Offshore Cable (including Nearshore and Landfall)

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Low (sand ridge) to Negligible (elsewhere)
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

286. Changes in the suspended sediment concentration do not directly impact on the identified geomorphological receptors *per se* but are important to consider because they inform subsequent assessment of impacts arising from any sediment deposition associated with the plume (Impact 4, **Section 7.7.7.4**). There is a direct physical pathway that potentially links the source of the impact (arising at the landfall) to the beaches and sea cliffs before the plume is diminished, but plume effects are **negligible** near these geomorphological receptors. There is also a direct physical pathway that potentially links the source of the impact (arising in the offshore part of the cable corridor) to the offshore sand ridge, but plume effects are **low** near this geomorphological receptor.

287. These changes in suspended sediment concentration arising from offshore cable removal are also important to consider in the assessment of impacts on marine water quality (see **Chapter 8, Marine Water and Sediment Quality**), benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.7.3.1. Mitigation

288. There is no suggested mitigation.

7.7.7.3.2. Residual Impact

289. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.7.4. Impact 4: Changes in Sea Bed Level Due to Removal of Offshore Cable (including Nearshore and Landfall)

290. Any sediment that becomes entrained within the plume generated by offshore cable removal (Impact 3, **Section 7.7.7.3**), during the decommissioning phase only, has the potential to be deposited on the sea bed at some distance from its point of release as it settles through the water column. Depositional effects will remain within the bounds of natural behaviour that are governed by storm waves and surge effects, with decommissioning phase effects being one-off and temporary in duration, and unlikely to be measurable. Based on this qualitative assessment the likely magnitude of effects are shown in **Table 7-40**.

291. There is a direct physical pathway that potentially links the source of the impact (arising at the landfall) to the beaches and sea cliffs, but effects on sea bed and beach levels are **negligible** for these geomorphological receptors. There is also a direct physical pathway that potentially links the source of the impact (arising in the offshore part of the cable corridor) to the offshore sand ridge, but effects on sea bed levels are **negligible** for this geomorphological receptor.

Table 7-40 Magnitude of Effects on Sea Bed Levels Due to Sediment Deposition Arising from Removal of the Offshore Cable

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Negligible
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

292. Changes in sea bed level due to sediment deposition arising from offshore cable removal are also important to consider in the assessment of impacts on benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.7.4.1. Mitigation

293. There is no suggested mitigation.

7.7.7.4.2. Residual Impact

294. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.7.5. Impact 5: Changes in Suspended Sediment Concentrations Due to Removal of Inter-Array Cable

295. During the decommissioning phase there is potential for inter-array cable removal activities within the Project to disturb sediments and release them into the water column as a plume. This will enhance the baseline suspended sediment concentrations in the water column, making it more turbid, until the plume becomes dispersed by tidal current action and the sediments eventually settle on the sea bed.

296. The sea bed of the Project is mostly composed of large areas of outcropping bedrock, with minimal relief and only sparse sediment cover, predominantly gravel, cobbles and rock boulders. Only in the south and southwest does the sea bed have superficial sediment that could potentially be affected by inter-array cable removal, where megaripples are present with heights up to 0.6 m.

297. Removal of the offshore cable will cause effects like those experienced during installation. These effects will be one-off and temporary in duration, with a return to the very low background suspended sediment concentrations occurring rapidly upon cessation of removal. Based on this qualitative assessment the likely magnitude of effects are shown in **Table 7-41**.

298. Changes in the suspended sediment concentrations do not directly impact on the identified geomorphological receptors *per se* but are important to consider because they inform subsequent assessment of impacts arising from any sediment deposition associated with the plume arising from inter-array cable removal (Impact 6, **Section 7.7.7.6**). There is no direct physical pathway that potentially links the source of the impact to the beaches and sea cliffs before the plume has diminished, and so there is **no change** to these shoreline geomorphological receptors. There is a direct physical pathway that potentially links the source of the impact (arising in parts of the Project) to the offshore sand ridge, but plume effects are **negligible** near this geomorphological receptor.

Table 7-41 Magnitude of Effects on Suspended Sediment Concentrations During Removal of the Inter-Array Cables

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

299. These changes in suspended sediment concentrations arising from inter-array cable removal are also important to consider in the assessment of impacts on marine water quality (see **Chapter 8, Marine Water and Sediment Quality**), benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.7.5.1. Mitigation

300. There is no suggested mitigation.

7.7.7.5.2. Residual Impact

301. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.7.6. Impact 6: Changes in Sea Bed Level Due to Removal of Inter-Array Cable

302. Any sediment that becomes entrained within the plume generated by inter-array cable removal (Impact 5, **Section 7.7.7.5**) will have the potential to be deposited on the sea bed at some distance from its point of release as it settles through the water column. However, these depositional effects will remain within the bounds of natural behaviour, with decommissioning phase effects being one-off and temporary in duration and unlikely to be measurable.

303. The deposition of sediments arising from plumes associated with inter-array cable removal will likely be immeasurable. Based on this qualitative assessment the likely magnitude of effects are shown in **Table 7-42**.

Table 7-42 Magnitude of Effects on Sea Bed Levels Due to Sediment Deposition Associated with Removal of the Inter-Array Cables

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

304. There is no physical pathway that links the source of the impact arising from inter-array cable removal to the beaches and sea cliffs and therefore there is **no change** to these identified shoreline geomorphological receptors. However, there is a direct physical pathway that potentially links the source of the impact (arising in the offshore part of the cable corridor) to the offshore sand ridge, but deposition effects on sea bed levels are **negligible** for this geomorphological receptor.

305. Changes in sea bed levels due to sediment deposition arising from inter-array cable removal are also important to consider in the assessment of impacts on benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.7.6.1. Mitigation

306. There is no suggested mitigation.

7.7.7.6.2. Residual Impact

307. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.7.7. Impact 7: Changes in Sea Bed Level Due to Indentations in the Seabed

308. During the decommissioning phase, specialist vessels will be used for removal activities. While these are present at the site, their jack-up legs or anchors will form scars or indentations on the sea bed morphology.

309. Due to the predominance of exposed bedrock on the sea bed, with occasional gravel, cobbles and boulders, the legs / anchors of the vessels will not cause significant effects. In areas where either a sand ridge is present (in the north of the Project) or where megaripples are present (in the south and southwest of the Project), there will be localised effects on the sand surface, but due to the high tidal energy environment across these areas, any depressions are likely to become re-worked soon after the legs / anchors are removed. Furthermore, at each location these effects will be local, one-off and temporary in duration. Based on this qualitative assessment the likely magnitude of effects are shown in **Table 7-43**.

Table 7-43 Magnitude of Effects on Sea Bed Levels due to Indentations in the Seabed

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
Far-field	No effect	Negligible	Negligible	Negligible	Negligible

310. There are no areas where the legs / anchors of vessels are likely to affect the beaches and cliffs and therefore there is **no change** in the shoreline geomorphological receptors. Changes in sea bed level due to indentations during decommissioning activities are **negligible** for the sea bed geomorphological receptor.

311. Changes in sea bed level due to indentations during installation are also important to consider in the assessment of impacts on benthic and intertidal ecology (see **Chapter 9, Benthic and Intertidal Ecology**), and fish and shellfish (see **Chapter 10, Fish and Shellfish Ecology**).

7.7.7.7.1. Mitigation

312. There is no suggested mitigation.

7.7.7.7.2. Residual Impact

313. The residual impact on the identified shoreline geomorphological receptors remains **no change** and on the identified sea bed geomorphological receptor remains **negligible**.

7.7.8. Cumulative and In-Combination Impacts

314. Of the projects listed in **Chapter 26, Cumulative and In-combination Effects**, the only one which could potentially have a cumulative or in-combination effect with the MDZ Project in respect of coastal processes is Minesto's Holyhead Deep. All other projects are either too remote from the Project or on land and thus do not affect coastal processes.

Minesto's Holyhead Deep project will be a 80 MW installation of tidal energy devices, delivered in a phased manner, and located a short distance due west of the MDZ Project. Based upon the geographical configuration of the Minesto Project Development Area (PDA) with respect to the MDZ Project, there is no possibility of changes in tidal flow interacting between projects, due to the alignment of flood and ebb flows off the coast of Anglesey (i.e. the two projects are not upstream/downstream of each other).

315. Similarly, any (minor) sediment plumes arising from construction from either project will not coalesce because of: (i) the alignment of principal tidal flows; and (ii) likely different construction programmes (note that phase 1 of the Holyhead Deep project is already installed).

316. The predicted impacts of Minesto's Holyhead Deep project on coastal processes have been assessed as being not significant in their own right (Minesto, 2016), and this conclusion is considered equally valid when both projects are considered in combination.

7.7.9. Inter-relationships

317. The range of effects on marine physical processes of the Project have the potential to directly affect the identified marine physical processes receptors but may also manifest as impacts upon receptors other than those considered within the context of marine physical processes. The assessments of significance of these impacts on other receptors are provided in the chapters listed in **Table 7-44**.

Table 7-44 Inter-topic relationships

Topic and description	**Related Chapter**	**Where addressed in this Chapter**	**Rationale**
Marine Water and Sediment Quality	Chapter 8	**Sections 7.7.5.1, 7.7.5.3, 7.7.5.5, 7.7.7.1, 7.7.7.3, 7.7.7.5**	Changes in certain metocean conditions, morphological features or coastal processes have been identified in this Chapter, with their significance on marine water and sediment quality assessed in **Chapter 8, Marine Water and Sediment Quality**
Benthic and Intertidal Ecology	Chapter 9	**Sections 7.7.5.1, 7.7.5.2, 7.7.5.3, 7.7.5.4, 7.7.5.5, 7.7.5.6, 7.7.5.7, 7.7.6.8, 7.7.7.1, 7.7.7.2, 7.7.7.3, 7.7.7.4, 7.7.7.5, 7.7.7.6, 7.7.7.7.**	Changes in certain metocean conditions, morphological features or coastal processes have been identified in this Chapter, with their significance on benthic and inter-tidal ecology assessed in **Chapter 9, Benthic and Intertidal Ecology**
Fish and Shellfish Ecology	Chapter 10	**Sections 7.7.5.1, 7.7.5.2, 7.7.5.3, 7.7.5.4, 7.7.5.5, 7.7.5.6, 7.7.5.7, 7.7.6.8, 7.7.7.1, 7.7.7.2, 7.7.7.3, 7.7.7.4, 7.7.7.5, 7.7.7.6, 7.7.7.7.**	Changes in certain metocean conditions, morphological features or coastal processes have been identified in this Chapter, with their significance on fish and shellfish ecology assessed in **Chapter 10, Fish and Shellfish Ecology**

7.7.10. Interactions

318. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 7-45** for construction/decommissioning and **Table 7-46** for operational impacts, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 7-45 Potential Interaction Between Metocean and Coastal Processes Impacts During Construction / Decommissioning

Potential interaction between impacts							
Construction / Repowering / Decommissioning	1: Changes in Suspended Sediment Concentrations During Foundation Installation / Device and Hub Removal in the Project	2: Changes in Sea Bed Level (Morphology) Due to Deposition During Foundation Installation / Device and Hub Removal in the Project	3: Changes in Suspended Sediment Concentrations During Offshore Export Cable Installation / Removal (including Nearshore and Landfall)	4: Changes in Sea Bed Level Due to Offshore Cable Installation / Removal (including Nearshore and Landfall)	5: Changes in Suspended Sediment Concentrations During Inter-Array Cable Installation / Removal	6: Changes in Sea Bed Level Due to Inter-Array Cable Installation / Removal	7: Changes in Sea Bed Level Due to Indentations in the Seabed
1: Changes in Suspended Sediment Concentrations During Foundation Installation / Device and Hub Removal in the Project	-	Yes	Yes	Yes	Yes	Yes	Yes
2: Changes in Sea Bed Level (Morphology) Due to Deposition During Foundation Installation / Device and Hub Removal in the Project	Yes	-	Yes	Yes	Yes	Yes	Yes
3: Changes in Suspended Sediment Concentrations During Offshore Export Cable Installation / Removal (including Nearshore and Landfall)	Yes	Yes	-	Yes	Yes	Yes	Yes
4: Changes in Sea Bed Level Due to Offshore Cable Installation / Removal (including Nearshore and Landfall)	Yes	Yes	Yes	-	Yes	Yes	Yes
5: Changes in Suspended Sediment Concentrations During Inter-Array Cable Installation / Removal	Yes	Yes	Yes	Yes	-	Yes	Yes

Potential interaction between impacts							
Construction / Repowering / Decommissioning	1: Changes in Suspended Sediment Concentrations During Foundation Installation / Device and Hub Removal in the Project	2: Changes in Sea Bed Level (Morphology) Due to Deposition During Foundation Installation / Device and Hub Removal in the Project	3: Changes in Suspended Sediment Concentrations During Offshore Export Cable Installation / Removal (including Nearshore and Landfall)	4: Changes in Sea Bed Level Due to Offshore Cable Installation / Removal (including Nearshore and Landfall)	5: Changes in Suspended Sediment Concentrations During Inter-Array Cable Installation / Removal	6: Changes in Sea Bed Level Due to Inter-Array Cable Installation / Removal	7: Changes in Sea Bed Level Due to Indentations in the Seabed
6: Changes in Sea Bed Level Due to Inter-Array Cable Installation / Removal	Yes	Yes	Yes	Yes	Yes	-	Yes
7: Changes in Sea Bed Level Due to Indentations in the Seabed	Yes	Yes	Yes	Yes	Yes	Yes	-

Table 7-46 Potential Interaction Between Metocean and Coastal Processes Impacts During Operation

Potential interaction between impacts								
Operation	1: Changes to the Tidal Regime Due to Presence of Structures in the Project	2: Changes to the Wave Regime Due to Presence of Structures in the Project	3: Changes to the Sediment Transport Regime Due to Presence of Structures in the Project	4: Increases in Suspended Sediment Concentrations Due to Sea Bed Scour Induced by the Project	5: Loss of Sea Bed Morphology Due to Footprint of Structures in the Project	6: Changes to the Morphology and Sediment Transport Regime Due to Offshore Cable and Cable Protection (including Nearshore and Landfall)	7: Changes to the Morphology and Sediment Transport Regime Due to Inter-Array Cable and Cable Protection	8: Changes in Sea Bed Level Due to Indentations During Maintenance in the Project
1: Changes to the Tidal Regime Due to Presence of Structures in the Project	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Potential interaction between impacts								
Operation	1: Changes to the Tidal Regime Due to Presence of Structures in the Project	2: Changes to the Wave Regime Due to Presence of Structures in the Project	3: Changes to the Sediment Transport Regime Due to Presence of Structures in the Project	4: Increases in Suspended Sediment Concentrations Due to Sea Bed Scour Induced by the Project	5: Loss of Sea Bed Morphology Due to Footprint of Structures in the Project	6: Changes to the Morphology and Sediment Transport Regime Due to Offshore Cable and Cable Protection (including Nearshore and Landfall)	7: Changes to the Morphology and Sediment Transport Regime Due to Inter-Array Cable and Cable Protection	8: Changes in Sea Bed Level Due to Indentations During Maintenance in the Project
2: Changes to the Wave Regime Due to Presence of Structures in the Project	Yes	-	Yes	Yes	Yes	Yes	Yes	Yes
3: Changes to the Sediment Transport Regime Due to Presence of Structures in the Project	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
4: Increases in Suspended Sediment Concentrations Due to Sea Bed Scour Induced by the Project	Yes	Yes	Yes	-	Yes	Yes	Yes	Yes
5: Loss of Sea Bed Morphology Due to Footprint of Structures in the Project	Yes	Yes	Yes	Yes	-	Yes	Yes	Yes
6: Changes to the Morphology and Sediment Transport Regime Due to Offshore Cable and Cable Protection (including Nearshore and Landfall)	Yes	Yes	Yes	Yes	Yes	-	Yes	Yes
7: Changes to the Morphology and Sediment Transport Regime Due to Inter-Array Cable and Cable Protection	Yes	Yes	Yes	Yes	Yes	Yes	-	Yes
8: Changes in Sea Bed Level Due to Indentations During Maintenance in the Project	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-

7.8. SUMMARY

319. As sediment plumes and sediment deposition will be governed by the axis of the tidal flows, there is limited potential for the sediment deposited from different turbine locations to coalesce and remain on the sea bed in any measurable magnitude within this area of strong tidal currents. Rather, deposited sediments would be very quickly re-suspended and redistributed across a wide area in low (immeasurable) quantities.

320. Due to the predominance of exposed bedrock on the sea bed, with occasional gravel cobbles and boulders, the Project will not cause significant changes in bed levels. In areas where a sand ridge is present (in the north of the Project) or where megaripples are present (in the south and southwest of the Project), there will be local effects on the sand surface. However, due to the high tidal energy environment across these areas, any depressions are likely to become rapidly re-worked following removal. Furthermore, these effects will be highly localised, one-off and temporary in duration.

321. Consideration of the potential effects of the Project is carried out over the following spatial scales:

- Near-field: the area within the immediate vicinity (tens or hundreds of metres) of the Project and along the offshore ECC; and
- Far-field: the wider area that might also be affected indirectly by the Project (e.g. due to disruption of waves, tidal currents or sediment pathways).

322. The magnitude of effect associated with these works have been assessed as being **negligible** to **medium** for near-field effects and **negligible** for far-field effects (**Table 7-47**).

323. **Chapter 7, Metocean Conditions and Coastal Processes** also identifies potential effects/changes on marine physical processes for which the receptor is considered in other Chapters (e.g. **Chapter 8, Marine Water and Sediment Quality** and **Chapter 9, Benthic and Intertidal Ecology**).

Table 7-47 Summary of potential impacts identified for metocean and coastal processes

Potential Effect	Scale	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Construction / Repowering Phase						
Effect 1: Changes in suspended sediment concentrations due to foundation installation in the Project	Near-field	Low	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 2: Changes in sea bed level (morphology) due to deposition during foundation installation in the Project	Near-field	Low	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 3: Changes in suspended sediment concentrations during offshore export cable installation (including nearshore) (construction only)	Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Low (sand ridge) to Negligible (elsewhere)
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 4: Changes in sea bed level due to offshore export cable installation (construction only)	Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 5: Changes in suspended sediment concentrations during inter-array cable installation	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 6: Changes in sea bed level due to inter-array cable installation	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 7: Changes in sea bed level (morphology) due to indentations during installation in the Project	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	No effect	Negligible	Negligible	Negligible	Negligible
Operational Phase						
Effect 1: Changes to the tidal regime due to the presence of structures in the Project	Device	Medium	High	Medium	Negligible	Medium
	Near-field	Low - Medium	High	Medium	Negligible	Low - Medium
	Far-field	Negligible	High	Medium	Negligible	Negligible

Potential Effect	Scale	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Effect 2: Changes to the wave regime due to the presence of structures in the Project	Device	Medium	High	Medium	Negligible	Medium
	Near-field	Low	High	Medium	Negligible	Low
	Far-field	Negligible	High	Medium	Negligible	Negligible
Effect 3: Changes to the sediment transport regime due to the presence of structures in the Project	Device	Low	High	Medium	Negligible	Low
	Near-field	Negligible	High	Medium	Negligible	Negligible
	Far-field	Negligible	High	Medium	Negligible	Negligible
Effect 4: Loss of sea bed morphology due to the footprint of structures in the Project	Near-field (direct footprint)	Low	High	Medium	Negligible	Low
	Far-field	No change	No change	No change	No change	No change
Effect 5: Morphological and sediment transport effects due to cable protection measures for offshore export cables (including nearshore and at the coastal landfall)	Near-field	Negligible	High	Medium	Negligible	Negligible
	Far-field	Negligible	High	Medium	Negligible	Negligible
Effect 6: Morphological and sediment transport effects due to cable protection measures for inter-array cables	Near-field	Negligible	High	Medium	Negligible	Negligible
	Far-field	Negligible	High	Medium	Negligible	Negligible
Effect 7: Changes in sea bed level (morphology) due to maintenance during maintenance in the Project	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	No effect	Negligible	Negligible	Negligible	Negligible
Repowering / Decommissioning Phase						
Effect 1: Changes in suspended sediment concentrations due to device and hub removal	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 2: Changes in sea bed level due to device and hub removal	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

Potential Effect	Scale	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Effect 3: Changes in suspended sediment concentrations during offshore export cable removal (including nearshore and at the coastal landfall) (decommissioning only)	Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Low (sand ridge) to Negligible (elsewhere)
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 4: Changes in sea bed levels due to removal of the offshore export cables (decommissioning only)	Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 5: Changes in suspended sediment concentrations during removal of parts of the inter-array cables	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 6: Changes in sea bed levels due to removal of parts of the inter-array cables	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 7: Changes in sea bed level (morphology) due to indentations during decommissioning in the Project	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	No effect	Negligible	Negligible	Negligible	Negligible

7.9. REFERENCES

ABPmer, (2008) Atlas of UK Marine Renewable Energy Resources. Available from: https://www.renewables-atlas.info/. Accessed on: 28/07/19

BGS (2005) 'DTI Strategic Environmental Assessment Area 6, Irish Sea, seabed and surficial geology and processes', (May).

Bowers, D. G. Ã., Ellis, K. M. and Jones, S. E. (2005) 'Isolated turbidity maxima in shelf seas', 25, pp. 1071–1080.

Bowers, D. G. (2003) 'A simple turbulent energy-based model of fine suspended sediments in the Irish Sea', 23, pp. 1495–1505. doi: 10.1016/j.csr.2003.08.006.

Bowers, D. G., Boudjelas, S. and Harker, G. E. L. (1998) 'The distribution of fine suspended sediments in the surface waters of the Irish Sea and its relation to tidal stirring', *International Journal of Remote Sensing*, 19(2789–2805).

Bowers, D. G. *et al.* (2002) 'Turbidity in the southern Irish Sea', 22, pp. 2115–2126.

Ellis, K. M. *et al.* (2008) 'A model of turbidity maximum maintenance in the Irish Sea', 76, pp. 765–774.

HR Wallingford (2019) Morlais Demonstration Zone – Tidal Resource Modelling. DEM8387-RT0001-R01-00. February 2019.

HR Wallingford (2017) Morlais Demonstration Zone – Tidal Resource Modelling. DEM7958-RT0001-R05-00. May 2017.

McMillan, A., Balstone, C., Worth, D., Tawn, J., Horsburgh, K. & Lawless, M., (2011) Coastal flood boundary conditions for UK mainland and islands. Project SC060064/TR2: Design sea levels. Published by Defra, SEPA, The Scottish Government and Environment Agency.

Minesto (2016) Deep Green Holyhead Deep Project Phase 1 – Non-Technical Summary. June 2016.

Mitchelson, E. G. (1984) Phytoplankton and suspended sediment distributions in relation to physical structure and water-leaving signals*. Ph.D. Thesis, University of Wales*.

Ocean Ecology. 2018. Morlais Demonstration Zone (MDZ) Benthic Ecology Characterisation Survey 2018. Technical Report to Marine Space, November 2018.

Palmer, M., Howard, T., Tinker, J., Lowe, J., Bricheno, L., Calvert, D., Edwards, T., Gregory, J., Harris, G., Krijnen, J., Pickering, M., Roberts, C. & Wolf, J., (2018) *UKCP18 Marine Report*. November 2018.

Partrac (2018) Morlais Demo Zone (MDZ) Hydrographic & Geophysical Survey. Volume 2 – Survey Report to Marine Space, July 2018.

Royal HaskoningDHV (2011) 'West of Wales SMP2. Appendix C: Review of Coastal Processes and Geomorphology', (February).

Simpson, J. H. and Brown, J. (1987) 'The interpretation of visible band imagery of turbid shallow seas in terms of the distribution of suspended particles', *Continental Shelf Research*, 7(1307–1313).

Weeks, A. R. and Simpson, J. H. (1991) 'The measurement of suspended particulate concentrations from remotely sensed data', *International Journal of Remote Sensing*, 12.

Weeks, A. R. (1989) Spatial and time dependent variations in suspended particulate material concentrations in the shelf seas*. Ph.D. Thesis, University of Wales*.

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Morlais Project
Environmental Statement

Chapter 8: Marine Water and Sediment Quality

Volume I

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-008

Chapter 8: Marine Water and Sediment Quality

Author: MarineSpace

MarineSpace
Making Sense of the Marine Environment ™

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GLOSSARY OF ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
BGS	British Geological Survey
BOD	Biological Oxygen Demand
CCME	Canadian Council of Ministers of the Environment
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
EA	Environment Agency
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standards
ES	Environmental Statement
HDD	Horizontal Directional Drilling
IPPC	Integrated Pollution and Prevention Control
JLDP	Joint Local Development Plan
MDZ	Morlais Demonstration Zone
MSFD	Marine Strategy Framework Directive
NPS	National Policy Statement
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
ORP	Oxidation-Reduction Potential
PDA	Project Development Area
PEL	Probable Effect Level
PPMP	Pollution Prevention and Management Plan
RBD	River Basin District
RBMP	River Basin Management Plan
SEA	Strategic Environmental Assessment
TEL	Threshold Effect Level
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UAV	Unmanned Aerial Vehicle
UK	United Kingdom
WFD	Water Framework Directive

GLOSSARY OF TERMINOLOGY

Bathymetry	Topography of the sea bed
Beach	A deposit of non-cohesive sediment (e.g. sand, gravel) situated on the interface between dry land and the sea (or other large expanse of water) and actively 'worked' by present-day hydrodynamic processes (i.e. waves, tides and currents) and sometimes by winds
Contaminant	A polluting substance within the sediment or water column
Current	Flow of water generated by a variety of forcing mechanisms (e.g. waves, tides, wind)
Ebb tide	The falling tide, immediately following the period of high water and preceding the period of low water
Fetch	The distance travelled by wind or waves across open water
Flood tide	The rising tide, immediately following the period of low water and preceding the period of high water
Gravel	Loose, rounded fragments of rock larger than sand but smaller than cobbles. Sediment larger than 2 mm (as classified by the Wentworth scale used in sedimentology)
Habitat	The environment of an organism and the place where it is usually found
Intertidal	Area on a shore that lies between Lowest Astronomical Tide (LAT) and Highest Astronomical Tide (HAT)
Megaripples	Bedforms with a wavelength of 0.6 to 10.0m and a height of 0.1 to 1.0m. These features are smaller than sand waves but larger than ripples
Neap tide	A tide that occurs when the tide-generating forces of the sun and moon are acting at right angles to each other, so the tidal range is lower than average
Nearshore	The zone which extends from the swash zone to the position marking the start of the offshore zone (~20m)
Numerical modelling	Refers to the analysis of coastal processes using computational models
Offshore	Area to seaward of nearshore in which the transport of sediment is not caused by wave activity
Sand	Sediment particles, mainly of quartz with a diameter of between 0.063mm and 2mm. Sand is generally classified as fine, medium or coarse
Scour	The erosion of sediment away from tan area as a result of the flow of water.
Sediment	Particulate matter derived from rock, minerals or bioclastic matter
Sediment transport	The movement of a mass of sediment by the forces of currents and waves
Semi-diurnal	Where two high and two low tides of approximately equal size occur every lunar day

Shallow water	Commonly, water of such depth that surface waves are noticeably affected by bottom topography. It is customary to consider water of depths less than half the surface wave length as shallow water
Significant wave height	The average height of the highest of one third of the waves in a given sea state
Spring tide	A tide that occurs when the tide-generating forces of the sun and moon are acting in the same directions, so the tidal range is higher than average
Surge	Changes in water level as a result of meteorological forcing (wind, high or low barometric pressure) causing a difference between the recorded water level and the astronomical tide predicted using harmonic analysis
Suspended sediment	The sediment moving in suspension in a fluid kept up by the upward components of the turbulent currents or by the colloidal suspension
Tidal current	The alternating horizontal movement of water associated with the rise and fall of the tide
Tidal range	Difference in height between high and low water levels at a point
Tide	The periodic rise and fall of the water that results from the gravitational attraction of the moon and sun acting upon the rotating earth
Water catchment	An area where water is collected by the natural landscape, eventually flowing to a river, lake, ocean or groundwater system
Wave height	The vertical distance between the crest and the trough

8. MARINE WATER AND SEDIMENT QUALITY

8.1. INTRODUCTION

1. Menter Môn Morlais Limited (Menter Môn) proposes the development of 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ). The development of the Morlais Project (the Project) will support the development of renewable energy technology objectives of the Anglesey and Gwynedd Joint Local Development Plan (JLDP), providing a consented tidal technology commercial demonstration zone. The Project will also provide opportunities for the local communities via direct employment and support of the local supply chain.

2. The development of the Project will provide a demonstration zone, specifically designed for the installation and commercial demonstration of multiple arrays of tidal energy devices. The Project will include communal infrastructure for tidal technology developers which provides a shared route to the cable landfall point via nine export cables, an onshore landfall substation, and an onshore electrical cable route to the existing electricity network via a grid connection substation (see **Chapter 4, Project Description**).

3. This chapter provides a summary description of key aspects relating to existing marine water and sediment quality, followed by an assessment of the magnitude and significance of the effects on the baseline conditions resulting from the construction, operation and decommissioning of the Project, as well as those effects resulting from cumulative interactions with other existing or planned projects.

4. This chapter has been prepared by MarineSpace Ltd on behalf of Menter Môn.

8.2. POLICY, LEGISLATION AND GUIDANCE

5. The principal European and International policy and legislation documents used to inform the assessment of potential impact on marine water and sediment quality include:

- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (the Water Framework Directive);
- Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive);
- Directive 76/464/EEC Water pollution by discharges of certain dangerous substances (Dangerous Substances Directive) and Priority Substances Directive (2008/105/EC);
- Directive 2006/7/EC concerning the management of bathing water quality and repealing Directive 76/160/EEC (the Bathing Waters Directive);
- Directive 2006/113/EC on the quality required of shellfish waters (The Shellfish Waters Directive);
- The International Convention for the Prevention of Marine Pollution by Ships (MARPOL Convention) 73/78;

- Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (Canadian Council of Ministers of the Environment, 2002); and
- Cefas Action Levels for the disposal of dredged material.

8.2.1. National Policy Statements

6. The Project is seeking consent for a Transport and Works Act Order from the Welsh Ministers and a Marine Licence from Natural Resources Wales (NRW). Although this Project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP), therefore guidance relevant to NSIPs is considered appropriate to use for this Project. Guidance that is relevant to assessing impacts on marine water and sediment quality for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to marine water and sediment quality include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3), July 2011 (DECC, 2011b).

7. Details of specific policies within EN-1 and EN-3 used to inform this assessment are provided in **Table 8-1** below. The specific assessment requirements for marine water and sediment quality are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 8-1 NPS EN-1 and EN-3 Assessment Requirements Relevant to Marine Water and Sediment Quality

NPS Requirement	NPS Reference	ES Reference
Infrastructure development can have adverse effects on the water environment, including transitional waters and coastal waters. During the construction, operation and decommissioning phases, discharges would occur. There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats and could, in particular, result in surface waters, ground waters of protected areas failing to meet environmental objectives established under the Water Framework Directive	EN-1 Paragraph 5.15.1	Potential impacts of the Project on water quality are assessed in **Section 8.6** and in the Water Framework Directive (WFD) Compliance Assessment found in **Appendix 8.1** (**Volume III**). Impacts to habitats and species are assessed in Chapter 10 Benthic and Intertidal Ecology, Chapter 11 Fish and Shellfish Ecology and Chapter 12 Marine Mammals.
Where the project is likely to have adverse effects on the water environment, the application should undertake an assessment of the existing status of, and impacts of the proposed project, on water quality, water resources and physical characteristics of the water environment as part of the Environmental Statement or equivalent	EN-1 Paragraph 5.15.2	The existing baseline is presented in **Section 8.5** and the baseline for relevant WFD marine bodies is provided in **Appendix 8.1** (**Volume III**).
The existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing discharges, proposed new discharges and proposed	EN-1 Paragraph 5.15.3	The existing baseline is presented in **Section 8.5** and the baseline for relevant WFD marine bodies is

NPS Requirement	NPS Reference	ES Reference
changes to discharges. Existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics; and any impacts of the proposed project on waterbodies or protected areas under the Water Framework Directive		provided in **Appendix 8.1** (**Volume III**).
The construction, operation and decommissioning of offshore energy infrastructure can affect marine water quality through the disturbance of sea bed sediments or the release of contaminants with subsequent indirect effects on habitats, biodiversity and fish stocks.	EN-3 Paragraph 2.6.189	Potential impacts during construction are assessed in **Section 8.6.4**.
Where the project is likely to have effects on water quality or resources the applicant should undertake an assessment as required in EN-1, Section 5.15.	EN-3 Paragraph 2.5.85	Potential impacts of the project on water quality are assessed in **Section 8.6** and in the Water Framework Directive (WFD) Compliance Assessment found in **Appendix 8.1** (**Volume III**).

8.2.2. Marine Policy Statement

8. The Marine Policy Statement (MPS) adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made in order to enable sustainable development. The MPS sets out a vision of having 'clean, healthy, safe, productive and biologically diverse oceans and seas' by supporting the development of Marine Plans. It also sets out the framework for environmental, social and economic considerations that need to be considered in marine planning.

8.2.3. Wales National Marine Plan

9. By adopting the MPS, the Welsh Government committed to the requirement to introduce Marine Plans for Wales.

10. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the Welsh National Marine Plan (WNMP). The Plan is being developed in accordance with the Marine and Coastal Access Act (MCAA) 2009, the MPS and the Maritime Spatial Planning Directive, a draft version has been issued for consultation (discussed further in **Chapter 2, Policy and Legislation**).

11. Objective 10 of the WNMP, "to maintain and enhance the resilience of marine ecosystems and the benefits they provide in order to meet the needs of present and future generations", is of relevance to this chapter as this covers policies and commitments on the wider ecosystem, as set out in the MPS including those to do with the Marine Strategy Framework Directive and the Water Framework Directive, as well as other environmental, social and economic considerations.

12. **Table 8-1** sets out national and regional policies which are particularly relevant to the Project.

Table 8-2 National and Regional Policy Requirements Relevant to Marine Water and Sediment Quality

Policy Description	Reference	ES Reference
MPS		
Developments and other activities at the coast and at sea can have adverse effects on transitional waters, coastal waters and marine waters. During the construction, operation and decommissioning phases of developments, there can be increased demand for water, discharges to water and adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants into the water environment and the likelihood of transmission of invasive non-native species, for example through construction equipment, and their impacts on ecological water quality need to be considered.	Section 2.6.4.1	An assessment of potential impacts arising from the construction, operation and decommissioning of the Project is located in **Section 8.6.4**, **8.6.5** and **8.6.6**, respectively.
Draft WNMP		
Proposals should demonstrate that they: avoid the deliberate introduction of litter into the marine plan area; and minimise the risk of accidental release.	ENV_04: Marine Litter	Impacts through accidental spillage are assessed in Sections **8.6.4.4**., **8.6.5.1** and **8.6.6.2**.
Proposals should demonstrate that they have considered their potential air and water quality impacts and should, in order of preference: a) avoid adverse impacts; and/or b) minimise adverse impacts where they cannot be avoided; and/or c) mitigate adverse impacts where they cannot be minimised. If significant adverse impacts cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding.	ENV_06: Air and water quality	An assessment of potential impacts arising from the construction, operation and decommissioning of the Project is located in **Section 8.6.4**, **8.6.5** and **8.6.6**, respectively.
Proposals should minimise their risk of marine pollution incidents.	SOC_03: Marine pollution incidents	Impacts through accidental spillage are assessed in Sections **8.6.4.4**., **8.6.5.1** and **8.6.6.2**.
Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01: Cumulative effects	Cumulative impacts are assessed in **Section 8.6.7** and in **Chapter 26**
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
Where appropriate, that the proposal does not have a significant unacceptable effect on the quality and supply of water	AND 3: Other Renewable Energy and Low Carbon Technologies	The impacts to marine water and sediment quality are assessed as minor to negligible and are summarised in **Section 8.7**, **Table 8-17**
It does not cause unacceptable harm to: i. water quality	AMG 4: Coastal Protection	

Policy Description	Reference	ES Reference
Wellbeing of Future Generations (Wales) Act 2015		
A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).	A resilient Wales	The Project is assessed to have minor to negligible impacts on marine water and sediment quality (**Section 8.6**) while providing a source of renewable energy to communities.

8.2.4. The Water Framework Directive (WFD)

13. The WFD commits EU member states to achieve good quantitative and qualitative status of all water bodies. In the UK, an integrated approach to the management of all freshwater bodies, groundwaters, transitional (estuarine) and coastal waters at the river basin level has been adopted.

14. The overall requirement of the WFD is that all waterbodies must achieve Good Ecological Status by 2027, with interim targets in 2015 and 2021. It also requires that environmental objectives be set for all waterbodies to either maintain Good Status, or to move towards Good Status if a waterbody is currently failing its target. Under all conditions, it requires that there should be no deterioration in status.

15. Ecological status is assessed against a scale of high, good, moderate, poor or bad, with 'High' denoting largely undisturbed conditions and the other classes representing a deterioration from the undisturbed condition. The ecological status classification for the water body, and the confidence in this, is determined from the worst scoring quality element.

16. River Basin Management Plans (RBMPs) developed for each River Basin District (RBD) set out the current status classification of all waterbodies, as well as the objectives and actions required to maintain or improve the current Status of each waterbody. The Project is located within the Western Wales River Basin District.

17. At its nearest point the MDZ is located 0.5 km from the west coast of Holy Island, Anglesey, and falls within the Caernarfon Bay North WFD coastal water body which currently has an overall Good status, with a Good chemical status and a Good ecological status.

8.2.5. Marine Strategy Framework Directive

18. The objective of the Marine Strategy Framework Directive (MSFD) is to achieve ''good environmental status'' in Europe's seas by 2020, and to protect the resources upon which marine-related economic and social activities depend.

19. The MSFD enshrines, in a legislative framework, the ecosystem approach to the management of human activities having an impact on the marine environment, in order to enable the sustainable use of the marine environment and to safeguard its use for future generations.

20. The MSFD establishes European marine regions and sub-regions on the basis of geographical and environmental criteria and requires each Member State to develop a strategy for its marine waters (or Marine Strategy). In addition, because the MSFD follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every six years.

21. In coastal waters out to 1 nm, both the WFD and the MSFD apply, however, in coastal waters the MSFD only applies for aspects of good environmental status that are not already addressed by the WFD.

8.2.6. The Dangerous Substances Directive and the Priority Substances Directive

22. The Dangerous Substances Directive and its associated Directives are concerned with controlling discharges that may contain dangerous substances that may reach inland, coastal and territorial waters.

23. The Dangerous Substances Directive set specific emission limit values and quality objectives for 17 substances (List I) in five specific directives, also called ‘daughter’ directives.

24. Some of these Environmental Quality Standards (EQS) have now been superseded by standards established by the Priority Substances Directive 2008/105/EC. Where this is not the case, limit values and environmental quality standards set by the ‘daughter’ Directives remain valid.

25. The Priority Substance Directive is implemented in England and Wales by the River Basin District Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010. Compliance with these standards forms the basis of good surface water chemical status under the WFD.

26. The EQS under the Dangerous Substances Directive and Priority Substances Directive for selected List I substances are shown in **Table 8-3**.

Table 8-3 Environmental Quality Standards for Selected List I Substances

Substance	EQS Type	EQS under Priority Substances Directive (annual average, µg/l)	EQS under Dangerous Substances Directive (annual average, µg/l)
Arsenic (dissolved)	Annual average	-	25
Chromium (dissolved)	Annual average	-	15
Copper (dissolved)	Annual average	-	5
Lead (dissolved)	Annual average	7.2	25
Nickel (dissolved)	Annual average	20	30
Tributyl tin (TBT)	Maximum concentration	0.0002	0.002
Zinc (total)	Annual average	-	40

27. The EQSs for selected List II substances, based on data from the EA (2011) are shown in **Table 8-4** and includes the relevant EQSs under the Priority Substances Directive (where applicable).

Table 8-4 Selected List II Environmental Quality Standards (EA, 2011)

Substance	EQS Type	EQS under Priority Substances Directive (annual average, µg/l)	EQS under Dangerous Substances Directive (annual average, µg/l)
Mercury (dissolved)	Annual average	0.05	0.3
Cadmium (dissolved)	Annual average	0.2	2.5
HCH (Lindane)	Annual average	0.002	0.02
Total DDT	Annual average	0.025	0.025
ppDDT	Annual average	0.01	0.01
Pentachorophenol	Annual average	0.4	2
Aldrin	Annual average	Σ = 0.01	0.01
Dieldrin	Annual average	Σ = 0.01	0.01
Endrin	Annual average	Σ = 0.01	0.005
Isodrin	Annual average	Σ = 0.01	0.005
Total 'Drins'	Annual average	-	0.03
Hexachlorobenzene	Annual average	0.01	0.03
Hexachlorobutadiene	Annual average	0.1	0.1
Carbon tetrachloride	Annual average	12	12
Chloroform	Annual average	-	12
1,2-dichloroethane	Annual average	10	10
Trichloroethyleme	Annual average	10	10
Perchloroethylene	Annual average	-	10
Trichlorobenzene	Annual average	0.4	0.4

8.2.7. Bathing Waters Directive

28. The Bathing Water Directive is implemented through the Bathing Waters Regulations 2008. Member States must monitor bathing waters every year and the monitoring calendar should provide for at least four samples to be taken per season (except where the season is very short or where there are special geographic constraints). The sampling interval should not be longer than one month. Upon the monitoring results gathered in four years, Member States should assess the bathing waters at the end of every season. A shorter period may be acceptable in some cases.

29. The Environment Agency (EA) monitors and assesses bathing water quality at each designated bathing water site in England and Wales between May and September.

30. Under the revised Bathing Waters Directive (2006/7/EC) more stringent water quality standards have been set, and a stronger emphasis placed on beach management. The bacterial parameters listed above have been replaced by tests for:

- Escherichia coli; and
- Intestinal enterococci.

31. Given that bathing water is measured by testing for the above parameters and this Project has no pathway to introduce such bacterial elements, this has been scoped out of the assessment.

8.2.8. Shellfish Waters Directive

32. This Directive concerns the quality of shellfish waters and applies to those coastal and brackish waters designated by the Member States as needing protection or improvement in order to support shellfish (bivalve and gastropod molluscs) life and growth and thus to contribute to the high quality of shellfish products directly edible by man.

33. The parameters applicable to the waters designated by the Member States are listed in Annex I.

8.2.9. MARPOL Convention 73/78

34. The International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78) was developed by the International Maritime Organization in an effort to minimize pollution of the oceans and seas, including dumping, oil and air pollution. The UK is a signatory to the MARPOL Convention 73/78.

35. All ships flagged under countries that are signatories to MARPOL are subject to its requirements, regardless of where they sail; and member nations are responsible for vessels registered on their national ship registry.

36. The objective of this convention is to preserve the marine environment in an attempt to completely eliminate pollution by oil and other harmful substances and to minimize accidental spillage of such substances.

8.2.10. International and National Sediment Quality Standards

8.2.10.1. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (Canadian Council of Ministers of the Environment (CCME), 2002).

37. Canadian sediment guidelines for the protection of aquatic life were developed under the auspices of the Canadian Council of Ministers of the Environment (CCME) to help set targets for sediment quality that would sustain long-term aquatic ecosystem health. The guidelines were developed from the available scientific information on the biological effects of sediment-associated chemicals.

38. The sediment quality guidelines are numerical concentrations or narrative statements that, unless otherwise specified, refer to the total concentration of a substance in surficial sediments (i.e. the upper few centimetres) on a dry weight basis (e.g. mg/kg dry weight).

39. They are not statutory standards and are based on the protection of pristine environments. There are two assessment levels - the Threshold Effect Level (TEL) is the lower of the levels and represents the concentration below which adverse biological effects are expected to occur only rarely. The higher level, the Probable Effect Level (PEL), defines a concentration above which adverse effects may be expected in a wider range of organisms.

40. Selected Canadian guidelines are presented in **Table 8-5**.

Table 8-5 Selected Canadian Sediment Quality Guideline Values (taken from CCME, 2002)

Contaminant	Units	TEL	PEL
As	mg/kg	7.24	41.6
Cd	mg/kg	0.7	4.2
Cr	mg/kg	52.3	160
Cu	mg/kg	18.7	108
Hg	mg/kg	0.13	0.7
Pb	mg/kg	30.2	112
Zn	mg/kg	124	247
Acenaphthene	µg/kg	6.71	88.9
Acenaphthylene	µg/kg	5.87	128
Anthracene	µg/kg	46.9	245
Benz(a)anthracene	µg/kg	74.8	693
Benzo(a)pyrene	µg/kg	88.8	763
Chrysene	µg/kg	108	846
Dibenz(a,h)anthracene	µg/kg	6.22	135
Fluoranthene	µg/kg	113	1494
Fluorene	µg/kg	21.2	144
Napthalene	µg/kg	34.6	391
Phenanthrene	µg/kg	86.7	544
Pyrene	µg/kg	153	1398

8.2.10.2. Cefas Action Levels for the Disposal of Dredged Material (Cefas, 2000)

41. One means of assessing the pollution potential associated with marine sediment is to compare their analysed contaminant levels with the ‘Action Levels’ for contaminants as defined by Centre for Environment, Fisheries and Aquaculture Science (Cefas). However, these are not statutory standards.

42. Action Levels are used by Cefas as part of a ‘weight of evidence’ approach to assessing sediment contamination, and the suitability for the disposal at sea of such sediment. For Cefas’ decision making process these values are used in conjunction with a range of other assessment methods, including bioassays, the disposal site characteristics and other relevant data.

43. In general, contaminant levels in sediment below Action Level 1 are of no concern to Cefas and unlikely to influence the licensing decision, while sediment with contaminant levels above Action Level 2 is generally considered unsuitable for sea disposal. Where contaminant levels lie between Action Levels 1 and 2, further consideration must be made before disposal, but there is no prohibition that sediment exceeding Action Level 1 for contaminants is unsuitable for further use or disposal at sea. Fine (muddy) sediments have a higher risk of containing contaminants (due to a relatively large surface area and greater cation exchange capacity) than coarser sediments, such as sand and gravel.

44. Selected current Action Levels are set out in **Table 8-6**.

Table 8-6 Selected Cefas Action Levels

Contaminant / Compound	mg/kg Dry Weight (ppm)	mg/kg Dry Weight (ppm)
Arsenic	20	100
Mercury	0.3	3
Cadmium	0.4	5
Chromium	40	400
Copper	40	400
Nickel	20	200
Lead	50	500
Zinc	130	800
Orgotins; TBT DBT MBT	0.1	1
PCB's, sum of ICES 7	0.01	none
PCB's, sum of 25 congeners	0.02	0.2
*DDT	*0.001	
*Dieldrin	*0.005	

Levels marked with * were set in 1994

8.3. CONSULTATION

45. Consultation with statutory bodies and key stakeholders was undertaken through a formal Environmental Impact Assessment (EIA) scoping process for the Project. Key responses of relevance to marine water and sediment quality have been summarised in **Table 8-7**.

Table 8-7 Summary of Consultation Responses as a Result of Scoping, Relating to Marine Water and Sediment Quality

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Scoping	The Scoping Report identifies marine water quality designations including bathing waters and a European Shellfish Water within the offshore scoping area and adjacent Holy Island coastal area. Table 7-2 (Potential impacts on marine sediment and water quality) of the Scoping Report identifies potential impacts but does not relate impacts to specific receptors such as designated sites for water quality. The ES should clearly identify and assess impacts to specific receptors where significant effects are likely. The ES should include figures that clearly depict the locations of such receptors.	See **Table 8-13**, which provides details of designated or sensitive sites within the vicinity of the MDZ and of relevance to the marine water and sediment quality assessment, and **Section 8.6** for the assessment.
Planning Inspectorate	2018 Scoping	Section 7.2.1.2 of the Scoping Report indicates the potential for contaminated sediments in the offshore area. The mobilisation of contaminants during construction has not been identified as a potential impact in Table 7-2 of the	**Section 8.6.4.3** assesses change in water quality due to release of

Consultee	Date/Document	Comment	Response
		Scoping Report, although it is noted that it has been identified as a potential impact on benthic ecology in Table 8-4. The Applicant should identify other receptors that may be significantly affected by the mobilisation of contaminants and if so, assess any impacts accordingly within the ES.	contaminated sediments.
Planning Inspectorate	2018 Scoping	Evidence should be provided within the ES to justify the assertion that any suspended sediments would be rapidly dispersed due to tidal flows, particularly in the nearshore and intertidal areas.	**Section 8.6.4.1** assesses change in water quality due to sediment plumes generated via foundation installation. Detailed information on tidal flows is provided in **Chapter 7, Metocean Conditions and Coastal Processes**.
Planning Inspectorate	2018 Scoping	Site-specific sediment contaminant sampling: It is recommended that the sampling programme is discussed and agreed with NRW.	No project-specific sediment contaminant sampling undertaken – See **Section 8.4.2.2**.
Planning Inspectorate	2018 Scoping	The Scoping Report has not detailed how the potential impacts will be assessed. The methodology must be detailed in the ES. It is considered that modelling will be required to predict the anticipated increase in suspended sediment from the Proposed Works. The ES should include details of the parameter inputs to the model and provide an explanation/justification of any worst case scenario that has been assumed.	Impact assessment methodology is included in **Section 8.4.3** and **Chapter 5, EIA Methodology**. Modelling has been used to assess the baseline hydrodynamic regime and the impacts from the Proposed Works on the baseline hydrodynamic regime. A description of this modelling process is provided in **Appendix 7.1** (**Volume III**). The results from the baseline understanding and

Consultee	Date/Document	Comment	Response
			hydrodynamic modelling have then been used to inform the assessment (**Section 8.6**).
NRW	2018 Scoping	In section 7.2.1.1 there is reference to the bathing water quality for eight beaches in the MDZ coastal area and reference to one designated European Shellfish Water. There is, however, no inclusion of the Water Framework Directive (WFD) existing water body status for the coastal water bodies within the demonstration zone. This must be included in the ES.	See **Table 8-13**, which provides details of all designated or sensitive sites within the vicinity of the MDZ (including coastal water bodies) of relevance to the marine water and sediment quality assessment.
NRW	2018 Scoping	The demonstration zone is located at its nearest point, 0.5 km (0.27 nautical miles) from the west coast of Holy Island Anglesey and falls within the Caernarfon Bay North WFD coastal water body which currently has an overall Good status, with a Good chemical status and a good ecological status. A Preliminary WFD Assessment report must be prepared by the applicant and submitted with the Marine Licence application and, where required, a detailed WFD Compliance Assessment Report should be undertaken.	A WFD compliance assessment report has been produced, please see **Appendix 8-1** (**Volume III**).
NRW	2018 Scoping	Contaminated sediments could be present in the demonstration zone and investigations should be carried out to determine the level of contaminated sediments particularly in areas where sediment may be disturbed into suspension during the construction phase i.e. installation of devices and the cable laying activities which could potentially release contaminants into the water column. We note your comment (section 7.2.3) “It is likely that site-specific sediment contaminant sampling would also be undertaken during the EIA” and advise that this activity is carried out.	No project-specific sediment contaminant sampling undertaken - See **Section 8.4.2.2**.
NRW	2018 Scoping	There has been no inclusion of tidal current data in the demonstration zone which shows the magnitude and direction of flow over the zone to substantiate the assumption that the suspended sediments would rapidly disperse. We agree that in fast flowing currents, dispersion of suspended sediments could occur rapidly and the	An assessment of the effects on the tidal regime have been included in **Chapter 7, Metocean Conditions and Coastal Processes**.

Consultee	Date/Document	Comment	Response
		potential for smothering would be reduced as a result (table 7.2). However, there is no baseline evidence presented in the metocean section that supports this assessment of impact. Further evidence should be presented in the ES to show the magnitude and direction of the tidal currents in the nearshore and intertidal areas which are often much smaller than those experienced offshore, and which may not be enough to promote rapid dispersion of suspended sediments and potential contaminants released through trenching activities over this zone.	
NRW	2018 Scoping	Section 7.2.3 states “baseline water quality conditions within the offshore scoping area. This would be done through a review of available literature”. It is unclear which baseline water quality conditions are being referred to. If the baseline water quality conditions are not adequately evidenced after review of available literature, further surveys should be carried out to inform the baseline characterisation.	There is suitable data on bathing water quality for nearby designated bathing beaches and these data have been used in this assessment (see **Section 8.5**) and the WFD compliance assessment (**Appendix 8-1, Volume III**).
NRW	2015 Scoping	The potential impacts on marine sediment are provided in Table 6.2 which we agree with, however, there is also potential for the release of contaminants into the water column if marine sediment is disturbed. This should be assessed in the EIA.	**Section 8.6.4.3** assesses change in water quality due to release of contaminated sediments.

8.4. METHODOLOGY

8.4.1. Study Area

46. The study area for marine water and sediment quality has a total area of 39.75 km², comprising the MDZ of 35 km², the export cable corridor (ECC) area of 4.75 km² and includes an intertidal area of 0.01 km² shared between the ECC and the onshore development area (ODA). The ECC connects the MDZ to the landfall location at Abraham’s Bosom on the west coast of Holy Island. The ECC encompasses much of the sea area to landward of the MDZ, to the landfall at Abraham’s Bosom.

8.4.2. Data Sources

8.4.2.1. Desk Study

47. The data and information presented in this section uses information collated for **Chapter 7, Metocean Conditions and Coastal Processes**. Data sources include information from existing

nearby projects, such as the Deep Green Holyhead Deep Project Phase I (0.5 MW) Environmental Statement (Minesto, 2016), as well as published literature. Baseline data and information have been collected from the following sources:

- Barne *et al*., 1995. Coasts and seas of the United Kingdom, Region 12 Wales;
- British Geological Survey (BGS) seabed sediment data;
- BGS Offshore Regional Report for the Irish Sea;
- Horizon Nuclear Power, 2018. Wylfa Newydd Project Water Framework Directive Compliance Assessment. 429pp;
- Horizon Nuclear Power, undated. Wylfa Newydd Project Disposal Site Characterisation Report. 227pp;
- Howarth, 2005. Technical report on the hydrography of the Irish Sea conducted as part of the Strategic Environmental Assessment (SEA) process; and
- Minesto, 2016. Deep Green Holyhead Deep Project Phase I (0.5 MW) Environmental Statement. 487pp.

8.4.2.2. Site-Specific Surveys and Reports

48. In addition to the general baseline data and information indicated in **Section 8.4.2** a number of site-specific surveys have also been used in this assessment (**Table 8-8**). Further details can be found in **Chapter 7, Metocean Conditions and Coastal Processes** of this ES.

Table 8-8 Data Sources

Data	Year	Coverage	Confidence	Notes
Geophysical Survey	2018	MDZ, buffer zone and Abraham's Bosom	High	High-resolution sea bed bathymetry, seabed texture and morphological features, and shallow geology using multibeam echosounder, side-scan sonar, and boomer (Partrac, 2018).
Subtidal Grab Sample Survey	2018	MDZ and buffer zone	High	Drop-down camera and five grab samples at selected suitable sites (Ocean Ecology, 2018).
Intertidal Survey	2018	Abraham's Bosom	High	Unmanned Aerial Vehicle (UAV) survey and intertidal walkover (Ocean Ecology, 2018).
Metocean Survey	2014	MDZ	High	Bottom-mounted Acoustic Doppler Current Profilers (ADCP) deployed for a continuous 40-day period in November and December 2014 at two locations.

49. With respect to any site-specific sediment contaminant sampling, following review of the local seabed conditions in the MDZ and ECC, it was clear that given the area's very high tidal energy and limited sediment cover, as well as the absence of any history of, or any apparent mechanism for, contaminant inputs, the potential for sediment contamination was low. In addition, the highly limited presence of sediment would limited opportunity for any sediment samples to be collected. Therefore, inclusion of contaminant sampling within project-specific EIA characterisation surveys was judged inappropriate and unlikely to be successful.

50. In practice, as indicated by initial review of the site, only limited sediment samples were able to be collected within the MDZ site during the summer 2018 survey, due to the absence of sediment cover for most of the site. These samples were of insufficient quality and quantity to have enabled any sediment contamination analysis.

51. Consideration has also been given to the outcome of recent sediment sampling for the adjacent Minesto project. This site is located much closer to the active Holyhead Deep marine disposal site (ISO40) than the MDZ and ECC and has seabed sediment present which might be expected to act as a sink for contaminants.

52. Analysis of samples for this project, collected by Minesto as part of their EIA studies in close proximity to the active disposal site, showed that levels of contamination in all the sediment samples were below Cefas AL1.levels (Minesto, 2016). Were sediment contamination to be an issue in this region, it would be more likely to occur in the Minesto site than the MDZ or ECC because of the greater proximity to the active disposal site and the larger amount of sediment cover compared to the MDZ and ECC.

8.4.3. Impact Assessment Methodology

53. This impact assessment follows the general methodology as set out in **Chapter 5, EIA Methodology**, of this ES.

54. The first stage in the assessment of potential impacts on marine water and sediment quality is to determine the baseline conditions of the marine water (i.e. the naturally occurring levels of contamination and concentrations of suspended sediments) and the sediments (in terms of physical properties and contamination). The physical properties of the sediments are important because fine muddy sediments have a higher risk of containing/taking up contaminants (due to a relatively large surface area and greater cation exchange capacity) than coarser sediments, such as sand and gravel.

55. Potential effects on marine water and sediment are then compared against existing baseline conditions and potential impacts are assessed against natural variation, the study area characteristics, spatial and temporal scales.

56. The EIA framework used in this assessment is based on the 'source-pathway-receptor' conceptual model process where the 'source' describes the origin of potential effects, and the 'pathway' describes the means by which the effect reaches the receiving sensitive 'receptor'. If the source, pathway or receptor is absent, no linkage exists and thus there will be no potential for an impact to occur.

8.4.3.1. Sensitivity

57. The sensitivity of a receptor is a measure of its ability to adapt to change, tolerate, and/or recover from potential impacts. The overall receptor sensitivity is therefore determined by a consideration of the receptor value, adaptability, tolerance and recoverability.

58. The sensitivity criterion also combines an assessment of the value of the receptor, which considers whether, for example, the receptor is rare, has protected or threatened status, has

importance at a local, regional, national or international scale, and in the case of biological receptors whether the receptor has a key role in the ecosystem function.

59. In order to define the sensitivity on marine water and sediment quality receptors, the criteria indicated in **Table 8-9** have been used.

Table 8-9 Definitions of the Sensitivity Levels for the Marine Water and Sediment Quality Receptors

Sensitivity	Definition
High	The marine water and sediment quality receptors support or contribute towards the designation or nationally important feature and have a very limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Medium	The marine water and sediment quality receptors support high biodiversity and have a limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Low	The marine water and sediment quality of the receptor have a high capacity to accommodate change to status, due, for example, to large relative size of the receiving water and capacity for dilution and flushing. Background concentrations of certain parameters may already exist.
Negligible	Specific marine water and sediment quality conditions are likely to be able to tolerate proposed change with very little or no impact upon the detectable baseline conditions

8.4.3.2. Magnitude

60. An assessment of the magnitude of effect is based on the consequences the effect has on marine water and sediment quality. The definitions of magnitude, specific to this assessment of marine water and sediment quality are indicated in **Table 8-10**.

Table 8-10 Definitions of the Magnitude Levels for the Marine Water and Sediment Quality Receptors

Magnitude	Description
High	Very significant changes to key characteristics of the marine water and sediment quality status of the receiving water feature. Water quality status degraded to the extent that a permanent or long-term change occurs.
Medium	Significant changes to key characteristics of the marine water and sediment quality status, taking account of the receptor volume, mixing capacity, flow rate, etc. Marine water and sediment quality status likely to take considerable time to recover to baseline conditions.
Low	Noticeable but not considered to be significant changes to the marine water and sediment quality status taking account of the receiving water features. Activity not likely to alter local status to the extent that water quality characteristics change considerably or EQSs are compromised.
Negligible	Although there may be some impact upon marine water and sediment quality status, activities predicted to occur over a short period. Any change to marine water and sediment quality status will be quickly reversed once activity ceases.

8.4.3.3. Impact Significance

61. Impacts are assessed by relating the magnitude of an effect to the sensitivity/value of the receptor, which in this case is marine water and sediment quality. The relationship is presented as a matrix, as shown in **Table 8-11**.

Table 8-11 Impact Assessment Matrix

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

62. In the context of marine water and sediment quality, the impact significance categories in **Table 8-12** can be defined.

Table 8-12 Impact Significance Definitions

Impact Significance	Definition
Major	Very large or large change in marine water and sediment quality, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in marine water and sediment quality, which is likely to be important considerations at a local level.
Minor	Small change in marine water and sediment quality, which may be raised as local issue but is unlikely to be important in the decision-making process.
Negligible	No discernible change in marine water and sediment quality

63. For the purposes of the EIA, 'major' and 'moderate' impacts are significant in terms of the EIA regulations and have to be avoided or reduced through mitigation, where possible. In addition, whilst 'minor' impacts are not significant in their own right, they may contribute to significant impacts cumulatively or through interactions.

64. Where the potential for an accidental spillage is concerned, the assessment is based on the risk of a spill or other accidental pollution event occurring. This is considered in relation to control measures that are available to minimise the risk.

8.5. EXISTING ENVIRONMENT

8.5.1. Regional Context

65. The MDZ is situated west of Holy Island and Anglesey, in an offshore area known as the Holy Island Shelf. The Holy Island Shelf is identified as an inlier of Precambrian metamorphic bedrock fringed to the north and west southwest with Lower Palaeozoic (undivided) sedimentary strata (Jackson et al., 1995).

66. The seaward coastline of Holy Island is formed of hard rock cliffs, and small sandy bays. The northern coastline is also rocky but has significant development through the port town of Holyhead. East of Holyhead the rocky cliffs persist as far as Penrhos beach. The eastern coastline of Holy Island is characterised by the salt marshes and mud-flats of the Alaw Estuary.

67. This bedrock, like the bedrock on areas of Anglesey, is part of the Monian Supergroup, comprising Holy Island, New Harbour and Gwna Groups. It is thought to have formed more than 570 million years (Ma) ago, although there is some debate that the formation may extend into

the Cambrian (Gibbons, 1983; McIlroy and Horak, 2006). The Monian Supergroup comprises gneisses, schists and igneous rocks, overlain by extrusive igneous rocks (Jackson et al., 1995). The igneous rocks are mostly volcanic-arc types, although some, as with the Gwna Group, show affinities with ocean floor basalts (Jackson et al., 1995).

68. The Holy Island Shelf to the west and north of South Stack is cut by Anglesey dykes of Tertiary age, orientated north northwest to south southeast (Jackson et al., 1995). These dykes are thought to be igneous in origin (Dolerite) (BGS, 2017) formed during a period of regional extension in the Palaeocene, resulting from a major north-south uplift (Jackson et al., 1995) as part of the final breakup of Pangea and the early stages of the opening of the Atlantic Ocean.

69. The BGS (1990) Seabed Sediments chart of Anglesey indicates that much of the MDZ consists of this exposed bedrock substrate with only local and/or intermittent cover of mobile and lag sediment in the nearshore. The BGS (1990) indicates that, offshore, there is less potential for finer sediment as it is likely to have been winnowed out by strong tidal processes, leaving a coarser surficial sediment.

70. A number of statutory and non-statutory designated sites occur in the vicinity of the MDZ and are potentially relevant to this assessment. These are detailed in **Table 8-13** and shown in **Figure 8-1** (**Volume II**).

Table 8-13 Designated or Sensitive Sites Within the Vicinity of the MDZ and of Relevance to the Marine Water and Sediment Quality Assessment

Site Name	Designation	Relevance to Assessment	Distance from the MDZ (km)
Caernarfon Bay North	Coastal Water Body	Welsh Coastal Water Body	Partial overlap
Holyhead Bay	Coastal Water Body	Welsh Coastal Water Body	3.0
Porth Dafarch	Bathing Water	Bacterial water quality monitoring for public health	1.4
Trearddur Bay	Bathing Water	Bacterial water quality monitoring for public health	4.2
Anglesey Inland Sea Shellfish Sites	Bivalve mollusc production area	Shellfish Water	21.0
Borth Wen	Bathing Water	Bacterial water quality monitoring for public health	6.7
Silver Bay Rhoscolyn	Bathing Water	Bacterial water quality monitoring for public health	8.3
Church Bay	Bathing Water	Bacterial water quality monitoring for public health	10.0

Site Name	Designation	Relevance to Assessment	Distance from the MDZ (km)
Rhosneigr	Bathing Water	Bacterial water quality monitoring for public health	11.2
Maltraeth	Cockle Fishery	Shellfish Water	21.7

71. The MDZ lies in close proximity to two Welsh WFD Coastal Water Bodies – the eastern part of the MDZ overlaps the Caernarfon Bay North (GB621010380000) water body, while the Holyhead Bay (GB681010360000) water body is located approximately 3 km away from the MDZ at its nearest point (**Figure 8-1, Volume II**).

72. The Caernarfon Bay North water body is classified as having good status overall. Data reported by Horizon Nuclear Power (2018) show that biological quality elements are at good status (based on benthic invertebrates); the classification of physico-chemical quality elements is high (based on dissolved oxygen, copper and zinc); the hydromorphological supporting elements are classified as 'supports good' (based on morphology); and the chemical assessment is good (based on an assessment of priority substances).

73. There are six bathing water beaches along the west coast of Anglesey (**Figure 8-1, Volume II**), all of which meet the higher water quality standard and have consistently met the higher standard since 2010.

74. The water catchment areas have a mix of rural, residential and commercial use but are predominantly rural in nature. Water catchment areas typically have a low level of sewage and industrial run-off. Based on the classifications reviewed as part of this assessment, there are no known issues with agricultural run-off.

8.5.2. Physical Environment

8.5.2.1. Hydrodynamics

75. Tides within the MDZ are semi-diurnal, with a spring tidal range of up to 4.5 m. Tides enter the Irish Sea from the Atlantic Ocean through St George's Channel and the North Channel to the south and north respectively.

76. Tidal currents within part of the MDZ are characterised by the ADCP surveys from Sites 1 and 2 (**Table 8-14**). These data show that current velocities at the measurement locations are slightly lower towards the sea bed due to bed-friction, but all values recorded exhibit very high baseline current speeds.

Table 8-14 Peak Tidal Currents at Sites 1 and 2 within the MDZ (source: OpenHydro, 2015)

Height above sea bed	Peak Velocities on a Mean Spring Tide Site 1 (m/s)	Peak Velocities on a Mean Spring Tide Site 2 (m/s)
10 m	2.71	2.64
15 m	2.84	2.79

20 m	2.92	2.90

77. Current roses from Sites 1 and 2 (and shown in **Figure 7-11, Volume II**) show that at both sites the baseline current velocities are strongly aligned from just east of south to north-northwest. However, further north in the MDZ, the tidal currents flow around Holy Island (to the north on a flooding tide and to the south on an ebbing tide) along a more south-north and then (with progression north) south-southwest-north-northeast axis.

78. Tidal current speeds and directions were also predicted by the baseline numerical modelling undertaken by HR Wallingford (2017) and showed peak speeds are generally faster through the eastern parts of the sub-zones, reaching around 2.6 – 2.8 m/s in most areas, apart from the northernmost and southernmost sub-zones. The highest velocities within the MDZ are recorded just off Holy Island (4.0 m/s; as discussed within **Chapter 7, Metocean Conditions and Coastal Processes**). For the western parts of the sub-zones, peak speeds are lower, reaching around 2.2 – 2.6 m/s.

79. These data are supported by other studies, e.g. Minesto (2016) indicates that the peak depth averaged mean spring current speeds at the coastal margins of the North Channel are up to 3 m/s, while peak depth-averaged mean neap currents approach 1.5 m/s. Horizon Nuclear Power (Undated) also reports tidal velocities in excess of 2.5 m/s during spring tides. Horizon Nuclear Power (Undated) also reports that the tidal current velocity is relatively unvarying with depth, except near the seabed, and results in well mixed unstratified waters.

80. SEACAMS modelling, reported in Minesto (2016), shows that the bed shear stresses (the frictional force exerted on the seabed by the movement of water) within the MDZ for a 15 day simulation is between 6 N/m^2 at the western offshore boundary, increasing to approximately 22 N/m^2 at points closest to Holy Island. These bed shear stresses are sufficient to transport fine and medium sands, and help to explain the swept bedrock in much of the MDZ (see below and Partrac, 2018). The MDZ is, therefore, dispersive of fine sediments and sands, generally transporting them to the north-east.

81. As a result of the semi-enclosed nature of the Irish Sea, waves are mostly locally generated (Morlais, 2016). Horizon Nuclear Power (Undated) reports that predominant wave directions are from the southwest and west, with the highest frequency from the southwest. These waves also have the longest fetch distances.

82. The wave regime was characterised using data obtained from the Met Office at three locations northwest of the MDZ and show the dominant offshore wave direction is south-southwest to southwest (see **Chapter 7, Metocean Conditions and Coastal Processes** for more details). The annual mean significant wave height (SWH) for the area is 1.26 – 1.50 m, ranging from 0.76 – 1.00 m in the summer to 1.51 – 1.75 m in the winter (Atlas of UK Marine Renewable Energy Resources, 2008).

83. Potential bed sediment transport is dominated by the tidal flow because water depths are, typically, sufficiently large that wave energy does not reach the seabed. Minesto (2016) shows that bed shear stresses are dominated by tidal flows, but that under extreme wave conditions (e.g. 8 m waves and larger) some wave interaction with the seabed could occur.

8.5.2.2. Seabed Sediments

84. Seabed data across the MDZ, collected and interpreted by Partrac (2018) show that throughout most of the northern, central and eastern parts of the MDZ the surface is dominated by outcropping rock. Sandy gravels are considered to generally make up the sediment patches that overlie the rock; and the deeper, western part of the MDZ consists of a relatively uniform gravel or gravelly sand, with small areas of outcropping rock to the north and localised megaripples to the south. Along the northwestern boundary of the MDZ, an increase in grain size is interpreted, meaning the gravels that dominate the seabed may contain coarser material.

85. Three grab samples collected by Ocean Ecology Ltd (2018) from the offshore area returned gravelly sands and sandy gravels with very low fines content (one sample contained 1.9 % <63 µm, while the other two samples contained no sediments finer than 63 µm). The very low fines content is consistent with sediments present in high energy environments, where fine grained material is rapidly winnowed and transported away. Only three samples were able to be collected due to the generally hard rock, tidally-swept seabed.

86. Within the shallower bays, along the Holy Island coast, are deposits of finer sediments. Sediments in the bays generally consist of sandy gravel or coarse sand, and in the case of the shallow waters within 'Abraham's Bosom' the sediments become finer, being interpreted as consisting of fine sand. A grab sample collected within 'Abraham's Bosom' by Ocean Ecology Ltd (2018) returned a sample of moderately sorted medium sand, with a d50 of approximately 0.4mm and a low fines content (3.6 % <63 µm).

87. The seabed in the north of Anglesey is characterised by exposed bedrock, or bedrock thinly overlain by boulders and gravels in a patchy composition (Rees, 2005). The intertidal areas around Anglesey are extensive areas of relatively undisturbed habitats comprised of high energy rocky shores, sea cliffs, coastal heathlands and coastal grazing. The west of Anglesey, where the export cable will landfall, has substantial areas of exposed shores which are largely coastal cliff headlands with beaches comprise of moderate coarse sediments.

88. Boulders are identified by Partrac (2018) as occurring over almost the entire offshore area surveyed. These range in size between 0.2 m – 1.5 m. Further, within the subtidal and intertidal surveys conducted to support **Chapter 9, Benthic and Intertidal Ecology**, extensive areas of both stony reef and bedrock reef were recorded (Ocean Ecology Ltd, 2018). Bedrock and stony reefs are both types of rocky reef which occur where the bedrock or stable boulders and cobbles arise from the surrounding seabed. A stony reef is defined as an area which is comprised of coarse sediments with a diameter of greater than 64 mm (cobbles and boulders) that provide a hard substratum. A reef is defined as having relief from the seafloor and elevation is used as a criterion in its classification. Epifaunal communities of a potential reef are also key in the determination of reefiness, with percentage cover of fauna used as a determination criterion. Irving (2009) classification of reef requires an area of potential stony reef habitat to be greater than 25 m^2 to be classified as a reef.

89. The north east spreading along the eastern central area of the site to the south west of the MDZ were dominated by stony reefs, while the central and north east area of the site were recorded as bedrock reef areas. Within the south east of the site, there were several areas of patchy

bedrock reef observed, and likewise in the southwest there were areas of patch stony reefs. Within the intertidal zone, the immediate seabed is covered by an expanse of bedrock reef, tailing into stony/bedrock reef in the north east and south east of the site.

90. Partrac (2018) also identified a large sandwave feature was identified near to South Stack which extends to the northwest for approximately 1 km. Bed levels either side of this feature are approximately 8 to 10 m different in height either side of the ridge, with bed levels deeper on the southwest side. This ridge is generally symmetrical in profile. Several smaller ridge features run parallel to the main ridge, extending to the north-northeast.

8.5.2.3. Suspended Sediment Transport

91. Measurements of suspended sediment concentration were carried out generally across the Irish Sea during June and November 1997, and April and September 1998 at a total of 85 stations. Overall, suspended sediment concentrations were between 2.55 and 23 mg/l over the period (**Table 8-15**), although concentrations varied seasonally (Bowers *et al*., 2002). More specific to the sea bed off Anglesey, suspended sediment concentrations remain very low, reaching about 5mg/l in summer and 10 – 15 mg/l in winter.

Table 8-15 Concentration of Total Suspended Solids (mg/l) in the Irish Sea 1997 - 1998

	Min	**Max**	**Mean**
June 1997, 16 stations	3.73	14.18	6.57
November 1997, 17 stations	2.55	20.38	9.82
April 1998, 26 stations	3.30	23.00	10.27
September 1998, 26 stations	2.76	17.18	5.70

8.5.2.4. Marine Disposal Areas

92. Marine water and sediment quality can be affected by the presence of marine disposal sites. The MDZ is located close to the boundary of the currently active Holyhead Deep disposal site (ISO40). The MDZ is also close to two closed disposal sites, namely Holyhead South (IS041), and Holyhead East (IS042) (**Figure 8-2, Volume II**).

93. The currently active Holyhead North site lies 5 km northwest of Holy Island and extends over an area of approximately 28.8 km^2. Horizon Nuclear Power (undated) indicates that since Holyhead Deep was opened in 1983, licences have been granted for the disposal of both capital and maintenance dredge arisings.

94. Horizon Nuclear Power (undated) also indicates that, over the period of operation of Holyhead Deep, approximately 1.66 Mt (1.1 Mm^3) of sediment has been disposed of at the site. This helps set the context for the potential worst-case sediment resuspension calculations for the MDZ presented in **Section 8.6.4.1** and **8.6.4.2** of this chapter.

95. Minesto (2016) indicates that all recent (since at least 2009) dredge spoil disposal at the Holyhead Deep disposal site has been maintenance dredge material from Holyhead Port; and Potter (2014; reported in Minesto (2016)) determined that the material dredged from the harbour is in the silt range (i.e. 0.0039 to 0.0625 mm on the Wentworth scale (Wentworth, 1922)).

96. The sediment disposed of at Holyhead Deep is, therefore, much finer-grained than the bed sediments present in the MDZ and its associated cable corridor. This sediment, by virtue of its finer-grained nature, has a higher risk of containing contaminants (due to a relatively large surface area and greater cation exchange capacity) than coarser sediments, such as sand and gravel. In addition, its fine-grained nature means it will remain in suspension longer than coarser material and, hence, is more likely to produce a sediment plume.

97. Marine disposal areas are also assessed within **Chapter 16, Infrastructure and Other Users** in relation to accessing the sites.

8.5.2.5. Marine Water and Sediment Contaminants

98. There is little site-specific information on water quality. The offshore area has a dynamic hydrological regime with a varied wave regime and a strong tidal regime that provides the site with high levels of mixing and dispersal. Given the generally low level of industrial activity in adjacent coastal areas and dynamic hydrological regime, it is anticipated that water quality offshore will be good.

99. Sources of sediment input to the coastal area are generally low, although periods of heavy rain increase surface run-off from rural and populated land, increasing riverine and coastal suspended sediment levels. However, sources of contaminated sediment are limited and no sources that would cause significant sediment contamination have been identified.

100. Sediment grain size is a significant factor that controls the capacity for both suspended and bed sediment to concentrate and retain metals and organic pollutants (Horoitz, 1991). Finer sediment fractions (clay and silt sized material (<2 μm)) have a greater adsorbing capacity, owing to larger surface area and greater cation exchange capacity. The proportion of fine sediments within the MDZ is low, with mainly coarse sediments and rock being present due to the presence of strong hydrological regimes. As a result, the sediments surrounding the MDZ are unlikely to contain high concentrations of contaminants.

101. Horizon Nuclear Power (undated) present the results of a water quality survey carried out within the Holyhead North sediment disposal site, approximately 4 km offshore from the WFD designated Caernarfon Bay North coastal water body. This is currently achieving ‘good’ ecological and chemical status under the WFD, while the classified bathing waters on the west coast of Anglesey are all currently rated as achieving excellent status.

102. Horizon Nuclear Power (undated) indicate that physico-chemical parameters were measured *in situ* throughout the vertical water column, including temperature, conductivity, salinity, dissolved oxygen (DO), pH and oxidation-reduction potential (ORP). The chemical and biochemical determinants monitored were total organic carbon (TOC), dissolved organic carbon (DOC), biological oxygen demand (BOD), total suspended solids (TSS), cations and anions, nutrients, metals, organic compounds and cyanide. There was no exceedance of EQS, all concentrations were in line with ‘good’ chemical status as defined by the WFD, most concentrations were below the analytical laboratory’s Minimum Reportable Value and all values were consistent with other coastal waters that are absent of pollutants.

103. In addition, during the October to December 2016 survey, seabed sediment samples were collected for analysis of chemical contaminants. Five samples were collected within the disposal site and one just outside, to the east. The majority of the samples were coarse, with two being finer slightly muddy gravelly sediment. The results showed that levels of contamination in all the sediment samples were below Cefas AL1.

8.5.3. Study Area Sensitivity

104. The study area has a large physical scale and a high degree of temporal and spatial variance. Whilst conservation designations are present within the study area, the sensitivity of the surrounding offshore marine environment with respect to water quality is considered to be Low. However, the landfall and near shore element of the cable route is located close to designated bathing water sites and therefore the sensitivity of the water for the landfall area is considered to be High.

8.6. IMPACT ASSESSMENT

8.6.1. Overview of Potential Impacts

105. The potential impacts on marine water and sediment quality receptors are:

- Changes in marine water quality as a result of sediment re-suspension caused by seabed disturbance;
- Change in marine water quality as a result of mobilisation of contaminants adsorbed onto potentially re-suspended seabed sediments; and
- Impacts on marine water quality and sediment quality as a result of potential accidental discharge and spillage of oils, fuels and materials utilised during construction, operation and decommissioning phases of the Project.

8.6.2. Mitigation Measures

8.6.2.1. Embedded Mitigation

106. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the Project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process.

107. A range of different information sources has been considered as part of embedding mitigation into the design of the Project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

108. The embedded mitigation relevant to marine water and sediment quality includes;

- So far as other constraints (for example, Chapter 24, Chapter Seascape, Landscape and Visual Impact Assessment) allow, devices within the MDZ are most likely to be placed towards the eastern part of the MDZ, where the baseline tidal currents are higher. This means that any suspended sediment effects will be more rapidly and more widely dispersed than if devices were to be placed towards the west of the MDZ.

8.6.2.2. Additional Mitigation Measures

109. An outline Pollution Prevention and Management Plan (**Document MOR/RHDHV/DOC/0077**) and outline Construction Environmental Management Plan (CEMP) (**Document MOR/RHDHV/DOC/0073**) have been prepared to provide an outline of the mitigation measures to be undertaken during construction, to minimise any impacts predicted. will be submitted with the TWAO application and Marine Licence application.

110. The development of the detailed design and final CEMP will refine the worst-case impacts assessed in this EIA. It is recognised that mitigation is an important element in the management and verification of the actual Project impacts. The requirement for appropriate design and scope of mitigation would be agreed with NRW prior to construction works commencing.

8.6.3. Worst Case Scenarios in Relation to Marine Water and Sediment Quality

111. In relation to the marine water and sediment quality within the MDZ and ECC, the worst case would relate to those scenarios which have the greatest potential to disturb seabed sediment. This would cause an increased suspended sediment concentration and could, in turn, lead to increased levels of contaminants within the water column, if contaminants exist in the seabed sediments.

112. With respect to foundation installation, the worst-case option would be pin-piles, as drill arisings (maximum of 117,780 m^3 predicted) and larger sediment plumes are produced during installation of this foundation type compared to Gravity Base Structure (GBS) foundations.

113. In addition, activities with the greatest risk of causing accidental spills/leaks of chemicals and other construction materials are also considered to represent the worst-case scenario. These scenarios are associated with the installation method and type of foundations as well as the installation methods chosen for the inter-array cables and subsea export cable.

114. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50 % of the tenants will undertake repowering, i.e. for 50 % of the tenants, their infrastructure will be removed and replaced (potentially with different infrastructure by a different tenant). For the other 50 % of tenants, their infrastructure will remain over the lifetime of the project.

115. In terms of impact assessment parameters, the repowering process has been defined as per below:

- Initial temporary seabed disturbance via deployment of barge anchors to remove foundations, TEC's, hubs, inter-array cables and monitoring equipment for 50 % of the Tenants (berths); and

- Further temporary seabed disturbance via re-installation (repowering) of foundations, TEC's, hubs, inter-array cables and monitoring equipment for the same 50 % of Tenants (berths).

116. The operational phase values include the temporary seabed disturbance that would arise via repowering and also up to ten cable repair events.

117. During all project phases, disturbance to sediments (temporary seabed disturbance) will occur via device, hubs and cable installation and also anchor deployments for installation barges. Based on information provided in **Chapter 4, Project Description**, the values in

118. **Table 8-16** have been calculated to define the worst-case parameters for temporary seabed disturbance. These are defined in terms of project phase, as different amounts of temporary seabed disturbance are predicted to arise in each phase.

Table 8-16 Summary of Worst-Case Scenario Temporary Habitat Loss during Construction, Operation (Repowering) and Decommissioning Phases

Activity	Footprint	Unit	Description of Activity
Construction Phase:			
Post-lay burial of cable	27,259	m^2	Area of sandwave field where post-lay burial via Mass-Flow Excavator (MFE) may be required.
Deployment of anchor blocks by barges during cable installation	100,240	m^2	Up to 8 x 25 m^2 (5x5 m) anchor blocks for a single barge = a total footprint per anchor deployment of 200 m^2 (8 x 25 m^2) Assumed that these types of anchor barges generally deploy a spread every 500 m. So, for every 500 m of cable installation a footprint of 200 m^2 of temporary seabed disturbance occurs (via the anchor blocks) Combining all potential export, array and cable tails the total length of cables (full 240 MW) is 250.6 km Assumes the footprint of 200 m^2 every 500 m (0.5 km), or 400 m^2 every 1 km, and assumes all cables are installed using anchor barges Temporary disturbance impact of (400 m^2 x 250.6) = 100,240 m^2 (0.10 km^2)
Deployment of anchor blocks by barges during TEC device installation	248,000	m^2	Max. no of devices set at 620 x small (0.3 kW devices) Assumed that deployment of each device requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2) Therefore, total temporary seabed disturbance = 620 x 400 m^2 = 248,000 m^2
Deployment of anchor blocks by barges during hub installation	48,000	m^2	Max. no of seabed mounted hubs set at = 120 Assumed that deployment of each hub requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2)

Activity	Footprint	Unit	Description of Activity
			Therefore, total temporary seabed disturbance = 120 x 400 m^2 = 48,000 m^2
Construction Phase TOTAL		**423,499 m^2 (0.42 km^2)**	
Operational Phase:			
50 % of tenants infrastructure (Foundations; TEC's; hubs' array cables; monitoring equipment) removed and replaced with new (different) tenant infrastructure	377,400 m^2	m^2	Initial removal of tenant infrastructure from 50 % of berths ▪ 50 % of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 ▪ 50 % of anchor block value of tidal device installation = 124,000 m^2 ▪ 50 % of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2 Subsequent re-installation (re-powering) of tenant infrastructure from 50 % of berths ▪ 50 % of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 ▪ 50 % of anchor block value of tidal device installation = 124,000 m^2 ▪ 50 % of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2
Cable repairs	3,000	m^2	Up to 10 major cable repairs (5 days each) may be required throughout the Project life. It is assumed that up to 750 m of cable will be subject to repair works per event (7,500 m in total). Using same value of 400 m^2 temporary seabed disturbance per 1 km of cable works (400 x 7.5) = 3,000 m^2
Operational Phase TOTAL		**380,400 m^2 (0.38 km^2)**	
Decommissioning Phase:			
Decommissioning Phase TOTAL		**423,499 m^2 (0.42 km^2) –** same worst-case as per construction phase due to same activities needed to remove infrastructure	

119. In addition to these worst-case parameter values for sediment disturbance, there is also the potential for the deterioration in water and sediment quality due to accidental spillages / leakages of construction and maintenance materials as well as fuels and oils from vessels and the tidal devices. It is estimated that there will be approximately 7,000 vessel days throughout the duration of the construction phase; therefore, this number of vessel movements will be taken forward as the worst case scenario.

120. With respect to the liquid inventory of actual devices deployed within the MDZ, the following worst-case values have been assumed:

- Oil (gearboxes, transformers etc.) 240,000 litres;

- Grease (bearing, seals etc.) 12,000 litres; and
- Hydraulic fluid 192,000 litres.

8.6.4. Potential Impacts during Construction

8.6.4.1. Construction Impact 1: Change in Water Quality Due to Sediment Plume Generated via Foundation Installation

121. During the construction phase there is the potential for disturbance and re-suspension of sediments, either directly from the sea bed, or from sub-seabed cuttings, and for these re-suspended sediments to be dispersed through the water column as a plume. This has the potential to increase the baseline suspended sediment concentrations and potentially increase turbidity around the MDZ.

122. During the drilling of pin pile foundations within the proposed MDZ development site, sediments will be released at the surface via the drilling equipment as cuttings of the bedrock which exists below the seabed. In addition, seawater and bentonite are likely to be used as a drilling fluid to lubricate the drill bit and the bentonite will be discharged along with the cuttings. Sediment generated as a result of the installation activities will be finer than the surface sediments. Data from Horizon Nuclear Power and Minesto show that the tidal currents within the MDZ are strong, while SEACAMS modelling shows that the bed shear stresses within the MDZ are sufficiently strong to transport fine and medium sands, and the MDZ is, therefore, dispersive of fine sediments and sands, generally transporting them to the northeast. The fine sediment arising from the pin pile installation activities is therefore likely to be dispersed quickly due to the surrounding energetic tidal environment; with any larger sediment clasts settling in the vicinity of the foundations. Further detail of the results of the coastal modelling conducted in relation to the Project are presented in **Chapter 7, Metocean Conditions and Coastal Processes**.

123. Based on a 240 MW capacity, the worst-case volume of cuttings for the entire site would amount to 117,780 m^3. However, this is the total for all foundations and foundations will be installed sequentially. A single device requiring four drilled piles will produce 160 m^3 of cuttings.

124. As discussed in **Chapter 7, Metocean Conditions and Coastal Processes**, this is likely to result in peak increases in suspended sediment concentration at the points of release within the Project being only a few mg/l (typically less than 10 mg/l) and peak values at only a short distance from each release point reducing rapidly to less than 1 mg/l. This low (barely measurable) effect is partly due to the low volume of sediment released from drilling at the location of each release point, and partly because any fine material released would be rapidly dispersed by the strong tidal currents along the axis of tidal flow.

125. The maximum envisaged effect associated with sediment plumes arising from the foundation installation activities will cause a small increase in suspended sediment concentration (typically less than 1 mg/l a short distance from the release point) over only a small geographical area (a few hundred metres). The effects will be temporary, with a return to very low background concentrations occurring rapidly upon cessation of installation activities (i.e. the effect is temporary only). Other than at the immediate release point, such a change would be immeasurable.

126. Therefore, the negligible magnitude of effect coupled with the low sensitivity of water quality receptors in this area result in a **negligible** impact via increased suspended sediment via foundation installation.

8.6.4.1.1. Mitigation

127. None required.

8.6.4.1.2. Residual Impact

128. The residual impact on water quality via sediment plume generated during foundation installation will remain **negligible**.

8.6.4.2. Construction Impact 2: Change in Water Quality Due to Sediment Plume Generated via Cable Installation

129. During the construction phase there is potential for offshore cable installation activities within the cable corridor (including the nearshore and landfall) to disturb sediments and release them into the water column as a plume. This will enhance the baseline suspended sediment concentrations in the water column, making it more turbid, until the plume becomes dispersed by tidal current action and the sediments settle once again on the sea bed.

130. The offshore parts of the cable corridor are mostly covered by large areas of outcropping bedrock, with minimal relief and only sparse sediment cover, predominantly gravel, cobbles and rock boulders. However, the northern part of the cable corridor is covered by a sand ridge north of South Stack headland and extending northwest for around 1 km. This is where post-lay jetting may be required to bury the offshore cable, which would cause some sea bed sediment disturbance.

131. Nearer to the landfall, Abraham's Bosom is a bay bounded by rock headlands to the north and south, with a cover of sediment overlying bedrock. The grab sample from this location recovered medium-grained sand. Just offshore of the bay is a patch of megaripples (up to 0.6 m high).

132. The free-laying of cables and the placement of cable protection would not cause plumes along the offshore sections of the cable corridor because the sea bed is characterised by bedrock or, where sparse sediment cover does exist, by sediments with a particle size that cannot be suspended in the water column. In the nearshore, the bedrock is overlain by sand which has the potential to be disturbed by the free-laying of cables and the placement of cable protection. However, any plume arising from these activities would only arise from the force of the cable or protection measures on the sea bed. At the landfall, the worst case scenario would be open trenching rather than the preferred option of Horizontal Directional Drilling (HDD). Under open trenching, approximately 8,880 m^3 of sand would be excavated and the majority replaced to backfill the trench, with only a small net loss to the inshore system. Due to these factors, the likely increase in suspended sediment concentration in areas with sand cover nearer to shore (including at the landfall) will remain within the bounds of natural behaviour that are governed by storm waves and surge effects. Furthermore, these effects will be one-off and temporary in duration and are unlikely to be measurable.

133. The principal effect would arise from the post-installation jetting to bury the offshore cable across the sand ridge feature in the northern half of the cable corridor. Under this activity, it is likely that the maximum envisaged effect associated with sediment plumes arising from the jetting will cause only modest (but measurable) increases in suspended sediment concentration locally (typically a few tens of mg/l above background levels). This increase would reduce rapidly with distance from the point of disturbance to a few mg/l over a small geographical area (within a few hundred metres, along the axis of tidal currents). Furthermore, these effects will be one-off and temporary in duration, with a return to the very low background concentrations occurring rapidly upon cessation of installation.

134. Therefore, the low magnitude of effect coupled with the low sensitivity of water quality receptors in this area result in a **minor adverse** impact via increased suspended sediments in the area around the sandwave field and a lower, **negligible** impact in other areas away from the sandwave field.

8.6.4.2.1. Mitigation

135. None required.

8.6.4.2.2. Residual Impact

136. The residual impact on water quality in the area around the sand-wave field will remain as **minor adverse.** The residual impact on water quality via cable installation in other parts of the MDZ will remain **negligible**.

8.6.4.3. Construction Impact 3: Change in Water Quality Due to Release of Contaminated Sediments

137. The re-suspension of sediments during construction activities could also lead to the release of any contaminants that may be present within them, which may in turn affect compliance with water quality standards.

138. The baseline environment section concluded that sediment contamination within the MDZ is low, due to the dynamic hydrological regime and generally low level of industrial activity in this region. The low proportion of fine sediments within the MDZ (which have a greater adsorbing capacity for contaminants) is another factor that indicates low sediment contamination levels.

139. Therefore, even though mobilisation of the relatively limited amount of sediments in the MDZ will occur via construction works, none of these sediments are known to have high levels of contaminants, which will result in a negligible magnitude of effect. The sensitivity of receptors in this area to water quality changes is low, therefore a **negligible** impact is predicted on general water quality in the MDZ via release of contaminated sediments.

8.6.4.3.1. Mitigation

140. None required.

8.6.4.3.2. Residual Impact

141. The residual impact on water quality via potential release of contaminated sediments in the MDZ will remain **negligible**.

8.6.4.4. Construction Impact 4: Change in Water Quality Due to Discharge of Construction Material and/or Chemicals

142. The liquid inventory for the Project indicates that there are large amounts of chemicals including oil, grease and hydraulic fluid that could be accidentally released/leaked from Project components. Other sources of potential chemicals include drilling fluids from any drilled pin-piles and also from HDD works at landfall.

143. If any such substances were accidentally released/leaked, quantities would likely be small due to relatively small amounts being present in individual devices. Due to the dynamic nature of the tidal and wave regime in and around the MDZ, lateral and vertical dispersion rates of any spilled substances would be expected to be high. The magnitude of this potential effect is considered to be low, as it is not anticipated to significantly affect local water quality and would also be temporary in nature (established controls would prevent further spillage/leakage once an event was detected).

144. The receptor is defined as general water quality and is judged to be low. Therefore, a **minor adverse** impact on general water quality in and around the MDZ is predicted.

8.6.4.4.1. Mitigation

145. Adherence to a project-specific Construction Environmental Management Plan (CEMP) and Pollution Prevention and Management Plan (PPMP). All solids will be separated from the drill fluid and disposed of in accordance with a project-specific Site Waste Management Plan; this is expected to stipulate the offsite removal of solids from drill arisings. Bentonite clay and water are considered to be non-toxic earthen materials and any arisings are likely to be dispersed quickly due to the dynamic tidal environment.

146. Menter Môn is committed to the use of best practice and pollution prevention guidelines at all times. A Pollution Prevention Management Plan (PPMP) would be in place and agreed with NRW in line with the Integrated Pollution Prevention and Control (IPPC) Directive such that any potential risk is minimised. Any permitted discharges would be small volumes, intermittent and dilute and disperse quickly. An outline Pollution Prevention and Management Plan (**Document MOR/RHDHV/DOC/0077**) and outline Construction Environmental Management Plan (CEMP) (**Document MOR/RHDHV/DOC/0073**) has also been prepared to provide an outline of the mitigation measures to be undertaken during construction, to minimise any impacts predicted.

8.6.4.4.2. Residual Impact

147. The residual impact on local water quality via potential release of construction materials and/or chemicals is judged to be reduced to **negligible** if appropriate mitigation measures are adhered to.

8.6.4.1. Construction Impact 5: Deterioration in Status of WFD Waterbodies and/or Local Designated Bathing Waters

148. The existing environment section indicated the MDZ lies in close proximity to two Welsh WFD Coastal Water Bodies – the eastern part of the MDZ overlaps the Caernarfon Bay North (GB621010380000) water body, while the Holyhead Bay (GB681010360000) is located approximately 3 km away from the MDZ at its nearest point (**Figure 8-1, Volume II**).

149. There are also six designated bathing water beaches along the west coast of Anglesey all of which meet the higher water quality standard and have consistently met the higher standard since 2010.

150. Potential exists for the status of these waterbodies/beaches to be adversely affected via deterioration in water quality/release of contaminants due to construction activities. However, the preceding impact assessments have concluded that no significant impacts on water quality are predicted via planned works. Therefore, it is judged that the magnitude of any effect is low.

151. The sensitivity of these receptors is judged to be medium as they have formal EU-level designations that require regular monitoring and compliance with. Therefore, a **minor adverse** impact is predicted on local WFD waterbodies and designated beaches via deteriorations in water quality during construction.

8.6.4.1.1. Mitigation

152. Adherence to project-specific CEMP and PPMP which themselves will take full account of relevant pollution control legislation and guidance, i.e. MARPOL regulations.

8.6.4.1.2. Residual Impact

153. The residual impact on these WFD waterbody and bathing beach receptors via potential release of construction materials and/or chemicals is judged to be reduced to **negligible** if appropriate mitigation measures are adhered to.

8.6.5. Potential Impacts during Operation

8.6.5.1. Operational Impact 1: Change in Water and/or Sediment Quality Due to Accidental Spillages/Leaks from Operational Devices

154. During the operational phase of the Project there is a potential risk to water and/or sediment quality via accidental spillage or release of materials such as grease and oils during maintenance work and from vessels associated with these works. Similar scope for accidental spillages/leaks will arise during any major cable repair works and/or repowering activities.

155. Menter Môn is committed to the use of best practice and pollution prevention guidelines at all times. An PPMP would be in place and agreed with NRW in line with the IPPC Directive such that any potential risk is minimised. Any permitted discharges would be small volumes, intermittent and dilute and disperse quickly.

156. As per during the construction phase, if any such substances were accidentally released/leaked, quantities would likely be small due to relatively small amounts being present in individual devices. Due to the dynamic nature of the tidal and wave regime in and around the MDZ, lateral and vertical dispersion rates of any spilled substances would be expected to be high. The magnitude of this potential effect is considered to be low, as it is not anticipated to significantly affect local water quality and would also be temporary in nature (established controls would prevent further spillage/leakage once an event was detected).

157. The receptor is defined as general water quality and is judged to be medium. Therefore, a minor adverse impact on general water quality in and around the MDZ is predicted.

8.6.5.1.1. Mitigation

158. Adherence to project-specific CEMP and PPMP which themselves will take full account of relevant pollution control legislation and guidance, i.e. MARPOL regulations.

8.6.5.1.2. Residual Impact

159. The residual impact on local water/sediment quality via potential leaks/releases of chemicals and other substances from operational devices and/or operation and maintenance activities is judged to be reduced to **negligible** if appropriate mitigation measures are adhered to.

8.6.5.2. Operational Impact 2: Change in Water Sediment Quality Due to Sediment Plumes Generated by Repowering and/or Cable Repair Works

160. During the operational phase of the Project there is an assumption that repowering of a maximum of 50 % of the berths will occur. In the 50 % of berths affected, all tenant infrastructure (foundations; TEC's; hubs; array cables will be removed and then new (possibly different) infrastructure will be re-installed (repowered). This will result in two, temporally separate effects of temporary seabed disturbance via the deployment of barge anchors to firstly remove infrastructure and then, further barge anchor deployments to re-install new infrastructure.

161. An assumption has been made that cable repairs would be required in the operational phase, with further temporary seabed disturbance from barge anchors deployed to undertake these repair operations.

162. The quantification of these potential impact (as defined by footprint of temporary seabed disturbance) is set out in **Table 8-15**.

163. These activities will create similar effects as previously assessed for the construction phase. The potential removal and re-installation of seabed mounted devices and/or seabed anchor systems for floating devices coupled with potential cable de-burial and re-burial in sedimentary areas will all result in creation of localised sediment plumes and subsequent deposition.

164. The magnitude of this effect will be less than for the main construction phase (0.42 km^2) due to a lower amount of temporary seabed disturbance via these operational phase activities (0.38 km^2). Therefore, magnitude is assessed as negligible.

165. The sensitivity of water quality receptors is judged to remain as low, resulting in a **negligible** impact.

8.6.5.2.1. Mitigation

166. None required.

8.6.5.2.2. Residual Impact

167. Negligible.

8.6.5.3. Operational Impact 3: Change in Water Sediment Quality Due to Sediment Plumes Produced via Scour around Seabed Mounted Project Infrastructure

168. Placing any structure on the seabed has the potential to result in scour around the structure, leading in turn to mobilisation of any available sediment in the area around the structure via plumes.

169. In areas of the MDZ where the sea bed is comprised of bare bedrock or where this is covered with boulders, cobbles or gravels there is unlikely to be any scouring effects, therefore there will be no change in suspended sediment concentrations. Where devices are placed in areas of the MDZ characterised by sands (e.g. southwest section and in the vicinity of the sand ridge in the north) there is potential for locally accelerated flows around foundations to increase suspended sediment concentrations, but since flows in these areas are very high in the baseline conditions, this will not be a major exacerbation of the issue.

170. Given the nature of the sea bed morphology, comprised mostly of exposed bedrock, the potential for adverse effects of this nature is extremely limited.

171. Therefore, for the majority of the site, where sediment cover is absent/limited, the magnitude of this effect is judged to be negligible. Coupled with the low sensitivity of water quality receptors, a negligible impact is predicted.

172. In areas where there is some sediment cover and, thus where scour may occur, the magnitude of effect is judged to be low. Coupled with the low sensitivity of water quality receptors in this area this results in a minor adverse impact.

8.6.5.3.1. Mitigation

173. There is no recommended further mitigation.

8.6.5.3.2. Residual Impact

174. The residual impact on water quality via scour-induced plumes in the area around the sand-wave field will remain as **minor**. The residual impact on water quality via scour-induced plumes in all in other parts of the MDZ will remain **negligible**.

8.6.6. Potential Impacts during Decommissioning

8.6.6.1. Decommissioning Impact 1: Changes in Suspended Sediment Concentrations During Removal of Project Infrastructure

175. During the decommissioning phase the removal of Project infrastructure has the potential to disturb sediments on the sea bed and release them into the water column as a plume. If this effect does occur, the magnitude of the effect will generally be lower than the effects arising from installation of foundations/cables.

176. The magnitude of effect is judged to be low and receptor sensitivity low, resulting in a **negligible impact.**

8.6.6.1.1. Mitigation

177. There is no recommended further mitigation.

8.6.6.1.2. Residual impact

178. The residual impact on water quality via plumes created via decommissioning activities will remain **negligible.**

8.6.6.2. Decommissioning Impact 2: Change in Water and/or Sediment Quality due to Accidental Spillages/Leaks from Vessels Involved in Decommissioning Works

179. During the decommissioning phase of the Project there is a potential risk to water and/or sediment quality via accidental spillage or release of materials from vessels associated with the works. Similar scope for accidental spillages/leaks will arise during any major cable repair works and/or repowering activities.

180. As per during the construction phase, if any such substances were accidentally spilt/leaked, quantities would likely be small due to relatively small amounts being present in individual devices. Due to the dynamic nature of the tidal and wave regime in and around the MDZ, lateral and vertical dispersion rates of any spilled substances would be expected to be high.

181. The magnitude of this potential effect is considered to be low, as it is not anticipated to significantly affect local water quality and would also be temporary in nature (established controls would prevent further spillage/leakage once an event was detected.

182. The receptor is defined as general water quality and is judged to be low. Therefore, a minor adverse impact on general water quality in and around the MDZ is predicted.

8.6.6.2.1. Mitigation

183. As per for the construction and operational phase impacts, Menter Môn is committed to the use of best practice and pollution prevention guidelines at all times. A PPMP would be in place and agreed with NRW in line with the IPPC Directive such that any potential risk is minimised.

184. Adherence to project-specific CEMP and PPMP which themselves will take full account of relevant pollution control legislation and guidance.

8.6.6.2.2. Residual Impact

185. The residual impact on local water/sediment quality via potential leaks/releases of chemicals and other substances from devices being decommissioned and/or vessels involved in these works is judged to be reduced to **negligible** if appropriate mitigation measures are adhered to.

8.6.7. Cumulative Impacts

186. Of the projects listed in **Chapter 27, Cumulative and In-combination Effects**, the only one which could potentially have a cumulative or in-combination effect with the Project in respect of marine water and sediment quality is judged to be Minesto's Holyhead Deep project, which lies immediately to the west of the MDZ. All other projects listed are either too remote from the Project for interactions between water/sediment quality impacts or on land and thus do not affect coastal processes.

187. In June 2014, Minesto was awarded an Agreement for Lease by The Crown Estate for a 10 MW installation, the Holyhead Deep project. An initial deployment of a 0.5 MW device was undertaken in summer 2018.

188. Minesto are now beginning EIA studies for a planned 80 MW installation of tidal energy devices, delivered in a phased manner, and located a short distance due west of the MDZ Project. Based upon the geographical configuration of the Minesto Project Development Area (PDA) with respect to the MDZ Project, there is no possibility of changes in tidal flow interacting between projects, due to the alignment of flood and ebb flows off the coast of Anglesey (i.e. the two projects are not upstream/downstream of each other).

189. Similarly, any (minor) sediment plumes arising from construction from either project will not coalesce because of: (i) the alignment of principal tidal flows; and (ii) likely different construction programmes (note that phase 1 of the Holyhead Deep project is already installed).

190. The one area where potential cumulative impact may occur were if construction activities were to occur simultaneously on both projects, which could produce a cumulative impact via spill events and accidental discharges of liquids/materials. If this cumulative impact occurred, a major adverse impact on local marine water quality could be produced. However, both projects would independently adopt standard best practice measures with respect to spill prevention and response and as such, the significance of this potential cumulative impact would be reduced to a negligible level.

8.6.8. Inter-Relationships

191. **Table 8-17** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 8-17 Inter-Topic Relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Metocean Conditions and Coastal Processes	Chapter 7	Section 8.5.2 and 8.6.4	Both chapters consider the potential effects of the Project on suspended sediment concentrations
Infrastructure and Other Users	Chapter 16	Section 8.5.2	Both chapters consider the potential effects of disposal sites on the Project

192. Habitat loss and disturbance is also discussed separately in a number of other chapters, including **Chapter 9, Benthic and Intertidal Ecology** and **Chapter 10, Fish and Shellfish Ecology**.

8.6.9. Interactions

193. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 8-18**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 8-18 Potential Interaction Between Impacts

Potential interaction between impacts					
Construction	1. Change in water quality via foundation installation	2. Change in water quality via cable installation	3. Change in water quality due to release of contaminated sediments	4. Change in water quality due to discharge of construction material and/or chemicals	5. Deterioration in status of WFD waterbodies etc.
1. Change in water quality via foundation installation	-	Yes	No	Yes	No
2. Change in water quality via cable installation	Yes	-	No	Yes	No
3. Change in water quality due to release of contaminated sediments	No	No	-	No	No
4. Change in water quality due to discharge of construction material and/or chemicals	Yes	Yes	No	-	Yes
5. Deterioration in status of WFD waterbodies and/or local designated bathing waters	No	No	No	Yes	-

Potential interaction between impacts			
Operation / Repowering	1. Change in water and/or sediment quality due to accidental spillages/leaks	2. Change in water sediment quality due to sediment plumes	3. Change in water sediment quality due to sediment plumes produced via scour
1. Change in water and/or sediment quality due to accidental spillages/leaks from operational devices	**-**	Yes	Yes
2. Change in water sediment quality due to sediment plumes generated by repowering and/or cable repair works	Yes	**-**	Yes
3. Change in water sediment quality due to sediment plumes produced via scour around seabed mounted Project infrastructure	Yes	Yes	-
Decommissioning	1. Changes in suspended sediment concentrations	Change in water and/or sediment quality	
1. Changes in suspended sediment concentrations during removal of Project infrastructure	**-**	Yes	
2. Change in water and/or sediment quality due to accidental spillages/leaks from vessels involved in decommissioning works	Yes	-	

8.7. SUMMARY

194. This chapter has provided an overview on the potential impacts which may occur within the several stages associated with the development of the Project: construction, operation, repowering and maintenance, and decommissioning to marine and water sediment quality within the MDZ.

195. **Table 8-19** collates the determinations of each of the impacts assessed and is presented as a summary of the determinations. It is evident that the vast majority of the impacts to the Marine Water and Sediment Quality throughout the various stages of development are likely to be of minor adverse significance, even when assessed with the worse-case scenario. Therefore, the effects on the Marine Water and Sediment Quality are unlikely to cause long-term changes to the MDZ environment and surrounding region, either through direct changes in the species composition or due to changes in sediment structure.

Table 8-19 Summary of Potential Impacts on Marine Water and Sediment Quality Associated with the Development of the Project

Potential Impact	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase					
1. Change in water quality due to sediment plume generated via foundation installation	Negligible	Low	Negligible	None required	Negligible
2. Change in water quality due to sediment plume generated via cable installation	Low (sandwave area) Negligible (other areas)	Low	Minor Adverse (sandwave area) Negligible (other areas)	None required	Negligible
3. Change in water quality due to release of contaminated sediments	Negligible	Low	Negligible	None required	Negligible
4. Change in water quality due to discharge of construction material and/or chemicals	Low	Low	Minor Adverse	Adherence to project-specific CEMP and PPMP which themselves will take full account of relevant pollution control legislation and guidance, i.e. MARPOL regulations	Negligible
5. Deterioration in status of WFD waterbodies and/or local designated bathing waters	Low	Medium	Minor Adverse	Adherence to project-specific CEMP and PPMP which themselves will take full account of relevant pollution control legislation and guidance, i.e. MARPOL regulations	Negligible
Operational / Repowering Phase					
1. Change in water and/or sediment quality due to accidental spillages/leaks from operational devices	Low	Low	Negligible	Adherence to project-specific CEMP and PPMP which themselves will take full account of relevant pollution control legislation and guidance, i.e. MARPOL regulations.	Negligible

Potential Impact	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
2. Change in water sediment quality due to sediment plumes generated by repowering and/or cable repair works	Negligible	Low	Negligible	None required	Negligible
3. Change in water sediment quality due to sediment plumes produced via scour around seabed mounted Project infrastructure	Low (sandwave/ sediment areas) Negligible (no sediment areas)	Low	Minor	None required	Minor adverse (sandwave / sediment areas) Negligible (no sediment areas)
Decommissioning Phase					
1. Changes in suspended sediment concentrations during removal of Project infrastructure	Negligible	Low	Negligible	None required	Negligible
2. Change in water and/or sediment quality due to accidental spillages/leaks from vessels involved in decommissioning works	Low	Low	Minor Adverse	Adherence to project-specific CEMP and PPMP which themselves will take full account of relevant pollution control legislation and guidance, i.e. MARPOL regulations.	Negligible

8.8. REFERENCES

Department of Energy and Climate Change (DECC) (2011a). Overarching National Policy Statement for Energy (EN-1). July 2011.

DECC, (2011b). National Policy Statement for Renewable Energy Infrastructure (EN-3). July 2011

Irving R (2009). The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. JNCC Rep No. 432:44.

Horizon Nuclear Power, 2018. Wylfa Newydd Project Water Framework Directive Compliance Assessment. 429pp;

Horizon Nuclear Power, undated. Wylfa Newydd Project Disposal Site Characterisation Report. 227pp;

Howarth, 2005. Technical report on the hydrography of the Irish Sea conducted as part of the Strategic Environmental Assessment (SEA) process; and

Minesto (2016). Deep Green Holyhead Deep Project Phase I (0.5 MW) Environmental Statement. Report prepared by Xodus on behalf of Minesto. June 2016.

Ocean Ecology (2018). Morlais Demonstration Zone (MDZ) Benthic Ecology Characterisation Survey 2018. Technical Report to Marine Space, November 2018.

Partrac (2018) Morlais Demo Zone (MDZ) Hydrographic & Geophysical Survey. Volume 2 – Survey Report to Marine Space, July 2018.

Rees E. I. S (2005). Assessment of the status of horse mussel (*Modiolus modiolus*) beds in the Irish Sea off NW Anglesey. DTI SEA6 Sub-contract report.

Morlais Project
Environmental Statement

Chapter 9: Benthic and Intertidal Ecology

Volume I

Applicant: Menter Môn Morlais Limited

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Chapter 9: Benthic and Intertidal Ecology

Author: MarineSpace

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GLOSSARY OF ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
BAP	Biodiversity Action Plan
BGS	British Geological Survey
CAA	Civil Aviation Authority
CCW	Countryside Council for Wales
CD	Chart Datum
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CIA	Cumulative Impact Assessment
DCO	Development Consent Order
DDC	Drop Down Camera
DDV	Drop Down Video
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ERCoP	Emergency Response Cooperation Plan
ES	Environmental Statement
EU	European Union
EUNIS	European Nature Information System
GBS	Gravity Base Structure
HDD	Horizontal Directional Drilling
ICES	International Council for Exploration of the Sea
INNS	Invasive Non-Native Species
JLDP	Joint Local Development Plan
JNCC	Joint Nature Conservation Committee
MarLIN	Marine Life Information Network
MBES	Multi Beam Echo Sounder
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MDZ	Morlais Demonstration Zone
MFE	Mass-Flow Excavator
MLW	Mean Low Water
MMO	Marine Management Organisation
MNCR	Marine Nature Conservation Review
MSFD	Marine Strategy Framework Directive
NPS	National Policy Statement
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
OEL	Ocean Ecology Limited
PfCO	Permission for Commercial Operations
RPQs	UAV Pilots
SAC	Special Area of Conservation
SCI	Site of Community Importance

SOPEP	Ship Oil Pollution Emergency Plan
SPA	Special Protected Area
S-P-R	Source-Pathway-Receptor
SSS	Side Scan Sonar
TEC	Tidal Energy Converter
TWAO	Transport and Works Act Order
UAV	Unmanned Aerial Vehicle
VER	Valued Ecological Receptors
WFD	Water Framework Directive
WNMP	Wales National Marine Plan

GLOSSARY OF TERMINOLOGY

Anthozoa	A class of marine animals including sea anemones and coral
Ascidian	A marine invertebrate - a sea quirt or tunicate
Bathymetry	Topography of the sea bed
Benthic	The lowest level of a body of water including the sediment surface
Bioaccumulation	The gradual accumulation of substances in an organism
Biogenic	Something that is produced or brought about by living organisms, such as a reef
Biotope	A region of habitat associated with a particular ecological community
Circalittoral	The region of a sea or ocean below the infralittoral zone to the maximum depth at which photosynthesis is still possible
Current	Flow of water generated by a variety of forcing mechanisms (e.g. waves, tides, wind)
Ebb tide	The falling tide, immediately following the period of high water and preceding the period of low water
Ecology	The relation of organisms to one another, and to their physical surroundings
Eulittoral	The area of the shore between the spring high and spring low tide lines.
Fetch	The distance travelled by wind or waves across open water
Flood tide	The rising tide, immediately following the period of low water and preceding the period of high water
Gravel	Loose, rounded fragments of rock larger than sand but smaller than cobbles. Sediment larger than 2mm (as classified by the Wentworth scale used in sedimentology)
Habitat	The environment of an organism and the place where it is usually found
Infralittoral	The region of shallow water closest to the shore, excluding the intertidal, dominated by algae
Intertidal	Area on a shore that lies between Lowest Astronomical Tide (LAT) and Highest Astronomical Tide (HAT)
Littoral	The area of a sea or lake between the high water mark and the edge of the continental shelf

Megaripples	Bedforms with a wavelength of 0.6 to 10.0m and a height of 0.1 to 1.0m. These features are smaller than sand waves but larger than ripples
Numerical modelling	Refers to the analysis of coastal processes using computational models
Offshore	Area to seaward of nearshore in which the transport of sediment is not caused by wave activity
Polychaete	A marine worm, such as a bristle worm
Sand	Sediment particles, mainly of quartz with a diameter of between 0.063mm and 2mm. Sand is generally classified as fine, medium or coarse
Scour	The erosion of sediment away from tan area as a result of the flow of water.
Sediment	Particulate matter derived from rock, minerals or bioclastic matter
Sediment transport	The movement of a mass of sediment by the forces of currents and waves
Shallow water	Commonly, water of such depth that surface waves are noticeably affected by bottom topography. It is customary to consider water of depths less than half the surface wave length as shallow water
Spring tide	A tide that occurs when the tide-generating forces of the sun and moon are acting in the same directions, so the tidal range is higher than average
Sublittoral	The area of a sea or ocean where sunlight reaches the sea floor, includes the infra- and circalittoral zones
Substrate	The surface or material on or from which an organism lives, grows, or obtains its nourishment.
Subtidal	An area of sea bed which lies below the level of the Lowest Astronomical Tide
Supralittoral	The area above the spring high tide line that is regularly splashed, but not submerged by ocean water
Surge	Changes in water level as a result of meteorological forcing (wind, high or low barometric pressure) causing a difference between the recorded water level and the astronomical tide predicted using harmonic analysis
Suspended sediment	The sediment moving in suspension in a fluid kept up by the upward components of the turbulent currents or by the colloidal suspension
Tidal current	The alternating horizontal movement of water associated with the rise and fall of the tide
Tide	The periodic rise and fall of the water that results from the gravitational attraction of the moon and sun acting upon the rotating earth

9. BENTHIC AND INTERTIDAL ECOLOGY

9.1. INTRODUCTION

1. Menter Môn Morlais Limited (Menter Môn) proposes the development of 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ). The development of the Morlais Project (the Project) will support the development of renewable energy technology objectives of the Anglesey and Gwynedd Joint Local Development Plan (JLDP), providing a consented tidal technology commercial demonstration zone which supports installation, testing and commercial demonstrations of tidal energy devices. The Project will also provide opportunities for the local communities via direct employment and support of the local supply chain.

2. The Project will include communal infrastructure for tidal technology developers which provides a shared route to a local grid connection via nine export cable tails, an onshore landfall substation, and an onshore electrical cable route to a grid connection via a grid connection substation.

3. This chapter provides a summary description of key aspects relating to existing benthic and intertidal ecology, followed by an assessment of the magnitude and significance of the effects on the baseline conditions resulting from the construction, operation and decommissioning of the Project, as well as those effects resulting from cumulative interactions with other existing or planned projects.

4. This chapter incorporates the data collected from the 2018 subtidal and intertidal surveys conducted by Ocean Ecology Ltd (OEL) (Ocean Ecology, 2018) within the MDZ and surrounding environment. The assessment process has been informed by the following:

   - **Chapter 7, Metocean Conditions and Coastal Processes**;
   - Interpretation of survey data specifically collected for the project including intertidal survey, benthic survey and analysis of seabed sediments;
   - Consideration of the existing evidence base regarding the effects of Project infrastructure on the subtidal and intertidal environments; and
   - Application of expert-based assessment and judgement by MarineSpace Ltd.

5. This chapter has been prepared by MarineSpace Ltd on behalf of Menter Môn

9.2. POLICY, LEGISLATION AND GUIDANCE

6. This section outlines the relevant national and regional policy and guidance and industry guidance which has be used to support the compilation of this Chapter.

7. An overview of the relevant legislative context for the Project is provided in **Chapter 2, Policy and Legislation**.

8. In addition to the general legislation and policy guidance set out in **Chapter 2, Policy and Legislation**, industry guidance on the generic requirements for the assessment of impacts on

benthic ecology studies associated with tidal array developments is provided by Natural Resources Wales (NRW) (Guidance Note 030) (NRW, 2018):

International:

- Habitats Directive Council (Directive 92/43/EEC) and other associated habitat regulations:
  - Birds Directive (Directive 2009/147/EC);
  - Ramsar Convention of Wetlands of International Importance;
  - Water Framework Directive (WFD) (EU Directive 200/60/EC);
  - Marine Strategy Framework Directive (MSFD); and
  - The Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention 1992).

National:

- Environment (Wales) Act 2016;
- The Wildlife and Countryside Act 1981(amended by the Countryside and Rights of Way (CROW) Act 2000);
- Marine and Coastal Access Act;
- Welsh Marine Protected Area Network; and
- Draft Wales National Marine Plan (WNMP).

Regional:

- Anglesey and Gwynedd Joint Local Development Plan (JLDP).

9.2.1. National Policy Statements

9. The Project is seeking consent for a Transport and Works Act Order from the Welsh Government and a Marine Licence from Natural Resources Wales (NRW). Although this project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP), therefore guidance relevant to NSIPs is considered appropriate to use for this Project. Guidance that is relevant to assessing impacts on marine water and sediment quality for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to marine water and sediment quality include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3), July 2011 (DECC, 2011b).

10. Details of specific policies within EN-1 and EN-3 used to inform this assessment are provided in **Table 9-1** below. The specific assessment requirements for marine water and sediment quality are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 9-1 NPS EN-1 and EN-3 Assessment Requirements Relevant to Marine Water and Sediment Quality

NPS Requirement	NPS Reference	ES Reference
Where the development is subject to EIA the applicant should ensure that the ES clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the IPC consider thoroughly the potential effects of a proposed project.	EN-1 Section 5.3.3	The designated sites relevant to the assessment are outlined in **Section 9.5.6**.
Applicants should assess the potential for the scheme to have both positive and negative effects on marine ecology and biodiversity.	EN-3 Para 2.6.67	Potential impacts of the Project on benthic and marine ecology are presented in **Section 9.6**.
Mitigation may be possible in the form of a careful design of the development itself and the construction techniques employed.	EN-3 Para 2.6.70	Embedded and additional mitigation measures are outlined in **Section 9.6.1**.
An assessment of the effects of installing cable across the intertidal zone should include information, where relevant, about: ▪ Any alternative landfall sites that have been considered by the applicant during the design phase and an explanation for the final choice; ▪ Any alternative cable installation methods that have been considered by the applicant during the design phase and an explanation for the final choice; ▪ Potential loss of habitat; ▪ Disturbance during cable installation and removal (decommissioning); ▪ Increased suspended sediment loads in the intertidal zone during installation; and ▪ Predicted rates at which the intertidal zone might recover from temporary effects.	EN-3 Para 2.6.81	The Project will use Horizontal Directional Drilling as the method of construction at landfall, which will avoid direct impacts to sensitive habitats and species. In case this is not technically feasible the worst case assessment covers trenching and/or surface laying of cables. Potential impacts of the Project on benthic and marine ecology are presented in **Section 9.6**. Potential impacts of the Project on ecology at the landfall, above Mean High Water, are presented in **Chapter 19, Onshore Ecology**
Applicants are expected to have regard to guidance issued in respect of Food and Environmental Protection Act (FEPA) [now Marine Licence] requirements.	EN-3 Section 2.6.83	Other relevant guidance, including in respect to the Marine Licence, is outlined further below in this section.
Where necessary, assessment of the effects on the subtidal environment should include: ▪ Loss of habitat due to foundation type including associated sea bed preparation, predicted scour, scour protection and altered sedimentary processes;	EN-3 Section 2.6.113	Due to the nature of the seabed within the MDZ and ECC, the preferred method of cable installation is surface laying. Potential impacts

NPS Requirement	NPS Reference	ES Reference
▪ Environmental appraisal of array cables and cable routes and installation methods; ▪ Habitat disturbance from construction vessels' extendible legs and anchors; ▪ Increased suspended sediment loads during construction; and ▪ Predicted rates at which the subtidal zone might recover from temporary effects.		of the Project on benthic and marine ecology are presented in **Section 9.6**.
Construction and decommissioning methods should be designed appropriately to minimise effects on subtidal habitats, taking into account other constraints. Mitigation measures which the Infrastructure Planning Commission (IPC) (now the Planning Inspectorate) should expect the applicants to have considered may include: ▪ Surveying and micrositing of the export cable route to avoid adverse effects on sensitive habitat and biogenic reefs; ▪ Burying cables at a sufficient depth, taking into account other constraints, to allow the seabed to recover to its natural state; and ▪ The use of anti-fouling paint might be minimised on subtidal surfaces, to encourage species colonisation on the structures.	EN-3 Section 2.6.119	Potential construction, operation, repowering and decommissioning impacts of the Project on benthic and marine ecology are presented in **Sections 9.6.2, 9.6.3** and **9.6.4.** Details of mitigation measures are provided within each of these sections where necessary.
Activities should have been designed taking into account sensitive benthic environmental aspects and intertidal habitats.	EN-3 Para 2.6.116	Details of the existing environment are provided in Section 9.5 and mitigation measures where necessary are provided in **Sections 9.6.2, 9.6.3** and **9.6.4.**
Where adverse effects are predicted, the assessment should consider the extent to which the effects are temporary or reversible. This includes the installation and decommissioning of cables.	EN-3 Para 2.6.117	The magnitude of each impact, which includes the extent to which the effects are temporary or reversible, has been considered in **Sections 9.6.2, 9.6.3** and **9.6.4.**

9.2.2. Marine Policy Statement

11. The Marine Policy Statement (MPS) adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made in order to enable sustainable development. The MPS sets out a vision of having 'clean, healthy, safe, productive and biologically diverse oceans and seas' by supporting the development of Marine Plans. It also sets out the framework for environmental, social and economic considerations that need to be considered in marine planning.

9.2.3. Wales National Marine Plan

12. By adopting the MPS, the Welsh Government committed to the requirement to introduce Marine Plans for Wales.

13. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the Welsh National Marine Plan (WNMP). The Plan is being developed in accordance with the Marine and Coastal Access Act (MCAA) 2009, the MPS and the Maritime Spatial Planning Directive, a draft version has been issued for consultation (discussed further in **Chapter 2, Policy and Legislation**).

14. Objective 10 of the WNMP, “to maintain and enhance the resilience of marine ecosystems and the benefits they provide in order to meet the needs of present and future generations”, is of relevance to this chapter as this covers policies and commitments on the wider ecosystem, as set out in the MPS including those to do with the Marine Strategy Framework Objective Directive and the Water Framework Directive, as well as other environmental, social and economic considerations.

15. **Table 9-2** sets out other national and regional policies which are particularly relevant to the Project.

Table 9-2 National and Regional Policy Requirements Relevant to Benthic and Intertidal Ecology

Policy Description	Reference	ES Reference
MPS		
Noise resulting from a proposed activity or development in the marine area or in coastal and estuarine waters can have adverse effects on biodiversity although knowledge of the extent of impacts is limited and there are few systematic monitoring programmes to verify adverse effects. Man-made sound emitted within the marine environment can potentially affect marine organisms in various ways. It has the potential to mask biologically relevant signals; it can lead to a variety of behavioural reactions, affect hearing organs and injure or even kill marine life. Manmade sound sources of primary concern with regard to disturbance of marine life are explosions, shipping, seismic surveys, offshore construction and offshore industrial activities, for example dredging, drilling and piling, sonar of various types and acoustic deterrent devices.	Section 2.6.3.1	Indirect noise impacts arising from the Project have been assessed on fish, birds and marine mammals. Please see **Chapters 10**, **Fish and Shellfish Ecology**, **Chapter 11, Marine Ornithology** and **Chapter 12 Marine Mammals**.
The UK Administrations are committed to allowing damaged ecosystems to recover in order to realise the benefits from the marine environment. This will be achieved through integrating conservation objectives into marine planning and decision making and incorporating the requirements for specific designated conservation areas.	Section 3.1.1	Conservation importance and objectives, where applicable are discussed in **Section 9.5.5**. Designated sites are presented in **Section 9.5.6**. Protected habitats and species are discussed in **Section 9.5.7**. These are considered fully within the impact assessment (**Section 9.6**)
These are sites identified and designated under Directives and include Special Areas of Conservation (SACs)	Section 3.13	Designated sites are presented in **Section 9.5.6**.

Policy Description	Reference	ES Reference
designated under the Habitats Directive, and Special Protection Areas (SPAs) classified under the Wild Birds Directive for rare, vulnerable and migratory bird populations. The Conservation of Habitats and Species Regulations 2010, the Conservation (Natural Habitats &c) Regulations 1994 (for Scotland only), the Conservation (Natural Habitats &c) Regulations (Northern Ireland) 1995 and the Offshore Marine Conservation (Natural Habitats &c) Regulations 2007, among others, provide statutory protection for these sites64, but do not provide statutory protection for potential Special Protection Areas (pSPAs) before they have been classified as SPAs. For the purpose of considering development proposals affecting them, as a matter of policy, UK Administrations wish pSPAs to be considered in the same way as if they had already been classified. Listed Ramsar sites also receive the same protection.		These are considered fully within the impact assessment (**Section 9.6**) as well as the Information to Support HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**)
A number of SSSIs extend into the marine environment, primarily the inter-tidal zone. The statutory protection afforded to SSSIs, and the procedures to be followed with regard to development proposals that may affect them, are detailed in Wildlife and Countryside legislation.	Section 3.1.5	There are no SSSIs with marine components in the vicinity of the Project.
Marine energy deployments, that is wave and tidal deployments, may pose potential risks to the environment if inappropriately sited. However, the level of risk and ecological significance is largely unknown since, in particular, tidal stream and wave technologies are at a relatively early stage of development. Studies of tidal range technologies, including barrages, have indicated that these structures can have adverse impacts on migratory fish and bird species and on the hydrodynamics of the estuarine environments in which they are situated. To underpin the marine planning process further research is needed to develop a better understanding of the potential impacts that marine technologies might have on potentially sensitive environmental features. For example, adaptation and mitigation methods for such impacts may be supported by detailed monitoring programmes and co-ordinated research initiatives, including post deployment of devices.	Section 3.3.25	Impacts to hydrodynamics are considered in **Chapter 7, Metocean Conditions and Coastal Processes** and any potential impacts during the operation of the Project on benthic and intertidal ecology is considered in **Section 9.6.3.1** and **9.6.3.2**
Draft WNMP		
Proposals should demonstrate how they contribute to the protection, restoration and/or enhancement of marine ecosystems.	ENV_01: Resilient marine ecosystems	The Project will put in place mitigation to ensure minimal disturbance to and loss of habitats and species during construction via pre-construction surveys and micro-siting.
Proposals should demonstrate how they: ▪ avoid adverse impacts on individual Marine Protected Areas (MPAs) and the coherence of the network as a whole; ▪ have regard to the measures to manage MPAs; and ▪ avoid adverse impacts on non-marine designated sites.	ENV_02: Marine Protected Areas	Consideration of effects on MPAs is included within **Section 9.6**. Additionally, consideration of impacts to European Designated sites is provided in **Document MOR/RHDHV/DOC/0067,**

Policy Description	Reference	ES Reference
		Information to Support HRA.
Proposals should include biosecurity measures to reduce the risk of introducing and spreading invasive non-native species.	ENV_03: Invasive non-native species	As a means of mitigation, an INNS risk assessment, to be undertaken once installation vessels and construction/manufacturing ports have been identified. Development of an outline Invasive Species and Biosecurity Management Plan (ISBMP) is suggested (**Section 9.6.2.5**). An outline Invasive and Non-Native Species (INNS) Management Plan has been submitted as part of this application (**Document MOR/RHDHV/DOC/0075, INNS Management Plan**).
Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01: Cumulative effects	Cumulative impacts are assessed in **Section 9.6.5** and in **Chapter 26**
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced	Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	The impact assessment is included within **Section 9.6** and includes mitigation measures to reduce impact significance.
It does not cause unacceptable harm to: iv. the area's biodiversity interests (including European Protected Areas such as marine Special Areas of Conservation and Special Protected Areas) due to their location, scale, form, appearance, materials, noise, or emissions or due to an unacceptable increase in traffic.	Policy AMG 4: Coastal Protection	Valued Ecological Receptors are discussed in **Section 9.5.5**, designated sites **in Section 9.5.6** and protected habitats and species in **Section 9.5.7**. Potential impacts to these are assessed throughout **Sections 9.6.2, 9.6.3** and **9.6.4**.
Proposals must protect and, where appropriate, enhance biodiversity that has been identified as being important to the local area	Policy AMG 5: Local Biodiversity Conservation	The Project will put in place mitigation to ensure minimal disturbance to and loss of habitats and species during construction via pre-construction surveys and micro-siting.

Policy Description	Reference	ES Reference
Wellbeing of Future Generations (Wales) Act 2015		
A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).	A resilient Wales	The Project is assessed to have minor to negligible impacts on benthic and intertidal biodiversity (**Table 9-32**) while providing a source of renewable energy to communities.

9.3. CONSULTATION

16. Scoping and consultation have been ongoing throughout the EIA and have supported the scope of the baseline characterisation work and ensuring that the requirements of the regulators and their advisors are met. **Table 9-3** summarises relevant consultation responses on the offshore elements of the Project received prior to and during preparation of the ES and which were considered in this Chapter. A full list of consultation responses and how they have been taken into account in finalising the Project is presented in **Chapter 6, Consultation**.

Table 9-3 Summary of Consultation Responses with Statutory Consultees Relating to Benthic and Intertidal Ecology

Consultee	Comment	Response
Planning Inspectorate	▪ *Sabellaria alveolata* and *Modiolus modiolus* reef: The Scoping Report notes the potential for *Sabellaria alveolata* and *Modiolus modiolus* reef to be present in the offshore scoping area. The Applicant should take into account NRW's response (see Appendix 1 of Scoping Opinion) stating that several areas of *Sabellaria alveolata* have developed into Sabellaria reef. Any likely significant effects on Sabellaria reef should be assessed within the ES. The ES should consider potential direct impacts from construction and also the potential impacts from maintenance activities on reef that may colonise the cables during the operational phase.	*Sabellaria alveolata* and *Modiolus modiolus* reef is considered within **Section 9.5.7** and **Sections 9.6.2, 9.6.3** and **9.6.4** of this chapter.
Planning Inspectorate	▪ Annex I habitats: The Scoping Report states that "there are no SAC or Annex I habitats identified within the offshore scoping area". NRW's response (see Appendix 1 of Scoping Opinion) states that Annex I Reef habitat is present within the zone. The ES should assess impacts to Annex I habitats where significant effects are likely to occur.	Annex I habitats are discussed within **Section 9.5.5** and considered throughout **Sections 9.6.2, 9.6.3** and **9.6.4** of this chapter.
Planning Inspectorate	▪ Section 7 marine habitats and species: Section 7 marine habitats and species which could be impacted by the Proposed Works should be acknowledged within the ES and an assessment of likely significant effects upon them should be	Marine habitats and species have been assessed throughout **Sections 9.6.2, 9.6.3** and **9.6.4**of this chapter. A differentiation between the

Consultee	Comment	Response
	undertaken. The ES should assess and differentiate between likely significant effects to intertidal and subtidal ecology.	Benthic Biological Environment and the Intertidal Biological Environment has been made within **Section 9.5.3.1**, **Section 9.5.3.2** and throughout **Impact Assessment.**
Planning Inspectorate	▪ Loss of habitat due to infrastructure footprint: It is understood that the type and locations of TEC devices within the offshore area will not be determined by the time of application. As such, the ES should consider a worst-case scenario of habitat loss. When assessing the potential impacts from loss of habitat, the ES should also give consideration to habitat loss resulting from the introduction of any scour and cable protection.	Loss of habitat due to infrastructure footprint has been assessed throughout **Sections 9.6.2, 9.6.3** and **9.6.4,** within the operational and maintenance phase and during the decommission phase of the Project. Temporary Habitat Disturbance has been assessed at all phases.
Planning Inspectorate	▪ Construction phase impacts: Potential construction phase impacts identified in Table 8-4 of the Scoping Report are equally applicable for the decommissioning phase and should be assessed as such in the ES.	Construction phase impacts are considered within **Section 9.6.2** of this chapter.
Planning Inspectorate	▪ Potential impacts: The ES should assess the likely significant effects from pollution from accidental spillages, impacts due to changes in water movements and changes in habitat type.	Release of pollutants due to accidental events is considered within **Section 9.6.2.3**.
Planning Inspectorate	▪ Impacts to benthic communities due to changes in sediment regime: Potential impacts due to change in sediment regime are included in Table 8.4. However, Table 8-2 identifies potential impacts to benthic ecology interest features of designated marine and coastal sites due to changes in coastal processes, sedimentology and hydrodynamic regime in Table 8-2. The ES should assess the likely significant effects on intertidal and subtidal benthic ecology from changes to physical process (e.g. alteration to flow conditions, waves regime and sediment transport pathways).	Increased suspended sediment concentration and sediment deposition is considered within **Section 9.6.2.2.**
Planning Inspectorate	▪ EIA Baseline Characterisation: The Applicant should consider the applicability of existing data to the Proposed Works. The Scoping Report explains that ecology characterisation surveys may potentially be required. It is recommended that the sufficiency of any existing data, and the need for any site-specific surveys, is discussed with NRW.	A Subtidal Survey (**Section 9.4.4.2**) and Intertidal Survey (**Section 9.4.4.3**) were conducted to support the impact assessment within this chapter.

Consultee	Comment	Response
	NRW's comments (see Appendix 1 of this Scoping Opinion) regarding the need for subtidal and intertidal surveys should be taken into account by the Applicant.	
Planning Inspectorate	▪ EIA Baseline Characterisation: The ES should explain how the sensitivity of benthic receptors sensitive to smothering and disturbance is determined, for example if it based on research or guidance. The ES should also take into account the sensitivity of benthic receptors to the other potential impacts identified in Table 8-4 of the Scoping Report.	The sensitivity of receptors is discussed in **Section 9.5.5**, and habitats and biotopes have been aggregated into Valued Ecological Receptors groups to allow for a streamlined assessment.
Planning Inspectorate	▪ Colonisation of structures: The ES should assess any likely significant effects from the colonisation of hard structures by non-native species.	Introduction of new habitat is considered within **Section 9.6.3.3**Operation Impact 3: Introduction of New Habitat in the Form of Project Infrastructure**.**
NRW	▪ Reference has been made to the HABMAP dataset (see Section 8.2) in relation to the benthic habitats that are within and adjacent to the Morlais demonstration zone. Whilst this is valid, it should be recognised that the confidence with which the HABMAP biotopes have been predicted is generally low to moderate. Comprehensive survey data does not exist for the demonstration zone, although there are some records in the Marine Recorder database which should be examined and incorporated into the summary. The ES must include an assessment of the confidence in the available data, as detailed in Schedule 3 of the MWR.	Survey data has been used to generate a greater understanding of the MDZ and surrounding environment, as presented throughout **Section 9.5**.
NRW	▪ There are a number of factual inaccuracies in Section 8.2.1.1 which must be corrected in the ES. Page 79 states that "there are no SAC or Annex I habitats identified within the offshore scoping area….". This is incorrect, as HABMAP predicts several rock biotopes and also coarse sediments and mixed sediments, which in some cases may form stony reef. In addition, data in Marine Recorder confirms the presence of Annex I Reef habitat within the zone. It is likely that Annex 1 rocky reef and / or stony reef will be present within the demonstration zone, and / or export cable corridor.	Following the survey conducted by OEL, all three reef Annex I habitats were observed, as discussed within **Section 9.5**.
NRW	▪ References to "*Sabellaria alveolata*" should be changed to "*Sabellaria* spp". Recent survey work by NRW TE in and around North and West Anglesey found several areas of developed Sabellaria reef.	Reference to *S. spinulosa* is used throughout this chapter, following survey data obtained by OEL.

Consultee	Comment	Response
	Video analysis, though inconclusive from a species identification point of view, appears to show a mix of both *S. alveolata* and *S. spinulosa* present in the elevated reef structures. It is therefore likely that any similar reef aggregations found within the zone will contain a mixture of Sabellaria species.	
NRW	▪ Section 7 (formerly BAP / Section 42) marine habitat records are present within or near the Morlais Demonstration Zone. These include *Musculus discor*s beds (two records to the North of Holyhead from 1996), seagrass (recent and historic records) in shallow water on the east and west sides of Holy Island (outside of the zone but potentially within the wider zone of impact) and fragile sponge and anthozoan communities both within and adjacent to the zone. Section 7 subtidal mixed muddy sediments, and subtidal sands and gravels are also predicted to occur in and adjacent to the zone, along with patches of Annex 1 rocky reef (survey records and BGS hard substrate map). The Section 7 species *Arctica islandica and Haliclystus auricular* have also previously been found in shallow waters off Holy Island (MNCR records from 1996) and may occur within the zone. These habitats and species must be acknowledged and considered in the EIA.	Section 7 marine habitat records are discussed within **Section 9.5.7.**
NRW	▪ It is difficult to comment on the potential impacts outlined in Table 8.4 due to the range of unknowns associated with such a broad PDE approach. Impacts will depend on the number, size and types of devices put in place. The table currently states “significance of impact unknown” in the “anticipated significance” column for many impact pathways. The potential impacts listed are quite broad and will need to be subdivided into specific parts for the EIA (for example, “impact to benthic communities due to the creation of sediment plumes during construction” could cause impacts both through increases in suspended sediment and also increases in sediment deposition). Some of the impact pathways that are missing include (but are not limited to) pollution from accidental spillages, impacts due to changes in water movements and changes in habitat type. A full assessment of potential impacts needs to be undertaken in the EIA.	A full assessment has been presented within **Chapter 7, Metocean Conditions and Coastal Processes**, and within **Section 9.6.2.2.**
NRW	▪ Specifically, in Table 8.4, the impact pathway identified as “impact to benthic communities due to	This impact has been assessed within **Section**

Consultee	Comment	Response
	the creation of sediment plumes during construction" is assessed as "effects unlikely to be significant". However, the comment for this impact states that the significance of impact would depend on the sensitivity of the local benthic habitats as well as the nature of sediment dispersal. In light of this fact, the significance level should be considered "unknown" until further knowledge of the benthic communities present is attained via site specific surveys.	**9.6.2.2** of this chapter following collation of survey data and extensive coastal processes modelling.
NRW	▪ We welcome the acknowledgement of potential impacts to benthic ecology interest features of designated marine and coastal sites due to changes in coastal processes, sedimentology and hydrodynamic regime in Table 8.2. We note, however, that only potential impacts due to change in sediment regime are included in Table 8.4 'Potential impacts on benthic ecology'. As noted in the Metocean Conditions and Coastal Processes section of this Opinion, we have raised some comments relating to coastal process aspects of the Scoping Report which will have consequences for benthic ecology. Specifically, we would welcome clarity on how the potential impacts to the physical processes caused by the deployment of multiple tidal energy devices and associated infrastructure will be adequately assessed using a non-numerical (conceptual model) approach, and how this will be applied in the context of potential impacts to intertidal and subtidal benthic ecology, water quality and coastal morphodynamics arising due to physical process impacts (alteration to flow conditions, waves regime and sediment transport pathways).	This impact has been assessed within **Section 9.6.2.2** of this chapter following collation of survey data and coastal processes modelling as detailed within **Chapter 7, Metocean Conditions and Coastal Processes**.
NRW	▪ The text in the EIA baseline characterisation section (Section 8.2.3) does not specifically state how further information will be obtained on the benthic habitats and species within the demonstration zone. Survey work is only mentioned as potentially being required. We advise that a targeted ground-truthing survey is carried out within the demonstration zone to properly characterise the area in terms of subtidal ecology (we understand that multibeam data already exists for the marine development area). This would reduce uncertainty as to the presence of sensitive features or receptors in the area. NRW TE can provide guidance on the interpretation and ground truthing of acoustic data (multibeam and side scan) for ecological	A Subtidal Survey (**Section 9.4.4.2**) and Intertidal Survey (**Section 9.4.4.3**) were conducted to support the Impact Assessment within this chapter.

Consultee	Comment	Response
	purposes and can advise on the scope of such surveys if required.	
NRW	▪ We note that the Offshore Scoping Zone now includes the sea area between the demonstration zone and the shore. Additional multibeam / acoustic survey and benthic ground-truthing will be needed in this area to inform the benthic impact assessment associated with the export cable route from the Lease Area if not already available.	A Subtidal Survey (**Section 9.4.4.2**) and Intertidal Survey (**Section 9.4.4.3**) were conducted to support the Impact Assessment within this chapter.
NRW	▪ The intertidal ecology section (Section 8.2.1.2) is very brief. The inclusion of an intention to 'assess' CCW Phase 1 habitat survey data, as part of the applicant's data gathering exercise to inform EIA baseline characterisation, is welcomed. This information needs to be presented in a similar way to the subtidal section (see Table 8.3) and assessed against a realistic worst-case scenario for the anticipated installation method, landfall location and spatial extent of the export cables.	A Subtidal Survey (**Section 9.4.4.2**) and Intertidal Survey (**Section 9.4.4.3**) were conducted to support the Impact Assessment within this chapter.
NRW	▪ With regards to the proposed export cable landfall location, the ES must include a detailed assessment of potential impacts to the intertidal habitats present in and around the Penrhos Feilw area. We recommend that, in order to inform baseline/characterisation of the intertidal zone at the proposed landfall location, the applicant undertakes a repeat of the Phase 1 intertidal habitat survey at an appropriate scale for the planned works.	Physical disturbance to intertidal habitats and species during landfall works is assessed within **Section 9.6.2.4**.
NRW	▪ We welcome the recognition in Table 11.1 that a thorough biosecurity risk assessment should be undertaken as part of the EIA process. The ES and associated biosecurity risk assessment should include consideration of how *Didemnum vexillum* will be contained within the marina and detail any measures to mitigate the onward spread of this species. This is particularly important if, during any stage of the development (construction, operation, decommissioning), the applicant intends to use the facilities at Holyhead marina or port for berthing of vessels, materials or equipment.	Discussion of *Didemnum vexillum* is presented within **Section 9.5.8** and **Section 9.6.2.5.** An assessment of INNS has been undertaken within **Section 9.6.2.5**. As a means of mitigation, an INNS risk assessment, to be undertaken once installation vessels and construction/manufacturing ports have been identified. Development of an ISBMP is suggested. An outline INNS Management Plan has been submitted as part of this application (**Document MOR/RHDHV/DOC/0075, INNS Management Plan**).

9.4. METHODOLOGY

9.4.1. Impact Assessment Methodology

17. A detailed description of the methodology employed within this chapter is described within **Chapter 5, EIA Methodology.**

18. The assessment approach has adopted the following stages:

- Review of existing relevant data and information;
- Acquisition of additional project-specific data to fill any gaps;
- Formulation of a conceptual understanding of baseline conditions;
- Consultation and agreement with the regulators regarding proposed assessment approaches;
- Determination of the worst-case scenarios;
- Consideration of embedded mitigation measures; and
- Assessment of effects using data analysis, numerical modelling outputs, and expert-based judgements by MarineSpace Ltd.

19. The assessment of effects on subtidal and intertidal ecology is predicated on a Source-Pathway-Receptor (S-P-R) conceptual model, whereby the source is the initiator event, the pathway is the link between the source and the receptor impacted by the effect, and the receptor is the receiving entity.

20. An example of the S-P-R conceptual model is provided by cable installation which disturbs sediment on the sea bed (source). This sediment is then transported by tidal currents until it settles back to the sea bed (pathway). The deposited sediment could smother and have an effect on the species on this area of the seabed (receptor).

21. Consideration of the potential effects of the Project is carried out over the following spatial scales:

- Near-field: the area within the immediate vicinity (tens or hundreds of metres) of the project and along the offshore export cable corridor (ECC); and
- Far-field: the wider area that might also be affected indirectly by the project (e.g. due to disruption of waves, tidal currents or sediment pathways).

22. Three main phases of development are considered over the life-cycle of the project, in conjunction with the present-day baseline. These are:

- Construction phase;
- Operation and maintenance phase (including repowering); and
- Decommissioning phase.

9.4.1.1. Sensitivity, Value and Magnitude

23. The sensitivity of a receptor is dependent upon its:

- Tolerance to an effect (the extent to which the receptor is adversely affected by an effect);
- Adaptability (the ability of the receptor to avoid adverse impacts that would otherwise arise from an effect); and
- Recoverability (a measure of a receptor's ability to return to a state at, or close to, that which existed before the effect caused a change).

24. In addition, a value component may also be considered when assessing a receptor. This ascribes whether the receptor is rare, protected or threatened.

25. The magnitude of an effect is dependent upon its:

- Scale (i.e. size, extent or intensity);
- Duration;
- Frequency of occurrence; and
- Reversibility (i.e. the capability of the environment to return to a condition equivalent to the baseline after the effect ceases).

26. The sensitivity and value of receptors and the magnitude of effect are assessed using expert judgement and described with a standard semantic scale. Definitions for each term are provided in **Table 9-4** to **Table 9-6**. These expert judgements of receptor sensitivity, value and magnitude of effect are guided by the conceptual understanding of baseline conditions.

Table 9-4 Definitions of Sensitivity Levels for an Ecological Receptor

Sensitivity	Definition
High	Tolerance: Receptor has very limited tolerance of effect Adaptability: Receptor unable to adapt to effect Recoverability: Receptor unable to recover resulting in permanent or long-term (greater than ten years) change
Medium	Tolerance: Receptor has limited tolerance of effect Adaptability: Receptor has limited ability to adapt to effect Recoverability: Receptor able to recover to an acceptable status over the medium term (5-10 years)
Low	Tolerance: Receptor has some tolerance of effect Adaptability: Receptor has some ability to adapt to effect Recoverability: Receptor able to recover to an acceptable status over the short term (1-5 years)
Negligible	Tolerance: Receptor generally tolerant of effect Adaptability: Receptor can completely adapt to effect with no detectable changes Recoverability: Receptor able to recover to an acceptable status near instantaneously (less than one year)

Table 9-5 Definitions of the Different Value Levels for an Ecological Receptor

Value	Definition
High	Value: Receptor is designated and/or of national or international importance for marine geology, oceanography and physical processes. Likely to be rare with

Value	Definition
	minimal potential for substitution. May also be of significant wider-scale, functional or strategic importance
Medium	Value: Receptor is not designated but is of local to regional importance for marine geology, oceanography and physical processes
Low	Value: Receptor is not designated but is of local importance for marine geology, oceanography and physical processes
Negligible	Value: Receptor is not designated and is not deemed of importance for marine geology, oceanography and physical processes

Table 9-6 Definitions of Magnitude of Effect Levels for an Ecological Receptor

Magnitude	Definition
High	Scale: A change which would extend beyond the natural variations in background conditions Duration: Change persists for more than ten years Frequency: The effect would always occur Reversibility: The effect is irreversible
Medium	Scale: A change which would be noticeable from monitoring but remains within the range of natural variations in background conditions Duration: Change persists for 5-10 years Frequency: The effect would occur regularly but not all the time Reversibility: The effect is very slowly reversible (5-10 years)
Low	Scale: A change which would barely be noticeable from monitoring and is small compared to natural variations in background conditions Duration: Change persists for 1-5 years Frequency: The effect would occur occasionally but not all the time Reversibility: The effect is slowly reversible (1-5 years)
Negligible	Scale: A change which would not be noticeable from monitoring and is extremely small compared to natural variations in background conditions Duration: Change persists for less than one year Frequency: The effect would occur highly infrequently Reversibility: The effect is quickly reversible (less than one year)

9.4.1.2. Impact Significance

27. Following the identification of receptor sensitivity and value, and magnitude of effect, it is possible to determine the significance of the impact. A matrix is presented in **Table 9-7** as a framework to guide how a judgement of the significance is determined.

Table 9-7 Impact Significance Matrix

		Negative Magnitude				**Beneficial Magnitude**			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

28. Through use of the matrix shown in **Table 9-7** an assessment of the significance of an impact can be made in accordance with the definitions in **Table 9-8**.

Table 9-8 Impact Significance Definitions

Impact Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation
Moderate	Intermediate change in receptor condition, which is likely to be an important consideration at a local level
Minor	Small change in receptor condition, which may be raised as a local issue but is unlikely to be important in the decision-making process
Negligible	No discernible change in receptor condition

29. For the purposes of this ES, ‘major’ and ‘moderate’ impacts are deemed to be significant (in EIA terms). In addition, whilst ‘minor’ impacts may not be significant, it is important to distinguish these from other non-significant (negligible) impacts as they may contribute to significant impacts cumulatively.

9.4.1.3. Cumulative Impact Assessment

30. Cumulative impacts are assessed through consideration of the extent of influence of changes to intertidal and benthic ecology arising from the project alone and those arising from the project cumulatively or in combination with other developments including the adjacent Deep Green (DG) Holyhead Deep Tidal Array project. The Scoping Report proposes that the export cable from the DG Holyhead Deep Tidal Array project will link with that of the Morlais Project and that both projects have a joint landfall.

9.4.2. Study Area

31. Study areas are defined for each topic at the relevant scale. These are determined by a number of factors such the distribution of receptors, footprint of potential impact, or perhaps political/management boundaries (e.g. territorial waters, ICES rectangles) and where possible these were agreed with regulators or advisors.

The MDZ is in the eastern Irish Sea, encompassing a sea bed area of approximately 39 km^2. Its nearest point is located approximately 0.5 km from the west coast of Anglesey. Export cables connect the Project across an offshore export cable corridor (ECC) to the east of the MDZ and then to the landfall at Abraham’s Bosom near Penrhos Feilw (**Figure 1-1, Volume II**). The benthic and intertidal study area encompasses the entirety of the offshore site (both the development site and the export cable route), as the footprint of the Project and associated engineering works has the potential to impact benthic ecology within these areas.

9.4.3. Data Sources – Desk Study

32. Prior to site-specific surveys, a detailed desk-based study was conducted. A comprehensive review of available information was conducted to support the scope of works, survey design and

regional characterisation. The resources from which detail were extracted included, but were not limited to:

- Marine Life Information Network (MarLIN);
- Consultation responses;
- UK SeaMap data 2010 (McBreen et al., 2011);
- British Geological Survey (BGS) data; and
- Published and unpublished literature.

9.4.4. Data Sources – Site-specific Surveys and Reports

9.4.4.1. Project-Specific Benthic and Intertidal EIA Characterisation Survey

33. To characterise the benthic ecology of the offshore site and the surrounding area, and to support the identification of possible Habitats Directive Annex I/II habitats/species, subtidal and intertidal surveys were conducted capturing ecological data. These surveys were conducted by OEL and involved the collection of marine data including high resolution seabed imagery, grab samples, core samples, quadrat data and aerial imagery to enable the collation of a detailed biotope map of the MDZ.

34. Site specific surveys were conducted in summer 2018 by OEL (Ocean Ecology, 2018), which aimed to characterise the benthic and intertidal ecology. Details of these surveys are described within **Table 9-9** with survey specific details, and sample site location displayed within **Figure 7-2** (**Volume II**). Sampling stations for general seabed classification purposes were spread throughout the survey area to ensure representative coverage of all predicted habitats identified in the review of geophysical data.

Table 9-9 Summary of Site-Specific Surveys Conducted to Support the Development of this ES Chapter

Survey Date	Survey Type	Key Outputs
4/09/2018 – 06/09/2018	Subtidal survey	42 subtidal DDV sample stations collecting 277 still images and 220 minutes of video footage; and Five grab sample stations for particle size analysis and in-situ faunal analysis.
30/08/2018	Intertidal survey	UAV mapping collected 243 high resolution nadir images across 500 m wide area; and Intertidal walkover survey of the Project cable landfall area.

35. A breakdown of all grab and camera sampling is presented within **Table 9-10**. A total of 227 still images and over 220 minutes of video data were collected from 42 subtidal sampling stations within the study area. Only four grab samples were obtained from the proposed 18 target stations, due to unsuitable substrate types across the majority of the sampling array. As the intertidal zone was dominated by hard substrate, the majority of the sampling was conducted using a 0.25 m^2 quadrat with the collection of two core samples.

9.4.4.2. Subtidal Survey

36. A subtidal survey array was developed around a diamond grid of sampling stations (**Figure 7-3, Volume II**) to allow a seabed biotope map to be produced for the benthic ecology requirements

of the EIA (Hitchin et al. 2015, Turner et al. 2015). Additional stations were added and located at potential transitions between substrates at key areas of development (along the cable corridor and Abraham's Bosom), and within a 1km buffer zone up- and down-stream of the development. Selection of these areas was aided by an initial interpretation of sidescan sonar backscatter, allowing for suitable substrates to be surveyed. The proposed survey designs were further sense checked against project-specific acoustic sidescan sonar and multibeam echo sounder data collected in 2018 by Partrac (Partrac, 2018).

37. The subtidal survey was completed between the 4th and 6th September 2018 and was comprised of 42 ground truthing stations across the Project area (including the buffer area and proposed cable corridors). At each of these stations, a drop-down camera (DDC) was deployed to collect seabed imagery data. Sediment samples were proposed to be collected at 18 grab sample stations, allowing for analysis of particle size and in-situ faunal analysis to aid biotope mapping. Due to substrate types, grabs were only collected from four of these 18 stations.

Table 9-10 Grab and Drop-Down Camera Sampling Undertaken During the Morlais Demonstration Zone Benthic Ecology Characterisation 2018 Survey

Location	Grab Samples (Macrobenthic and PSF Sub-Sample)	Drop Down Camera (DDC) Stations
Morlais Demonstration Zone	1	33
Associated buffer area	2	6
South cable corridor	1	3
Total	**4**	**42**

9.4.4.3. Intertidal Survey

38. The intertidal survey was undertaken during the spring tides on the 30th August in line with guidance in the Marine Monitoring Handbook (Davies *et al*., 2001) and CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn *et al*., 2006). Biotopes were classified according to the EUNIS classification (Parry, 2015) and were also correlated to the Marine Nature Conservation Review (MNCR) biotope classification. Boundaries of biotopes were recorded in areas where this was possible. The methods described below are those described within the survey report produced by OEL (Ocean Ecology Ltd, 2018).

39. This survey was conducted in two phases around the proposed cable landfall at Abraham's Bosom. In phase one, an Unmanned Aerial Vehicle (UAV) was flown at low tide to capture high-resolution aerial imagery which aided the generation of ortho-mosaic mapping. Each flight was planned to achieve a minimum resolution of 5 cm/pixel with an accuracy of 5-10 m and flown by qualified UAV Pilots (RPQs) under a Permission for Commercial Operations (PfCO) granted to OEL by the Civil Aviation Authority (CAA). All flights were conducted in line with relevant CAA regulations (Cap 722, 2015) with received permission from RSPB.

40. This process allowed for identification of key habitats during the Phase I intertidal walk over survey conducted during a second visit to ground-truth biotope boundaries and cryptic biotopes. For any soft sediments identified in the UAV mapping and/or walk over survey, a series of quadrat sampling stations were sampled to further inform subsequent biotope mapping.

41. Areas representative of each key hard substrate habitat at different tidal heights were assessed by recording the epibiota taxa present in randomly placed 0.04 m^2 (0.2 m x 0.2 m) quadrats. Identification was taken to species level where possible and undertaken in the field. Areas representative of each key soft sediment habitat were assessed by sampling the upper 10 cm of a 0.04 m^2 (0.2 m x 0.2 m) quadrat using a spade and screened on a 0.5 mm sieve. Any macrobenthos retained on the sieve was identified to species level where possible in the field. The quadrats were then dug to c. 30 cm depth to check for the presence of larger, burrowing species. All soft sediment samples were also subject to a visual inspection and observations of colour, smell, depth of RPD layer, texture and presence of surface features (accretions, algae, fauna, etc.) recorded.

9.5. EXISTING ENVIRONMENT

42. This section provides an overview of the baseline ecological environment in relation to the benthic and intertidal study area associated with the Project. This section provides details of species and habitats associated with the MDZ and wider area, while identifying those which may be of particular conservation concern. The characterisation of the existing environment is undertaken using the aforementioned data sources listed in **Section 9.4.3** and **Section 9.4.4** sections and the site-specific survey data, plus other relevant literature.

9.5.1. Regional Context

43. Within the wider Irish Sea, relatively shallow depths are observed of around 20-100 m over considerable areas. A deeper channel running north-south is located to the west of the Irish Sea exists, connecting the Irish Sea to the Celtic Sea via St George’s Channel and the Malin Shelf via the North Channel (Vincent et al., 2004).

44. A diverse array of seabed types are observed within Irish Sea, from gravelly sediments occurring extensively across a broad central belt (usually in areas exposed to strong tidal currents); mobile sands and megaripples around the coast of the Isle of Man, Liverpool Bay, Cardigan Bay and in St George’s Channel; two areas of muddy sediments in the northern half and exposed bedrock locally in the North Channel and between Anglesey and the Isle of Man (Boelens et al., 1999).

45. Around the coast of Anglesey, extensive platforms of pre-Cambrian rock expand up to 25 km offshore. The seabed in the north of Anglesey is characterised by exposed bedrock, or bedrock thinly overlain by boulders and gravels in a patchy composition (Rees, 2005). The intertidal areas around Anglesey are extensive areas of relatively undisturbed habitats comprised of high energy rocky shores, sea cliffs, coastal heathlands and coastal grazing. The west of Anglesey, where the export cable will landfall, has substantial areas of exposed shores which are largely coastal cliff headlands with beaches comprise of moderate coarse sediments. The benthic communities around the Project are typically common in the Anglesey area and the wider Welsh coastal regions. These communities are typically comprised of common polychaetes, crustaceans, molluscs and echinoderms.

46. Section 7 (formerly BAP / Section 42) marine habitat records are present within or near the MDZ. These include *Musculus discors* beds (two records to the North of Holyhead from 1996), seagrass (recent and historic records) in shallow water on the east and west sides of Holy Island (outside of the zone but potentially within the wider zone of impact) and fragile sponge and

anthozoan communities both within and adjacent to the zone. Section 7 subtidal mixed muddy sediments, and subtidal sands and gravels are also predicted to occur in and adjacent to the zone, along with patches of Annex 1 rocky reef (survey records and BGS hard substrate map). The Section 7 species *Arctica islandica* and *Haliclystus auricular* have also previously been found in shallow waters off Holy Island (MNCR records from 1996) and may occur within the zone.

9.5.2. Physical Environment

47. Water depths across the MDZ and export cable corridor vary between approximately -2 m CD at the landfall and -72 m CD in the northwest part of the MDZ (**Figure 7-1, Volume II**) (Partrac, 2018). The average depth across the MDZ is approximately 40 m.

48. Most of the sea bed comprises large areas of outcropping bedrock with minimal relief above surrounding bed levels. Secondary bathymetric features include a large, generally symmetric, sand ridge north of South Stack which extends to the northwest for approximately 1 km (within the offshore cable corridor). The crest of the ridge is about 8 m to 10 m higher than the surrounding sea bed. Several smaller ridges oriented parallel to the main ridge occur to its north-northeast. Within Abraham's Bosom (a bay towards the landfall), the bathymetry is smoother, representing the surface of an area of sediment on top of the bedrock, bounded by rock outcrops to the north and south.

49. At a more local scale the sea bed is uneven due to the presence of bedforms of various sizes. Megaripples occur close to Abraham's Bosom within the offshore cable corridor. They are up to 0.6 m high, up to 12.8 m wavelength, with crests oriented approximately west-east, indicative of north-south tidal currents. Larger fields of megaripples occur in the south and southwest parts of the MDZ, where they are up to 0.6 m high, up to 12.9 m wavelength, with crests oriented approximately west-east.

50. Given the semi-enclosed nature of the Irish Sea, most oceanic swell waves are prevented from reaching the Anglesey coastline through St George's Channel and from the north due to the shelter provided by the Isle of Man. As a result, waves arriving at the Anglesey coastline are predominantly wind generated within the Irish Sea (Royal HaskoningDHV, 2011). The fetch between Ireland and Wales is generally less than 100 km, limiting the height that waves can grow from the west. The largest fetch originates from a southwest direction, where the fetch can reach thousands of kilometres into the Atlantic Ocean. Further details of the physical details of the area surrounding the MDZ are presented within **Chapter 7, Metocean Conditions and Coastal Processes**.

9.5.2.1. Seabed Sediment Distribution

51. Throughout most of the northern, central and eastern parts of the MDZ the sea bed is dominated by outcropping bedrock with thin patches of sandy gravel, whereas the deeper western part comprises relatively uniform gravel or gravelly sand.

52. Following the collection of video and still image data from the 42 subtidal sampling stations, only five of the 18 target sampling stations were deemed suitable for grab sampling due to the hard substrate present resulting the in the acquisition of just four grab samples. Only one sea bed

sediment sample (location 41) was recovered from the MDZ, on its eastern boundary, northwest of South Stack (Ocean Ecology, 2018). This low level of successful sediment sampling reflected the predominantly hard seabed substrate across the survey area. Two samples were collected in the buffer zone, one north of South Stack (location 15) and one to the south of the MDZ (location 20). One sample (42) was collected along the landward part of the offshore cable corridor in Abraham's Bosom (Ocean Ecology, 2018).

53. The dominant sediment type in sample 41 is gravel (73%) with 27 % sand, with a median particle size of about 3.8 mm. In samples 15 and 20, the dominant component is sand (89-93 %) with a median particle size of 0.63 mm and 0.75 mm (both coarse sand) (Folk, 1954) (**Table 9-11**). The particle size characteristics of sample 42 were dominated sand (96 %) with a median particle size of about 0.41 mm (medium sand). This sample falls within the Abraham's Bosom sediment deposition zone identified by Partrac (2018).

Table 9-11 Particle Size Characteristics of Sea Bed Sediment Samples in the MDZ and Buffer Zone. Data from Ocean Ecology (2018)

Station	Gravel (%)	Sand (%)	Mud (%)	d_{50} (mm)
41	73	27	0	3.8
15	9	89	2	0.63
20	7	93	0	0.75
42	0	96	4	0.41

9.5.3. Biological Environment

9.5.3.1. Benthic Biological Environment

54. A total of 42 subtidal sampling stations were targeted allowing for the collection of 277 still images and over 220 minutes of video footage. Of the 18 target sample stations for benthic grabs, only five were deemed suitable due to the presence of hard substrate. Therefore, only four grab samples were obtained within this survey.

55. Due to the prevalence of hard substrate across the survey area very few grab and core samples were acquired during the subtidal and intertidal surveys demonstrating the limited extent of sediment habitats across MDZ. The few samples that were acquired were seemingly impoverished with a maximum of six taxa and nine specimens recorded in any one sample.

9.5.3.2. Intertidal Biological Environment

56. The dominance of hard substrate in the intertidal zone meant that the majority of intertidal sampling involved 0.25 m^2 quadrat sampling (18 stations) and the collection of just two core samples. The UAV mapping survey resulted in the collection of 243 high resolution nadir images across a 500 m wide area of the intertidal area.

57. The intertidal survey area was found to support a wide variety of littoral rock biotopes interspersed with discrete patches of barren shingle and occasional areas of sandy sediment. Biotopes within the intertidal zone were those which are typically associated with a high energy intertidal area, such as *Mytilus edulis* and barnacles on very exposed eulittoral rock, *Semibalanus balanoides*, *Patella vulgata* and *Littorina* spp. on exposed to moderately exposed

or vertical sheltered eulittoral rock, *Fucus* spp. on exposed to moderately exposed upper eulittoral rock and Fucoids and kelp in deep eulittoral rockpools.

9.5.4. Biotope Classification and Mapping

58. The subtidal environment within and surrounding the MDZ was found to be constituted by a complex assortment of subtidal biotope mosaics dominated by circalittoral and/or infralittoral rock and coarse sediments. A total of 28 intertidal and 15 subtidal EUNIS biotopes were mapped across the survey area based on a comprehensive synthesis of all information collected during the survey and all available existing information including geophysical data and existing biotope mapping. A summary of all intertidal and subtidal biotopes is mapped in **Figure 9-1** and **Figure 9-2** (**Volume II**), and also displayed within **Table 9-12**.

59. The deeper areas of the site were characterised by coarse sediments (A5.14) representative of Annex I stony reef habitat (as per Irving, 2009) frequently overlain by varying coverage of *Sabellaria spinulosa* tube aggregations representative of Annex I biogenic reef in some areas (as per Gubbay, 2007) (A4.22). The amount of overlying sediment was reduced in the slightly shallower waters in central, southern and northern areas where tide-swept and mixed faunal turf communities (A4.11 / A4.13) representative of Annex I bedrock reef were prevalent. Closer to shore sediment biotopes dominated grading from coarse gravels (A5.14) to subtidal sands (A5.2) in Abraham's Bosom transitioning into macrophyte dominated infralittoral rock in the shallow subtidal and sublittoral fringes across the whole area (A3.1111, A3.1112, A3.2111). **Plate 9-1** illustrates images of biotopes observed within across the MDZ survey area.

60. Due to the hard nature of the seabed across most of the subtidal survey area, biotope mapping across this zone was largely informed by the results of the seabed imagery analysis and a detailed interpretation of the MBES and SSS data available for the site. This area was found to be constituted by a complex array of subtidal biotope mosaics dominated by circalittoral and/or infralittoral rock and coarse sediments. All three Annex I reef types (bedrock, stony and biogenic) were noted across this area.

61. The intertidal area supports a wide variety of littoral rock biotopes interspersed with discrete patches of barren shingle and occasional areas of sandy sediment. The graduation down the shore followed that of other exposed to moderately exposed shores with notable lichen and barnacle bands (B3.111, A1.112, A1.1131) in the supralittoral and upper-mid shore areas, especially in the more gradually inclining areas within the main bay areas, grading into fucoid and then kelp dominated rock biotopes.

62. Impoverished shingle (A2.111) was recorded in upper shore areas within the bays overlain by a narrow strandline biotope constituted by decomposing seaweed supporting sandhopper (*Talitrid* amphipods) communities (A2.211).

63. The gradation of biotopes observed in the bays was compressed into narrow bands in the southern and northern sections of the survey area due to the steep cliffs and vertical rock faces. All areas of littoral rock biotopes within the intertidal area were representative of Annex I bedrock reef as mapped in **Plate 9-1**.

64. Similar to the subtidal zone, the intertidal survey area was largely characterised by hard substrate meaning the majority of the biotope mapping was informed by quadrat data, UAV imagery and existing biotope mapping. The intertidal survey area was found to support a wide variety of littoral rock biotopes representative of Annex I bedrock reef interspersed with discrete patches of barren shingle and occasional areas of sandy sediment.

Table 9-12 Biotopes Identified within the Survey Area (Ocean Ecology, 2018)

EUNIS Code	JNCC Marine Habitats Classification Biotope Code	Biotope Description
A1.1	LR.HLR	High energy littoral rock
A1.111	LR.HLR.MusB.MytB	*Mytilus edulis* and barnacles on very exposed eulittoral rock
A1.112	LR.HLR.MusB.Cht.Cht	*Chthamalus* spp. on exposed upper eulittoral rock
A1.1131	LR.HLR.MusB.Sem.Sem	*Semibalanus balanoides*, *Patella vulgata* and *Littorina* spp.on exposed to moderately exposed or vertical sheltered eulittoral rock
A1.1132	LR.HLR.MusB.Sem.FvesR	*Semibalanus balanoides*, *Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock
A1.123	LR.HLR.FR.Him	*Himanthalia elongata* and red seaweeds on exposed to moderately exposed lower eulittoral rock
A1.125	LR.HLR.FR.Mas	*Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock
A1.212	LR.MLR.BF.FspiB	*Fucus spiralis* on exposed to moderately exposed upper eulittoral rock
A1.213	LR.MLR.BF.FvesB	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock
A1.2141	LR.MLR.BF.Fser.R	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock
A1.311	LR.LLR.F.Pel	*Pelvetia canaliculata* on sheltered littoral fringe rock
A1.3141	LR.LLR.F.Asc.FS	*Ascophyllum nodosum* on full salinity mid eulittoral rock
A1.411	LR.FLR.Rkp.Cor	Coralline crust-dominated shallow eulittoral rockpools
A1.412	LR.FLR.Rkp.FK	Fucoids and kelp in deep eulittoral rockpools
A1.413	LR.FLR.Rkp.SwSed	Seaweeds in sediment-floored eulittoral rockpools
A1.444	LR.FLR.CvOv.RhoCla	*Rhodochorton purpureum* and *Cladophora rupestris* on upper to mid-shore cave walls
A1.4461	LR.FLR.CvOv.SpR.Den	Sponges, shade-tolerant red seaweeds and *Dendrodoa grossularia* on wave-surged overhanging lower eulittoral bedrock and caves
A1.451	LR.FLR.Eph.Ulv	Ulva spp. on freshwater-influenced and/or unstable upper eulittoral rock
A2.111	LS.LCS.Sh.BarSh	Barren littoral shingle
A2.2	LS.LSa	Littoral sand
A2.211	LS.LSa.St.Tal	*Talitrids* on the upper shore and strand-line
A2.211	LS.LSa.St.Tal	*Talitrids* on the upper shore and strand-line
A3.1	IR.HIR	High energy infralittoral rock
A3.1111	IR.HIR.KFaR.Ala.Myt	*Alaria esculenta*, *Mytilus edulis* and coralline crusts on very exposed sublittoral fringe bedrock

EUNIS Code	JNCC Marine Habitats Classification Biotope Code	Biotope Description
A3.1112	IR.HIR.KFaR.Ala.Ldig	*Alaria esculenta* and *Laminaria digitata* on exposed sublittoral fringe bedrock
A3.2111	IR.MIR.KR.Ldig.Ldig	*Laminaria digitata* on moderately exposed sublittoral fringe bedrock
A4.11	CR.HCR.FaT	Very tide-swept faunal communities
A4.13	CR.HCR.XFa	Mixed faunal turf communities
A4.22	CR.MCR.CSab	Circalittoral *Sabellaria* reefs (on rock)
A5.13	SS.SCS.ICS	Infralittoral coarse sediment
A5.14	SS.SCS.CCS	Circalittoral coarse sediment
A5.2	SS.SSa	Sublittoral sands and muddy sands
A5.23	SS.SSa.IFiSa	Infralittoral fine sand
B3.111	LR.FLR.Lic.YG	Yellow and grey lichens on supralittoral rock
B3.1131	LR.FLR.Lic.Ver.B	*Verrucaria maura* and sparse barnacles on exposed littoral fringe rock
B3.1132	LR.FLR.Lic.Ver.Ver	*Verrucaria maura* on very exposed to very sheltered upper littoral fringe rock

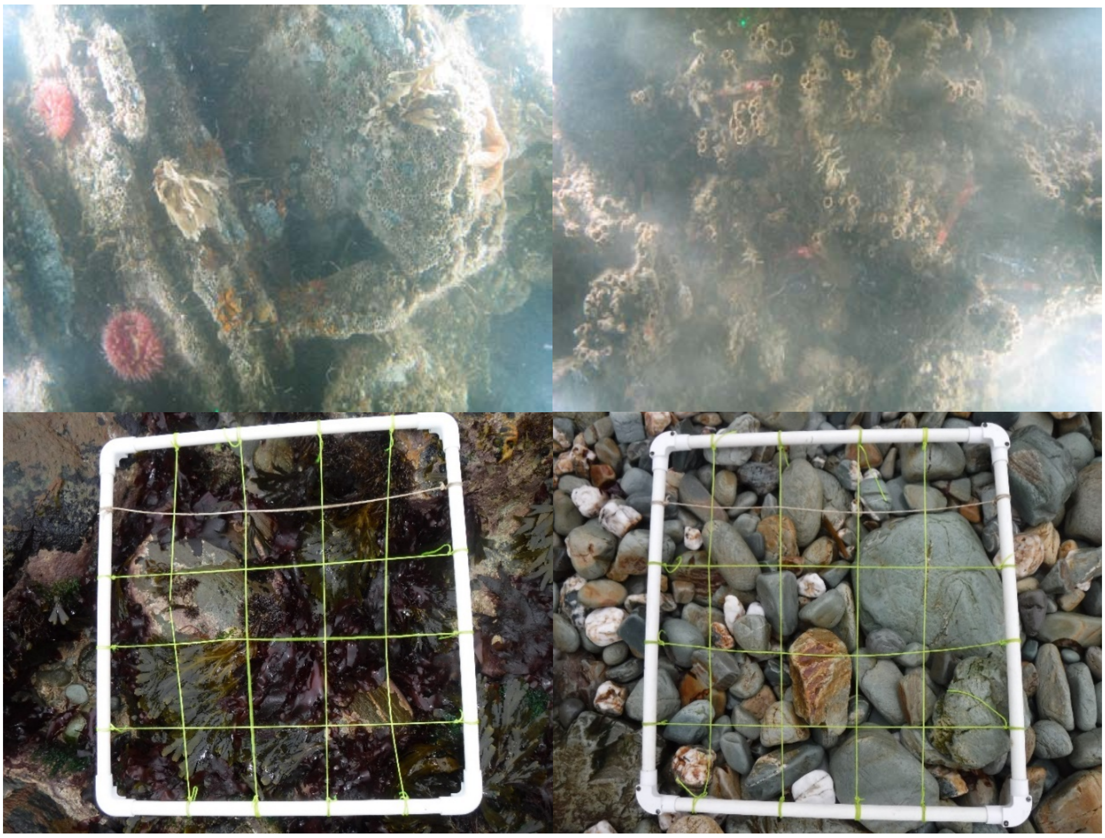


Plate 9-1 Still images representing biotopes observed across the MDZ and surrounding environment (Ocean Ecology, 2018). Top left: Very tide-swept faunal communities (A4.11); top right: Circalittoral *Sabellaria* reefs (on rock) (A5.14); bottom left: *Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock (A1.2141), and bottom right: Barren littoral shingle (A2.111).

9.5.5. Valued Ecological Receptors

65. The value of ecological features is dependent upon their biodiversity, social and economic value within a geographic framework of appropriate reference (CIEEM, 2016). Identifying those habitats and species that have a specific biodiversity value recognised through international or national legislation, or through local, regional or national conservation plans (e.g. Annex I habitats under the Habitats Directive, Section 7 (formerly BAP/Section 42), existing and recommended Marine Conservation Zones (MCZ and rMCZ, respectively) is understood to be the most straightforward context for assessing ecological value. Under the existing legislative or policy framework, a very small proportion of marine habitats and species are afforded protection and therefore evaluation must also assess value according to the functional role of the habitat or species. For example, some features may not have a specific conservation value in themselves but may be functionally linked to a feature of high conservation value.

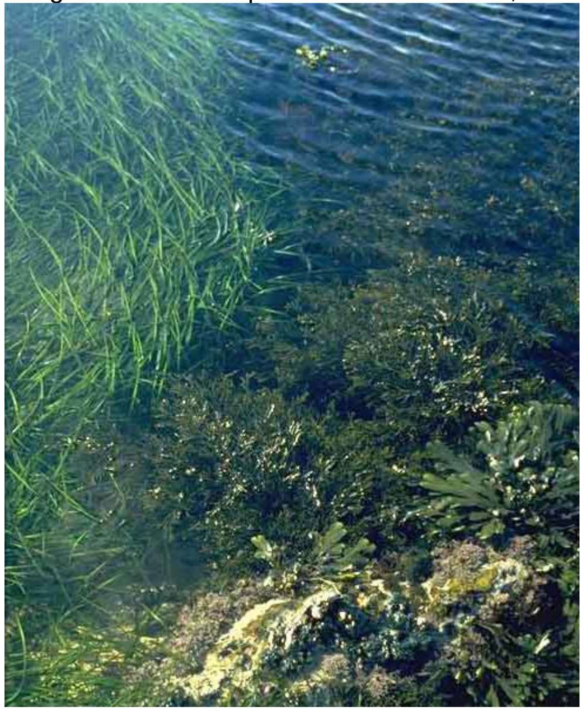
66. For the purpose of this environmental impact assessment, habitats with similar physical, biological characteristics as well as conservation status/interest have been grouped together. Consideration was also given to the inherent sensitivities of different habitats, such that habitats and species with similar vulnerability and recoverability, often as a result of similar broad sediment types and species complements, were grouped together. The biotopes and Annex I habitats within the MDZ have been split into 12 broad community and habitat types. These 12 Valued Ecological Receptors (VERs) represent the benthic and intertidal biological environment in and around the MDZ, and the impacts associated with this project have been assessed against these groups (**Table 9-13**).

67. **Figure 9-3** and **Figure 9-4** (**Volume II**) illustrate the location of the VER groups throughout the MDZ. The VER habitat groups 9 and 10 dominate the MDZ. These groups are both comprised of biotopes relating to Annex I reefs (biogenic, stony and bedrock). However, it should be noted that the VER groupings are not suggestive of definite presence, and therefore it cannot be assumed that Annex I reefs are present in all areas which are marked as habitat group 9 or 10.

Table 9-13 Criteria Valued Ecological Receptors within the Morlais Demonstration Zone (MDZ) Benthic Ecology Study Area, their Conservation Status and Importance.

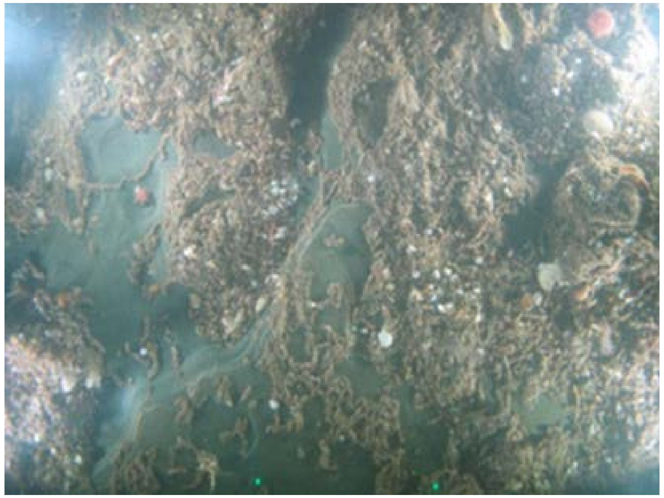
VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 1: High energy littoral rock	▪ LR.HLR ▪ LR.HLR.MusB.MytB ▪ LR.HLR.MusB.Cht.Cht ▪ LR.HLR.MusB.Sem.Sem ▪ LR.HLR.MusB.Sem.FvesR ▪ LR.HLR.FR.Him ▪ LR.HLR.FR.Mas	Contains sub-features of Annex I habitats: larger shallow inlets and bays, and reefs.	Not a designated feature of North Anglesey Marine SAC	Image of LR.HLR.MusB.Sem.FvesR from MarLIN, copyright JNCC. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 2: *Fucus spp.* on exposed to moderately exposed upper eulittoral rock	▪ LR.MLR.BF.FspiB ▪ LR.MLR.BF.FvesB ▪ LR.MLR.BF.Fser.R	Contains sub-features of Annex I reef habitats.	Not a designated feature of North Anglesey Marine SAC	Image of LR.MLR.BF.FspiB from MarLIN, © JNCC. 
Habitat Group 3: *Pelvetia canaliculata* on sheltered littoral fringe rock and *Ascophyllum nodosum* on full salinity mid eulittoral rock	▪ LR.LLR.F.Pel ▪ LR.LLR.F.Asc.FS	Contains sub-features of Annex I reef habitat and biotopes previously listed as UK BAP habitats.	Not a designated feature of North Anglesey Marine SAC Contains biotopes previously UK BAP	Image of LR.LLR.F.Pel from MarLIN, © JNCC. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 4: Coralline crust, Fucoids and kelps in eulittoral rockpools	▪ LR.FLR.Rkp.Cor ▪ LR.FLR.Rkp.FK ▪ LR.FLR.Rkp.SwSed	Contains sub-features of Annex I reef habitats.	Not a designated feature of North Anglesey Marine SAC	Image of LR.FLR.Rkp.SwSed from MarLIN, © JNCC. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 5: Upper to mid-shore cave walls and wave-surged overhanging lower eulittoral bedrock and caves	▪ LR.FLR.CvOv.RhoCla ▪ LR.FLR.CvOv.SpR.Den	Contains sub-features of Annex I reef habitat and biotopes previously listed as UK BAP habitats.	Not a designated feature of North Anglesey Marine SAC Contains biotopes previously UK BAP	Image of LR.FLR.CvOv.RhoCla from MarLIN, © JNCC. 
Habitat Group 6: Ulva spp. on freshwater-influenced and/or unstable upper eulittoral rock	▪ LR.FLR.Eph.Ulv	Contains sub-features of Annex I reef habitats.	Not a designated feature of North Anglesey Marine SAC.	Image of LR.FLR.Eph.Ulv from MarLIN, © JNCC. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 7: Barren littoral shingle	▪ LS.LCS.Sh.BarSh	N/A	N/A	Image of LS.LCS.Sh.BarSh from MarLIN, © JNCC. 
Habitat Group 8: Littoral sand with Talitrids	▪ LS.LSa ▪ LS.LSa.St.Tal	N/A	N/A	Image of LS.LSa.St.Tal from MarLIN, © JNCC. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 9: High energy infralittoral and circalittoral rock/ coarse sediment with Annex I stony/bedrock reef	▪ SS.SCS.CCS ▪ CR.HCR.FaT ▪ CR.HCR.XFa ▪ IR.MIR.KR.Ldig.Ldig ▪ IR.HIR ▪ IR.HIR.KFaR.Ala.Myt ▪ IR.HIR.KFaR.Ala.Ldig	Annex I Habitats Directive	Group containing possible Annex I Habitats (stony/bedrock reef) protected by Annex I Habitats Directive. Not a designated feature of North Anglesey Marine SAC	Image from the OEE 2018 survey. 
Habitat Group 10: Circalittoral Sabellaria reefs – Annex I biogenic reefs	▪ CR.MCR.CSab	Annex I Habitats Directive OSPAR	Group containing possible Annex I Habitat (biogenic reef) protected by Annex I Habitats Directive Not a designated feature of North Anglesey Marine SAC	Image from the OEE 2018 survey. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 11: Sublittoral and infralittoral sands and muddy sands	▪ SS.SSa ▪ SS.SSa.IFiSa	N/A	N/A	Image from the OEE 2018 survey. 
Habitat Group 12: Yellow and grey lichens on supralittoral rock	▪ LR.FLR.Lic.YG ▪ LR.FLR.Lic.Ver.B ▪ LR.FLR.Lic.Ver.Ver	N/A	N/A	Image of LR.FLR.Lic.YG from MarLIN, © JNCC. 

9.5.6. Designated Sites

68. Due to the diverse array of habitats present within Anglesey and the wider area, the region hosts a variety of designated sites, illustrated within **Figure 9-5** (**Volume II**) and described within **Table 9-14**. These include Special Areas of Conservation (SAC), Special Protected Areas (SPA) and Ramsar sites.

69. There are no MCZs within close proximity to, or potentially impacted by, the proposed Project. The closest MCZ is over 100 km to the north east of the proposed site. There are three SACs with marine components on the west coast of Anglesey relevant to benthic ecology, and one offshore SAC. The MDZ is located within one of these, the North Anglesey Marine SAC. This SAC runs from the northern coast of the Isle of Anglesey into the Irish Sea and has been identified as an important area for harbour porpoise. Covering an area of 3,249 km^2, this site spans water depths which range from the Mean Low Water (MLW) level down to 100 m along the western boundary, though much of the site is 50 m or shallower. The North Anglesey Marine SAC overlaps a range of other habitats including coarse and sandy sediments, rock, and mud.

70. The MDZ also sits within the Anglesey Terns SPA, a site which extends around most of the east, north and west coasts of Anglesey, from the mean high water mark out to between 10 km and 20 km from shore. This site is primarily designated to protect the classified population of foraging terns during the breeding season.

71. The distance of these designations and primary reason for their designation are displayed in **Table 9-14.**

Table 9-14 Designated Sites Within the MDZ and Surrounding Area (up to 100 km)

Site Name	Designation	Distance from Project (km)	Site Features
North Anglesey Marine/ Gogledd Môn Forol	SAC	0	North Anglesey Marine SAC has been identified as an area of importance for harbour porpoise. North Anglesey Marine SAC overlaps a range of other habitats including coarse and sandy sediments, rock, and mud. Encompassed within the site is the Croker Carbonate Slabs SCI which was designated for submarine structures made by leaking gases.
Bae Cemlyn/ Cemlyn Bay	SAC	13.98	Coastal lagoons; Perennial vegetation of stony banks.
Glannau Môn: Cors heli/ Anglesey Coast: Saltmarsh	SAC	16.84	Annex I habitats are the primary reason for selection of this site such as Salicornia and other annuals colonizing mud and sand, and Atlantic salt meadows.
Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay	SAC	27.76	The site is designated for Annex I habitats such as sandbanks which are slightly covered by seawater all the time; mudflats and sandflats not covered by seawater at low tide; and limestone reefs.
Croker Carbonate Slabs	Site of Community	29.83	This site is characteristic of the habitat ‘submarine structures made by leaking gases’ under the subtype “bubbling reefs”. These

Site Name	Designation	Distance from Project (km)	Site Features
	Importance (SCI)		structures form a complex seabed topography providing a diverse habitat for a range of marine life. In other parts of the site, thin slabs form ‘pavements’, which are often overlain with a thin veneer of mobile sand and gravel
Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau	SAC	32.22	Annex I habitats: sandbanks which are slightly covered by seawater all the time, estuaries, coastal lagoons, large shallow inlets and bays, reefs. Additional Annex I habitats present - Mudflats and sandflats not covered by seawater at low tide, Salicornia and other annuals colonising mud and sand, Atlantic salt meadows, submerged or partially submerged sea caves. Annex II species, not primary reason for site selection: Bottlenose dolphin, otter and grey seal
West Wales Marine/ Gorllewin Cymru Forol	SAC	33.51	West Wales Marine SAC has been identified as an area of importance for harbour porpoise. The area included within the site covers important summer habitat for harbour porpoise, while part of the site in Cardigan Bay was also identified as important during the winter.
Dee Estuary/ Aber Dyfrdwy	SAC	85.64	Annex I habitats: mudflats and sandflats not covered by seawater at low tide, Salicornia and other annuals colonising mud and sand, Atlantic salt meadows. Additional Annex I habitats present – Estuaries, annual vegetation of drift lines, vegetated sea cliffs of the Atlantic and Baltic Coasts, Embryonic shifting dunes, shifting dunes along the shoreline with *Ammophila arenaria*, fixed coastal dunes with herbaceous vegetation, humid dune slacks. Annex II species; not primary reason for site selection: Sea lamprey, river lamprey and Petal wort.
Shell Flat and Lune Deep	SAC	105.32	Shell Flat is considered to be an excellent example of Annex I sandbank Habitat. In terms of sediment type, the bank comprises a range of mud and sand sediments from silts and clays through to coarse sands. Shell Flat is characterised by its low biodiversity, high biomass and is noted as an important foraging ground for many over wintering bird species.
Morecambe Bay	SAC	124.81	Designated for Annex I habitats: estuaries, mudflats and sandflats not covered by seawater at low tide, large shallow inlets and bays amongst several others.
Anglesey Terns/ Morwenoliaid Ynys Môn	SPA	0	Largest tern colony in Wales (500-900 breeding pairs) of roseate, sandwich, common and arctic. Series of islands about 1km out to sea
Liverpool Bay/ Bae Lerpwl	SPA	28.07	Marine site supports red-throated diver, common scoter and little gull.

Site Name	Designation	Distance from Project (km)	Site Features
Traeth Lafan/ Lavan Sands, Conway Bay	SPA	37.86	Local Nature Reserve; supports wintering waterbirds, especially oystercatchers and great crested grebes found here for their autumn moult.
Irish Sea Front	SPA	35.51	The site regularly supports a population of European importance for Manx shearwater (*Puffinus puffinus*), which are likely to use the area as a foraging location during the breeding season. The Irish Sea Front SPA is the third largest marine aggregation of breeding Manx shearwaters identified in the UK.
Northern Cardigan Bay/ Gogledd Bae Ceredigion	SPA	47.97	Qualify as a SPA for its wintering population of red throated diver. Although this is a proposed new SPA, most of the site lies within the existing Pen Llŷn a'r Sarnau Special Area of Conservation.

72. A shadow Habitats Regulations Assessment (HRA) has been compiled to inform the assessment as to whether the Project has the potential to have an adverse effect on the integrity and features of a Natura 2000 site. In summary however, no adverse effects on integrity of any European designated sites are predicted by the Project. Information to support the HRA is provided in **Document MOR/RHDHV/DOC/0067**.

9.5.7. Protected Habitats and Species

73. Within the Ocean Ecology (2018) survey report (**Appendix 9.1, Volume III**), the presence of several habitats of conservation importance in the wider survey area were recorded, including the three Annex I reef habitats: bedrock reef, biogenic reef and stony reef. All of these reefs are extremely variable, both in structure and in the communities they support. These range from vertical rock walls to horizontal ledges, sloping or flat bed rock, broken rock, boulder fields, and aggregations of cobbles. These three reef habitats are afforded protection under the Habitats Regulations.

74. In the UK, the main species that form biogenic reefs are blue mussel *Mytilus edulis*, horse mussel *Modiolus modiolus*, Ross worm *Sabellaria spinulosa*, honeycomb worm *Sabellaria alveolata*, the serpulid worm *Serpula vermicularis*, and cold-water corals such as *Lophelia pertusa*. As noted within the MDZ, the relatively common tube-dwelling polychaete Ross worm *S. spinulosa* was recorded in the surveys conducted by OEL.

75. *S. spinulosa* can form areas of biogenic reef which are highly varied in nature and include reefs which stand up to 30cm high of the surrounding seabed and can extend for hundreds of metres. When considering the potential of an area to qualify as possible *S. spinulosa* reef, several criteria are required to be used to assess the given area of interest. These include elevation, area and patchiness (**Table 9-15**).

Table 9-15 Criteria for Determining *Sabellaria spinulosa* Reefiness (Gubbay, 2007)

Measure of Reefiness	Not classed as a reef	Low	Medium	High
Area (m^2)	<25	25-10,000	10,000-1,000,000	>1,000,000
Elevation (tube height in cm)	<2	2-5	5-10	>10
Patchiness (% cover)	<10	10-20	20-30	>30

76. Within the survey conducted by OEL, (2018), biogenic reefs were observed across 16 stations, (1, 2, 3, 4, 5, 6, 8, 9, 16, 17, 21, 22, 23, 24, 33, 36: Appendix XI of Ocean Ecology Limited (2018)). The quality of the reefs and the levels of 'reefiness' varied between these sample stations, however typically present in 'low' to 'medium' levels of reefiness. The stills of several of these recorded reefs are presented within Appendix XI of the OEL 2018 survey report (Ocean Ecology Limited, 2018).

77. Bedrock and stony reefs are both types of rocky reef which occur where the bedrock or stable boulders and cobbles arise from the surrounding seabed. A stony reef is defined as an area which is comprised of coarse sediments with a diameter of greater than 64 mm (cobbles and boulders) that provide a hard substratum. A reef is defined as having relief from the seafloor and elevation is used as a criterion in its classification. Epifaunal communities of a potential reef are also key in the determination of reefiness, with percentage cover of fauna used as a determination criterion. Irving (2009) classification of reef requires an area of potential stony reef habitat to be greater than 25 m^2 to be classified as a reef.

78. Unlike biogenic and stony reefs, there is currently no specific criteria defined to determine if an area constitutes Annex I bedrock reef. Within the EU directives interpretation, a bedrock reef is defined as:

"*Reef can be either biogenic concretions or of geogenic origin. They are hard compact substrata on solid and soft bottoms, which arise from the sea floor in the sublittoral and littoral zone. Reefs may support a zonation of benthic communities of algae and animal species as well as concretions and corallogenic concretions*."

79. These bedrock reefs create a habitat that is colonised by many different marine animals and plants to many species such as corals, sponges and sea squirts as well as giving shelter to fish and crustaceans such as lobsters and crabs. Rocky reefs can be very variable in terms of both their structure and the communities that they support.

80. Within the surveys conducted for the MDZ, extensive areas of both stony reef and bedrock reef were recorded. The north east spreading along the eastern central area of the site to the south west of the MDZ were dominated by stony reefs, while the central and north east area of the site were recorded as bedrock reef areas. Within the south east of the site, there were several areas of patchy bedrock reef observed, and likewise in the southwest there were areas of patch stony reefs. Within the intertidal zone, the immediate seabed is covered by an expanse of bedrock reef, tailing into stony/bedrock reef in the north east and south east of the site.

9.5.8. Invasive Non-Native Species

81. Invasive Non-Native Species (INNS) are species that have been introduced, either intentionally or unintentionally, to areas outside their natural range. Although many of these non-native species cause no apparent adverse impact, some cause negative impacts on native species and ecosystems due to competition and gradual replacement. There are over forty non-native species reported to occur within Welsh waters (Marine Evidence Working Group, CCW (2012)), seven of which are considered invasive with negative effects, these are:

- *Elminius modestus* – an Australasian intertidal barnacle;
- *Eriocheir sinensis* – Chinese mitten crab;
- *Botrylloides violaceus* – a colonial ascidian native to north-west Pacific;
- *Crassostrea gigas* – Pacific oyster;
- *Crepidula fornicata* – American slipper limpet;
- *Didemnum vexillum* – colonial ascidian commonly known as the carpet sea squirt; and
- *Sargassum muticum* – wireweed/japweed.

82. Further, Anglesey is considered a focal point for INNS due to a high number of hotspots around its coast, including Holy Island and the Menai Strait. The colonial ascidian *Didemnum vexillum*, was recorded in Holyhead Port in September 2008, representing the first confirmed record of the species on the British mainland (Griffith et al., 2009). This is a great concern for both Welsh waters and the waters of the UK due to its ability to successful invade and establish.

9.6. IMPACT ASSESSMENT

83. The following assessment provides a summary of all impacts identified during scoping study and those which have been noted as the EIA has progressed. Each impact is not necessarily relevant to all stages of the project, and thus impacts have been assessed within the stage of the project at which they will occur (construction, operation and decommissioning). Further, these impacts are comprised of both direct and indirect impacts.

84. Impacts are classified as follows:

- Direct impacts: these may arise from impacts associated with the construction, operation and maintenance, or decommissioning of the project;
- Indirect impacts: these may be experienced by a receptor that is removed (e.g. in space or time) from the direct impact;
- Inter-relationships between impacts; or Cumulative impacts: these may occur as a result of the project in conjunction with other existing or planned projects within the study area for each receptor.

9.6.1. Embedded Mitigation

85. The following assessment provides a summary of all impacts identified during scoping study and those which have been noted as the EIA has progressed. These impacts are not relevant to all stages of the project, and thus impacts have been assessed within the stage of the project at

which they will occur (construction, operation and decommissioning). Further, these impacts are comprised of both direct and indirect impacts.

86. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process (see **Chapter 4, Project Description** for further details). A range of different information sources has been considered as part of embedding mitigation into the design of the project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

9.6.1. Worst Case Parameters

9.6.1.1. Temporary Habitat Disturbance

87. During all project phases, temporary habitat disturbance will occur to seabed habitats via device, hubs and cable installation and also anchor deployments for installation barges. Based on information provided in **Chapter 4, Project Description**, the values in **Table 9-16** have been calculated to define the worst-case parameters for temporary habitat disturbance . These are defined in terms of project phase, as different amounts of temporary seabed disturbance are predicted to arise in each phase.

88. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50 % of the tenants will undertake repowering, i.e. for 50 % of the tenants, their infrastructure will be removed and replaced (potentially with different infrastructure by a different tenant). For the other 50 % of tenants, their infrastructure will remain over the lifetime of the Project.

89. In terms of impact assessment parameters, the repowering process has, therefore, been defined as per below:

- Initial temporary seabed disturbance via deployment of barge anchors to remove foundations, TEC’s, hubs, inter-array cables and monitoring equipment for 50 % of the Tenants (berths);
- Further temporary seabed disturbance via re-installation (repowering) of foundations, TEC’s, hubs, inter-array cables and monitoring equipment for the same 50 % of Tenants (berths); and
- Additional permanent habitat loss (over and above that via initial construction phase), due to placement of re-installed (repowered) foundations/TECs in different areas to where originally installed.

90. The operational phase values also include the temporary seabed disturbance that would arise from up to ten cable repair events.

Table 9-16 Summary of Worse-Case Scenario Temporary Habitat Loss during Construction, Operation (repowering) and Decommissioning Phases

Project Component	Worse Case (240 MW)	Unit	Notes
Construction Phase:			
Post-lay burial of cable	27,259	m^2	Area of sandwave field where post-lay burial via Mass-Flow Excavator (MFE) may be required
Deployment of anchor blocks by barges during cable installation	100,240	m^2	Up to 8 x 25 m^2 (5x5) m anchor blocks for a single barge = a total footprint per anchor deployment of 200 m^2 (8 x 25 m^2) Assumed that these types of anchor barges generally deploy a spread every 500 m. So, for every 500 m of cable installation a footprint of 200 m^2 of temporary seabed disturbance occurs (via the anchor blocks) Combining all potential export, array and cable tails the total length of cables (full 240 MW) is 250.6 km Assumes the footprint of 200 m^2 every 500 m (0.5 km), or 400 m^2 every 1 km, and assumes all cables are installed using anchor barges Temporary disturbance impact of (400 m^2 x 250.6) = 100,240 m^2 (0.10 km^2)
Deployment of anchor blocks by barges during TEC device installation	248,000	m^2	Max. no of devices set at 620 x small (0.3 kW devices) Assumed that deployment of each device requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2) Therefore, total temporary seabed disturbance = 620 x 400 m^2 = 248,000 m^2
Deployment of anchor blocks by barges during hub installation	48,000	m^2	Max. no of seabed mounted hubs set at n = 120 Assumed that deployment of each hub requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2) Therefore, total temp. seabed disturbance = 120 x 400 m^2 = 48,000 m^2
Construction Phase TOTAL		**423,499 m^2 (0.42 km^2)**	
Operational Phase:			
(Repowering) 50 % of tenants infrastructure (Foundations; TEC's; hubs' array cables; monitoring equipment) removed and replaced with new	377,400	m^2	Initial <u>removal</u> of tenant infrastructure from 50 % of berths ▪ 50 % of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 ▪ 50 % of anchor block value of tidal device installation = 124,000 m^2 ▪ 50 % of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2

Project Component	Worse Case (240 MW)	Unit	Notes
(different) tenant infrastructure			Subsequent re-installation (re-powering) of tenant infrastructure from 50 % of berths ▪ 50 % of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 ▪ 50 % of anchor block value of tidal device installation = 124,000 m^2 ▪ 50 % of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2
Cable repairs	3,000	m^2	Up to 10 major cable repairs (5 days each) may be required throughout the project life. It is assumed that up to 750 m of cable will be subject to repair works per event (7,500 m in total). Using same value of 400 m^2 temp seabed disturbance per 1 km of cable works (400 x 7.5) = 3,000 m^2
Operational Phase TOTAL		**380,400 m^2 (0.38 km^2)**	
Decommissioning Phase:			
Decommissioning Phase		**TOTAL 423,499 m^2 (0.42 km^2) –** same worst-case as per construction phase due to same activities needed to remove infrastructure	

91. The installation of project infrastructure, including anchor systems for TEC devices, seabed mounted devices, hubs and cables/cable protection, will all result in permanent habitat loss. Based on information provided in **Chapter 4, Project Description**, the following values have been calculated to define the worst-case parameters for permanent habitat loss via project infrastructure (**Table 9-17**). The majority of these effects will only occur in the operational phase. The exception is the value of 7,400 m^2 related to the trench for up to nine cables at landfall. Trenching of cables will only be undertaken if HDD works (preferred method) are not possible/viable. Without detailed geotechnical analysis it is not currently possible to state if trenching, and subsequent backfill of the trench(es) would be possible. If it was, this would represent a temporary disturbance on intertidal habitats. However, to ensure a precautionary approach, it has been concluded that trenching/surface-laying of the landfall cables would lead to permanent habitat loss and is included below.

Table 9-17 Summary of worse-case scenario: permanent habitat loss via project infrastructure (including repowering)

Project Component	Worse Case (240 MW)	Unit	Notes
Main operational phase			
Gravity Base Structures (GBS)	74,790	m^2	Max value across entire project. Based on anchor mooring systems for floating devices. Includes hubs.
Swept Area of Catenary Cables	2,055,000	m^2	Based on: 30 devices having swept area of 9,500 m^2 (large floating devices (Orbital, Magallanes)

Project Component	Worse Case (240 MW)	Unit	Notes
			140 devices having swept area of 7,500 m^2 floating devices (Tocardo UFS, Aquantis) & hubs 240 devices having swept area of 3,000 m^2 small floating devices (Instream, SME PLATO)
Export Cable Footprint (cables; protection systems; rock bags)	11,745	m^2	Up to 40.5 km of export cables (with split-pipe protection/shells and rock bags)
Array Cable Footprint (cables; protection system; rock bagss)	30,040	m^2	Up to 204.5 km of array cables (with split-pipe protection/shells and rock bags)
Cable tails	120	m^2	Based on 9 x tails of 620 m length
Trench for 9 x landfall cables	7,400	m^2	740 m long trench x 10 m width
Footprint of Navigation Marker Buoys	540	m^2	3 m diameter square gravity anchor (9 m^2) per anchor x 60 anchors/buoys
Footprint of ADCP moorings	280	m^2	7 m^2 per ADCP mooring x 40 units
Footprint of seabed mounted environmental monitoring units	112	m^2	14 m^2 per env monitoring unit x 8 units
Footprint of mooring for floating environmental monitoring units	45	m^2	9 m^2 per mooring x 5 units
Permanent habitat loss (initial operational phase: 2,180,072 m^2 (2.18 km^2)			
Repowering Phase			
New tenant infrastructure in 50 % of berths	52,504	m^2	
Permanent habitat loss (repowering of 50 % of berths): 52,504 m^2			
Permanent Habitat Loss: Total of 2,232,576 m^2 (2.23 km^2)			

9.6.1.2. Construction Programme

92. The construction of offshore works (for installation of tidal devices and associated cabling and infrastructure) would be phased over a period of several years, taking: up to 15 days per device or hub; and up to 1.5 days for each inter-array cable; up to 20 days for each offshore cable; and up to 12 days for each phase of cable protection. Up to eight separate cable laying and protection campaigns are possible. The HDD at the landfall would be completed over a 10 month period with 2 months for offshore cable tail installation.

9.6.2. Potential Impacts during Construction

9.6.2.1. Construction Impact 1: Physical Disturbance to Benthic Habitats and Species and Temporary Habitat Disturbance

93. Throughout the various stages of construction, there will be possible disturbance and temporary habitat loss to benthic species within the MDZ. Under the worst-case scenario, an area of up to 423,499 m^2 (0.42 km^2) would be temporarily disturbed due to construction associated activities

such as post-lay burial of cable through the large sandwave feature present in the site and installation of an anchor barge to allow for device installation.

94. The proposed total area of the MDZ and export cable corridor (ECC) is 39.75 km^2, comprised of 35 km^2 within the offshore development site, an ECC area of 4.75 km^2, of which 0.01 km^2 falls within the intertidal region (MLWS to MHWS). Therefore, given that the worst-case construction scenario, seabed footprint of the project could result in the temporary loss of up to 423,499 m^2, a worst-case scenario design would result in the temporary disturbance of a 1.06 % of the seabed within the MDZ and ECC.

95. Based on the biotope mapping conducted by OEL (Ocean Ecology, 2018), the site is covered by a high percentage of the biotopes CR.HCR.FaT, CR.HCR.XFa, CR.MCR.CSab and SS.SCS.CCS. Following the process of assigning each biotope to a VER group, habitat group 9 (High energy infralittoral and circalittoral rock/ coarse sediment with Annex I stony/bedrock reef) and 10 (Circalittoral Sabellaria reefs – Annex I biogenic reefs) were the most frequently occurring groups in the subtidal region. These groups contain possible Annex I reef habitats (biogenic, bedrock and stony). In the OEL survey report, observations of Annex I stony reef habitat (as per Irving 2009) frequently overlain by varying coverage of *S. spinulosa* tube aggregations (representative of Annex I biogenic reef were observed in deeper areas of the survey site (as per Gubbay 2007)). The amount of overlying sediment was reduced in the slightly shallower waters in central, southern and northern areas where tide-swept and mixed faunal turf community representative of Annex I bedrock reef were prevalent. Within this assessment of temporary habitat loss, VER habitat group 9 and VER habitat group 10 have been assessed.

96. Given the high percentage coverage of similar habitat types available within the MDZ and the low level of overall temporary habitat disturbance or loss that will occur in the construction phase, this impact is of a scale which would be barely noticeable from monitoring and would occur only occasionally. Therefore, the magnitude of this effect has been assessed as low.

97. Habitat group 10 represents the group which contains possible areas of biogenic Annex I reef (*Sabellaria* spp.). Within the MarLIN assessment for abrasion and disturbance assessment, this habitat is assessed with a medium sensitivity, as abrasion at the surface of *S. spinulosa* reefs is considered likely to damage the tubes and result in sub-lethal and lethal damage to the worms. However, it should be noted that this assessment was suggested as relatively precautionary and it should be noted the degree of resilience will be mediated by the character of the impact. The recovery of small areas of surficial damage in thick reefs is likely to occur through tube repair and may be relatively rapid.

98. Considering the current knowledge of *S. spinulosa* reef ecology it is evident that such habitat follows a cycle of evolution and degradation within periods of months (evolution of functioning reefs has been recorded within a 6-month period) and demonstrates a high degree of recoverability following direct impacts (Pearce et al., 2007; Hendrick et al., 2011; Last et al., 2011).Therefore, it is unlikely that if any reef is impacted, that the consequent direct impacts will be long-lived i.e. the reef habitat demonstrates a high recoverability.

99. Based on advice provided by Natural England (Advice on Operations) for The Wash and North Norfolk Coast SAC (as this site contains Annex I stony reef), stony reefs are associated with a medium sensitivity in relation to cable laying activities. Within this assessment, no assessments

on sensitivity were available for bedrock and a low sensitivity has been concluded. An overall medium sensitivity has been assessed for VER habitat group 9 and VER habitat group 10.

100. As the VERs have been assessed with an overall medium sensitivity and the magnitude of the impact is low, physical disturbance and overall temporary disturbance of subtidal habitats is likely to result in a **minor adverse** impact.

9.6.2.1.1. Mitigation

101. Topic-specific mitigation will be conducted to ensure minimal disturbance and loss of habitats and species during construction. Following consent, pre-construction surveys could be carried out to check for the presence of any rare or protected habitats and species e.g. *S. spinulos*a reefs. Following these surveys, micro-siting of the cable would be used to mitigate impacts to these receptors where possible.

9.6.2.1.2. Residual Impact

102. The impact will remain of minor adverse significance (**Table 9-18**).

Table 9-18 Summary of Construction Impact 1: Physical Disturbance to Benthic Habitats and Species and Temporary Habitat Disturbance

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Impact 1: Physical disturbance to habitats and species and temporary habitat loss	VER Group 9 and 10	Medium	Low	Minor Adverse	Mitigation will be conducted to ensure minimal disturbance to and loss of habitats and species during construction via pre-construction surveys and micro-siting.	Minor Adverse

9.6.2.2. Construction Impact 2: Increased Suspended Sediment Concentration and Sediment Deposition

103. The following assessment is supported by the information presented within **Chapter 7, Metocean Conditions and Coastal Processes**.

104. Throughout the construction phase there is potential for foundation installation activities within the Project to disturb sediments, either from the seabed surface or from below the seabed (depending on foundation type). This disturbance can release sediment into the water column as a plume which may then be deposited within or around the MDZ. Suspended sediment concentrations can increase in the water column, making it more turbid, until the plume becomes

dispersed by tidal current action and the sediments settle once again on the sea bed. This could then interact with the subtidal environment and cause smothering of sensitive sessile species.

105. The principal causes of disturbance during foundation installation would be:

- The preparatory works for foundation installation, including boulder clearance;
- Placement of bed-mounted gravity base foundations on the sea bed;
- Installation of anchor points for floating systems;
- Pre-drilling of rock sockets for piled foundations (e.g. monopiles or pin piles); and
- Cable post-lay burial.

106. Within the MDZ there is a paucity of surface sediment, with tide-swept bedrock prevailing. Where sediment does exist in these areas, it is sparse, and predominantly gravel, cobbles and rock boulders. These particle sizes are so large that they either cannot be suspended in the water column or will drop from suspension within a few centimetres from location of disturbance. In effect they will not form part of a sediment plume even if disturbed during construction. Therefore, release of sediments from pre-drilling below the sea bed is of greater potential significance. This would be associated with the installation of piled foundation (for hubs) that may be required for the Project and has been considered as the worst-case scenario for this impact.

107. In practice, the pre-drilling work required for the hub foundations will progress sequentially over time (rather than being instantaneous). Therefore, the realistic worst-case scenario is sediment release from one foundation location at a time. Under this scenario, any plume that is generated would disperse well before the potential exists for its coalescence with plumes from adjacent (or any other) pre-drill locations.

108. The total volume of sediment released from pre-drilling for hub foundation installation would be extremely small (340 m^3 per foundation, as discussed within **Chapter 7, Metocean Conditions and Coastal Processes**), likely to result in peak increases in suspended sediment concentration of typically less than 10 mg/l within the points of release, rapidly reducing to less than 1 mg/l at only a short distance from each release point. This low (barely measurable) effect is partly due to the low volume of sediment released from drilling at the location of each release point; and partly because any fine material released would be rapidly dispersed by the strong tidal currents along the axis of tidal flow.

109. The maximum envisaged effect associated with sediment plumes arising from the foundation installation activities will cause only very minor enhancements in suspended sediment concentration (typically less than 1 mg/l a short distance from the release point) over only a small geographical area (a few hundred metres). This very minor enhancement of suspended sediment concentration over a small geographic area (typically less than 1 mg/l within short distances from release point) would be temporary and return to very low background concentrations rapidly upon cessation of the construction activity.

110. Any sediment that becomes entrained within the plume generated by foundation installation will have the potential to deposit on the sea bed at some distance from its point of release. Based upon a realistic worst case of sediment release from a single piling activity at a time, the sediment deposition on the sea bed will be extremely small in thickness. It is envisaged that in the

immediate vicinity of the release point, deposition depths of no more than 0.1 m will be observed. These sediments are then highly likely to become re-entrained by currents during the peak velocities of the following tide and transported further away in small concentrations.

111. MFE/jetting will be employed to bury the cable across any sandwave features. As part of this process the sediment will be mobilised, creating a very localised sediment plume that re-settle 10-100 metres from the source of jetting and will remain in the system.

112. Therefore, based on the assessments presented in **Chapter 7, Metocean Conditions and Coastal Processes**, changes in the suspended sediment concentration and sediment deposition arising from the construction phase of the Project would be negligible and a **negligible** magnitude has been assessed.

113. The ‘light smothering and siltation rate changes’ and ‘changes in suspended solids’ MarLIN pressures were used to inform this assessment. It is noted that the impacts of increased suspended sediment concentrations and deposition on benthic and epibenthic communities will vary greatly in relation to species present. Filter feeders are likely to be more sensitive to potential adverse effects, whereas deposit feeders may benefit from a sediment influx. Within this assessment, the sensitivity assessment was conducted against the VER habitat group 10 (Circalittoral *Sabellaria* reefs – Annex I biogenic reefs) due to its designation as an Annex I habitat and high coverage of the MDZ.

114. Due to the natural ecology of *Sabellaria* spp., there is a reliance on a supply of suspended solids and organic matter in order to filter feed and build protective tubes and so they are often found in areas with high levels of turbidity. Studies such as Davies, et al. (2009) have shown that at high and intermediate sediment regimes (~71 mg/l) *S. spinulosa* maintained a cumulative growth rate. This supports the view that availability of suspended particles is necessary for *S. spinulosa* development and that tolerance of elevated levels is likely (Davies et al., 2009). Further, studies have provided evidence which indicate that *S. spinulosa* can survive short-term (32 days), periodic sand burial of up to 7 cm (Last et al., 2011). Within the MDZ, it is expected that suspended sediment concentration will rise to less than 10mg/l within the points of release, rapidly reducing to less than 1 mg/l at only a short distance from each release point. Likewise, it is envisaged that in the immediate vicinity of the release point, deposition depths of no more than 0.1 m will be observed and will be rapidly reduced following a tidal flow over the area.

115. Sediment deposition in association with cable lay post-burial activity will be restricted to the footprint of the sandwave features. The benthos associated with these features are adapted to living within sediments and are not sensitive to deposition of sediments and smothering effects.

116. Therefore, it is unlikely that there will be impacts to this VER group or other benthic groups, and a low sensitivity has been assessed for increased sediment plumes and deposition. As the magnitude of effect is deemed to be negligible and the sensitivity as low, an overall **negligible** impact is predicted.

9.6.2.2.1. Mitigation

117. As the impact assessment for potential increased suspended sediments and smothering is **negligible**, no specific mitigation is proposed.

9.6.2.2.2. Residual Impact

118. As no mitigation is proposed, the impact will remain of **negligible** significance (**Table 9-19**).

Table 9-19 Summary of Construction Impact 2: Increased Suspended Sediment Concentration and Sediment Deposition

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Impact 2: Increased suspended sediment concentration and sediment deposition	VER Group 10	Low	Negligible	Negligible	None required	Negligible

9.6.2.3. Construction Impact 3: Release of Pollutants Due to Accidental Events

119. Although the probability of an oil spill occurring within the MDZ during construction is deemed to be negligible, the impacts of such an event are assessed further.

120. Within all project phases, there is the risk of potential accidental release of pollutant discharges from the hydrocarbon inventories carried by installation and maintenance vessels, and other harmful substances. This accidental spill may occur due to poor weather, collision or equipment failure. The exact worse-case scenario of potential pollutants is not possible to calculate as vessels have not been planned for works, however an estimate of a total of up to 444,000 litres of oils for gearboxes and transformers; grease for bearings and seals, and hydraulic fluid has been assigned for this assessment (based on 240 x 1 MW drivetrains).

121. Marine pollution would be restricted to matters related to leakage of lubricants and the type of paint or coating that the subsurface structures would use to prevent excessive growth of marine organisms. Any leak is not likely to result in the discharge of more than 1,000 litres of oil based hydraulic fluid. Discharges from installation and O&M vessels may occur (such as cooling water) however, this will be restricted by maritime standards and regulations.

122. Therefore, given that the possibility of an oil spill is very low and would result in a temporary change, the likelihood and therefore magnitude of this event occurring have been assessed as low.

123. Spilled oils have the potential to affect the subtidal and intertidal benthic ecology in numerous ways, from suffocation, poisoning, bioaccumulation, modification of habitats and other indirect routes. An environments sensitivity to oil pollution varies greatly between habitats and species, and is also linked to sediment types, substrates and the exposure of an area. Given that the Project being developed is a tidal energy demonstration zone, the MDZ is a very exposed area with a high tidal energy range. This highly energetic environment will therefore react in a less sensitive way to an oil spill than would an environment comprised of low energy soft sediments.

124. The rocky and hard substrates observed within and around the MDZ are less sensitive to oil spills (than sediment systems), and these hard substrates aid in the breaking up of oils into smaller droplets thereby increasing surface area and increasing biodegradation rates. However, the coasts around Anglesey are varied and several types of habitat and sediment types could be impacted. This coupled with the generally high sensitivity benthic receptors display in relation to oil spills has concluded a high sensitivity to this impact.

125. Based on a low magnitude score due to the very unlikely possibility of such an event occurring, and the high sensitivity of the impact of this event, an overall **moderate adverse impact** is predicted.

9.6.2.3.1. Mitigation

126. To minimise the risk of a pollution event occurring within the MDZ, several mitigation measures will be implemented as part of the project embedded mitigation (**Chapter 4, Project Description**):

- Development of an Emergency Response Cooperation Plan (ERCoP) with guidance set out by MCA in MGN 371, issued and approved by MCA;
- Development of a Marine Pollution Contingency Plan and Vessel Management Plan, which would include the following measures:
  - Notice to Mariners to be issued to reduce collision risks;
  - Vessels associated with all Project operations will comply with IMO/MCA codes for prevention of oil pollution and any vessels over 400 GT will have on board SOPEPs;
  - Vessels associated with all Project operations will carry on-board oil and chemical spill mop up kits; and
  - Where possible, vessels will avoid working in poor weather conditions.

9.6.2.3.2. Residual Impact

127. Given the suggested mitigation to reduce and lessen risk due to guidance and mitigation plans, the impact will be reduced but will remain of **minor adverse** significance (**Table 9-20**).

Table 9-20 Summary of Construction Impact 3: Pollution of Water and Sediment through Accidental Events

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Impact 3: Pollution of water and sediment through accidental events	Benthic habitats within MDZ	High	Low	Moderate	▪ Development of an Emergency Response Co-operation Plan; ▪ Development of a Marine Pollution	Minor Adverse

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
					Contingency Plan and Vessel Management Plan ▪ Notice to Mariners; ▪ Compliance with IMO/MCA codes/ on board SOPEPs; ▪ On-board oil and chemical spill mop up kits; and ▪ Where possible, avoid working in poor weather conditions.	

9.6.2.4. Construction Impact 4: Physical Disturbance to Intertidal Habitats and Species during Landfall Works

128. As described above, the worst-case scenario for benthic and intertidal impacts at landfall would be as a result of the export cables being installed in a cut trench. This would result in the temporary disturbance of all sessile species and habitats within up to 7,400 m^2 to the trench for up to nine cables at landfall in the intertidal and near shore subtidal zones.

129. Trenching of cables will only be undertaken if HDD works (preferred method) are not possible/viable. Without detailed geotechnical analysis it is not currently possible to state if trenching, and subsequent backfill of the trench(es) would be possible. If it was, this would represent a temporary disturbance on intertidal habitats.

130. Within the surveys conducted to support this assessment, an intertidal survey was conducted and the habitat across the area described as supporting a wide variety of littoral rock biotopes representative of Annex I bedrock reef interspersed with discrete patches of barren shingle and occasional areas of sandy sediment.

131. Following the biotope mapping and assignment of VER groups, VER habitat group 1 (high energy littoral rock) and habitat group 12 (yellow and grey lichens on supralittoral rock) were observed to dominate the intertidal area of the MDZ. However, group 9 (High energy infralittoral and circalittoral rock/ coarse sediment with Annex I stony/bedrock reef) has been used as the

receptor in the assessment as several areas of this habitat were observed in the intertidal site, and this is the most valued group containing habitats which are designated as Annex I habitat.

132. The intertidal area of the MDZ equates to 10,000 m^2 and the temporary disturbance of 7,400 m^2 equates to 74 % of the MDZ intertidal area. Although a very high percentage of temporary disturbance, a medium magnitude has been applied. This is due to the scale of the impact, which will cause a change which will be noticeable from monitoring, and due to the reversibility of the effect.

133. Due to the exposed nature of the offshore site to wave regimes, habitats and species of the intertidal are not likely to be sensitive to disturbance and therefore a medium sensitivity is considered appropriate for this impact despite the possible presence of Annex I bedrock reef due to the possible level of temporary disturbance that may occur. Therefore, given that a medium magnitude and a medium sensitivity have been assigned, an overall **moderate adverse** impact is predicted via temporary disturbance to the intertidal zone due to temporary habitat loss.

9.6.2.4.1. Mitigation

134. If it is not possible to conduct cable-lay via the preferred HDD method, then prior to the excavation of the trench and installation of the cables, a detailed installation methodology would be produced. This will outline how the substratum will be reinstated with the right stratification of layers and will describe how physical impacts will be kept to a minimum, for example restricted working corridors for vehicles and personnel. Larger boulders would be moved sideways out of the cable trench corridor to an equivalent area of the shore, prior to trenching work commencing. These boulders would then be used as the upper layer after backfilling the trench.

9.6.2.4.2. Residual Impact

135. Given the suggested mitigation to reduce and lessen the impact on the intertidal area from cable laying, the impact will be reduced to **minor adverse** (**Table 9-21**).

Table 9-21 Summary of Construction Impact 4: Physical Disturbance to Intertidal Habitats and Species During Landfall Works

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Impact 4: Physical disturbance to intertidal habitats and species during landfall works	VER Group 1, 9, 12	Medium	Medium	Moderate	Agree work method with NRW to minimise disturbance.	Minor adverse

9.6.2.5. Construction Impact 5: Potential Introduction/Spread of Invasive Non-Native Species

136. During the construction stages of the MDZ, there is the potential for the introduction and spread of invasive non-native species (INNS), particularly as Anglesey is considered a focal point for INNS due to a high number of hotspots around its coast. The colonial ascidian *Didemnum vexillum*, was recorded in Holyhead Port in September 2008, representing the first confirmed record of the species on the British mainland. This record sparked concern due to the potential vigorous growth which could occur in both artificial aquaculture facilities and in the natural environment.

137. There are several mechanisms by which vessels associated with the project may introduce INNS to waters within and around the MDZ:

- Attached to equipment such as anchors/anchor chains;
- Fouling on hulls;
- Seawater in pipework; and
- Ballast water and within sediment within ballast tanks.

138. Introductions may present themselves from vessels from foreign waters, and from within Wales. Therefore, there is the potential for the introduction of both new INNS and an increased range for those which are established within the marine environment within Wales.

139. Given the complex interaction between the introduction of a non-native species into an environment and establishment within the MDZ or Wales, the magnitude of the impact has been assessed with caution as medium.

140. Based on the above, the introduction/spread of invasive non-native species within the MDZ and around Anglesey is plausible, however it is unlikely that this will lead to alterations in the benthic habitats or communities due to the current high level of hard substrate naturally available. Therefore, the project associated infrastructure does not present a novel environment within the MDZ, as it would if it was to be placed within a soft sediment area. It is therefore unlikely that the level of risk associate with the new infrastructure and/or the project construction activities will lead to significantly greater levels of INNS.

141. Given the current possible risk held by the receptor (the benthic habitats within the MDZ), the sensitivity has been assessed as medium**.** Overall, a **moderate adverse impact** is predicted via he potential introduction/spread of INNS.

9.6.2.5.1. Mitigation

142. Project embedded mitigation measures are proposed to minimise the risk of INNS and their successful invasion within the MDZ and wider region (**Chapter 4, Project Description**), including compliance with relevant guidance regarding ballast water and INNS risk assessment prior to each deployment to identify mechanisms behind risk identified and appropriate mitigation measures. This can be undertaken once installation vessels and construction / manufacturing ports have been identified through maintenance of an Invasive Species and Biosecurity

Management Plan (ISBMP). An outline INNS Management Plan has been provided with this application (**Document MOR/RHDHV/DOC/0075, INNS Management Plan**).

9.6.2.5.2. Residual Impact

143. If the above mitigation is followed and measures put in place to assess the possible likelihood of INNS invasion based on project vessels, the likelihood of introducing INNS to the MDZ and wider area will be reduced to and re-assessed to **minor adverse** significance (**Table 9-22**).

Table 9-22 Summary of Construction Impact 5: Potential Spread of Non-Native

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Impact 5: Potential spread of non-native	Benthic habitats within MDZ	Medium	Medium	Moderate	Compliance with guidelines, risk assessment of project vessels for INNS and further mitigation measures if required.	Minor Adverse

9.6.3. Potential Impacts during Operation

9.6.3.1. Operational Impact 1: Long Term Loss of Benthic Habitat via (a) Initial Placement of Project Infrastructure and (b) Repowering

144. Due to the initial placement of project infrastructure directly on the seabed, a direct long-term habitat loss will occur for the duration of the operation phase of the Project. In addition to that initial impact, repowering of up to 50 % of the berths may take place. Repowering is defined in **Chapter 4, Project Description** as being ‘the removal of a tenant’s infrastructure at the end of a demonstration period and replacement with the infrastructure of a new tenant, including the removal of devices (including foundations, TECs, support/super structure, inter-array cables, hubs and monitoring equipment) and reinstallation via the original construction methods. For the purpose of this assessment it has been assumed that any new (repowered) infrastructure would be deployed in a new area, i.e. an additional loss of habitat.

145. Under the worst-case scenario, an area of up to 2,180,072 m^2 (2.18 km^2) of seabed would be lost due to the initial placement of project infrastructure. This includes a maximum design and worst case scenario of a loss of a possible 2,055,000 m^2 due to the swept area of the catenary cables, based on 30 devices with a swept area of 9,500 m^2 each, 140 devices with a 7,500 m^2 swept area and 240 devices with a 3,000 m^2 swept area.

146. As a result of repowering, an additional 52,504 m^2 of permanent habitat loss would occur (although it should be recognised that in areas where original infrastructure has been removed, these seabed habitats will no longer be "lost" and will begin a process of recovery). Therefore, the combined permanent habitat loss from initial installation and then repowering amounts to 2,232,576 m^2 (2.23 km^2).

147. The proposed total area of the MDZ and export cable corridor (ECC) is 39.75 km^2, comprised of 35 km^2 within the offshore development site, and an ECC area of 4.75 km^2, of which an intertidal region (MLWS to MHWS) is 0.01 km^2. Therefore, given that the worst-case scenario seabed footprint for a maximum design of the MDZ within the construction period of the project could result in the loss of up to 2,232,576 m^2, a worst-case scenario design would result in the loss of a 5.61 % of the seabed within the MDZ and ECC area.

148. The subtidal area of the MDZ is dominated by the biotopes CR.HCR.FaT, CR.HCR.XFa, CR.MCR.CSab and SS.SCS.CCS which fall within the Valued Ecological Receptors habitat group 9 (High energy infralittoral and circalittoral rock/ coarse sediment with Annex I stony/bedrock reef) and 10 (Circalittoral Sabellaria reefs – Annex I biogenic reefs), while the intertidal zone is dominated by the VER habitat group 1 (high energy littoral rock) and habitat group 12 (yellow and grey lichens on supralittoral rock).

149. It has not been possible to provide an accurate calculation of the loss of each VER due to the current unknown location of devices and therefore VERs which will be impacted. Although there is a high percentage coverage of similar habitat types within the MDZ available, the scale of the change would be noticeable due to an overall habitat loss of 5.61 %. This impact will occur at a scale which would be noticeable from monitoring but would remain within the range of natural variations of background conditions. Further, the effect is slowly reversible following decommissioning (5-10 years) and therefore has a medium level magnitude has been assigned.

150. Based on MarLIN assessments, as discussed within Construction Impact 1, medium sensitivity has been applied to the most sensitive receptors (VER habitat group 9 and 10) and the most frequently occurring within the intertidal zone (VER habitat group 1 and 12).

151. Therefore, as a medium magnitude and a medium sensitivity to the receptors, an overall **moderate adverse** impact is predicted for the permanent loss of habitat due to the placement of infrastructure from the Project.

9.6.3.1.1. Mitigation

152. Given that a moderate significant impact is predicted for the permanent loss of habitat arising from the placement of project infrastructure, topic-specific mitigation will be conducted to ensure minimal loss of habitats and species within the operational phase. Following consent, pre-construction surveys will be carried out to check for the presence of any rare or protected habitats and species, including Annex I habitats which may be classified as reef features. Following these surveys, micro-siting of the cable would be used to mitigate impacts to these receptors where possible. This would inform areas which should be avoided and areas which infrastructure should not be placed.

9.6.3.1.2. Residual Impact

153. The mitigation measures would ensure the minimal possible infrastructure footprint during the operational phase of the project; allow for the impact level to be adjusted to a **minor adverse** impact (**Table 9-23**).

Table 9-23 Summary of Operational Impact 1: Long Term Loss of Benthic Habitat via (a) Initial Placement of Project Infrastructure and (b) Repowering

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Operation and Maintenance						
Impact 1: Long term loss of benthic habitat via placement of project infrastructure	VER Habitat Group 1, 9 and 12	Medium	Medium	Moderate	Following consent, pre-construction surveys and possible micro-siting will be conducted to allow for identification of important areas of habitat.	Minor Adverse

9.6.3.2. Operational Impact 2: Changes in Hydrodynamic and Inter-Related Effects on Benthic Ecology

154. There is the potential of alteration to local hydrodynamics within the MDZ which would link to changes in the sediment type and structure and therefore the benthic species composition. An interaction between tidal driven flows and cylindrical piles or structure creates an array of hydrological phenomena including water flow contractions, 'horse-shoe' vortices and turbulent lee-wake vortices (Hoegald and Hald, 2005). This leads to the net removal of sediments in soft sediment areas, and ultimately the creation of scour pits around the base of the infrastructure. Within the MDZ, there are few areas of soft sediment and the site is dominated by hard substrates. Therefore, it is unlikely that scour pits will develop and thus there is little chance of vast changes to sediment compositions within the area.

155. Due to the small scale of the Project, perceptible changes on the wider water flow regime and sediment compositions, possible impacts to benthic communities would be very small and localised. Coastal process modelling concluded that even within the worst cases of seabed deployment, the magnitude of reduction in tidal current flow (up to 0.8 m/s) results in a residual current flow at high speeds, because the baseline flow conditions in these most affected areas are typically greater than 2 m/s.

156. Subsequently, the near-field magnitude of effect was assessed as low-medium, and the far field effect as negligible.

157. Due to the sensitivities discussed in relation to changes in suspended sediment within **Section 9.6.2.2**) and the naturally exposed nature of the site, a low sensitivity has been assessed for all

benthic receptors in relation to changes in hydrodynamics. Therefore, a **minor adverse** significant impact is predicted.

9.6.3.2.1. Mitigation

158. No mitigation is proposed.

9.6.3.2.2. Residual Impact

159. As no mitigation is proposed, the impact will remain minor adverse (Table 9-24).

Table 9-24 Summary of Operational Impact 2: Changes in Hydrodynamic and Inter-Related Effects on Benthic Ecology

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Operation and Maintenance						
Impact 2: Changes in hydrodynamic and inter-related effects on benthic ecology	Benthic habitats within MDZ	Low	Medium	Minor Adverse	None required	Minor Adverse

9.6.3.3. Operation Impact 3: Introduction of New Habitat in the Form of Project Infrastructure

160. The development of infrastructure within the site presents new surface areas for colonisation by a variety of species, including INNS. This therefore has potential to alter the benthic species and communities in the offshore site.

161. Although it is hard to predict the species that will potentially colonise these structures, they will likely be similar to those that are already within the various biotopes across the MDZ subtidal area, as the hard structures will be similar to the hard bedrock and stony reefs within the area. Therefore, the impacts of introduction of hard substrates into an already largely hard sediment dominated area will not be as significant as the impacts of the introduction of hard substrates into a predominately soft sediment environment.

162. As discussed within the PTEC benthic ecology assessment (PTEC, 2014), monitoring of the impacts of the SeaGEN device within Strangford Lough, Northern Ireland (Royal HaskoningDHV, 2011a) concluded that the colonisation on the infrastructure largely replaced that of which was lost during the installation of the foundations. These results also represent a hard, rocky reef environment, within a high energy environment.

163. Total new surface area of hard substrates from the introduction of hard substrates are not currently available due to the possible variances in the project development. However, the effect would be highly localised around each installed structure and therefore the magnitude of the impacts of the introduced substrate on the existing communities is considered to be negligible.

164. In the absence of sufficient information, a cautionary medium sensitivity of all benthic VER groups has been applied. A negligible magnitude and medium sensitivity have concluded an assessment of **minor adverse impact**.

9.6.3.3.1. Mitigation

165. No mitigation is suggested for this impact.

9.6.3.3.2. Residual Impact

166. As no mitigation is suggested, a **minor adverse** significance remains for this impact (**Table 9-25**).

Table 9-25: Summary of Operational Impact 3: Introduction of New Habitat in the Form of Project Infrastructure

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Operation and Maintenance						
Impact 3: Introduction of new habitat in the form of project infrastructure	Benthic habitats within MDZ	Medium	Negligible	Minor Adverse	None required	Minor Adverse

9.6.3.4. Operational Impact 4: Temporary Physical Disturbance of Seabed Caused by Maintenance Activities and Repowering

167. As with other marine energy infrastructures, there will be a requirement for planned and unplanned maintenance activities throughout the operation phase of the Project. These activities may vary in nature, however the maintenance activities considered likely to cause disturbance impacts are cable repairs and repowering works.

168. Cable repairs will result in localised and temporary disturbance of the seabed up ten times throughout the project life, each requiring around 5 days of repair work. This equates to a total of a possible 3,000 m^2 of temporary disturbance occurring due to project maintenance works throughout the project life, equal to around 0.007 % of the MDZ total area.

169. As a worst-case scenario, repowering works of 50 % of the berths is predicted, which will involve removal of existing tenant infrastructure and the re-installation of new infrastructure.

170. Based on the values in **Table 9-16**, a total area of 377,400 m^2 is predicted to be subject to additional temporary seabed disturbance via repowering. Therefore, a total of 380,400 m^2 (0.38 km^2) of seabed will be temporarily disturbed for cable repairs and repowering. All this activity will take place within the main MDZ array site (35 km^2), meaning that 1.1 % of the MDZ array area will be affected.

171. Due to the low frequency of these activities the magnitude of the effect is judged to be negligible as the amount of predicted temporary habitat disturbance will cover a very small extent of the development site (far less than the seabed footprint), for very short, discrete periods.

172. The MarLIN pressure factor relevant to this impact and used to inform this assessment is ‘physical disturbance and abrasion’. As discussed within Impact 1, the dominant and most sensitive receptors within the MDZ are VER habitat group 9 (High energy infralittoral and circalittoral rock/ coarse sediment with Annex I stony/bedrock reef) and VER habitat group 10 (Circalittoral Sabellaria reefs – Annex I biogenic reefs). These groups contain possible Annex I reef habitats (biogenic, bedrock and stony), and were both assigned a medium sensitivity.

173. The most sensitive receptors (VER habitat group 9 and 10) have a medium sensitivity to physical disturbance and abrasion, and an overall negligible magnitude. Therefore, a **minor adverse** impact on these receptors during operational phase maintenance and/or repowering activities.

9.6.3.4.1. Mitigation

174. As it was concluded that the impact was of minor adverse significance no mitigation measures are proposed. Efforts shall be made to minimise operation and maintenance works undertaken to reduce impacts beyond the worst case assessed here.

9.6.3.4.2. Residual Impact

175. No mitigation is proposed. The residual impact remains of **minor adverse** significance (**Table 9-26**).

Table 9-26 Summary of Operational Impact 4: Temporary Physical Disturbance of Seabed Caused by Maintenance and Repowering Activities

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Operation and Maintenance						
Impact 4: Temporary physical disturbance of seabed caused by maintenance and repowering activities	VER Habitat Group 9 and 10	Medium	Negligible	Minor Adverse	None required	Minor Adverse

9.6.4. Potential Impacts during Decommissioning

9.6.4.1. Decommissioning Impact 1: Physical Disturbance to Habitats and Species and Temporary Habitat Loss

176. Within the decommissioning phase, temporary disturbance and habitat loss will occur due to the removal of the project related infrastructure. The removal of infrastructure and cabling from the seabed will result in a temporary loss of habitat and physical disturbance and therefore can be assessed in the same way as for construction which was adjudged to be of low magnitude (**Section 9.6.2.1**).

177. In the event that the cables on the intertidal zone are trenched and not laid via HDD methods, the decommissioning phase would require re-opening of the trench to extract the cable in a similar process to the construction phase. This trench would also be back filled with the removed material as within the construction phase.

178. The impacts are predicted to be similar or less than those which occurred within the construction phase and will be localised and for a short duration. Therefore, the magnitude of impact has been assessed as low. Given that the habitats and species which will be disturbed are predicted to be similar to those which will be disturbed within the construction phase, a medium sensitivity has been assigned for the benthic biotopes which will be disturbed. An overall **minor adverse** impact is assigned for the potential disturbance and temporary loss of habitats within the decommissioning phase.

9.6.4.1.1. Mitigation

179. Topic-specific mitigation will be conducted to ensure minimal loss of habitats and species within the operational phase. Following consent, pre-construction surveys would be carried out to check for the presence of any rare or protected habitats and species. Following these surveys, micro-siting of the cable would be used to mitigate impacts to these receptors where possible. This would inform areas which should be avoided and therefore minimal loss of important or protected habitats will occur.

9.6.4.1.2. Residual Impact

180. Although the impacts will be lessened, a **minor adverse** impact will remain for this activity (**Table 9-27**).

Table 9-27 Summary of Impact 12: Physical Disturbance to Habitats and Species and Temporary Habitat Loss

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Decommissioning						
Impact 12: Physical disturbance to habitats and species and temporary habitat loss	VER Habitat Group 9 and 10	Medium	Low	Minor Adverse	Following consent, pre-construction surveys and possible micro-siting will be conducted to allow for identification of important areas of habitat.	Minor Adverse

9.6.4.2. Decommissioning Impact 2: Increases in Suspended Sediment Concentration and Subsequent Deposition

181. Throughout the decommissioning phase there is potential for decommissioning activities such as drilling to disturb sediments, either from the sea bed surface or from below the sea bed

(depending on foundation type) and release them into the water column as a plume which may then be deposited within or around the MDZ.

182. However, the disturbance of sediments on the sea bed and release of them into the water column as a plume is lower than the effects arising from installation of foundations within the construction phase. This is primarily because the removal activities will cause less direct interference (i.e. no pre-drilling) and the Project substrate is largely characterised by bedrock with little surface sediment other than occasional gravel, cobbles and boulders, which would not form a plume.

183. Therefore, it is unlikely that there will be impacts to any of the identified VER groups within the MDZ, and a low sensitivity has been assessed for increased sediment plumes and deposition. As the magnitude of effect is deemed to be negligible and the sensitivity as low, an overall **negligible** impact is predicted.

9.6.4.2.1. Mitigation

184. As the impact assessment for potential increased suspended sediments and smothering is **negligible**, no specific mitigation is proposed.

9.6.4.2.2. Residual Impact

185. An overall **negligible** significance remains as no mitigation is required (**Table 9-28**).

Table 9-28 Summary of Impact 13: Increases in Suspended Sediment Concentration and Subsequent Deposition

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Decommissioning						
Impact 13: Increases in suspended sediment concentration and subsequent deposition	Benthic habitats within MDZ	Low	Negligible	Negligible	None required	Negligible

9.6.4.3. Decommissioning Impact 3: Permanent Loss of Habitat

186. Within the decommissioning phase, the hard substrates which have been placed within the subtidal area of the MDZ will be removed and therefore a loss of habitat will occur for those species which may have colonised it over the project lifetime. However, this loss of species and habitat will be balanced by the re-exposure of seabed habitats within the offshore site that can then be recolonised, therefore the impact is **negligible.**

9.6.4.3.1. Mitigation

187. As the impact assessment for permanent habitat loss during decommissioning is **negligible**, no specific mitigation is proposed.

9.6.4.3.2. Residual Impact

188. An overall **negligible** significance remains as no mitigation is required (**Table 9-29**).

Table 9-29 Summary of Impact 14: Permanent Loss of Habitat

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Decommissioning						
Impact 14: Permanent loss of habitat	Benthic habitats within MDZ	Negligible	Negligible	Negligible	None required	Negligible

9.6.5. Cumulative Impacts

As observed within the above assessments, the majority of impacts which are associated with benthic ecology are restricted to the immediate footprint of the Project. Therefore, it is only projects that will affect the same area of seabed, or more generally, the same local resource of benthic habitats that require consideration. The only identified project is Minesto's Holyhead Deep project, an 80 MW installation of tidal energy devices, delivered in a phased manner, located a short distance due west of the MDZ Project.

9.6.5.1. Potential Cumulative and In-Combination Impacts during Construction

189. The main potential cumulative and in-combination impacts during construction and installation relate to the direct physical disturbance and habitat loss caused by the installation of Project infrastructure on the seabed. Construction activities of the Project with the Minesto project may overlap on a temporal scale as the construction and installation of the Minesto project is following a phased approach and their seabed footprints should be considered in the overall footprint of habitat loss in the region.

190. The temporal overlap of construction activities presents a possible risk of elevated suspended sediment concentrations within the region beyond a level which would occur for individual project construction activities. However, as discussed within **Chapter 7, Metocean Conditions and Coastal Processes**, there is no possibility of changes in tidal flow interacting between projects, due to the alignment of flood and ebb flows off the coast of Anglesey (i.e. the two projects are not upstream/downstream of each other). The predicted impacts of Minesto's Holyhead Deep project on coastal processes have been assessed as being not significant in their own right (Minesto, 2016), and this conclusion is considered equally valid when both projects are considered in combination.

191. In comparison to the amount of comparable habitat identified in the survey area, the overall area of habitat that will be impacted by the Minesto project and the Project is small and it is predicted that no significant impacts should occur. Further, Minesto and Morlais may in future investigate options to share the future export cable; which will reduce the footprint of both projects and ensure that any habitat loss associated with these upcoming projects is kept to a minimum.

192. Although there is an increased risk of the introduction of INNS to the marine environment due to an increased amount of vessel traffic in the area and thus an increased window of opportunity, if

all projects abide to agreed mitigation measures and follow relevant guidelines then the probability will remain low. Therefore, the likelihood of simultaneous construction cumulatively impacting vulnerable benthic communities and receptors within the wider area is extremely low and is considered not significant.

9.6.5.2. Potential Cumulative and in-Combination Impacts during Operation and Maintenance

193. During the operational and maintenance phase, there is potential for impacts to act in-combination with other developments within the area. The two main impact pathways are:

- Modified hydrodynamic regime and sediment regime; and
- New hard substrates and their potential for INNS.

194. The small scale of the Project and the lack of impact this has on the environment within the MDZ makes it unlikely to interact with other developments within the region. The Minesto project is also of a small scale and is unlikely to have an impact on the hydrodynamics within its project space. Therefore, it is unlikely that there will be a significant alteration to the hydrodynamics in a regional context. Due to both of these projects being situated within areas of hard substrate and low levels of soft sediments, it is unlikely that scour pits will form around either projects infrastructure, and thus unlikely for an interaction to occur between the two projects.

195. Both the Project and the Minesto project involve introduction of hard substrate into a marine environment, which presents a risk of colonisation, inward migration and the settlement of species. Further, this hard substrate presents a substrate which could be utilised by INNS. However, as both of these projects are located within predominately hard substrate areas, the effects of possible colonisation of the infrastructure will not be as pronounced as those which would occur if the infrastructure was to be placed within soft sediments, as this would lead to the colonisation of an environment by species which are not typically found in this area. Further, due to the large level of available natural hard substrate (stony reef, bedrock etc), a large sink will occur to these readily available habitats.

196. The current dominance of hard substrates within the MDZ and the wider region suggests additional hard substrate through infrastructure will not present a vastly different environment for INNS than already within the region. Therefore, it is unlikely that the new infrastructure and additional hard substrates within the region will lead to a significant impact.

9.6.5.3. Potential Cumulative and in-Combination Impacts During Decommissioning

197. The main impact with any potential for cumulative effects at the decommissioning stage is direct physical disturbance and habitat loss. It is unlikely that the other projects will be decommissioned at the same time as the Project. Even if it is, the potential cumulative/in-combination impacts will be comparable to those during construction.

9.6.6. Inter-Relationships

198. **Table 9-30** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 9-30 Inter-Topic Relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Metocean Conditions and Coastal Processes	Chapter 7	Section 9.6.2	Both chapters consider the potential effects of the project on sediment concentrations in the water column

199. Habitat loss and disturbance is also discussed separately in a number of other chapters, including **Chapter 8, Marine Water and Sediment Quality** and **Chapter 10, Fish and Shellfish Ecology.**

9.6.7. Interactions

200. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 9-31**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 9-31 Potential Interaction Between Impacts

Potential interaction between impacts					
Construction	1: Physical disturbance and temporary habitat loss	2: Increased suspended sediment concentration	3: Pollution of water and sediment	4: Physical disturbance (intertidal)	5: Potential spread of non-native
1: Physical disturbance to habitats and species and temporary habitat loss	-	Yes	Yes	Yes	Yes
2: Increased suspended sediment concentration and sediment deposition	Yes	-	No	Yes	No
3: Pollution of water and sediment through accidental events	Yes	No	-	Yes	No
4: Physical disturbance to intertidal habitats and species during landfall works	Yes	Yes	Yes	-	Yes
5: Potential spread of non-native	Yes	No	No	Yes	-
Operation	1: Long term loss of benthic habitat	2: Changes in hydrodynamic and inter-related effects	3: Introduction of new habitat	4: Temporary physical disturbance	
1: Long term loss of benthic habitat via placement of project infrastructure	-	Yes	Yes	Yes	

Potential interaction between impacts				
2: Changes in hydrodynamic and inter-related effects on benthic ecology	Yes	-	Yes	Yes
3: Introduction of new habitat in the form of project infrastructure	Yes	Yes	-	Yes
4: Temporary physical disturbance of seabed caused by maintenance and repowering activities	Yes	Yes	Yes	-
Decommissioning	1: Physical disturbance to habitats	2: Increases in suspended sediment concentration	3: Permanent loss of habitat	
1: Physical disturbance to habitats and species and temporary habitat loss	-	Yes	Yes	
2: Increases in suspended sediment concentration and subsequent deposition	Yes	-	No	
3: Permanent loss of habitat	Yes	No	-	

9.7. SUMMARY

201. This chapter provides an overview on the potential impacts which may occur within the several stages associated with the development of the Project: construction, operation and maintenance, and decommissioning to the benthic and intertidal ecology of the MDZ.

202. **Table 9-32** collates the determinations of each of the impacts assessed and is presented as a summary of the determinations. It is evident that the majority of the impacts to the benthic and intertidal ecology throughout the various stages of development are likely to be of minor adverse significance, even when assessed with the worse-case scenario. Therefore, the effects on the benthic and intertidal ecology are unlikely to cause long-term changes to the MDZ environment and surrounding region, either through direct changes in the species composition or due to changes in sediment structure.

Table 9-32 Summary of potential impacts for the benthic ecology receptors associated with the development of the project

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction						
Impact 1: Physical disturbance to habitats and species and temporary habitat loss	VER Group 9 and 10	Medium	Low	Minor Adverse	▪ Mitigation will be conducted to ensure minimal disturbance to and loss of habitats and species during construction via pre-construction surveys and micro-siting.	Minor Adverse
Impact 2: Increased suspended sediment concentration and sediment deposition	VER Group 10	Low	Negligible	Negligible	▪ None required	Negligible

Impact 3: Pollution of water and sediment through accidental events	Benthic habitats within MDZ	High	Low	Moderate	▪ Development of an Emergency Response Cooperation Plan (ERCoP) with guidance set out by MCA in MGN 371, issued and approved by MCA;
					▪ Development of a Marine Pollution Contingency Plan and Vessel Management Plan, which would include the following measures:
					  ▪ Notice to Mariners to be issued to reduce collision risks;
					  ▪ Vessels associated with all Project operations will comply with IMO/MCA codes for prevention of oil pollution and any vessels over 400 GT will have on board SOPEPs;
						Minor Adverse

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
					▪ Vessels associated with all Project operations will carry on-board oil and chemical spill mop up kits; and ▪ Where possible, vessels will avoid working in poor weather conditions.	
Impact 4: Physical disturbance to intertidal habitats and species during landfall works	VER Group 1, 9, 12	Medium	Medium	Moderate	▪ Agree work method with NRW to minimise disturbance, using excavated materials to backfill, and to safeguard some boulders from top layer pre trench excavation, for replacement at end of backfilling.	Minor Adverse
Impact 5: Potential spread of non-native	Benthic habitats within MDZ	Medium	Medium	Moderate	▪ Compliance with guidelines, risk assessment of project vessels for INNS and further mitigation measures if required.	Minor Adverse
Operation and Maintenance						
Impact 1: Long Term Loss of Benthic Habitat via (a) Initial Placement of Project Infrastructure and (b) Repowering	VER Habitat Group 1, 9 and 12	Medium	Medium	Moderate	▪ Following consent, pre-construction surveys and possible micro-siting will be conducted to allow for identification of important areas of habitat.	Minor Adverse
Impact 2: Changes in hydrodynamic and inter-related effects on benthic ecology	Benthic habitats within MDZ	Low	Medium	Minor Adverse	▪ None required	Minor Adverse
Impact 3: Introduction of new habitat in the form of project infrastructure	Benthic habitats within MDZ	Medium	Negligible	Minor Adverse	▪ None required	Minor Adverse

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Impact 4: Temporary physical disturbance of seabed caused by maintenance and repowering activities	VER Habitat Group 9 and 10	Medium	Negligible	Minor Adverse	▪ None required	Minor Adverse
Decommissioning						
Impact 1: Physical disturbance to habitats and species and temporary habitat loss	VER Habitat Group 9 and 10	Medium	Low	Minor Adverse	▪ Following consent, pre-construction surveys and possible micro-siting will be conducted to allow for identification of important areas of habitat.	Minor Adverse
Impact 2: Increases in suspended sediment concentration and subsequent deposition	Benthic habitats within MDZ	Low	Negligible	Negligible	▪ None required	Negligible
Impact 3: Permanent loss of habitat	Benthic habitats within MDZ	Negligible	Negligible	Negligible	▪ None required	Negligible

9.8. REFERENCES

Boelens R.G.V., Walsh A.R., Parsons A.P., & Maloney D.M (1999). Ireland's marine and coastal areas and adjacent seas: an environmental review. Quality Status Report on behalf of the Departments of Environment and Local Government and Marine & Natural Resources. Marine Institute. Dublin.

Cap 722 (2015). Unmanned Aircraft System Operations in UK Airspace – Guidance.

Chartered Institute of Ecology and Environmental Management (2016). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal. Second Edition.

Davies J, Baxter J, Bradley M, Connor D, Khan J, Murray E, Sanderson W, Turnbull C, and Vincent M (2001). Marine Monitoring Handbook March 2001.

Davies A.J, Last K.S., Attard K., and Hendrick V.J (2009). Maintaining turbidity and current flow in laboratory aquarium studies, a case study using *Sabellaria spinulosa*. Journal of Experimental Marine Biology and Ecology, **370,** 35-40.

Folk R (1954) The distribution between grain size and mineral composition in sedimentary rock nomenclature. Journal of Geology 63, 344–359.

Foster-Smith, R.L. and Sotheran, I.S., (2003). Mapping marine benthic biotopes using acoustic ground discrimination systems. International Journal of Remote Sensing, 24(13), pp.2761-2784.

Griffith K., Mowat S., Holt R.H.F., Ramsay K., Bishop J.D.D., Lambert G. and Jenkins S.R (2009). First records in Great Britain of the invasive colonial ascidian *Didemnum vexillum* Kott, 2002. Aquatic Invasions 4, 581–590.

Gubbay S (2007). Defining and managing *Sabellaria spinulosa* reefs: Report of an inter-agency workshop 1-2 May 2007. JNCC Rep No. 405 44:22.

Hendrick V.J., Foster-Smith R.L., and Davies A.J (2011). Biogenic Reefs and the Marine Aggregate Industry. Marine ALSF Science Monograph Series No. 3. MEPF 10/P149. (Edited by R.C. Newell and J. Measures).

Hitchin R, Turner, Verling (2015). Epibiota Remote Monitoring from Digital Imagery: Operational Guidelines.

Høgedal, M. & Hald, T (2005). Scour assessment and design for monopile foundations for offshore wind turbines. Proceedings Copenhagen Offshore Wind, Copenhagen, 26-28 October 2005.

Irving R (2009). The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. JNCC Rep No. 432:44.

Last K.S., Hendrick V. J, Beveridge C. M & Davies A. J (2011). Measuring the effects of suspended particulate matter and smothering on the behaviour, growth and survival of key species found in areas associated with aggregate dredging. Report for the Marine Aggregate Levy Sustainability Fund.

Minesto (2016). Deep Green Holyhead Deep Project Phase 1 – Non-Technical Summary. June 2016.

McBreen, Fionnuala & Askew, N & Cameron, A & Connor, D & Lillis, Helen & Carter, Anita. (2011). UK SeaMap 2010. Predictive mapping of seabed habitats in UK waters.

Natural Resources Wales (NRW) (2018). Benthic habitat assessment guidance for marine developments and activities: over-arching principles and methods for benthic marine habitat survey and monitoring in the context of ecological impact assessment. Guidance Note: GN030. Available from: https://cdn.naturalresources.wales/media/687907/gn030-benthic-habitat-assessment-guidance-for-marine-developments-and-activities-introduction.pdf. Accessed on: 28/07/19

Ocean Ecology (2018). Morlais Demonstration Zone (MDZ) Benthic Ecology Characterisation Survey 2018. Technical Report to Marine Space, November 2018.

Parry ME V (2015) Guidance on Assigning Benthic Biotopes using EUNIS or the Marine Habitat Classification of Britain and Ireland.

Partrac (2018). Morlais Demo Zone (MDZ) Hydrographic & Geophysical Survey. Volume 2 – Survey Report to Marine Space, July 2018.

Pearce B., Taylor J., and Seiderer L.J (2007). Recoverability of *Sabellaria spinulosa* following aggregate extraction. MALSF funded project. MAL 0027 by Marine Ecological Surveys Ltd.

Perpetuus Tidal Energy Centre (PTEC), 2014. Chapter 12: Benthic and Intertidal Ecology. A report produced by Royal Haskoning DHV.

Rees E. I. S (2005). Assessment of the status of horse mussel (Modiolus modiolus) beds in the Irish Sea off NW Anglesey. DTI SEA6 Sub-contract report.

Royal HaskoningDHV (2011). 'West of Wales SMP2. Appendix C: Review of Coastal Processes and Geomorphology', (February).

Royal Haskoning (2011a). SeaGen Environmental Monitoring Programme. Final Report

Turner J.A, Hitchin R, Verling E, Rein H van (2015). Epibiota Remote Monitoring from Digital Imagery: Operational Guidelines.

Vincent M.A., Atkins S.M., Lumb C.M., Golding N., Lieberknecht L.M. & Webster M (2004). Marine nature conservation and sustainable development - the Irish Sea Pilot. Report to Defra by the Joint Nature Conservation Committee, Peterborough.

Wyn G, Brazier P, Birch K., Bunker A, Cooke A, Jones M, Lough N (2006) CCW Handbook for Marine Intertidal Phase 1 Biotope Mapping Survey.

Morlais Project
Environmental Statement

Chapter 10: Fish and Shellfish Ecology

Volume I

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GLOSSARY OF ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
BAP	Biodiversity Action Plan
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CFP	Common Fisheries Policy
CIA	Cumulative Impact Assessment
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
ES	Environmental Statement
FOCI	Feature of Conservation Importance
GBS	Gravity Base Structure
HDD	Horizontal Directional Drilling
HRA	Habitat Regulations Assessment
HNP	Horizon Nuclear Power
ICES	International Council for Exploration of the Sea
INNS	Invasive Non Native Species
IUCN	International Union for Conservation of Nature
JLDP	Joint Local Development Plan
JNCC	Joint Nature Conservation Committee
LNG	Liquid Natural Gas
MarLIN	Marine Life Information Network
MCZ	Marine Conservation Zone
MDZ	Morlais Demonstration Zone
MMO	Marine Management Organisation
NBN	National Biodiversity Network
NERC	National Environment and Rural Communities
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
RYA	Royal Yachting Association
SAC	Special Area of Conservation
S-P-R	Source-Pathway-Receptor
TAC	Total Allowable Catch
TEC	Tidal Energy Converter
TWAO	Transport and Works Act Order

GLOSSARY OF TERMINOLOGY

Beam trawl	A trawl net whose lateral spread during trawling is maintained by a beam across its mouth.
Benthic	Relating to, or occurring at the sea bottom.
Bony fish	Any of a major taxon (class Osteichthyes or superclass Teleostomi) comprising fishes with a bony rather than a cartilaginous skeleton.
Clupeid	Any of various fishes of the family Clupeidae, which includes the herrings, sprats, sardines and shads.
Crustacean	An arthropod of the large, mainly aquatic group Crustacea, such as a crab, lobster, shrimp, or barnacle.
Demersal	Living on or near the seabed.
Diadromous	Migrating between fresh and salt water.
Elasmobranch	Any cartilaginous fish of the subclass Elasmobranchii which includes the sharks, rays and skates.
Epibenthic	Relative to the flora and fauna living on the surface of the sea bottom.
Gadoid	A bony fish of an order (Gadiformes) that comprises the cods, hakes, and their relatives.
Otter trawl	A trawl net fitted with two ‘otter’ boards which maintain the horizontal opening of the net.
Pelagic	Living in the water column.
Swim bladder	A gas-filled sac present in the body of many bony fish, used to maintain and control buoyancy.

10. FISH AND SHELLFISH ECOLOGY

10.1. INTRODUCTION

1. Menter Môn Morlais Limited (Menter Môn) proposes the development of 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ). The development of the Morlais Project (the Project) will support the development of renewable energy technology objectives of the Anglesey and Gwynedd Joint Local Development Plan (JLDP), providing a consented tidal technology demonstration zone which supports installation, testing and commercial demonstrations of tidal energy devices. The Project will also provide opportunities for the local communities via direct employment and support of the local supply chain.

2. The Project will include communal infrastructure for tidal technology developers which provides a shared route to a local grid connection via nine export cable tails, an onshore landfall substation, and an onshore electrical cable route to a grid connection via a grid connection substation.

3. This chapter of the Environmental Statement (ES) aims to provide an assessment of potential impacts on fish and shellfish ecology within Welsh waters which may arise during the construction, operation and maintenance, repowering, and decommissioning of the Project.

4. This chapter characterises the baseline environment of fish and shellfish, as discerned from local and regional data in the published and 'grey literature'. The chapter then identifies potential impacts on the fish and shellfish receptor species that can arise through the Project phases, presents an impact assessment and associated results, and where applicable proposes mitigation measures. Additional relevant information has been used from other chapters of the ES, specifically:

   - **Chapter 7, Metocean Conditions and Coastal Processes**;
   - **Chapter 9, Benthic and Intertidal Ecology**; and
   - **Chapter 14, Commercial Fisheries**.

5. This chapter has been prepared by MarineSpace Ltd on behalf of Menter Môn.

10.2. POLICY, LEGISLATION AND GUIDANCE

6. A detailed overview of the policy and legislation surrounding this project can be found in **Chapter 2, Policy and Legislation**.

7. The Project is seeking consent for a Transport and Works Act Order from the Welsh Government and a Marine Licence from Natural Resources Wales (NRW). Although this project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is of a scale equivalent to a Nationally Significant Infrastructure Project (NSIP). Therefore, guidance for the DCO procedure constitutes the most appropriate guidance for a project of this scale and as such can be used to inform the approach for this Project. Guidance that is relevant to assessing impacts on fish and shellfish for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to fish and shellfish ecology include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3), July 2011.

8. Details of specific policies within EN-1 and EN-3 used to inform this assessment are provided below.

9. Other relevant legislation has been considered during this assessment (see **Chapter 2, Policy and Legislation**). The following are of particular relevance to the assessment of fish and shellfish ecology:

- EU Habitats Directive (Directive 92/43/EEC);
- Conservation of Habitats and Species Regulations 2010 (the Habitats Regulations) implements species protection requirements of the Habitats Directive in England in inshore waters;
- UK Post-2010 Biodiversity Framework, superseding the UKBAP the UK Governments response to the Convention on Biological Diversity (CBD) 1992;
- Conservation of European Wildlife and Natural Habitats Convention (Bern convention);
- Wildlife and Countryside Act 1981;
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); and
- Environment (Wales) Act 2016 (which incorporates the same list of species of principal importance as originally presented in Sections 41 and 42 of the Natural Environment and Rural Communities Act 2006.

10.2.1. National Policy Statement

10. The Project is seeking consent for a Transport and Works Act Order from the Welsh Government and a Marine Licence from Natural Resources Wales (NRW). Although this project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP), therefore guidance relevant to NSIPs is considered appropriate to use for this Project. Guidance that is relevant to assessing impacts on marine water and sediment quality for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to marine water and sediment quality include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3), July 2011 (DECC, 2011b).

11. Details of specific policies within EN-1 and EN-3 used to inform this assessment are provided in below. The specific assessment requirements for fish and shellfish ecology are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 10-1 NPS EN-1 and EN-3 Assessment Requirements Relevant to Fish and Shellfish Ecology

NPS Requirement	NPS Reference	ES Reference
"There is the potential for the construction and decommissioning phases, including activities occurring both above and below the seabed, to interact with seabed sediments and therefore have the potential to impact fish communities, migration routes, spawning activities and nursery areas of particular species. In addition, there are potential noise impacts, which could affect fish during construction and decommissioning and to a lesser extent during operation."	EN-3, Paragraph 2.6.73	Potential impact to fish and shellfish ecology arising from construction and decommissioning activities associated with the seabed are discussed in throughout the Impact Assessment in **Section 10.6**.
The applicant should identify fish species that are the most likely receptors of impacts with respect to feeding areas; spawning grounds; nursery grounds; overwintering areas for crustaceans and migration routes;	EN-3, Paragraph 2.6.74	Fish and shellfish species present within the study area have been identified through desk-based assessment of available data and are presented in **Section 10.5**.
Where mitigation measures are applied to offshore export cables to reduce electromagnetic fields (EMF) the effects on sensitive species during operation are unlikely to be a reason for PINS to have to refuse to grant consent. Once installed, operational EMF impacts are unlikely to be of sufficient range or strength to create a barrier to fish movement;	EN-3 Para 2.6.75	EMF impacts to fish and shellfish could arise during the operation of the Project. These are assessed in **Section 10.6.5.6**.
EMF during operation may be mitigated by use of armoured cable for inter-array and export cables which should be buried at a sufficient depth	EN-3 Para 2.6.76	EMF impacts and any proposed mitigation measures are discussed in **Section 10.6.5.6**.
During construction, 24 hour working practices may be employed so that the overall construction programme and the potential for impacts to fish communities are reduced in overall time.	EN-3 Para 2.6.77	24-hour working practices will be employed for offshore construction (see **Chapter 4, Project Description**).

10.2.2. Marine Policy Statement

12. The Marine Policy Statement (MPS) adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made in order to enable sustainable development. The MPS sets out a vision of having 'clean, healthy, safe, productive and biologically diverse oceans and seas' by supporting the development of Marine Plans. It also sets out the framework for environmental, social and economic considerations that need to be considered in marine planning.

10.2.3. Wales National Marine Plan

13. By adopting the MPS, the Welsh Government committed to the requirement to introduce Marine Plans for Wales.

14. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the Welsh National Marine Plan (WNMP). The Plan is being developed in accordance with the Marine and Coastal Access Act (MCAA) 2009, the MPS and the Maritime Spatial Planning Directive, a draft version has been issued for consultation (discussed further in Chapter 2, Policy and Legislation).

15. Objective 10 of the WNMP, “to maintain and enhance the resilience of marine ecosystems and the benefits they provide in order to meet the needs of present and future generations”, is of relevance to this chapter as this covers policies and commitments on the wider ecosystem, as set out in the MPS including those to do with the Marine Strategy Framework Directive and the Water Framework Directive, as well as other environmental, social and economic considerations.

16. **Table 10-2** sets out other national and regional policies which are particularly relevant to the Project.

Table 10-2 National and Regional Policy Requirements Relevant to Fish and Shellfish Ecology

Policy Description	Reference	ES Reference
MPS		
Noise resulting from a proposed activity or development in the marine area or in coastal and estuarine waters can have adverse effects on biodiversity although knowledge of the extent of impacts is limited and there are few systematic monitoring programmes to verify adverse effects. Man-made sound emitted within the marine environment can potentially affect marine organisms in various ways. It has the potential to mask biologically relevant signals; it can lead to a variety of behavioural reactions, affect hearing organs and injure or even kill marine life. Manmade sound sources of primary concern with regard to disturbance of marine life are explosions, shipping, seismic surveys, offshore construction and offshore industrial activities, for example dredging, drilling and piling, sonar of various types and acoustic deterrent devices.	Section 2.6.3.1	The effects of underwater noise on migratory and non-migratory fish have been assessed using noise modelling from a similar recent tidal energy project, the PTEC project as well as a technical note prepared for this project (Subacoustech, 2019) This included species considered sensitivity to noise. Noise produced from a variety of activities (both construction and operation) have been included. See **Sections 10.6.4.1** and **10.6.5.1**.
Renewable energy developments can potentially have adverse impacts on marine fish and mammals, primarily through construction noise and may displace fishing activity and have direct or indirect impacts on other users of the sea, including mariners. Certain bird species may be displaced by offshore wind turbines, which also have the potential to form barriers to migration or present a collision risk for birds. Their foundation designs are likely to have an effect on hydrodynamics and consequent sediment movement. This includes potential scouring of sediments around the bases of turbines. These and other potential adverse impacts, together with potential mitigation measures, are considered in the National Policy Statement for Renewable Energy Infrastructure (EN-3).	Section 3.3.24	Potential impacts on fish and shellfish arising from the Project are assessed in **Sections 10.6.4**, **10.6.5** and **10.6.6**. Displacement of fishing activity is considered in **Chapter 14, Commercial Fisheries**
Marine energy deployments, that is wave and tidal deployments, may pose potential risks to the environment if inappropriately sited. However, the level of risk and ecological significance is largely unknown since, in particular, tidal stream and wave technologies are at a relatively early stage of development. Studies of tidal range	Section 3.3.25	A desk-based review of available data has been used to determine the species present (**Section 10.5.3**) and the potential impacts to

Policy Description	Reference	ES Reference
technologies, including barrages, have indicated that these structures can have adverse impacts on migratory fish and bird species and on the hydrodynamics of the estuarine environments in which they are situated. To underpin the marine planning process further research is needed to develop a better understanding of the potential impacts that marine technologies might have on potentially sensitive environmental features. For example, adaptation and mitigation methods for such impacts may be supported by detailed monitoring programmes and co-ordinated research initiatives, including post deployment of devices.		these species are assessed in **Section 10.6** to be of minor adverse significance.
Draft WNMP		
Proposals should demonstrate how they contribute to the protection, restoration and/or enhancement of marine ecosystems	ENV_01: Resilient marine ecosystems	Potential impacts to fish and shellfish are assessed in **Section 10.6** to be of minor adverse significance.
Proposals should demonstrate how they: · avoid adverse impacts on individual Marine Protected Areas (MPAs) and the coherence of the network as a whole; · have regard to the measures to manage MPAs; and · avoid adverse impacts on non-marine designated sites.	ENV_02: Marine Protected Areas	The conservation importance of fish and shellfish species is presented in **Section 10.5.** Potential impacts to these species are assessed in **Section 10.6** to be of minor adverse significance.
Proposals should include biosecurity measures to reduce the risk of introducing and spreading invasive non-native species.	ENV_03: Invasive non-native species	The assessment of the impact of invasive non-native species is addressed in **Chapter 9, Benthic and Intertidal Ecology**.
Proposals should demonstrate that they have considered man-made noise impacts on the marine environment and, in order of preference: a) avoid adverse impacts; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding	ENV_05: Underwater noise	The effects of underwater noise on migratory and non-migratory fish have been assessed using noise modelling from a similar recent tidal energy project, the PTEC project as well as a technical note prepared for this project (Subacoustech, 2019) This included species considered sensitivity to noise. Noise produced from a variety of activities (both construction and operation) have been included. See **Sections 10.6.4.1** and **10.6.5.1**.

Policy Description	Reference	ES Reference
Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01: Cumulative effects	Cumulative impacts are assessed in **Section 10.6.7** and in **Chapter 26**
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced	Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	The impact assessment is included within **Section 10.6** and includes mitigation measures to reduce impact significance.

10.3. CONSULTATION

17. An Environmental Impact Assessment (EIA) scoping process was undertaken for this project. An EIA Scoping Document (Royal HaskoningDHV, 2018) was produced and submitted to the regulators, who consulted with the statutory bodies and key stakeholders upon the contents. The project went through three rounds of scoping, in 2015, 2017 and 2018. All scoping comments from 2018 pertaining to this chapter have been presented in **Table 10-3**. These comments have been addressed fully in this chapter, with the location of the relevant information highlighted in the response column for ease of location.

Table 10-3 Consultation Responses Pertaining to Fish (Including Migratory Fish) and Shellfish from the 2018 Scoping Round

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Scoping Comments	Marine Fish: The documents referred to in footnotes 50 and 51, which have been used to inform the described marine fish baseline, are over 20 years old. Baseline information is expected to be informed by up to date studies, or evidence should be provided to demonstrate that these are still relevant. The Applicant is recommended to make efforts to agree the species to be included within the assessment with NRW; taking into account the comments made in NRW's consultation response (see Appendix 1 of this Scoping Opinion).	More recent references have been used to inform the marine fish baseline, such as Ellis et al. (2012) and Aires et al. (2014). See **Section 10.5.4** to **10.5.6**.
Planning Inspectorate	2018 Scoping Comments	Shellfish: The Fish and Shellfish Ecology chapter does not identify the European Shellfish Water designation that is identified in Section 7.2.1.1 of the Scoping Report. Appropriate cross reference should be made to the Marine Sediment and Water Quality chapter.	The European Shellfish Water designation has now been mentioned in **Section 10.5.7.3** Please also see **Figure 8-1** (**Volume II**) and **Chapter 8, Marine Water and Sediment Quality.**

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Scoping Comments	Potential Impacts: Table 8-7 of the Scoping Report states that the significance of effect for a number of potential impacts would be dependent on construction methods and project design. It is understood that the precise detail of the construction methods will not be known at the time of application. On this basis, the ES should ensure that a worst case scenario attributable to construction is assessed.	The worst-case scenario approach has been adopted throughout this chapter.
Planning Inspectorate	2018 Scoping Comments	Loss of shellfish habitat: The Scoping Report has identified the potential for loss of shellfish habitat through the placement of devices and the swept area of mooring cables. The loss of habitat (including seabed, spawning or nursery grounds) for demersal fish should also be assessed in the ES.	Loss of habitat for demersal fish (and other fish groups) has been considered in the impacts as well as the loss for shellfish. See **Section 10.5.5**.
Planning Inspectorate	2018 Scoping Comments	Impacts on fish and shellfish through a decrease in water quality: The ES should assess the likely significant effects from increased turbidity on larvae of fish and shellfish species.	A short description of the potential effects of turbidity on larvae has been included; see **Section 10.6.4.3**.
Planning Inspectorate	2018 Scoping Comments	EMF: The Scoping Report identifies EMF as a potential barrier to migratory fish. No reference is made of impacts to non migratory fish. This should be considered and if significant effects are likely this should be assessed within the ES.	The effects of EMF on non-migratory fish and shellfish have been included. See **Section 10.6.5.7**.
Planning Inspectorate	2018 Scoping Comments	Underwater noise: The Scoping Report identifies the potential for underwater noise to displace migratory fish. No reference is made of impacts to non-migratory fish (e.g. behavioural impacts, injury or death). Impacts to non-migratory fish which could result in significant effects should be assessed within the ES. The ES should also justify the approach to the assessment based on fish species sensitivity to underwater noise. The assessment of underwater noise during construction should include all construction activities e.g. piling, vessels, seabed preparation and cable installation.	The effects of underwater noise on non-migratory fish have been included in this chapter. The chapter has used species-specific sensitivity levels in the approach. Noise produced from a variety of activities (both construction and operation) have been included. See **Sections 10.6.4.1** and **10.6.5.1**.
Planning Inspectorate	2018 Scoping Comments	Site specific surveys: The need for and design of site specific surveys should be discussed and agreed with NRW.	The rationale for not conducting site specific surveys has been included under **Section 10.4.4**.

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Scoping Comments	Changes to species composition: Table 9-4 has identified the potential for changes in abundance of commercial fisheries target species. If significant effects are likely, changes to species composition should also be assessed in the Fish and Shellfish chapter of the ES.	**Chapter 14, Commercial Fisheries** has been reviewed. The greatest impact predicted for commercial fisheries was minor adverse, which is not significant. Therefore, there are no significant impacts for commercial fisheries that need to be included in this chapter.
Planning Inspectorate	2018 Scoping Comments	Biosecurity: The ES should assess the potential impacts from the spread of non-native invasive species. Any measures to mitigate the spread of this species should be identified in the ES.	The assessment of the impact of invasive non-native species is addressed in **Chapter 9, Benthic and Intertidal Ecology**. A cross-reference to this chapter has been added to **Section 10.6.1**.
National Resource Wales (NRW) (for PINS)	2018 Scoping Comments	The assessment of fish species to inform the Environmental Statement needs to identify all possible fish species that may be affected by the proposed development and indicate the relevant legislation for each, for example: Common Fisheries Policy zero TAC species, UK Biodiversity Action Plan species, Section 7 Environment Act species, IUCN European Red List species etc. Assessment should consider the impacts of all stages of development (i.e. construction, operation and decommissioning).	All of the listed legislation has been included when assessing the fish species to be included in the assessment. See **Table 10-10, Table 10-12, Table 10-14, Table 10-17**.
NRW (for PINS)	2018 Scoping Comments	In light of the above information we advise that species such as the spurdog or spiny dogfish *Squalus acanthias* will need to be included as a potential impact receptor in the ES; it is known to use the area and is classed as vulnerable in the IUCN Red List. This, and other elasmobranch species may be impacted by, for example, electromagnetic field effects and so should be included in the ES for assessment.	The spiny dogfish and other elasmobranch species have been included in the assessment. See **Section 10.5.4** for the elasmobranch species included, and **Section 10.6.5.7** for EMF effects.
NRW (for PINS)	2018 Scoping Comments	The Pembrokeshire Marine SAC fish species features of sea lamprey, river lamprey and allis shad (note that twaite shad is missing) are included in Table 8-1 but Pembrokeshire Marine SAC has been	The Pembrokeshire Marine SAC (Site code 13116) has been included in this assessment (as shown in

Consultee	Date/Document	Comment	Response
		omitted from Table 8-6 Relevant SACs for migratory fish. NRW welcomes the statement in Table 11-1 that migratory fish will be fully considered in the ES, including the provision of a justification where specific sites and species are scoped out.	**Figure 10-4, Volume II**) as well as the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). Migratory fish have been fully considered in this chapter, aligned with the rationale in the HRA.
NRW (for PINS)	2018 Scoping Comments	Section 8.4.2.1 of the EIA scoping report states “that shellfish are the only commercial species landed at Holyhead”. This statement is incorrect as fish species are also landed there. The EIA suggests ‘that no scallop vessels at Holyhead are licenced for scallop fishing’, however, several vessels fish for scallops from Holyhead. Longlining fishing for rays occasionally occurs off western Anglesey with vessels from Holyhead participating.	A brief overview of commercial fisheries information has been included in this chapter, with cross-reference made to **Chapter 14, Commercial Fisheries**
NRW (for PINS)	2018 Scoping Comments	We welcome the acknowledgement of the potential impact pathways identified for Annex II species (fish) features and natural fish and shellfish in Table 8.1 and Table 8.7. We note, however, that the potential impact to migratory and non-migratory fish from ‘collision risk with devices’ has been identified as ‘unlikely to be significant’, despite the applicant indicating that migratory pathways are not well understood, and that more information is required to assess potential impacts to non-migratory fish. A full examination and evidenced justification in support of this view will be required within the ES.	A full impact assessment of collision risks with migratory and non-migratory fish has been included in this chapter. See **Section 10.6.5.6.**
NRW (for PINS)	2018 Scoping Comments	We advise that impacts on migratory fish from underwater noise should include consideration of impacts on hearing specialists such as herring which are a prey species of marine mammals. Other impacts which we recommend are assessed within the ES include possible impacts on larvae of fish and shellfish species from increased turbidity.	The impact on migratory fish from underwater noise has been assessed using noise modelling from a similar recent tidal energy project, the PTEC project as well as a technical note prepared for this project (Subacoustech, 2019) This included species considered sensitivity to noise. See **Section 10.6.4.1**. The effect of turbidity on larvae has been included in **Section 10.6.4.3.1**

Consultee	Date/Document	Comment	Response
NRW (for PINS)	2018 Scoping Comments	We welcome the applicant's indication in Table 11.1 that transitional fish species (such as bass, whiting and herring) will be considered as part of the wider fish assessment which will include consideration of seasonal variation in fish spawning and larval activity. We maintain that the ES should differentiate between transitional and migratory fish assemblages where possible.	Transitional fish species and their general seasonality have been included in the assessment. See **Table 10-13** for an example.
NRW	2018 Scoping Comments	No information is provided on the proposed approach to assessing potential underwater noise effects. This should follow the latest guiding principles for the assessment of the impacts of underwater noise. This includes applying an appropriate acoustic model, published exposure criteria or acoustic thresholds and relevant noise sources and model input data. The limitations and constraints of any approach should be set out. The noise assessment should also include a general review of the latest available scientific evidence of the observed responses of fish to different types of underwater sound for context. Consideration should be given to the sensitivity of fish to particle motion (not just sound pressure level) recent research indicated this to be an equally or potentially more important than sound pressure in some fish	The noise modelling output from a similar project (PTEC, 2014) has been used within this assessment, plus outputs from a recent technical note on subsea noise (Subacoustech, 2019).
NRW	2018 Scoping Comments	Impacts on migratory fish from underwater noise should include consideration of impacts on hearing specialists such as herring which are a prey species of marine mammals. Other impacts which should be assessed within the ES include possible impacts on larvae of fish and shellfish species from increased turbidity.	See above.
NRW	2018 Scoping Comments	We welcome your indication in Table 11.1 that transitional fish species (such as bass, whiting and herring) will be considered as part of the wider fish assessment which will include consideration of seasonal variation in fish spawning and larval activity. The ES should differentiate between transitional and migratory fish assemblages where possible.	See above.

10.4. METHODOLOGY

10.4.1. Impact Assessment Methodology

18. The assessment approach has adopted the following stages:

- Review of existing relevant data and information;
- Formulation of a conceptual understanding of baseline conditions;
- Consultation and agreement with the regulators regarding proposed assessment approaches;
- Determination of the worst-case scenarios;
- Consideration of embedded mitigation measures; and
- Assessment of effects using data analysis, numerical modelling outputs, and expert-based judgements by MarineSpace Ltd.

19. A detailed description of the Impact Assessment Methodology is provided in **Chapter 5, EIA Methodology**. A short summary is provided here for completeness, with additional detail provided for the specific receptor of this chapter.

20. A Project Design Envelope approach, often referred to the ‘Rochdale Envelope’, has been used in this assessment. This approach “defines a series of realistic maximum extents and magnitudes for the description of a development, so that a realistic ‘worst case scenario’ is assessed”. **Chapter 4, Project Description**, sets out the parameters of the project in order to complete the assessment.

21. Effects are changes in the physical environment that may arise during Project activities. Effects can result in impacts where a receptor is sensitive to them. Impacts can be considered as direct, indirect, inter-relationships, or cumulative (see **Chapter 5, EIA Methodology** for definitions).

22. The assessment of effects on fish and shellfish ecology is predicated on a Source-Pathway-Receptor (S-P-R) conceptual model, whereby the source is the initiator event, the pathway is the link between the source and the receptor impacted by the effect, and the receptor is the receiving entity.

23. An example of the S-P-R conceptual model is provided by cable installation which disturbs sediment on the sea bed (source). This sediment is then transported by tidal currents until it settles back to the sea bed (pathway). The deposited sediment could smother and have an effect on the species on this area of the seabed (receptor).

24. Consideration of the potential effects of the Project is carried out over the following spatial scales:

- Near-field: the area within the immediate vicinity (tens or hundreds of metres) of the project and along the export cable corridor; and
- Far-field: the wider area that might also be affected indirectly by the project (e.g. due to disruption of waves, tidal currents or sediment pathways).

25. The S-P-R approach has been used in order to provide systematic approach to "understanding the potential for effects to arise, the spatial extents of the effect-receptor interactions, impact pathways, and potential impact significance."

26. Three main phases of development are considered over the life-cycle of the Project, in conjunction with the present-day baseline. These are:

- Construction phase;
- Operation and maintenance phase (including repowering); and
- Decommissioning phase.

10.4.1.1. Sensitivity, Value and Magnitude

27. The determination of each aspect of the receptor (sensitivity, value, magnitude) was considered for each species, using available evidence, including published data sources, and expert judgement.

28. The sensitivity of the receptor was considered in terms of its:

- Tolerance to an effect (the extent to which the receptor is adversely affected by an effect);
- Adaptability (the ability of the receptor to avoid adverse impacts that would otherwise arise from an effect); and
- Recoverability (a measure of a receptor's ability to return to a state at, or close to, that which existed before the effect caused a change).

29. In addition, a value component may also be considered when assessing a receptor. This ascribes whether the receptor is rare, protected or threatened; has key life stages in the area; or is of commercial value, which is of particular relevance to fish and shellfish receptors. It is important to note that value does not necessarily imply greater sensitivity to effects.

30. The magnitude of an effect is dependent upon its:

- Scale (i.e. size, extent or intensity);
- Duration;
- Frequency of occurrence; and
- Reversibility (i.e. the capability of the environment to return to a condition equivalent to the baseline after the effect ceases).

31. The sensitivity and value of receptors and the magnitude of effect are assessed using available literature and data, expert judgement, and also published sensitivity assessments on the Marine Life Information Network (MarLIN) (2019). Definitions for each term are provided in **Table 10-4** to **Table 10-6**. These expert judgements of receptor sensitivity, value and magnitude of effect are guided by the conceptual understanding of baseline conditions.

Table 10-4 Definitions of the Sensitivity Levels for Fish and Shellfish Receptors

Sensitivity	Definition
High	Tolerance: Receptor has very limited tolerance of effect Adaptability: Receptor unable to adapt to effect Recoverability: Receptor unable to recover resulting in permanent or long-term (greater than ten years) change
Medium	Tolerance: Receptor has limited tolerance of effect Adaptability: Receptor has limited ability to adapt to effect Recoverability: Receptor able to recover to an acceptable status over the medium term (5-10 years)
Low	Tolerance: Receptor has some tolerance of effect Adaptability: Receptor has some ability to adapt to effect Recoverability: Receptor able to recover to an acceptable status over the short term (1-5 years)
Negligible	Tolerance: Receptor generally tolerant of effect Adaptability: Receptor can completely adapt to effect with no detectable changes Recoverability: Receptor able to recover to an acceptable status near instantaneously (less than one year)

Table 10-5 Definitions of the Value Levels for Fish and Shellfish Receptors

Value	Definition
High	Receptor is designated and/or of national or international importance. Likely to be rare. Has been identified as having a key life stage (spawning or nursery ground) that overlaps the MDZ Is of significant commercial importance (i.e. regularly landed from the area, as revealed by local fishermen or ICES data)
Medium	Receptor is not designated but is of local to regional importance. Has been identified as having a key life stage in the greater region, but not directly overlapping the MDZ The receptor has been landed but not on a regular basis
Low	Receptor is not designated but is of local importance
Negligible	Receptor is not designated and is not deemed of importance

Table 10-6 Definitions of Magnitude of Effect for Fish and Shellfish Receptors

Magnitude	Definition
High	Scale: A change which would extend beyond the natural variations in background conditions Duration: Change persists for more than ten years Frequency: The effect would always occur Reversibility: The effect is irreversible
Medium	Scale: A change which would be noticeable from monitoring but remains within the range of natural variations in background conditions Duration: Change persists for 5-10 years Frequency: The effect would occur regularly but not all the time Reversibility: The effect is very slowly reversible (5-10 years)

Magnitude	Definition
Low	Scale: A change which would barely be noticeable from monitoring and is small compared to natural variations in background conditions Duration: Change persists for 1-5 years Frequency: The effect would occur occasionally but not all the time Reversibility: The effect is slowly reversible (1-5 years)
Negligible	Scale: A change which would not be noticeable from monitoring and is extremely small compared to natural variations in background conditions Duration: Change persists for less than one year Frequency: The effect would occur highly infrequently Reversibility: The effect is quickly reversible (less than one year)

10.4.1.2. Impact Significance

32. Following the identification of receptor sensitivity and value, and magnitude of effect, it is possible to determine the significance of the impact. A matrix is presented in **Table 10-7** as a framework to guide how a judgement of the significance is determined. The matrix approach ensures a consistent approach and limits the subjectivity of the impact assessment arising from expert judgement.

33. Through use of the matrix shown in **Table 10-7** an assessment of the significance of an impact can be made in accordance with the definitions in **Table 10-8**.

Table 10-7 Impact Significance Matrix

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Table 10-8 Impact Significance Definitions

Value	Definition
Major	Very large or large change in receptor condition, either adverse or beneficial, which are likely to be important at a population (national or international) level because they contribute to achieving national or regional objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor, which may to be important considerations at a regional population level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important at a regional population level.
Negligible	No discernible change in receptor condition

34. For the purposes of this ES, ‘major’ and ‘moderate’ impacts are deemed to be significant (in EIA terms). In addition, whilst ‘minor’ impacts may not be significant, it is important to distinguish these from other non-significant (negligible) impacts as they may contribute to significant impacts cumulatively.

10.4.1.3. Cumulative Impact Assessment

35. Impact inter-relationships are given consideration in this chapter. These can be defined as the potential for different residual impacts to have a combined impact on key sensitive receptors.

36. Cumulative impacts are assessed through consideration of the extent of influence of changes to fish and shellfish ecology arising from the project alone and those arising from the project cumulatively or in combination with other reasonably foreseeable plans and projects.

10.4.2. Study Area

37. The Project area is delineated by the Offshore Development Area (OfDA) for consent which offshore includes the Morlais Demonstration Zone (MDZ) and the export cable corridor (ECC; **Figure 1-1, Volume II**). The MDZ comprises 35 km^2 and the ECC 4.75 km^2, (including an intertidal area of 0.01 km^2) totalling an area of 39.75 km^2 for the RLB. The RLB extends westward from the west coast of Holy Island, Anglesey, Wales. At the nearest point the MDZ lies approximately 0.5 km from the coast, with the farthest point approximately 7 km from the coast. The ECC lies to the east of the MDZ, between it and the coast.

38. The study area for the purpose of this chapter is defined as the boundary of ICES Statistical Rectangle 35E5, within which the MDZ and ECC are located. The boundaries of ICES Statistical Rectangle are shown in **Plate 10-1**.

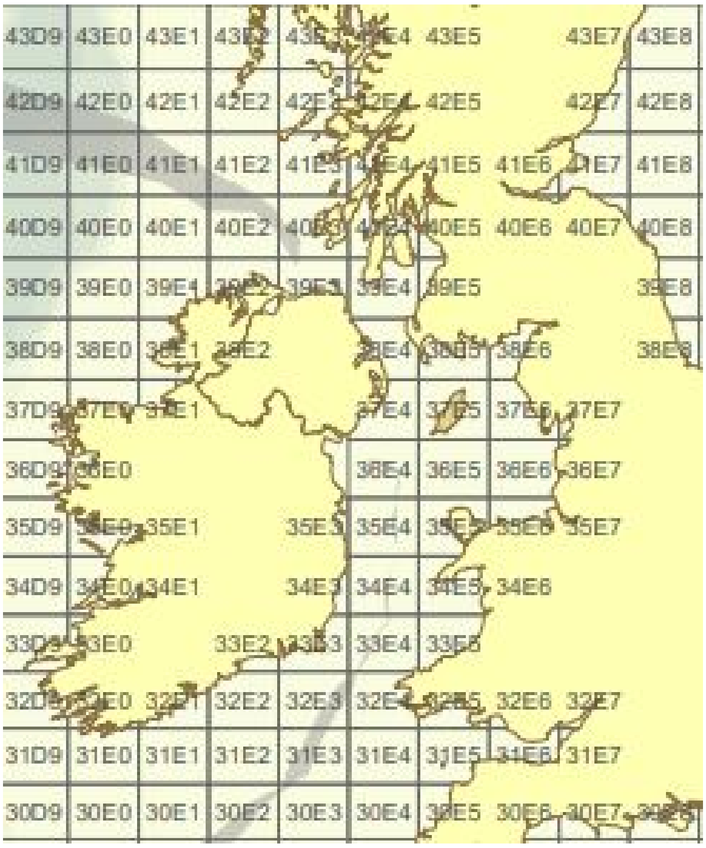

Plate 10-1 The ICES Statistical Rectangles in the Irish Sea

39. This study area lies within the greater Irish Sea West Functional Unit 15, in Division VIIa (Irish Sea), within subarea VII. The area is described in terms of its baseline environment of the fish

and shellfish community, with particular note of species that have key life stages in the area, or those that are of commercial or conservation importance. Where more fine-scale/local information is available, these have been used to supplement the knowledge at the study area scale.

40. The migratory fish community was characterised at a regional scale with their distribution based upon knowledge of their presence in rivers that lead into the Irish Sea (see **Document MOR/RHDHV/DOC/0067, Information to Support HRA,** for more details).

10.4.3. Data Sources – Desk Study

41. The primary resources used to inform this chapter include:

- Marine Life Information Network (MarLIN);
- SeaLifeBase and FishBase;
- SharkTrust;
- National Biodiversity Network (NBN) Atlas;
- ICES landings data;
- IUCN Red list;
- Relevant nature conservation legislative documents;
- Consultation responses; and
- Published and unpublished literature.

10.4.4. Data Sources – Site-Specific Surveys and Reports

42. No site-specific surveys for fish and shellfish were conducted for the Project. Based on the nature of the area and likely (low level of) impacts on fish species it was determined that site-specific surveys were not required. This approach follows the clear precedent set by offshore energy developments in recent years.

43. Although not directly related to fish, one site-specific survey conducted for the Project was used to inform this chapter (detailed results are presented in **Chapter 9, Benthic and Intertidal Ecology**):

- Ocean Ecology, 2018. MDZ Benthic Ecology Characterisation Survey 2018.

10.5. EXISTING ENVIRONMENT

44. The distribution of fish and shellfish is influenced by abiotic and biotic factors. Abiotic factors, those that characterise the physical environment, can include water temperature, salinity, nutrient levels, water depth, bathymetry, hydrographic regime, substrate and physical habitat. Biotic factors, those that characterise the biological environment, can include food availability, predator-prey interactions, competition and human activities.

10.5.1. Physical Environment

45. The study area lies within the eastern Irish Sea. The bathymetry of the Irish Sea is defined by a deep (up to 150 m) channel orientated north-south in the western part (Parker-Humphreys, 2004). This channel forms a boundary at the western edge of the extensive, shallow coastal shelf upon which the Project is located. The channel is thought to play an important role in the ecology of the demersal fish in the area, creating a divide between populations and consequent differences in their life history traits, and also allowing for the occurrence of deep-water fish from the Celtic and Sea and north-west Scotland.

46. The circulation of the Irish Sea is characterised by an overall south-to-north flow, passing to the west of the Isle of Man (Parker-Humphreys, 2004). The eastern Irish Sea, off the coast of North Wales, is dominated by an anti-clockwise gyre, which entrains water from south to north, along the north-west coast of Wales.

47. There are several seasonal fronts within the Irish Sea. In spring, a strong front develops in the western Irish Sea close to Ireland, keeping the mixed waters to the southeast (including the Project) separate from the stratified waters to the northwest. Local seasonal fronts may also develop in the eastern Irish Sea near Liverpool (to the east of the Project), and in Cardigan Bay (to the south of the Project).

48. The site-specific physical characteristics are detailed in **Chapter 7, Metocean Conditions and Coastal Processes**. Within the MDZ, water depth ranges from 2 m at the landfall and up to 72 m in the northwest part. The average depth is approximately 40 m. Most of the seabed comprises large areas of outcropping bedrock with minimal relief above surrounding bed levels. There is a sand ridge north of South Stack that extends northwards for approximately 1 km. The seabed is uneven at a local scale due to the presence of bedforms of a variety of size.

49. Tidal conditions are characterised as having a typical spring tidal range of around 4.5 m and a typical neap tidal range of around 3.0 m. There are very high baseline current speeds (>2 m/s) in the MDZ. Dominant wave conditions in the MDZ are from south-southwest to southwest. Dominant sediment type is gravel or gravelly sand in the MDZ.

10.5.2. Biological Environment

50. Food availability is an important factor in determining the distribution of fish and shellfish. Certain species are mobile and so able to forage large distances for food, whereas others remain in one area and so are reliant upon the environment at that location for food. Important food sources to fish and shellfish can range from plankton, for shellfish and small species including juvenile life stages, through to animals larger than themselves (cetaceans, sharks) for parasitic species such as lamprey.

51. Fish and shellfish are an important food source for many species in the area. Species that may predate on fish include other fish, birds, and cetaceans. As detailed in **Chapter 12, Marine Mammals**, the diet of the most common marine mammal species in the area (harbour porpoise, bottlenose dolphin, grey seal) is comprised mostly of fish, with crustaceans also important. Species such as herring, sprat and sandeel are key prey items of several marine ornithology receptors, as stated in **Chapter 11, Marine Ornithology**.

52. As fish and shellfish can comprise both prey and predators to certain species, there will be competition with identified species occupying the same trophic level. Furthermore, they may be competition for habitats for sessile species.

53. The biological habitats present in the greater region are outlined in **Chapter 9, Benthic and Intertidal Ecology**. In summary, the intertidal areas around Anglesey are extensive areas of relatively undisturbed habitats comprised of high energy rocky shores, sea cliffs, coastal heathlands and coastal grazing. The west of Anglesey, where the export cable will make landfall, has substantial areas of exposed shores which are largely coastal cliff headlands with beaches comprise of moderate coarse sediments. The benthic communities around the Project are typically common in the Anglesey area and the wider Welsh coastal regions. These communities are typically comprised of common polychaetes, crustaceans, molluscs and echinoderms.

54. Human activities may cause effects in the area that can potentially lead to impacts upon fish and shellfish species. This includes fishing activity, aquaculture, extraction and deposition activities, and development. Furthermore, human-induced climate change may affect the future distribution and production of the fish and shellfish resource.

55. Fisheries are a particularly important extractive activity in the area, as detailed in **Chapter 14, Commercial Fisheries.** The most common fishing activity in the MDZ utilises static fishing gear, particularly pots, targeted towards catching crab/lobster and whelks. Otter trawls for scallop species are also common in the deeper waters that surround the MDZ, within the study area.

56. The important biological factors of the receptor species that need to be taken into consideration include the distribution in the study area, with particular reference to the occurrence of key areas such as spawning, nursery or feeding grounds or migratory routes and any overlap with the MDZ.

57. The occurrence of the receptor species in the study area needs to be considered in terms of temporal and spatial patterns. Value of the species, in terms of conservation or commercial importance, is also determined.

58. The Irish Sea is utilised by species of migratory fish that spend part of their life cycle in the marine environment as well as the freshwater environment. Rivers that lead to the Irish Sea and have known populations of such migratory fish species are considered as part of the biological environment that can be influenced by the Project.

10.5.3. Fish and Shellfish Species Present

59. In order to establish the fish and shellfish present in the area a range of resources were used. An overview of the data from commercial fisheries is presented below, though a more in-depth analysis can be found in **Chapter 14, Commercial Fisheries**. Commercial fisheries data is not necessarily representative of the species present in an area, as the species landed are targeted using selective gear types and are predominantly driven by demand. Therefore, information has been sourced from published and grey literature reports, including surveys from nearby developments, to supplement commercial data.

10.5.3.1. Commercial Fisheries

60. Fisheries landing data from ICES Rectangle 35E5 for the period 2013-2017 (MMO, 2018) was used to determine the presence and relative importance of commercial fish and shellfish species. Shellfish species are the highest group by landed weight, of which whelks *Buccinium undutam* are the most landed at 170 tonnes and also the most valuable, worth nearly £5,000,000 from 2013-2017. Other commercially important shellfish species include crabs, lobsters, prawns, scallops, and specifically queen scallops *Aequipecten opercularis*, all of which had more than 50 tonnes landed from 35E5. Bass *Dicentrarchus labrax* are the by far the most landed fin fish at 60 tonnes, with cod *Gadus morhua*, flounder *Platichthys flesus*, mackerel *Scomber scombrus*, mullet species, plaice *Pleuronectes platessa*, pollack *Pollachius pollachius*, and thornback ray *Raja clavata* of minor commercial importance (10-20 tonnes landed).

61. Fishing activity in the MDZ, as indicated by local fishermen, is dominated by static gear, which are used to target shellfish species including crab (velvet and green shore), lobster, whelk and scallop. Prawns also feature highly in the MMO landings data (MMO, 2018), as well as bass. Skate were also highlighted as a key species during consultation. There is generally no pelagic fishing due to no quotas being available to fish species here.

10.5.3.2. Published Literature

62. The Irish Sea has a diverse fish community. Over 170 species of marine fish have been recorded in the area (Ellis et al., 2002). CEFAS beam trawls between 1993-2001 recorded over 100 species (Parker-Humphreys, 2004). Both of these species counts were based upon survey data taken from a spatial scale greater than the survey area. However, these have been used as there is no data at a more fine-scale resolution that contains the MDZ.

63. The fish surveys conducted between 2010-2015 as part of the Horizon Nuclear Power (HNP) development identified 96 unique species through their range of survey methods (HNP, 2018a). These surveys occurred off north Anglesey, wholly within ICES Statistical Rectangle 35E5. The data acquired are considered a good representation of the study area.

64. The Irish Sea contains several distinct assemblages of pelagic and demersal fish. There are three types of demersal fish assemblage, and four types of generic fish assemblage. The study area is characterised as having an inshore demersal assemblage, dominated by plaice, dab and sole, as revealed by otter trawls (Ellis et al., 2002). The MDZ is likely to have traits of the “eastern inshore” fish assemblage, based on depth, although there were no surveyed sites nearby. Little seasonal variation is reported for these assemblages (Ellis et al., 2002). Note that the surveys used for gathering this data are aimed at sampling commercially important species, and so do not sample large pelagic or littoral species, but are still very useful (Ellis et al., 2002).

65. Each of the species identified as overlapping the Project needs to be assessed for its protected status as well as the presence of any spawning, nursery or feeding grounds for the impact assessment. The sources used to identify these parameters are described below.

10.5.3.3. Species and Habitats of Conservation Importance

66. Certain fish and shellfish species found in the area have been given protection measures due to their nature conservation status. The protection measures and the relevant fish and shellfish they protect are listed below:

- Habitats Directive – under this Directive Special Areas of Conservation (SAC) are designated for protected habitats and species. Designated migratory fish species on Annex II of the Directive that are found in the region include sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, allis shad *Alosa alosa*, twaite shad *Alosa fallax*, and Atlantic salmon *Salmo salar*. All five species are interest features of nearby SACs;
- UK Post-2010 Biodiversity Framework (this replaces the earlier UK Biodiversity Action Plan (BAP)) - species which are of principal importance under this designation include those of commercial importance such as plaice, whiting and Dover sole, as well as rare species, such as some elasmobranchs and shellfish;
- Marine Conservation Zones (MCZ) – these focus on threatened, rare or declining habitats and species. One marine site in Wales has been designated as an MCZ, specifically around Skomer Isles in south-west Wales. A further 6 sites have been recommended as MCZs in offshore Welsh waters (beyond 12 nm) (Royal Yachting Association (RYA), 2019), of which the nearest to the site may be approximately 12 nm
- The OSPAR Convention - this Convention provides legislative protection for commercially exploited and ecologically vulnerable species such as cod, sea lamprey and European eel, all of which are found in the region. OSPAR has established a list of threatened and/or declining species and habitats in the north-east Atlantic. The list provides an overview of the biodiversity in need of protection and is being used by the OSPAR Commission to guide priorities for further work on the conservation and protection of marine biodiversity;
- Wildlife and Countryside Act, 1981 – Schedule 5 of this Act lists species that are afford legal protection from intentional harm. Species on the list that are found in the area include shad, basking shark, angel shark, and seahorses;
- Natural Environment and Rural Communities Act 2006 – this Act was designated to help achieve a rich and diverse natural environment as well as improving rural communities. Sections 41 and 42 of this Act lists species of principal importance to achieve this goal. Note that this legislative instrument has been replaced in Wales by the Environment (Wales) Act 2016 though the list remains the same; and
- Common Fisheries Policy (CFP) zero Total Allowable Catch (TAC) species – there are certain species which are not allowed to be landed commercially under the CFP. This includes key species such as European eel and the rarer elasmobranch species.

10.5.3.4. Spawning and Nursery Grounds

67. The presence of spawning and nursery grounds for different fish and shellfish species in the area were identified using the following sources: Pawson and Robson (1996), Coull et al. (1998), Ellis et al. (2012), and Aires et al. (2014). The location of spawning and nursery grounds for different fish species that are in the vicinity of the study area are presented in **Figures 10-1**, **10-2**, and **10-3** (**Volume II**).

68. In summary, the MDZ overlaps important spawning and nursery grounds for many fish species. The MDZ lies within a nursery area for anglerfish (**Figure 10-1, Volume II**). Cod, mackerel, sandeel and sole also have nursery areas that overlap the MDZ, with spawning grounds also nearby (~20 km away) (**Figures 10-1** and **10-2, Volume II**). The MDZ overlaps both spawning and nursery areas for spotted ray and whiting (**Figures 10-2** and **10-3, Volume II**). Tope shark and plaice spawning grounds overlap the MDZ, and plaice also has a nursery area nearby (~20 km) (**Figures 10-1** and **10-3, Volume II**). Thornback ray have spawning areas near (~20 km) the MDZ (**Figure 10-3, Volume II**).

10.5.4. Elasmobranchs

69. The study area is been defined as the ICES Statistical Rectangle 35E5. The presence of elasmobranch species within this study area was determined using several sources: ICES landings from region 35E5 (MMO, 2018), ICES factsheet for region VII (FAO, 2008), National Biodiversity Network (NBN) Atlas (NBN, 2019), and the Horizon Nuclear Power (HNP) report on fish and shellfish (HNP, 2018a).

70. According to the FAO (2008) the elasmobranchs in region VIIa include: thornback ray *Raja clavata,* spotted ray *Raja montagui*, blonde ray *Raja brachyura*. Fish surveys conducted around the north of Anglesey (HNP, 2018a) also confirm bull huss *Scyliorhinus stellaris*, spurdog *Squalus acanthias*, and tope *Galeorhinus galeus*. The NBN Atlas also list additional elasmobranch species with recorded presence (two or more confirmed records) in the study area, including: undulate ray *Raja undulata*, lesser-spotted dogfish *Scyliorhinus canicula*, and basking shark *Cetorhinus maximus*.

71. Common skate *Dipturus batis-c*omplex was historically distributed throughout the continental shelf waters of the north-east Atlantic, however it has declined severely in the Irish Sea, with only very occasional records reported (International Union for Conservation of Nature (IUCN), 2019). There is one record of this species in the area on the NBN Atlas, though this was obtained in 1983 (NBN Atlas, 2019). As a precautionary measure, due to its nature conservation status, this species has been included as part of the baseline community.

72. Similar to common skate, the angel shark *Squatina squatina* originally ranged across the continental shelf waters of northeast Atlantic, however now its presence is almost completely limited to the Canary Islands (IUCN, 2019). There exists one historic record off Anglesey in 1992 on the NBN Atlas. However, recent records of catches have been recorded off Wales (Angel Shark Project, 2019). Due to recent records in the study area, this species has been included as part of the baseline community.

73. Elasmobranch species that have confirmed presence in the study area have been described in terms of their ecology in **Table 10-9**.

74. It should be noted that many of these species would not be expected to be encountered in the MDZ due to absence of suitable habitat. Many elasmobranch species, particularly the skates, rays and angel shark, prefer soft bottoms, which are not found in the MDZ. Only the two *Scyliorhinus* species have habitat preferences that may align with the habitats present in the MDZ. Other more benthopelagic species, with less habitat preference (spurdog, tope, and basking shark), typically inhabit deeper waters with the shallow waters of the MDZ representing the upper limit of their range. .

Table 10-9 Important Elasmobranch Species Present in the Study Area and their Ecology

Species	Seasonality	Habitat Association	Migration	Predator-Prey relationship	Sources
Thornback ray	Overwinters in deeper water, migrating into shallower areas in the late spring and summer (February-September) to spawn.	Inhabits continental shelf and upper slope waters from 10-300 m, though it is most abundant in waters 10-60 m. Frequents a range of sediments, though not typically coarser sediments.	Mostly non-migratory, though fish often moves close inshore during the spring.	Adults feed on large crustaceans and small teleost fish such as sandeels, small gadoids and dragonets, whereas juveniles prefer small crustaceans.	SharkTrust, 2019 MarLIN, 2019
Spotted ray	Limited information on the reproductive biology of this species	Majority of population found in waters 100-500 m deep. Prefers soft, sandy substrates in coastal seas and on continental shelves	Mostly non-migratory, though females migrate to shallow waters from April-July to spawn.	Adults feed on large crustaceans, teleost fish, polychaetes and molluscs, juveniles on small crustaceans.	SharkTrust, 2019 MarLIN, 2019
Blonde Ray	Spawning occurs between February and August.	Varied depth range depending on location, up to 150 m in NE Atlantic, 10-300 m in Mediterranean, and globally up to 900 m. Typically occurs on soft substrate such as sandy and muddy ground.	Shallow, coastal waters are used as nursery areas, leading to an increased presence of juveniles.	Both adults and juveniles feed on crustaceans, with larger adults also taking cephlapods and small teleosts.	SharkTrust, 2019 MarLIN, 2019
Common skate complex	Mating occurs in spring, followed by spawning in summer.	Lives on sandy and muddy bottoms, at depths of 10-600 m.	Juveniles prefer shallow waters.	Actively hunts other elasmobranchs, teleosts, cephlapods and crustaceans.	SharkTrust, 2019 MarLIN, 2019
Undulate ray	Breeding occurs between March and June	The species occurs at a range of depths, from 10-200 m. It prefers sandy substrate	Unknown	Varied diet depending on age. Young feed on crustaceans, molluscs and small fish, whereas adults specialise in crustaceans only	SharkTrust, 2019 MarLIN, 2019
Lesser-spotted dogfish (aka smallspotted catshark)	Egg-laying occurs during spring and early summer	Found from shallow sublittoral waters up to 400 m, mostly on sand and mud, but also on algae, rocky and gravelly bottoms	Females come inshore during the warmer months to lay eggs	It feeds opportunistically on a range of benthic fauna, mostly crustaceans and molluscs. Feeding intensity is highest during the summer	SharkTrust, 2019
Greater spotted dogfish (aka	Spring and summer are when egg-laying occurs	Found at depths of up to 125 m but most common between 20-63 m.	Shallow waters are used for egg-laying. The Llŷn	Take a variety of prey, mostly crustaceans, but also molluscs, small teleosts and *S. canicula*	SharkTrust, 2019 MarLIN, 2019

Species	Seasonality	Habitat Association	Migration	Predator-Prey relationship	Sources
nursehound, bull huss)		Prefers rough, rocky or coralline grounds with algal cover	Peninsula is thought to be important		
Angel shark	Birthing occurs in July in this region	Inhabits coasts and estuaries, in waters of 5-150 m depth. Buries itself in the substrate during the day, active at night	Migratory in this region, moving north during summer, and south during winter	Diet comprises mostly bony fish, especially flatfish, and also skates, crustaceans, and molluscs	SharkTrust, 2019
Spurdog (aka spiny dogfish)	Timing of reproduction varies by location, though it broadly occurs between January-August	Found in inshore waters to continental shelf, most commonly 10-200 m but recorded up to 900 m. Is epibenthic but also occurs in water column, with no preference for habitat	Highly migratory, dependent on age and sex. Young females migrate to shallow waters to give birth	In this region their diet is mostly teleost fish (herring, whiting, Norway pout, cod, and Atlantic mackerel), with crustaceans often taken by smaller individuals	SharkTrust, 2019
Tope	Mating and partuition occurs during the spring	Found inshore through to 550 m depth, mostly near the seabed	Highly migratory in this region, moving north in the summer, and south in the winter. Females give birth in shallow waters	Feeds mostly on a wide variety of teleost fish, in addition to some invertebrates	SharkTrust, 2019
Basking Shark	Very little is known	Occurs mostly offshore but does venture into shallows near shore	Unknown	Passive filter feeder, feeding solely on plankton	SharkTrust, 2019

10.5.4.1. Commercial Importance

75. Commercially important elasmobranch species which are landed from ICES Statistical Rectangle (Rectangle) 35E5 (the study area) include lesser spotted dogfish and thornback ray. Other species of elasmobranch may also be caught, but not routinely identified to species when landed.

10.5.4.2. Spawning and Nursery Grounds

76. Of note is that the Project area overlaps with the spawning areas of tope shark and both the spawning area and nursery area of spotted ray. There are also spawning areas of thornback ray in the study area (nearest distance from the MDZ is 20 km).

10.5.4.3. Conservation Importance

77. The designated status of each of the species on the short list is listed in **Table 10-10**. The majority of elasmobranch species, specifically all but the two *Scyliorhinus* species, present in the study area are listed under nature conservation protection measures. Few of the elasmobranch species are of Least Concern; almost all have a greater threatened status according to the IUCN (2019). There are several species for which commercial landings are prohibited, in that they have a zero Total Allowable Catch (TAC) under the Common Fisheries Policy (CFP) (ICES, 2019).

78. In addition, the undulate ray is also an MCZ Feature of Conservation Importance (FOCI) species (Joint Nature Conservation Committee (JNCC), 2016).

Table 10-10 Nature Conservation Status of Elasmobranch Species Found Within the Study Area

Common Name	Nature Conservation Status							
	IUCN Red List	OSPAR Annex V (list of species threatened and / or in decline)	NERC Act 2006 Section 41 (England)	Environment Act Section 7 (replaced NERC Act Section 42 (Wales))	UK Biodiversity Action Plan (BAP)	UK Wildlife and Countryside Act 1981 Schedule 5	Habitats Directive	Common Fisheries Policy zero TAC species
Thornback ray	Near Threatened	Yes[1]	No	Yes	No	No	No	No
Spotted ray	Least Concern	Yes	No	No	No	No	No	No
Blonde Ray	Near Threatened	No	No	Yes	No	No	No	No
Common skate	Critically Endangered (A2bcd+4bcd)	Yes	Yes	Yes	Yes	No	No	Yes
Undulate ray	Global: Endangered (A2bd+3d+4bd) Europe: Near Threatened	No	Yes	Yes	Yes	No	No	Not assessed
Lesser-spotted dogfish (aka small spotted catshark)	Least Concern	No	No	No	No	No	No	Not assessed
Greater spotted dogfish (aka nurse hound, bull huss)	Near Threatened	No	No	No	No	No	No	Not assessed
Angel shark	Critically Endangered (A2bcd+3d)	Yes	No	Yes	Yes	Yes[2]	No	Yes
Spurdog (aka spiny dogfish)	Global: Vulnerable (A2bd+3bd) Europe: Endangered (A2bd)	Yes	Yes	Yes	Yes	No	No	Yes[3]

Common Name	Nature Conservation Status							
	IUCN Red List	OSPAR Annex V (list of species threatened and / or in decline)	NERC Act 2006 Section 41 (England)	Environment Act Section 7 (replaced NERC Act Section 42 (Wales))	UK Biodiversity Action Plan (BAP)	UK Wildlife and Countryside Act 1981 Schedule 5	Habitats Directive	Common Fisheries Policy zero TAC species
Tope	Vulnerable (A2bd+3d+4d)	No	No	Yes	Yes	No	No	No
Basking shark	Vulnerable (A2ad+3d)	Yes	Yes	Yes	Yes	Yes	No	Yes

1: Thornback ray is listed as under threat and / or in decline in OSPAR Region II (the Greater North Sea), which is outside the area.

2: Angel shark is only protected between 0 and 6 nautical miles; this protection does not apply to territorial waters between 6 and 12 nm.

3: Vessels are allowed to land spurdog as bycatch so long as they are part of a bycatch monitoring programme.

10.5.5. Demersal Fish

79. The fish community of the study area comprises mostly demersal fish species.

80. A “long list” of all potential species in the study area was created. The sources that informed this long list were Ellis et al. (2002) and the HNP report (2018a). The long list was then refined to a short list that only included species with preferences for habitat that can be found within the MDZ (based on depth and sediment type). The list was further refined by only including species of nature conservation, key life stages and/or commercial importance. The demersal fish species present on this short list are given in **Table 10-11**.

10.5.5.1. Commercial Importance

81. There are many species of demersal fish that were landed from ICES Rectangle 35E5 between 2013-2017 (MMO, 2018). Such species include bass, brill, cod, conger eel, dab, flounder, gurnards, haddock, john dory, lemon sole, ling, monkfish, mullet species, plaice, pollock, sole, turbot and whiting.

82. The area lies within a Bass Fishing Restricted Area for both recreational and commercial fisheries (MMO, 2019). For the 2019 season, only one individual seabass may be landed per recreational fisherman per day in the period 1st April to 31st October. Dependent on findings of future bass stock assessments, this restriction may be removed or revised in future years.

10.5.5.2. Spawning and Nursery Grounds

83. Of note is that the MDZ partially overlaps with nursery grounds for anglerfish, cod, sandeel, sole, and whiting. It also overlaps spawning grounds for plaice and whiting.

10.5.5.3. Conservation Importance

84. Within the demersal fish species identified as having potential presence in the MDZ (**Table 10-11)** there are many species which are protected under various nature conservation measures (**Table** 10-12). These include whiting, cod, anglerfish, hake, halibut and ling. There are several species with a threatened status according to the IUCN (2019). Only whiting are a zero TAC species under the CFP.

Table 10-11 Important Demersal Species with Likely Presence in the MDZ and their Ecology

Species	Seasonality	Habitat Association	Migration	Predator-Prey relationship	Sources
Whiting	Spawning occurs January-September	Depth range 10-200 m, most commonly 30-100 m, over mud and gravel bottoms mostly, but also on sand and rock	Individuals migrate to open sea after first year	Feed on a range of benthic prey	FishBase (2019) IUCN (2019)
Tub gurnard	Spawns from May to July	Occurs at depth ranges of 20-318 m, on sand and gravel habitats	Unknown, though increase in number over wintering in North Sea	Fish, crustaceans and molluscs are prey	FishBase (2019) Seafish (2010)
Grey gurnard	Spawns April to August	Common on sand, rocky and muddy bottoms between coastal and 140 m depth	Unknown	Feeds on crustaceans and fish	FishBase (2019) Seafish (2010)
Cod	Spawning occurs in winter and beginning of spring	Juveniles prefer shallower waters (10-30 m) with complex habitats than adults (up to 600 m)	Migrate between spawning, feeding and overwintering areas, journeys of <200 km	Omnivorous, feeding on mostly fish and invertebrates	FishBase (2019)
Angler/monkfish	Spawning occurs between January and June	Occur at depths from coast up to 1,000 m, on sandy and muddy bottoms. May also be found on rocky bottoms	Migrate between inshore and offshore spawning grounds	Feeds mostly on fish that it lures	FishBase (2019) IUCN (2019)
European hake	Spawning occurs April-December, with a peak in February-March	Found usually between 30-1075 m, normally 70-400 m	Diurnal; off bottom during day, on bottom at night	Feed mainly on fish, with young feeding on small crustaceans	FishBase (2019) IUCN (2019)
Brill	Spawning occurs in first half of year, varies by location	Live on sandy or mixed bottoms up to 50 m	Adults found more offshore than juveniles	Feed on benthic fish and crustaceans	FishBase (2019) IUCN (2019)
Red gurnard	Spawns in summer	Found over sand, gravel and rock between 15-400 m	Unknown	Feeds mostly on benthic crustaceans and fish	FishBase (2019) Seafish (2010)
Turbot	Spawning season is April-August	Most common on sandy, rocky or mixed bottoms. Depth range 20-70 m	Unknown	Feeds mostly on benthic fish and less on crustaceans and bivalves	FishBase (2019)
Golden grey mullet	Spawn between July-November	Prefers coastal waters including estuaries	Juveniles move inshore in spring and winter	Feed on small benthic organisms	FishBase (2019)

Species	Seasonality	Habitat Association	Migration	Predator-Prey relationship	Sources
Thin-lipped grey mullet	Spawn between September-February	Shallow water species (10-20 m)	Adults spawn at sea but spend most of the time in estuaries	Feed on algae and plankton	FishBase (2019)
Thick-lipped grey mullet	Spawns pelagic eggs in February-April	Prefers inshore waters	Move northward during summer due to temperature rises. Juveniles move between inshore and sea	Feed mostly on benthic plant matter and small invertebrates	FishBase (2019) IUCN (2019)
Bass	Spawning occurs in spring	Inhabit coastal waters up to 100 m on range of bottom types	Migrate from coastal to offshore waters in winter	Feeds mostly on shrimp and molluscs, as well as fish	FishBase (2019)
Conger eel	Spawn in summer	Found on rocky and sandy bottoms between 0-500 m	Moves to deeper waters as it matures	Feeds on fish, crustaceans and cephalopods at night	FishBase (2019)
John Dory	Spawning occurs at the end of winter/early spring	Remains near seabed	Unknown	Feeds mostly on teleosts, also cephalopods and crustaceans	FishBase (2019)
Ling	Spawn in spring	Occurs mostly in deep water (100-400 m) over rocky bottoms	Unknown	Feeds on large fish and invertebrates	FishBase (2019) IUCN (2019)
Pollack	Spawn in the late winter to spring	Found from nearshore to 200 m, over hard bottoms	Larger individuals move to more open sea. May take spawning migrations	Major predator of young cod	FishBase (2019)
Red mullet	Spawning occurs in May-July	Occurs mostly at depths up to 100 m over hard broken grounds	Adults migrate to shallows in spring/summer; juveniles move summer/autumn	Feeds mostly on benthic invertebrates	FishBase (2019) IUCN (2019)
Sand sole	Unknown	Occurs at depths usually 20-50 m. Found on gravel, sand or mud	Unknown	Feeds on a wide range of crustaceans, mostly bivalves	FishBase (2019) IUCN (2019)
Halibut	Spawn December-April	Lives mostly at sea bottom, depth range of 50-200 m. Occurs on sand, gravel or clay bottoms. Spawning over soft sediment	Unknown	Mostly feeds on other fish, also other benthos	FishBase (2019) IUCN (2019)

Table 10-12 Nature Conservation Status of Demersal Fish Species Found Within the Study Area

Common Name	Nature Conservation Status							
	IUCN Red List	OSPAR Annex V (list of species threatened and / or in decline)	NERC Act 2006 Section 41 (England)	Environment Act Section 7 (replaced NERC Act Section 42 (Wales))	UK Biodiversity Action Plan (BAP)	UK Wildlife and Countryside Act 1981 Schedule 5	Habitats Directive	Common Fisheries Policy zero TAC species
Whiting	Least Concern	No	Yes	Yes	Yes	No	No	Yes
Tub gurnard	Least Concern	No	No	No	No	No	No	Not assessed
Grey gurnard	Least Concern	No	No	No	No	No	No	Not assessed
Cod	Global: Vulnerable, Europe: Least Concern	Yes	Yes	Yes	Yes	No	No	No
Angler/monkfish	Least Concern	No	Yes	Yes	Yes	No	No	No
Hake	Least Concern	No	No	Yes	Yes	No	No	No
Brill	Least Concern	No	No	No	No	No	No	Not assessed
Red gurnard	Least Concern	No	No	No	No	No	No	No
Turbot	Europe: Vulnerable (A2bd)	No	No	No	No	No	No	Not assessed
Golden grey mullet	Least Concern	No	No	No	No	No	No	Not assessed
Thin-lipped grey mullet	Least Concern	No	No	No	No	No	No	Not assessed
Thick-lipped grey mullet	Least Concern	No	No	No	No	No	No	Not assessed
Bass	Least Concern	No	No	No	No	No	No	No
Conger eel	Least Concern	No	No	No	No	No	No	Not assessed
John Dory	Data Deficient	No	No	No	No	No	No	Not assessed
Ling	Least Concern	No	Yes	Yes	Yes	No	No	No

Common Name	Nature Conservation Status							
	IUCN Red List	**OSPAR Annex V (list of species threatened and / or in decline)**	**NERC Act 2006 Section 41 (England)**	**Environment Act Section 7 (replaced NERC Act Section 42 (Wales))**	**UK Biodiversity Action Plan (BAP)**	**UK Wildlife and Countryside Act 1981 Schedule 5**	**Habitats Directive**	**Common Fisheries Policy zero TAC species**
Pollack	Least Concern	No	No	No	No	No	No	No
Red mullet	Global: Least Concern; Europe: Data Deficient	No	No	No	No	No	No	No
Sand sole	Least Concern	No	No	No	No	No	No	Not assessed
Halibut	Global: Endangered (A1d); Europe: Vulnerable (A2ce)	No	Yes	No	Yes	No	No	Not assessed

10.5.6. Pelagic Fish

85. Four species of pelagic fish were identified as part of the ‘eastern inshore assemblage’ of the Irish Sea by Ellis et al. (2002). These were sprat *Sprattus sprattus*, herring *Clupea harengus*, Atlantic mackerel *Scomber scombrus* and horse mackerel *Trachurus trachurus*. Three of these species (not mackerel) were observed during the fish surveys as part of Horizon Nuclear development (HNP, 2018a).

86. Of these four species, herring and horse mackerel have designated status under protection measures. The Atlantic mackerel is the only species of pelagic fish which has been landed from ICES Rectangle 35E5 as sprat is not of conservation or commercial importance it is not considered further.

87. The ecology of the three pelagic species is presented in **Table 10-13**, and their nature conservation status presented in **Table 10-14**.

10.5.6.1. Spawning and Nursery Grounds

88. According to Pawson and Robson (1996), herring in the eastern Irish Sea have spawning grounds to the south of the Isle of Man and nursery grounds along the coastal, extending as far south as the north coast of Wales east of Anglesey. Neither of these are within 50 km of the study area. More recently herring has been assessed to have nursery grounds off the coast of Ireland (Coull et al., 1998; Aires et al., 2014) though again not overlapping the study area.

89. Mackerel is thought to spawn throughout the shelf waters of the UK (Pawson and Robson, 1996). The study area lies within a low intensity spawning ground, and there are low intensity nursery grounds in that adjacent ICES Rectangles to the north, which are approximately 20 km away (Ellis et al., 2012).

90. It is not possible to identify discrete spawning grounds for horse mackerel as juveniles are widespread (Ellis et al., 2012). Aires et al. (2014) indicate a patchy distribution of high probability of 0-group aggregations throughout the Irish Sea, including off north-west Wales.

Table 10-13 Important Pelagic Species Present in the MDZ and their Ecology

Species	Seasonality	Habitat Association	Migration	Predator-Prey relationship	Sources
Atlantic herring	Comes to coastal areas to spawn. Both autumn and winter-spawning stock present	Occupy the water column from surface to 200 m depth	Comes to coastal areas to spawn	Feed mostly on small shrimps and copepods, with occasional filter-feeding	MarLIN (2019)
Horse mackerel	Spawning occurs in early spring for the "West stock"	Found on continental shelves (frequently over sandy bottoms) up to 500 m depth	Following spawning the stock migrates north to southern Norway/northern North Sea	Feeds on crustaceans, cephlapods and dfsh	IUCN Red List (2019) MarLIN (2019)
Mackerel	Spawning occurs during summer	Widely distributed on coastal shelves up to 200 m depth	Migrate in winter and early spring to spawning areas (inshore); spawn in summer; migration to post-spawning feeding grounds and overwinter areas	Filter-feeders on zooplankton, such as small fish and prawns	Angler's World (2014) MarLIN (2019)

Table 10-14 Nature Conservation Status of Pelagic Fish Species Found Within the Study Area

Common Name	Nature Conservation Status							
	IUCN Red List	OSPAR Annex V (list of species threatened and / or in decline)	NERC Act 2006 Section 41 (England)	Environment Act Section 7 (replaced NERC Act Section 42 (Wales))	UK Biodiversity Action Plan (BAP)	UK Wildlife and Countryside Act 1981 Schedule 5	Habitats Directive	Common Fisheries Policy zero TAC species
Herring	Least Concern	No	Yes	No	Yes	No	No	No
Horse mackerel	Global: Vulnerable (A2bd); Europe: Least Concern	No	Yes	No	Yes	No	No	No
Mackerel	Least Concern	No	Yes	No	Yes	No	No	No

10.5.7. Shellfish

91. The long list of shellfish species found in the area was determined from Pierce et al. (2005), landings data from ICES Rectangle 35E5, consultation with local fishermen, the scoping document (Royal HaskoningDHV, 2018), and the HNP (2018a) report. The long list was then narrowed down to species for which the MDZ presents suitable habitat, followed by those which are of nature conservation, commercial, or key life stage importance. The resultant short list of species and their ecology is presented in **Table 10-15.**

92. Clams, and specifically razor clams, are listed as a species landed from the area (ICES Rectangle 35E5). However, this common name can comprise multiple species therefore it was not possible to determine which species should be included. This is not of issue to the assessment as it is unlikely that clams would be present in the area due to the absence of suitable burying habitat in the MDZ.

10.5.7.1. Commercial Importance

93. Species of shellfish that have been landed from ICES Rectangle 35E5 between 2013-2017 are squid, crab (including specifically velvet swimming crab), European lobster, scallops (including specifically queen scallop), whelks, common prawns, and Norway lobster.

94. In addition, key shellfish species for the local area identified during consultation include crab (velvet and green shore), lobster, whelk, scallop and prawns.

10.5.7.2. Spawning/Nursery Area

95. The majority of shellfish species found in the area do no undertake migrations as they remain in one area throughout their life cycle. Some may undertake seasonal migrations to more inshore waters for spawning and nursery (specifically veined squid and common prawn). As the site is inshore it can be assumed that any shellfish species found in the area will be spawning in the area.

10.5.7.3. Nature Conservation Status

96. Most shellfish species are not designated under any protected measures. Indeed, most species are not even evaluated by the IUCN, and those that are considered of Least Concern (common cuttlefish, curled octopus, European lobster, and Norway lobster).

97. The only designated species found in the study area is the native or flat oyster *Ostrea edulis*. The NBN Atlas details accepted records of this species around the west coast of Anglesey, including off Holy Island (within 10 km). This species is designated under the NERC Act 2006 Section 41 (England), Environment Act Section 7 (replaced NERC Act Section 42 (Wales)), and UK Biodiversity Action Plan (BAP). It is also listed as threatened and / or in decline under OSPAR however only in the North Sea.

98. Although the species in themselves are not designated, both blue mussel beds (including intertidal beds on mixed and sandy sediments) and native oyster beds are designated as MCZ Habitat FOCI (JNCC, 2016). These have been recorded throughout the coast of Holy Island, including landward of the MDZ (NBN Atlas, 2019).

99. These two species have been recorded in the study area and are of conservation importance, therefore they are listed here for precautionary measures. However, it should be noted that these were not found in the MDZ area during the site-specific benthic survey (see **Chapter 9, Benthic and Intertidal Ecology**).

100. There are Shellfish Water Protected Areas in the coastal and brackish waters in Wales which are protected under the Water Framework Directive (NRW, 2018). There are six Shellfish Water Protected Areas around the coast of Anglesey., of which the nearest to the site is approximately 20 km to the south. More information can be found in **Chapter 8, Marine Water and Sediment Quality**.

Table 10-15 Important Shellfish Species with Likely Presence in the MDZ and their Ecology

Species	Seasonality	Habitat Association	Migration	Predator-Prey relationship	Sources
European common squid	Spawning occurs intermittently over several months (season varies; in English Channel peak is late autumn/early winter)	Usually in the water column over sandy and hard bottoms. Occurs down to 200 m	Abundance varies	Squid feed upon fish, as well as crustaceans, polychaetes and other cephalopods	Pierce et al (2005) MarLIN (2019)
Brown crab	Mating takes place in spring and summer. Females are berried for 6-9 months, during which they remain in pits dug into the sediment or under rocks, not feeding. Larvae are released in late spring / early summer juveniles settle in the intertidal zone in late summer / early autumn.	Usually at depths between 6 m-40 m, but can be found offshore at depths of up to 100 m. Found on a range of substrates such as sand, gravel and rocky seabeds	Juveniles may remain in intertidal areas for approximately 3 years before moving to subtidal areas.	Crustaceans including smaller brown crabs as well as bivalve molluscs.	Royal HaskoningDHV (2018) HNP (2018a) Regnault (1994) Bennett (1995) MarLIN (2019)
Spider crab	This species is thought to move offshore during the autumn and inshore during the spring.	Adults occur in sublittoral to depths of 90 m, on rocky bottoms with algae. Juveniles prefer shallows on mixed soft/hard bottoms	Only use slow, small-scale, non-directional movements	Feed upon algae and molluscs during the winter and echinoderms during the summer; general omnivorous diet	Royal HaskoningDHV (2018) Bernardez *et al.* (2000) SealifeBase (2019)
Velvet swimming crab	Mating occurs after the moult. Females bear eggs mostly in spring, eggs hatch in late spring	Shallow and intertidal to 80 m	Females migrate to soft substrates for egg laying	Opportunistic feeder, mostly on molluscs and crustaceans but also detritus and algae	HNP (2018a) SeaLifeBase (2019)

Species	Seasonality	Habitat Association	Migration	Predator-Prey relationship	Sources
European lobster	Mating takes place in the summer and is annual or bi-annual. Eggs carried for 10-11 months.	Rocky and stony substrata, usually not deeper than 50 m	Do not undertake migrations; will only move a few miles along the shore	Preys on crabs, molluscs, sea urchins, polychaete worms and starfish	Royal HaskoningDHV (2018)
Blue mussel	Peaks in spawning in spring and summer	Occurs from the high intertidal to the shallow subtidal. Uses fibrous byssus threads to attach to suitable substrata	N/A	Filter feeders and collect algae, detritus and organic material	Royal HaskoningDHV (2018) Cefas (2014) MarLIN (2019)
Native oyster	Spawning is frequent, most often between June-September	Estuarine and shallow coastal water habitats on mud, rocks, muddy sand, muddy gravel with shells, and hard silt.	N/A. Dispersal of young estimated to be more than 10 km	Filter feeders of phytoplankton	Royal HaskoningDHV (2018) MarLIN (2019)
King scallop	Scallops spawn in spring or summer and probably require dense concentrations to achieve the successful production of larvae.	Coarse gravel with some erect epifauna and shell is known to be suitable for successful settlement and recruitment of larvae to the stock.	N/A	Filter feeder	Royal HaskoningDHV (2018) HNP (2018a)
Queen scallop	Scallops spawn in spring or summer and probably require dense concentrations to achieve the successful production of larvae.	Coarse gravel with some erect epifauna and shell is known to be suitable for successful settlement and recruitment of larvae to the stock.	N/A	Filter feeder	Royal HaskoningDHV (2018) HNP (2018a)
Common whelk	Whelk have a low fecundity and entirely benthic reproductive strategy. Whelk spawn between November and January, laying distinctive egg masses which are then	Muddy sand, gravel and rock.	Common whelk has low growth rates and restricted adult movements.	Carnivorous predator and active scavenger.	Royal HaskoningDHV (2018) HNP (2018a) MarLIN (2019)

Species	Seasonality	Habitat Association	Migration	Predator-Prey relationship	Sources
	attached to suitable substrate.				
Common cockle	Main reproductive season is May-June	Burrows in sand, mud, and gravel substrate in intertidal zone	N/A	Filter feeder	Cefas (2014) MarLIN (2019)
Common prawn	Mating directly after first moult; females carry eggs for 9-11 months	Rocky and muddy bottoms in the shallows (up to 40 m)	Occur in shallows (feeding and nursery habitat) during summer months and in deeper water during winter. Also tidal and diurnal migrations	Omnivorous, feeding on seaweed and small crustaceans	SeaLifeBase (2019)
Common/green shore crab	Berried females found January-May. Eggs hatch in spring/summer	From high water to 60 m depth, though most common in shallows. Found on all types of shore	Generally no migration, though females in estuary move to mouth of estuary to lay eggs	Omnivore, both animal and plant matter from a variety of species	MarLIN (2019)

10.5.8. Migratory Fish

101. There are several species of fish which spend part of their life cycle in the marine environment and the other in the freshwater environment, i.e. diadromous species. Whilst they are in the marine environment they may have the potential to overlap with the Project. It is therefore important to understand their migration patterns to determine whether they require assessment in this chapter. The migratory patterns of diadromous species are outlined in **Table 10-16**.

Table 10-16 Migratory Periods of Key Diadromous Species

Species	Time spent in freshwater before downstream migration	Timing of downstream migration	Time spent at sea before first return	Timing of upstream migration
Atlantic salmon	2-3 years	April- May (Smolt)	1, 2 or 3 years	All year round with peak in late summer early autumn (Adults)
Sea trout	2-3 years	Spring/early summer	2 or more in coastal areas	April- June
European eel	Males 7-20 years Females 9-50 years	Late spring (as silver eels)	Many do not return to fresh water	January to June (as juvenile glass eels)
Sea lamprey	3-4 years	July to September to open sea	18-24 months	April-May spawning in May/June
River lamprey	5 years or more. Remain in burrows in river silt beds until adults	July to September to feed in estuaries	2 years spent in estuaries.	Winter and spring when temps are <10oC. Migrate at night
Allis and Twaite Shad	Short period few months (Juveniles)	April/May (Juveniles)	3-4 years Estuarine areas	April to May spawning in freshwater

102. As a precautionary measure all species considered to have a migratory pathway overlapping the site in the HRA are scoped in for assessment here. This includes Atlantic salmon, both species of lamprey and both species of shad. Though it should be noted that there are no natal rivers for any of these species on the coastline adjacent to the MDZ.

103. The European eel undertakes extensive migration from rivers around the UK to their spawning grounds in the Sargasso Sea, North America. Eels travelling through the Irish Sea therefore migrate in a southerly direction, exiting through the southwest approaches. There are known stocks of European eel to the north of the site (Bark et al., 2007), therefore it can be considered that the species may overlap with the site and as such should be assessed.

104. Sea trout are present in the rivers of Anglesey, although it should be noted that no such rivers have mouths adjacent to the MDZ. When they move into the marine environment sea trout remain in coastal waters, as they have very limited migrations in terms of distance, although there is limited information on the range. Due to the lack of knowledge on at-sea migration and the presence of sea trout rivers nearby, this species has been screened in as a precautionary measure.

10.5.8.1. Commercial Importance

105. Most of the species listed in Table 10-16 are not commercially landed whilst at-sea, hence their absence from TACs and catch data from ICES Rectangle 35E5. The exception is European eel, for which ICES state that all anthropogenic impact (including recreational and commercial fishing) should be "reduced to – or kept as close to – zero as possible."

106. Across England and Wales in 2015 catches of eel (across all life stages) weighed a total of 25,000 kg (Environment Agency, 2017), indicating species value despite the near-zero TAC. By contrast lampreys caught in England and Wales in 2015 weighed 285 kg (Environment Agency, 2017), indicating limited commercial importance.

107. Atlantic salmon and sea trout are of importance to the recreational fishing industry in Wales. These species are typically caught by rod (of which, most are released) and by net. In Wales approximately 3,000 salmon and 15,000 sea trout were caught in 2015 (Environment Agency, 2017).

108. Shad are considered rare and as such are not meant to be fished in Wales.

10.5.8.2. Spawning/Nursery grounds

109. There is no predicted overlap between the study area and any spawning grounds of diadromous species. Almost all of the diadromous species return to freshwater to spawn; the exception is the European eel, though these spawn in the Sargasso Sea, North America.

110. Nursery grounds for the freshwater spawning fish can typically include coastal areas at the base of the rivers they have spawned in. There are no estuaries adjacent to the project, therefore it is not considered that it will overlap with any nursery areas.

10.5.8.3. Nature Conservation Status

111. The nature conservation status of migratory fish species is detailed in **Table 10-17**.

112. Of the migratory fish species listed in **Table 10-16** there are five that are listed under Annex II of the Habitats Directive. These species, listed in **Section 10.5.3.3**, are the sea lamprey, river lamprey, allis shad, twaite shad, and Atlantic salmon. These are all the species listed on Annex II that are known to enter the marine environment.

113. There are 20 SACs in the vicinity of the study area that are designated for Annex II migratory fish species. The location of these SACs are shown in **Figure 10-4** (**Volume II**). The nearest SAC, Afon Gwyrfai a Llyn Cwellyn, is approximately 30 km distance from the study area.

114. It is possible that individuals from populations designated under these sites may occur in the study area, due to their migratory behaviour. All five Annex II migratory fish species have populations in these nearby SACs.

115. The European eel is also an MCZ (highly mobile) species FOCI (JNCC, 2016), though no MCZs are designated for this species in the vicinity of the study area.

Table 10-17 Nature Conservation Status of Migratory Fish Species Found Within the Study Area

Common Name	Nature Conservation Status							
	IUCN Red List	OSPAR Annex V (list of species threatened and / or in decline)	NERC Act 2006 Section 41 (England)	Environment Act Section 7 (replaced NERC Act Section 42 (Wales))	UK Biodiversity Action Plan (BAP)	UK Wildlife and Countryside Act 1981 Schedule 5	Habitats Directive	Common Fisheries Policy zero TAC species
Atlantic salmon	Global: Least Concern; Europe: Vulnerable (A2ace)	Yes	Yes	Yes	No	No	Yes	Not assessed
Sea trout	Least Concern	No	Yes	Yes	No	No	No	Not assessed
European eel	Critically Endangered (A2bd+4bd)	Yes	Yes	Yes	No	No	No	Yes
Sea lamprey	Least Concern	Yes	No	Yes	No	No	Yes	Not assessed
River lamprey	Least Concern	No	No	Yes	No	No	Yes	Not assessed
Allis shad	Least Concern	Yes	Yes	Yes	No	Yes	Yes	Not assessed
Twaite shad	Least Concern	No	Yes	Yes	No	Yes	Yes	Not assessed

10.6. IMPACT ASSESSMENT

10.6.1. Overview of Potential Impacts

116. **Table 10-18** provides a brief list of the potential impacts on fish and shellfish that may arise during activities undertaken during each phase of the Project.

Table 10-18 Potential Impacts of the Project Phases on Fish and Shellfish

Phase	Potential Impact
Construction	Impact 1: Underwater Noise Impact 2: Physical disturbance of habitats and temporary habitat loss Impact 3: Increased suspended sediment concentration and sediment deposition
Operation and Maintenance	Impact 1: Underwater Noise (and via repowering) Impact 2: Long-term habitat loss via placement of project infrastructure (project footprint) (and via repowering) Impact 3: Physical disturbance of habitats and temporary habitat loss (repowering only) Impact 4: Increased suspended sediment concentration and sediment deposition (repowering only) Impact 5: Barrier Effects Impact 6: Collision Risk Impact 7: Electromagnetic Fields
Decommissioning	Impact 1: Underwater Noise Impact 2: Physical disturbance of habitats and temporary habitat loss Impact 3: Increased suspended sediment concentration and sediment deposition

117. It should be noted that the impact of Invasive Non-Native Species (INNS) is addressed in **Chapter 9, Benthic and Intertidal Ecology**.

10.6.2. Embedded Mitigation

118. The following assessment provides a summary of all impacts identified during scoping study and those which have been noted as the EIA has progressed. These impacts are not relevant to all stages of the project, and thus impacts have been assessed within the stage of the project at which they will occur (construction, operation and decommissioning). Further, these impacts are comprised of both direct and indirect impacts.

119. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process (see **Chapter 4, Project Description** for further details). A range of different information sources has been considered as part of embedding mitigation into the design of the project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

10.6.3. Worst Case Parameters

10.6.3.1. Temporary Habitat Disturbance

120. During all project phases, temporary habitat disturbance will occur to seabed habitats via device, hub and cable installation and also anchor deployments for installation barges. Based on information provided in **Chapter 4, Project Description** the following values listed in **Table 10-19** have been calculated to define the worst-case parameters for temporary habitat disturbance. These are defined in terms of project phase, as different amounts of temporary seabed disturbance are predicted to arise in each phase.

121. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50 % of the tenants will undertake repowering, i.e. for 50 % of the tenants, their infrastructure will be removed and replaced (potentially with different infrastructure by a different tenant). For the other 50 % of tenants, their infrastructure will remain over the lifetime of the project.

122. In terms of impact assessment parameters, the repowering process has, therefore, been defined as per below:

- Initial temporary seabed disturbance via deployment of barge anchors to remove foundations, TEC's, hubs, inter-array cables and monitoring equipment for 50 % of the Tenants (berths); and
- Further temporary seabed disturbance via re-installation (repowering) of foundations, TEC's, hubs, inter-array cables and monitoring equipment for the same 50 % of Tenants (berths).

123. The operational phase values also include the temporary seabed disturbance that would arise from up to ten cable repair events.

Table 10-19 Summary of Worse-Case Scenario Temporary Habitat Loss during Construction, Operation (repowering) and Decommissioning Phases

Project Component	Worse Case (240 MW)	Unit	Notes
Construction Phase:			
Post-lay burial of cable	27,259	m^2	Area of sandwave field where post-lay burial via Mass-Flow Excavator (MFE) may be required
Deployment of anchor blocks by barges during cable installation	100,240	m^2	Up to 8 x 25 m^2 (5x5) m anchor blocks for a single barge = a total footprint per anchor deployment of 200 m^2 (8 x 25 m^2) Assumed that these types of anchor barges generally deploy a spread every 500 m. So, for every 500 m of cable installation a footprint of 200 m^2 of temporary seabed disturbance occurs (via the anchor blocks) Combining all potential export, array and cable tails the total length of cables (full 240 MW) is 250.6 km

Project Component	Worse Case (240 MW)	Unit	Notes
			Assumes the footprint of 200 m^2 every 500 m (0.5 km), or 400 m^2 every 1 km, and assumes all cables are installed using anchor barges Temporary disturbance impact of (400 m^2 x 250.6) = 100,240 m^2 (0.10 km^2) "
Deployment of anchor blocks by barges during TEC device installation	248,000	m^2	Max. no of devices set at 620 x small (0.3 kW devices) Assumed that deployment of each device requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2) Therefore, total temporary seabed disturbance = 620 x 400 m^2 = 248,000 m^2
Deployment of anchor blocks by barges during hub installation	48,000	m^2	Max. no of seabed mounted hubs set at n = 120 Assumed that deployment of each hub requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2) Therefore, total temp. seabed disturbance = 120 x 400 m^2 = 48,000 m^2
Construction Phase TOTAL		**423,499 m^2 (0.42 km^2)**	
Operational Phase:			
(Repowering) 50 % of tenants infrastructure (Foundations; TEC's; hubs' array cables; monitoring equipment) removed and replaced with new (different) tenant infrastructure	377,400	m^2	Initial removal of tenant infrastructure from 50 % of berths • 50 % of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 • 50 % of anchor block value of tidal device installation = 124,000 m^2 • 50 % of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2 Subsequent re-installation (re-powering) of tenant infrastructure from 50 % of berths • 50 % of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 • 50 % of anchor block value of tidal device installation = 124,000 m^2 • 50 % of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2
Cable repairs	3,000	m^2	Up to 10 major cable repairs (5 days each) may be required throughout the project life. It is assumed that up to 750 m of cable will be subject to repair works per event (7,500 m in total). Using same value of 400 m^2 temp seabed disturbance per 1 km of cable works (400 x 7.5) = 3,000 m^2
Operational Phase TOTAL		**380,400 m^2 (0.38 km^2)**	

Project Component	Worse Case (240 MW)	Unit	Notes
Decommissioning Phase:			
Decommissioning Phase		**TOTAL 423,499 m^2 (0.42 km^2) –** same worst-case as per construction phase due to same activities needed to remove infrastructure	

10.6.3.2. Permanent Habitat Loss via Project Infrastructure

124. The installation of project infrastructure, including anchor systems for TEC devices, seabed mounted devices, hubs and cables/cable protection, will all result in permanent habitat loss. Based on information provided in **Chapter 4, Project Description** the following values listed in **Table 10-20** have been calculated to define the worst-case parameters for permanent habitat loss via project infrastructure. The majority of these effects will only occur in the operational phase. The exception is the value of 7,400 m^2 related to the trench for up to 9 cables at landfall. Trenching of cables will only be undertaken if horizontal directional drilling (HDD) works (preferred method) are not possible/viable. Without detailed geotechnical analysis it is not currently possible to state if trenching, and subsequent backfill of the trench(es) would be possible. If it was, this would represent a temporary disturbance on intertidal habitats. However, to ensure a precautionary approach is built into the assessment, it has been concluded that trenching/surface-laying of the landfall cables would lead to permanent habitat loss, thus this value is included below.

125. As detailed above, the permanent habitat loss values also account for additional permanent habitat loss due to placement of re-installed (repowered) foundations/TECs in different areas to where originally installed.

Table 10-20 Summary of Worse-Case Scenario: Permanent Habitat Loss via Project Infrastructure (including repowering)

Project Component	Worse Case (240 MW)	Unit	Notes
Main operational phase			
Gravity Base Structures (GBS)	74,790	m^2	Max value across entire project. Based on anchor mooring systems for floating devices. Includes hubs.
Swept Area of Catenary Cables	2,055,000	m^2	Based on: 30 devices having swept area of 9,500 m^2 (large floating devices (Orbital, Magallanes) 140 devices having swept area of 7,500 m^2 floating devices (Tocardo UFS, Aquantis) & hubs 240 devices having swept area of 3,000 m^2 small floating devices (Instream, SME PLATO)
Export Cable Footprint (cables; protection systems; rock bags)	11,745	m^2	Up to 40.5 km of export cables (with split-pipe protection/shells and rock bags)

Project Component	Worse Case (240 MW)	Unit	Notes
Array Cable Footprint (cables; protection system; rock bagss)	30,040	m^2	Up to 204.5 km of array cables (with split-pipe protection/shells and rock bags)
Cable tails	120	m^2	Based on 9 x tails of 620 m length
Trench for 9 x landfall cables	7,400	m^2	740 m long trench x 10 m width in intertidal region
Footprint of Navigation Marker Buoys	540	m^2	3 m diameter square gravity anchor (9 m^2) per anchor x 60 anchors/buoys
Footprint of ADCP moorings	280	m^2	7 m^2 per ADCP mooring x 40 units
Footprint of seabed mounted environmental monitoring units	112	m^2	14 m^2 per env monitoring unit x 8 units
Footprint of mooring for floating environmental monitoring units	45	m^2	9 m^2 per mooring x 5 units
Permanent habitat loss (initial operational phase: 2,180,072 m^2 (2.18 km^2)			
Repowering Phase			
New tenant infrastructure in 50 % of berths	52,504	m^2	See **Chapter 4, Project Description** for more details
Permanent habitat loss (repowering of 50 % of berths): 52,504 m^2			
Permanent Habitat Loss: Total of 2,232,576 m^2 (2.23 km^2)			

10.6.3.3. Underwater Noise

126. The installation of project infrastructure, including drilling for pin piles and cable installation, will result in the production of underwater noise. Therefore, as per **Chapter 12, Marine Mammals**, the assessment has been based on underwater noise modelling that has been conducted for the nearby Wylfa Newydd Development Area, the Perpetuus Tidal Energy Centre (PTEC) off the coast of the Isle of Wight and MeyGen in the Inner Sound of the Pentland Firth.

127. For each of the three projects modelling was undertaken in order to make an assessment of the source levels of underwater noise from several potential noise sources expected to occur during construction. All three projects made an assessment of the levels of underwater noise emitted from drilling and vessels. The results of the modelling studies have been provided in **Table 10-21**.

Table 10-21 Summary of Worse-Case Scenario: Subsea Noise Effects

Project Component	Worse Case (240 MW)	Notes
Noise from drilling of pin piles	Predicted source level was 179.8 dB re 1 μPa@1 m (RMS)	From PTEC (2014). Note that these results reflect the worst case scenario of drilling (4 m pin piles, 333 kW drill).
	Predicted unweighted source level of 185.3 dB re 1 μPa (RMS) @ 1 m	From Wylfa Newydd Development Area (HNP, 2018b).
	Drilling noise measurements of up to 178 dB re 1 μPa @ 1 m	From MeyGen (Kongsberg, 2012).
Vessel noise	172 dB re 1 μPa @ 1 m	From MeyGen (Kongsberg, 2012). Note that this value comes from assessment of noise from a tugboat, the noisiest type of vessel likely to be used during operations at MeyGen.
	170 – 180 dB re 1 μPa @ 1 m	From PTEC (2014).
	168 dB re 1µPa (RMS) @ 1 m for large vessels; 161 dB re 1µPa (RMS) @ 1 m for medium vessels	From Wylfa Newydd Development Area (HNP, 2018b).

128. PTEC (2014) give a high-level summary of the expected species-specific impact ranges from these other sources of underwater noise; these are provided in the following section.

10.6.3.4. Construction Programme

129. The construction of offshore works (for installation of tidal devices and associated cabling and infrastructure) would be phased over a period of several years, taking up to 15 days per device or hub and up to 1.5 days for each inter-array cable, up to 20 days for each offshore cable, and up to 12 days for each phase of cable protection. Up to eight separate cable laying and protection campaigns are possible. The HDD at the landfall would be completed over a four to six month period with two months for offshore cable tail installation.

10.6.4. Potential Impacts during Construction

10.6.4.1. Construction Impact 1: Underwater Noise Effects

130. Underwater noise may arise from the installation of project infrastructure, including TEC devices, cables and electrical hubs. Of the proposed foundation systems, the worst-case scenario for the production of underwater noise is predicted to be from pin pile foundations. These may need to be installed using drilling due to the hard substrate in the study area. The maximum amount of drilling that could arise would be 1,280 drill holes, which at three days each, would result in a total of 3,840 days of drilling on site to install the full 240 MW capacity.

131. In order to assess the potential impacts from underwater noise emitted during drilling the results from the three similar underwater noise modelling studies of percussive drilling have been utilised here (see **Table 10-21**).

132. The sensitivity of fish species to noise is poorly understood though it is thought to vary between species, depending on several factors including the auditory ‘threshold’, presence of and physical coupling of any swim bladder to ear structures, resonance frequency of the otolith system, and behavioural traits (Kongsberg, 2012; PTEC, 2014). Examples of predicted hearing sensitivity of different fish species are given in **Table 10-22**. It should be noted that shellfish are considered insensitive to noise due to the absence of a swim bladder (PTEC, 2014) and so have not been included in this assessment.

Table 10-22 Hearing Specialisation of Various Species of Fish Present in the Region (adapted from Kongsberg, 2012; PTEC, 2014)

Species	Family	Swimbladder connection	Sensitivity
Atlantic salmon/sea trout	Salmonidae	None	Medium
European eel	Anguillidae	None	Medium
Cod	Gadidae	None	Medium
Plaice	Pleuronectidae	No swim bladder	Low
Elasmobranchii		No swim bladder	Low
Mackerel	Scombridae	No swim bladder	Medium
Herring	Clupeidae	None	Medium

133. Underwater noise can cause a range of effects in fish, depending on the noise level produced. The sound levels at which different effects may be seen are as follows (from Parvin et al., 2007):

- Physical injury to mortality – 220-240 dB re 1uPa
- Strong behavioural reaction - 90 dB re 1uPa
- Mild behavioural reaction – 75 dB re 1uPa

134. All three modelling studies demonstrated that the noise produced by percussive drilling did not exceed the sound levels for physical injury to mortality. However, levels associated with behavioural changes can be emitted. Behavioural changes in fish can result in changes to migration, feeding, spawning etc. therefore they are important to assess.

135. The level of behavioural impact will depend on the apparent loudness of the noise source perceived by the target species. This can be calculated using the dB_{ht} technique, where the frequency spectrum of the source noise is compared with the hearing threshold of the target species. The dB_{ht} (species) metric and associated effect of exposure have been calculated by Nedwell et al. (2007) and are provided in **Table 10-23**. This metric was used in the modelling for PTEC (2014) and MeyGen (Kongsberg, 2012).

Table 10-23 Assessment Criteria used for the Potential Impact on Marine Species (after Nedwell et al., 2007)

Sound level dB_{ht} (Species)	Effect of exposure
Above 130	Possibility of traumatic hearing damage from a single event
90	Strong behavioural reaction

Sound level dB_{ht} (Species)	Effect of exposure
75	Some avoidance reaction by the majority of individuals, but habituation or context may limit effect

136. PTEC (2014) assessed that no physical or injury effects were predicted from noise levels emitted during drilling as determined in the noise modelling study. Behavioural reactions were predicted to different extents and at different ranges for the modelled species, as outlined in **Table 10-24**. Cod were demonstrated to be the most sensitive species to sound, showing a behavioural reaction at distances up to 50 m and a "startle" reaction at distances up to 8 m from the source (PTEC, 2014). The results for this species are considered the worst-case scenario and any other species are not considered likely to have a greater impact from noise.

Table 10-24 Summary of the Modelled Ranges for 90 and 75 dB_{ht} (Species) Levels for Worst-Case Scenario Percussive Drilling (taken from PTEC, 2014)

Species	90 dB_{ht} (Species)			75 dB_{ht} (Species)		
	Max Range (m)	Min Range (m)	Mean Range (m)	Max Range (m)	Min Range (m)	Mean Range (m)
Bass	<1	<1	<1	4	3	4
Cod	8	7	8	50	49	50
Dab	3	2	3	16	15	16
Salmon	<1	<1	<1	5	4	5
Elasmobranch	<1	<1	<1	<1	<1	<1

137. Kongsberg (2012) also assessed the distance from drilling activities at which the two metrics for behavioural reactions would occur (90 dB_{ht} and 75 dB_{ht}). They determined that both metrics (i.e. types of behavioural impact) would only occur within 1 m of the sound source, for both hearing specialists and generalists, under the most precautionary conditions. As a result, it was concluded that behavioural reactions are unlikely to be observed in fish species.

138. The underwater noise modelling undertaken for Wylfa Newydd were calculated based on Popper *et al.* (2014), and specifically assessed the distance at which the sound level would cause a recoverable injury (after 48 hours of exposure to continuous percussive drilling noise, using 170 dB re 1 µPa (SPL_{RMS})), and the distance at which the sound level would cause a temporary threshold shift (TTS) (after 12 hours of exposure, using 158 dB re 1 µPa (SPL_{RMS})), for fish with swim bladders involved in hearing i.e. hearing specialists. The maximum distance at which a recoverable injury would be caused was 7 m. The maximum distance at which TTS would occur was 67 m.

139. The impact ranges of vessel noise were assessed for the three projects, based on the source level metrics provided in **Table 10-24**. The modelling studies for MeyGen (Kongsberg, 2012) and PTEC (2014) utilised the dB_{ht} metric to assess the impact ranges from vessel noise on fish. Kongsberg (2012) predicted that the lowest level of noise that could cause a behavioural impact would occur up to 1 m from the vessel, under the most precautionary conditions, and for hearing specialists as well as generalists. PTEC (2014) indicate that the most sensitive species (cod) would receive sufficient sound levels to exhibit a behavioural impact at a maximum distance of 8 m from a large vessel (i.e. the worst-case scenario).

140. For the Wylfa Newydd project, HNP (2018b) assessed the vessel noise as a continuous noise, using the same metrics that were used for modelling drilling sound. The maximum distance at which a recoverable injury would be caused was <1 m for both large and medium vessels. The maximum distance at which TTS would occur was 4 m for large vessels, and <1 m for medium-sized vessels.

141. PTEC (2014) also assessed the behavioural impact ranges from other construction activities, specifically trenching and cable protection. For the most sensitive species (cod), the impact range for trenching was 1 m (using the 90 dB_{ht} metric) and 16 m (using the 75 dB_{ht} metric). For cable protection, the impact range was 2 m (using the 90 dB_{ht} metric) and 25 m (using the 75 dB_{ht} metric).

142. From the evidence presented it can be determined that the highest noise levels during installation will be emitted by drilling. The maximum impact range for fish during this activity is predicted to be 67 m. This contour is considered to be low; as a result, the maximum concluded sensitivity for fish receptor species is medium.

143. As part of the construction phase of operations it is anticipated that the installation of each hub may take up to 15 days. Under full site deployment circumstances, this could result in a total of 1,800 days (just under 5 years) of installation. It should be noted that these days are likely to occur concurrently for different devices, although the extent to which construction will overlap is not known. Due to the short-term scale of construction operations and taking into consideration the small extent of the site in the context of available habitat in the surrounding area, it is considered that the magnitude for effect is low.

144. As a result of the low magnitude of the effect in coupled with the medium sensitivity of the receptor there is a **minor adverse** impact on the receptors during construction.

10.6.4.1.1. Mitigation

145. No mitigation measures are considered to be required.

10.6.4.1.2. Residual Impact

146. The residual impact is **minor adverse**.

10.6.4.2. Construction Impact 2: Temporary Habitat Disturbance

147. Temporary seabed habitat disturbance will occur during the construction phase of the project via a range of effects including deployment of anchor blocks for installation barges and cable installation works.

148. The total area of seabed predicted to be subject to temporary disturbance over the duration of the construction phase is detailed in **Table 10-19.** This value of 423,499 m^2 (0.42 km^2) will not arise at one time as construction will be phased over several years. However, for the purpose of this assessment, this total amount of temporary habitat disturbance has been assessed.

149. Based on the values presented in **Table 10-19**, the total amount of temporary disturbance of habitat due to the deployment of anchor blocks during the construction phase will be 396,240 m^2 (0.39 km^2). It should be noted that this is highly precautionary as it is unlikely that a moored barge will be used to install all cables (a Dynamically Positioned (DP) vessel will likely be used for some cables which produces no seabed disturbance). This amount of temporary seabed disturbance equates to disturbance of less than 1% of the wider habitat within the MDZ. This disturbance will also be short-term, and as such is also classified as having a **low** magnitude.

150. The fish and shellfish species found in the study area are typical of this region and are widely distributed throughout the surrounding area. The study area does not represent unique habitat for any given species. The study area does lie within an area of low intensity spawning ground for cod, whiting, sandeel, mackerel, plaice and (dover) sole; a low intensity nursery ground for whiting, sandeel and plaice; and high intensity nursery ground for sole (Coull et al., 1998; Ellis et al., 2012; Pawson and Robson, 1996). Coull et al. (1998) also determined that the area was a spawning ground for sprat, in agreement with Aires et al. (2014) who indicated a high number of 0-year sprat in the area. The low intensity grounds listed for the species are typically widespread (Coull et al., 1998; Ellis et al., 2012; Pawson and Robson, 1996) and so not restricted to the study area. Similarly, the high intensity nursery ground for sole extends into the eastern Irish Sea, and it should also be noted that it is a “nominal” nursery ground due to the presence of juveniles only (Ellis et al., 2012). Indeed, the data in Coull et al. (1998) and Ellis et al. (2012) are high-level and broad scale and therefore is intended only to be used indicatively.

151. The worst-case scenario, therefore, is that the area is used as a low intensity spawning ground and a high intensity nursery ground for certain common, commercially important species. Due to the presence of this key life stage the sensitivity of fish receptors is considered medium, taking into account the fact that the study area represents a very small proportion of the total spawning and nursery grounds available to the species in the wider region.

152. Shellfish species typically occupy the seabed and as such are considered sensitive to habitat loss. Three representative species have been chosen for an assessment of sensitivity: blue/common mussel *Mytilus edulis* as a representative sessile species; and European spiny lobster[1] *Palinurus elephas* (as a proxy for mobile species). Blue mussel and European spiny lobster have undergone sensitivity assessments that are presented on MarLIN (2019).

153. Blue mussel is considered as having a moderate sensitivity to substratum loss and a low sensitivity to abrasion and physical disturbance. European spiny lobster is assessed as having a medium sensitivity to the abrasion/disturbance of the surface of the substratum or seabed. As a result, it is assessed that the worst-case scenario for sensitivity of shellfish receptor species is medium.

[1] European spiny lobster, though not found in the study area, is a similar species to the European lobster found in the study area, therefore it has been used as a proxy for effects on this species as it has undergone a sensitivity assessment on MarLIN.

154. The study area is subject to high tidal energy therefore the site is mainly exposed bedrock and boulders, though in the north there are sand and gravel habitats, in addition to the sandbank. The habitats suitable for spawning and nursery are therefore present across large portions of the study area, greater than the potential lost habitat. They are also present across the wider region, as revealed by the biotope mapping in **Chapter 9, Benthic and Intertidal Ecology**.

155. As a result of the low magnitude of the effect in coupled with the medium sensitivity of the receptor there is a **minor adverse** impact on the receptors during construction.

10.6.4.2.1. Mitigation

156. No mitigation measures are considered to be required.

10.6.4.2.2. Residual Impact

157. The residual impact is **minor adverse**.

10.6.4.3. Construction Impact 3: Increased Suspended Sediment Concentrations and Sediment Deposition

158. Increased suspended sediment concentrations and sediment deposition can arise during the construction phase due to installation of infrastructure on the seabed (foundations, hubs and cables). As the study area is highly tidal, with high nearbed transport, there is minimal fine sediment present.

159. Furthermore, any sediment that may be deposited as a result of construction activities will be immediately minnowed and un-detectable beyond a small spatial (100 m) and temporal (few tidal cycles i.e. days) scale. Though no specific modelling has been conducted, it is expected that there may be localised increased in sediment levels above 10 mg/l but these will rapidly disperse.

160. Specifically, during drilling of foundations it is expected that suspended sediment will not be detectable above background levels beyond 100 m. There are no sediment plumes to be expected to arise during construction that will significantly increase the suspended sediment concentration (SSC) or result in smothering from deposition. Deposition is considered to be effectively immeasurable at the benthic level.

161. For cable installation works, there is also potential for some sediments to be disturbed, creating a plume, particularly in the nearshore part of the cable (within ‘Abraham’s Bosom’). Any plume created will be short-term and will be dispersed by tidal current action until coarser sediments settle once again on the sea bed.

162. The principal causes of sediment disturbance during offshore cable installation would be:

- Free-laying of up to 35 km of offshore cable on the sea bed;
- Placement of cable protection (rock bags of concrete mattresses) at specific locations along the cable length; and

- Post-installation jetting to bury offshore cable across the sand ridge feature in the northern half of the cable corridor.

163. The free-laying of cables and the placement of cable protection would not cause plumes along the offshore sections of the cable corridor because the sea bed is characterised by bedrock or, where sparse sediment cover does exist, by sediments with a particle size that cannot be suspended in the water column. In the nearshore, the bedrock is overlain by sand which has the potential to be disturbed by the free-laying of cables and the placement of cable protection. However, any plume arising from these activities would only arise from the force of the cable or protection measures on the sea bed. At the landfall, the worst case scenario would be open trenching rather than the preferred option of HDD. Under open trenching, up to 7,440 m^3 of sand would be excavated and the majority replaced to backfill the trench, with only a small net loss to the inshore system. Due to these factors, the likely increase in suspended sediment concentration in areas with sand cover nearer to shore (including at the landfall) will remain within the bounds of natural behaviour that are governed by storm waves and surge effects. Furthermore, these effects will be one-off and temporary in duration and are unlikely to be measurable.

164. The principal effect would arise from the post-installation jetting to bury the offshore cable across the sand ridge feature in the northern half of the cable corridor. Under this activity, it is likely that the maximum envisaged effect associated with sediment plumes arising from the jetting will cause only modest (but measurable) increases in suspended sediment concentration locally (typically a few tens of mg/l above background levels). This increase would reduce rapidly with distance from the point of disturbance to a few mg/l over a small geographical area (within a few hundred metres, along the axis of tidal currents).

165. Furthermore, these effects will be one-off and temporary in duration, with a return to the very low background concentrations occurring rapidly upon cessation of installation.

166. With respect to sediment deposition, from experience of similar schemes, it is envisaged that in the immediate vicinity (up to 10 m from point of jetting) of the post-lay jetting through the sand wave area, deposition depths of no more than 0.1 m will be observed. These are highly likely to become quickly re-entrained by currents during the peak velocities of the following tide and transported further away in small concentrations.

167. Further away from the immediate vicinity of the post-lay jetting, the deposition of sediments would extend over a similar zone of influence to that of the sediment plume (i.e. within a few hundred metres of each release point, following the axis of the tidal current flow). Within a short distance from the release points the thickness of deposits will be extremely small, typically millimetres. In this highly dynamic tidal area, this is effectively an immeasurable change.

168. Overall, the magnitude of effect of increased suspended sediment and deposition is judged to be negligible for all areas apart from the sandwave area, where a low magnitude effect may arise (near-field).

169. The species considered most sensitive to increased sediment and deposition are the shellfish species. The blue (or common) mussel and European spiny lobster, have been used for assessing sensitivity to sediment changes, through the information presented on MarLIN (2019).

170. European spiny lobster is assessed as having a medium sensitivity to changes in suspended solids (water clarity) and is not sensitive to 'light' smothering and siltation rate changes. Blue/common mussel have a low sensitivity to smothering and are considered not sensitive to an increase in suspended sediments. Therefore, the worst-case scenario is a medium sensitivity of the receptor (also taking into account the receptor value).

171. As a result of the low/negligible magnitude of the effect in coupled with the medium sensitivity of the receptor there is a **minor adverse** impact on the receptors during construction.

172. It should also be noted that turbidity can positively impact the larvae of fish and shellfish species. Increased turbidity can create a "shading effect" which can lead to a reduction in predation rate on fish larvae, thereby increasing survival (Fiksen et al., 2002). The extent of this effect will likely vary depending on the trophic level of the larvae. Due to this species-specific variation this impact has not been directly considered as part of the impact assessment. However, it can be thought that the magnitude of adverse effect may be somewhat offset by this potentially positive effect.

10.6.4.3.1. Mitigation

173. No mitigation measures are considered to be required.

10.6.4.3.2. Residual Impact

174. The residual impact is **minor adverse**.

10.6.5. Potential Impacts during Operational Phase

10.6.5.1. Operational Impact 1: Underwater Noise Effects via (a) device operational noise and (b) repowering works

175. There is very little information on the operational noise produced by tidal devices. However, the information available has informed a number of preceding EIA studies, including the recently consented PTEC project. The results from the noise modelling conducted for the PTEC project (2014) and MeyGen (Kongsberg, 2012) have been applied to this project. Information from the Technical Note produced by Subacoustech (2019) for this project are also used.

176. Subacoustech (2019) reviewed the noise outputs of a suite of tidal devices. It was reported that predicted source noise levels ranged from 145 to 175 dB re 1 uPa @ 1 m. The corresponding frequency range was rarely reported. One turbine design with the most information available, OpenHydro, has a predicted source noise level of 152 dB SPL_{RMS}, with the majority of the energy centred on the 125 Hz 1/3 octave frequency band. This low frequency noise is within the typical frequency range of the predominant component of ambient noise (Subacoustech, 2019) as well as fish hearing ability (e.g. salmon; Harding *et al.,* 2016). The noise emitted from OpenHydro was reported to reach background noise levels within 1-1.5 km from the source.

177. For the PTEC project (2014), modelling was conducted of operational noise that would arise using 24 m rotor (worst-case scenario for this project). Note that this is smaller than the maximum rotor size potentially proposed for the Project, 27 m, however, the scale of potential effect on fish species associated with the noise of tidal turbines from PTEC and MeyGen shows

range to be limited to the low 10s of metres at greatest, and this is expected for other tidal turbines of a similar scale.

178. The worst-case scenario modelling for the 24 m rotor at threshold levels (90 dB_{ht} and 75 dB_{ht} (Species) (Nedwell et al., 2007)) for impact on fish species are listed in **Table 10-25**. The largest range at which a behavioural reaction can be expected (i.e. levels of 75 dB_{ht} are reached) is 36 m, specifically for cod species. The largest range at which a startle response can be expected (i.e. levels of 90 dB_{ht} are reached) is 3 m, also for cod.

Table 10-25 Summary of the Modelled Ranges for the 90 and 75 dB_{ht} (Species) Levels for an Operational Device with a Rotor Diameter of 24 m (taken from PTEC, 2014)

Species	90 dB_{ht} (Species)			75 dB_{ht} (Species)		
	Max Range (m)	Min Range (m)	Mean Range (m)	Max Range (m)	Min Range (m)	Mean Range (m)
Bass	<1	<1	<1	4	3	4
Cod	3	2	3	36	35	36
Dab	<1	<1	<1	<1	<1	<1
Salmon	<1	<1	<1	<1	<1	<1
Elasmobranch	<1	<1	<1	<1	<1	<1

179. For the MeyGen project, the behavioural impact ranges of fish were modelled for the operational noise predicted to be emitted from a 1 MW and 2.4 MW turbine. Operational noise was predicted to be up to 177 dB SPL_{RMS} for a 2.4 MW turbine, with peak energy content below 100 Hz but also significant peaks in the 1,500 Hz and 5,000 Hz bands (Subacoustech, 2019).

180. The operational noise from a single turbine of either size was predicted to cause a behavioural impact within 1 m of the source only (for both 90 dB_{ht} and 75 dB_{ht} metrics). The PTEC (2014) report modelled that for their fully deployed site (30 MW) the noise level "will generally be 130-150 dB re 1 uPa".

181. The exact cumulative noise produced by a fully deployed tidal demonstration zone (240 MW) is currently unknown. Although the modelling undertaken at PTEC is indicative of the scale of deployment anticipated by the Project for each single array deployment within the overall 240MW, the overall cumulative noise is expected to be greater.

182. The level of potential impact of operational noise is assessed in the context of background noise and natural variation. The level of noise predicted to be produced by the fully deployed PTEC site (130-150 dB re 1 uPa) was within the natural variation in background levels of the site (average of 120 dB re 1 μPa, and regularly exceed 130 dB re 1 μPa; PTEC, 2014). The background levels were measured from the PTEC site situated off southern Isle of Wight in the English Channel, an area exposed to heavy shipping traffic. As a result, they concluded a low magnitude for effect.

183. Four underwater noise monitoring stations were installed in the MDZ by SEACAMS (University of Bangor) to record background noise and assess variation on a daily and tidal cycle basis (Subacoustech, 2019). Underwater noise measurements were taken over periods of 15-30 days in 2016, 2017 and 2018.

184. Analysis of the records revealed that noise levels were highly consistent between sites and years; all were between 89 dB to 107 dB SPL_{RMS} re 1 µPa. As expected there was variation in the noise levels with the position of the tide, and when marine traffic was present.

185. Ambient noise levels have also been determined for the nearby Wylfa Newydd Development Area. Ambient underwater sound pressure levels were acquired between 2013 and 2014 to establish a baseline level of noise in the vicinity of Cemlyn Bay, Cemaes Bay and the Wylfa Newydd Development Area (see **Chapter 12, Marine Mammals**). The analyses reported that existing natural background noise levels for the area were between 111.4 dB re 1 µPa (SPL_{RMS}) and 120.9 dB re 1 µPa (SPL_{RMS}) (based on all transects measured).

186. It is considered that the main component to ambient noise in the MDZ is “shore noise”, though there was also influence of shipping noise to the north of the site (QinetiQ, 2005). In addition, due to the highly tidal nature of the site and the anticipated low levels of anthropogenic noise, tidal flow noise may also be a major component of the background noise levels in the MDZ (Merchant et al., 2016).

187. Due to the combination of potentially greater operational noise produced and lower background noise levels it can be expected that the magnitude of effect will be higher than that concluded in the PTEC report. Following the generic guidelines presented for the determination of magnitude of effect in **Chapter 5**, **EIA Methodology**, the magnitude of effect of underwater noise falls into the category of medium. The noise levels would constitute a minor alteration to the environment, occur on the long-term scale (i.e. duration of project, 37 years) though be reversible (once operations had stopped).

188. Whilst making consideration of the definitions for magnitude of effect, it is important to note that the zone of influence of noise generated during operation will have a limited spatial extent in the context of the wider habitat available to receptor species within the Irish Sea. As a result, based on expert judgement, it is concluded that the magnitude of effect of operational noise is low. This follows the rationale based in the PTEC assessment, which concluded low magnitude based on the very limited spatial range of the effect.

189. The most sensitive species to noise is the hearing specialists such as those in the herring family, which are considered as having a medium sensitivity to noise.

190. As a result of the low magnitude of the effect in coupled with the medium sensitivity of the receptor there is a **minor adverse** impact on fish and shellfish receptors during the operational phase via device noise.

191. With respect to repowering, the worst case scenario for underwater noise production as determined for the construction phase can also be applied to any repowering phase as similar sub-activities (installation, vessel presence) can be assumed.

192. As only 50 % of the berths will be subject to repowering, the magnitude of effect will be lower than for the main construction phase, due to a shorter time period of noise effects.

193. Therefore, in accordance with the assessment for construction and the short(er) term temporal scale of effect from repowering works, the magnitude of the effect is classified as low, the receptor sensitivity is considered medium, resulting in an impact significance that is **minor adverse**.

10.6.5.1.1. Mitigation

194. No mitigation measures are considered to be required.

10.6.5.1.2. Residual Impact

195. The residual impact is **minor adverse**.

10.6.5.2. Operational Impact 2: Permanent Habitat Loss via Project Infrastructure (including repowering)

196. The worst-case scenario for permanent habitat loss via initial installation of project infrastructure is 2,180,072 m^2; (2.18 km^2), plus an additional 52,504 m^2 via repowering of up to 50 % of the berths (see **Table 10-20**).

197. The worst-case scenario footprint accounts for 5 % of the 39.76 km^2 area covered within the study area. This is based on the assumption that all areas where infrastructure is placed would be “lost” as habitat during the operational phase (in practice, project infrastructure deployed over the lifetime of the project, such as anchor blocks and/or surface-laid cables will itself represent new habitat. However, for fish and shellfish, loss of existing habitat which currently provides foraging/spawning/nursery habitat is the focus of this assessment).

198. The exact layout of project infrastructure is currently unknown; therefore, it is not possible to make any specific conclusions on the specific habitat lost due to the location of infrastructure. The predominant seabed habitat type within the MDZ (as outlined in **Chapter 7, Metocean Conditions and Coastal Processes**) includes gravelly sand and sandy gravels, with large areas of exposed bedrock, and areas of sand and outcropping bedrock. There are also small areas of mobile sands with features of possible biogenic interest, areas of boulders and surface mobile sands.

199. The biotopes present within the export cable corridor include very tide-swept faunal communities, mixed faunal turf communities, circalittoral coarse sediment, and sublittoral sands and muddy sands (Ocean Ecology, 2018). As stated in **Chapter 9, Benthic and Intertidal Ecology** the habitats and associated benthic communities found in the study area are typical of those found in Anglesey and wider Welsh coastal regions.

200. As discussed previously, any loss of habitat for spawning and nursery grounds will be not be of significance as they are typically widespread throughout the surrounding regional waters.

201. Following the generic guidelines presented for the determination of magnitude of effect in **Chapter 5, EIA Methodology**, the magnitude of effect of habitat loss falls into the category of medium. Habitat loss would constitute a minor loss of the environment (5 % of available habitat in the MDZ), occurring on the long-term scale (i.e. duration of project, 37 years) though be reversible (once infrastructure removed).

202. Whilst making consideration of the definitions for magnitude of effect, it is important to note that the amount of habitat lost during operation will have a very limited spatial extent in the context of the wider habitat available to receptor species within the Irish Sea. Furthermore, there is evidence that habitat will not be completely lost as the infrastructure may be colonised by shellfish species (Langhamer and Wilhelmsson (2009), as cited in PTEC (2014)). As a result, based on expert judgement, it is concluded that the magnitude of effect of habitat loss during operations is low.

203. The same species used for the sensitivity assessment for habitat loss during the construction phase have been used for habitat loss for the operational and maintenance phase, specifically the blue/common mussel and European spiny lobster.

204. The blue/common mussel has a moderate sensitivity substratum loss and such changes are considered not relevant to the European spiny lobster. As a precautionary measure the maximum sensitivity to habitat loss for the receptor is concluded as medium.

205. As a result of the low magnitude of the effect in coupled with the medium sensitivity of the receptor there is a **minor adverse** impact on the receptors during operation via permanent habitat loss. This conclusion remains valid even with the additional permanent habitat loss that would be caused by repowering works.

10.6.5.2.1. Mitigation

206. No mitigation measures are considered to be required.

10.6.5.2.2. Residual Impact

207. The residual impact is **minor adverse**.

10.6.5.3. Operational Impact 3: Physical disturbance of habitats and temporary habitat loss (cable repair and repowering)

208. As with other marine energy infrastructures, there will be a requirement for planned and unplanned maintenance activities throughout the operation phase of the Project. These activities may vary in nature, however the maintenance activities considered likely to cause disturbance impacts are cable repairs and repowering works. Repowering is defined as being ‘the removal of a tenant’s infrastructure at the end of a demonstration period and replacement with the infrastructure of a new tenant, including the removal of devices (including foundations, TECs, support/super structure, inter-array cables, hubs and monitoring equipment) and reinstallation via the original construction methods.

209. Cable repairs will result in localised and temporary disturbance of the seabed up ten times throughout the project life, each requiring around 5 days of repair work. This equates to a total of a possible 3,000 m^2 of temporary disturbance occurring due to project maintenance works throughout the project life, equal to around 0.007 % of the MDZ total area.

210. As a worst-case scenario, repowering works of 50 % of the berths is predicted, which will involve removal of existing tenant infrastructure and the re-installation of new infrastructure.

211. Based on the values in **Table 10-19**, a total area of 377,400 m^2 is predicted to be subject to additional temporary seabed disturbance via repowering. Therefore, a total of 380,400 m^2 (0.38 km^2) of seabed will be temporarily disturbed for cable repairs and repowering during the operational phase of the project. All this activity will only take place within the main MDZ array site (35 km^2), meaning that 1.1 % of the MDZ array area will be affected.

212. This amount of temporary seabed disturbance via cable repair and repowering works is slightly less than that predicted from the main installation phase which concluded an impact of minor significance. Therefore, a similar impact is predicted for these operational phase impacts.

10.6.5.3.1. Mitigation

213. No mitigation measures are considered to be required.

10.6.5.3.2. Residual Impact

214. The residual impact is **minor adverse**.

10.6.5.4. Operational Impact 4: Increased Suspended Sediment Concentrations and Sediment Deposition Loss (via repowering)

215. The repowering phase may cause increased suspended sediment concentrations and sediment deposition during both the removal and construction of infrastructure. As outlined previously, it is not anticipated that a significant amount of sediment will be added to the water column due to the high tidal energy of the site. This results in a conclusion of very low/negligible magnitude of effect.

216. The very low/negligible magnitude of effect, in combination with the previously assessed medium sensitivity of representative worst-case receptor species, results in an impact significance that is **minor adverse**.

10.6.5.5. Operational Impact 5: Barrier Effects via Project Infrastructure

217. Barrier effects to the movements of fish and shellfish through the water column can arise during the Project due to the presence of tidal devices and associated infrastructure, including mooring chains and catenaries. The worst-case scenario (arising during full site deployment) for the swept area of TEC's is predicted to be 84,500 m^2 based on seabed-mounted multiple rotor platform device types with rotors up to 27 m in diameter.

218. The perceived barrier effect however will depend on a variety of factors including the type, width, number of tidal devices, and spacing between devices and the seabed. The potential distribution of infrastructure within the project area is currently unknown, however, it is unlikely to present a complete barrier to the passage of migratory fish due to the separation distance (70 m distance in the shortest dimension).

219. Of particular concern to barrier effects are the potential impacts on migratory fish who move from the freshwater to marine environment, thereby utilising the coastal environment as a migratory route. It should be noted that limited information is present on the fine-scale migration of migratory fish species. However, the study area does not form a barrier at the mouth of any

natal rivers. Indeed, the nearest protected area for migratory fish species is in excess of 50 km away.

220. Barrier effects that may arise during the operation of the project can be considered long-term and reversible in nature, as well as causing a minor alteration in the environment. As a result, the magnitude of the effect can be classified as medium.

221. The sensitivity of migratory fish species to barrier effects is considered low. This is based upon the site's potential 'barrier effect' not being at the mouth of any natal river for migratory fish species, and the small spatial extent of the site which results in individual receptors being able to avoid it.

222. As a result of the medium magnitude of the effect in coupled with the low sensitivity of the receptor there is a **minor adverse** impact on the receptors during operation.

10.6.5.5.1. Mitigation

223. No mitigation measures are considered to be required.

10.6.5.5.2. Residual Impact

224. The residual impact is **minor adverse**.

10.6.5.6. Operational Impact 6: Collision Risk

225. Collision risks can arise from fish and shellfish coming into contact with the devices. The area within which collision risk can occur is equivalent to the maximum swept area (84,500 m^2). However, it is not possible to determine the distance from the device at which entrainment may occur and result in collision risk, due to the lack of information and varied factors that can affect this parameter (e.g. species-specific avoidance as a function of swim speed, visual and auditory acuity amongst other factors, rotor structure, speed and visibility, etc.)

226. There is limited information available on the interaction of this risk and fish species. This assessment uses information from ABPmer (2010) report entitled "Collision Risk of Fish with Wave and Tidal Devices".

227. There are four factors which affect the likelihood of collision risk: exposure, long-range avoidance, close-range evasion, and collision damage (ABPmer, 2010). Exposure is based on likelihood of overlap between the fish and device based on the ecology of the fish. Long-range avoidance is based on the potential of the fish to detect the operational noise of the device. Close-range evasion is based on the potential of the fish to visually detect the device. Collision damage is based on the likely consequence of collision on the fish.

228. It is very difficult to assess the maximum sensitivity of the fish species to the effect. The worst-case scenario would assume that a fish species would overlap the device, would not be able to audibly detect the device (e.g. due to low hearing sensitivity), and are unable to conduct close-range evasion (due to insufficient burst swimming speeds). Fish behaviour when presented with a tidal turbine is unknown; however, the predicted maximum (average) rotor tip speed (22 m/s for small rotors) is above the threshold for which there is a significant risk of

physiological damage (10-12 m/s; ABPmer, 2010), therefore it can be assumed that the worst-case result of a collision will be mortality.

229. According to ABPmer (2010), the worst-case scenario for ability to avoid collision risk based on the different levels of avoidance are as follows:

- Long-range avoidance – ability to undertake this may (in a worst-case scenario) be <u>very low</u> i.e. long-range avoidance shown at distances of 10 m where close-range evasion begins. Predicted for all species that have low sensitivity to noise. Only assessed for horizontal axis turbine;

- Close-range evasion – ability to undertake this may (in a worst-case scenario) be <u>medium</u> i.e. most fish should be able to exhibit an evasion response although some strikes are possible. This is predicted for all species groups and tidal turbine combination; and

- Physiological damage – risk of physiological damage may (in a worst-case scenario) be <u>medium-high</u> i.e. moderate-high risk of physiological damage and/or mortality to some individuals. This is predicted for all species taking into account collision with the blade tip (i.e. the fastest segment).

230. Based on the findings of ABPmer (2010) that the worst-case scenario is a medium avoidance ability, i.e. it has some tolerance to avoid the impact, it is considered that the sensitivity of the receptor is low. The confidence in this assessment is low, reflecting the low confidence in the findings of ABPmer (2010).

231. It is very hard to assess the magnitude of the effect due to the absence of information. However, it can be assumed that if fatal collisions do occur, it is likely to only be to a small proportion of individuals and not result in a population-level effect. The loss of individuals, in the context of the total loss of individuals for a population, is considered to be within the natural levels of mortality due to other factors, therefore the magnitude of the effect at a population is considered to be very low/negligible.

232. According to the impact matrix the combination of a low sensitivity and a very low/negligible magnitude results in a negligible impact significance. However, due to the uncertainty over this assessment, the impact significance has been augmented to **minor adverse** as a precautionary measure.

10.6.5.6.1. Mitigation

233. No mitigation measures are considered to be required.

10.6.5.6.2. Residual Impact

234. The residual impact is **minor adverse**.

10.6.5.7. Operational Impact 7: Electromagnetic Fields

235. Electromagnetic fields (EMF) can arise in the immediate vicinity of electrical cables. The Project will include a maximum of 248 km of cable around which EMF can arise, with an overall footprint of 43,337 m^2 (see **Table 10-20**). Most turbines will export grid compliant power at 11 kV, though some may be 24 kV or 33 kV longer term. Note that the seabed cables will be covered with protection systems which will decrease the likelihood of overlap of EMF with fish and shellfish species occurrence.

236. The strength of EMF produced depends on a variety of environmental factors including strength of the magnetic (B) field, distance from cable, speed and direction of water flow, and to a lesser extent the chemical composition of the surrounding water (PTEC, 2014). Most of the cables in the Project will export at 11 kV, however the worst-case scenario is 33 kV.

237. This is within the lower range of voltage typically used for offshore windfarms (33-66 kV), for which it is currently industry practice to not conclude significant effects from EMF. Based on the predicted low voltage, the small spatial coverage of the cables, and the use of cable protection, it is predicted that the magnitude of EMF will be low.

238. There is limited information on the effect of EMF on fish and shellfish receptors. Certain groups of fish such as elasmobranchs, salmonids and eel use electromagnetic fields for key functions such as navigation and prey detection (PTEC, 2014), therefore it is possible that an alteration in the natural levels of EMF may affect these functions. Both avoidance and attraction responses have been reported to different extents for different species, making it difficult to generalise the response and infer the significance.

239. The majority of fish and shellfish species that utilise the study area are flexible in their habitat use. The worst-case scenario of complete exclusion from the area due to anthropogenic EMF and subsequent relocation to areas nearby of similar habitat function would not have a likely impact at the population level of most species.

240. However, of concern would be the potential impacts on migratory fish, as a change to their migration routes could lead to effects on the local population. Atlantic salmon and sea trout are unlikely to encounter areas of elevated EMF as they swim in the upper water column, away from the seabed cables.

241. In the unlikely event of encountering areas of increased EMF, it is considered unlikely to affect their navigation to natal rivers as this relies principally on their sense of smell. European eel have been shown to continue on their migratory paths over subsea export cables for offshore wind farms carrying a significantly higher voltage than can be expected for this Project (Westerberg and Lagenflet, 2008). It is therefore considered that effects of EMF on migratory fish will be negligible at a population level, taking into account the position of the site away from the mouth of any natal rivers.

242. Also of concern is the potential effects on the nearshore migration of shellfish species, particularly those that are of commercial importance or come to the nearshore to breed. OSPAR (2009) reported observations that marine species such as crab showed no impact on their migratory routes from the presence of subsea cables in the Baltic Sea.

243. There are a limited number of preliminary laboratory tests that also show minimal behavioural changes resulting from EMF on crab species (PTEC, 2014). As a result, it can be concluded that there will be little impact on shellfish populations from anthropogenic EMF arising through the Project.

244. The sensitivity assessment of fish and shellfish to EMF during operation of the Project is concluded as low. This assessment, coupled with the low magnitude of effect, results in the potential for a **minor adverse** impact upon receptor species. This is considered sufficiently precautionary given the lack of knowledge on potential impacts on receptor species.

10.6.5.7.1. Mitigation

245. The emplacement of cable protection constitutes embedded mitigation measures in the project design. No further mitigation measures are considered to be required.

10.6.5.7.2. Residual Impact

246. The residual impact is **minor adverse**.

10.6.6. Potential Impacts During Decommissioning

247. It is likely that decommissioning of individual structures will be the responsibility of the individual structures, as overseen by Mentor Môn. Decommissioning of the site comprises the complete removal of all infrastructure associated with the tidal energy project. Offshore decommissioning methodologies would vary considerably between devices but would be expected to be similar to the construction phase in reverse. For the purpose of this chapter, it is assumed that cables are required to be removed as this represents the worst-case scenario in terms of impacts. Therefore, it can be assumed that all impacts identified as having the potential to arise during the construction phase (**Section 10.6.4**) may also occur during the decommissioning phase.

248. As the methodologies for decommissioning are expected to be similar to construction it can be assumed that the same impacts arise, specifically underwater noise, physical disturbance and temporary loss of seabed habitat, and sediment changes. The conclusion of all three of these impacts were that they would cause a **minor adverse** impact significance, therefore this can be applied to the decommissioning phase. It should be noted that this is a highly precautionary assessment as it is likely that the impacts from decommissioning will be less than those from construction (PTEC, 2014).

10.6.6.1.1. Mitigation

249. No mitigation measures are considered to be required.

10.6.6.1.2. Residual Impact

250. The residual impact is **minor adverse**.

10.6.7. Cumulative Impacts

251. A draft list of projects and plans that, together with the Project, have the potential to result in cumulative or in-combination impacts is given in **Chapter 26, Cumulative Impact and In-Combination Effects**.

252. For this Cumulative Impact Assessment (CIA) the consideration of which projects may result in cumulative or in-combination impacts on fish and shellfish receptors has been based upon the Project-specific impact assessment and expert judgement.

253. As described in this chapter, the majority of impacts on fish and shellfish associated with the Project have a spatial extent that is limited to the site and the immediate surroundings. As such it is only projects that will affect the immediate local environment that shall be screened in for consideration. A nominal buffer of ~20 km has been chosen as a worst-case maximum extent over which impacts may overlap i.e. accumulate. Any projects beyond 20 km are screened out of this CIA on the basis that they are beyond the spatial extent of impacts from the Project. In addition, any projects that do not involve any construction in the marine environment have also been screened out. The projects taken forward for this CIA are outlined in **Table 10-26**.

254. Migratory fish have the potential to be impacted at distances greater than non-migratory fish. However, as the cumulative impacts on Annex II migratory fish are assessed as part of the HRA they are not included here, but a summary is provided for context. Of the European sites screened in for assessment for migratory fish, only two (Severn Estuary/ Môr Hafren SAC and Pembrokeshire Marine/ Sir Benfro Forol SAC) had the potential to directly spatially overlap with reasonably foreseeable plans or projects being screened in for combination effects, of which the projects were:

- Greenlink Interconnector;
- Marine aggregate dredging area 531 – Tarmac and Hanson Aggregates;
- M4 Corridor around Newport (M4CaN); and
- Newport Relocation Proposals.

255. The conclusion of the HRA for migratory fish was that no significant effects are expected at a designated population level on any of the sites due to the lack of spatial (or temporal) overlap with all reasonably foreseeable plans and projects.

Table 10-26 Projects Taken Forward into the Cumulative Impact Assessment

Project name	Project Developer	Overview	Distance from the Project	Project Status (as of July 2019)
Wylfa Decommissioning	Magnox Limited	Decommissioning of the Existing Power Station. The project is currently in a defueling phase, which will be followed by site care and maintenance, then decommissioning and final site clearance. Decommissioning understood as likely to be between 2015 and 2025. It is understood that the only marine works will be the explosive demolition of the cooling water jetty and offshore structures	17.5 km	Operational
Wylfa Nuclear Power Plant	Horizon Nuclear Power	Construction of a new nuclear power station. As part of the components there will be the disposal of dredged material at the “Holyhead North” dredge disposal site. Note that work on the project has been suspended since January 2019 for commercial reasons	17.5 km	Pre-consent
Amlwch LNG	Amlwch LNG (previously Cantaxx)	Project involves importing liquid gas to a mooring 3 km from the Amlwch coast and then transference of the gas by an undersea pipeline. Consent for this project was renewed in 2013, though the timescales of future plans are unclear	20.5 km	Consented
Holyhead Deep – 10 MW project	Minesto	10 MW Tidal kite installation plus associated onshore elements. A Marine Licence to build the first 0.5 MW installation was granted in April 2017. There is currently one device in the water. ES and HRA available: http://minesto.com/projects/holyhead-deep.	<2 km	Consented
Holyhead Deep – 80 MW project	Minesto	The Project includes construction, installation, commissioning, operation and maintenance, and decommissioning activities for an array of up to 160 DGUs (80 MW). The DGUs will be installed in clusters of between six and seven DGUs, with each DGU linked to a Deep Green Connection Hub (DGCH) via a subsea umbilical. Energy generated by the DGUs will be transmitted to the DGCH, before being ‘stepped-up’ on its way to the transmission infrastructure, a process whereby the voltage of the electricity is modified to reduce transmission losses. Each of the DGUs will require its own subsea foundation, utilising one of three options: a concrete gravity base structure, a monopile, or a mud mat foundation. Onshore aspects not discussed, intention to develop transmission infrastructure with Morlais Project.	<2 km	Pre-application

256. The main potential cumulative and in-combination impacts from the combination of projects are:

- Underwater noise;
- Physical disturbance of habitats and habitat loss; and
- Increased suspended sediment concentration and sediment deposition.

257. Each of these impacts can arise during multiple phases of the Project. Therefore, the worst-case scenario for each impact, across phases, was taken into consideration for a single assessment per impact pathway.

258. Collision risk was screened out from cumulative and in-combination effects as these can only occur within the footprint of the Project, for which there are no overlaps.

259. Barrier effects (from the emplacement of infrastructure in the water column) were screened out from cumulative and in-combination effects as there is no adjacent project which has infrastructure in the water column that may affect fish and shellfish receptors (see below for rationale behind screening out Holyhead Deep).

260. Similarly, EMF has been screened out from cumulative and in-combination effects as the two Wylfa projects and the Almwch LNG do not involve emplacement of electric cables in the marine environment, and Holyhead Deep has no pathway for impacting fish and shellfish receptors (see below).

261. It should be noted that, although Holyhead Deep project co-occurs with the current Project, any impacts on fish species was ruled out from the Holyhead Deep 10 MW project as the "*nature of device deemed of very low impact to fish ecology*". There is no further detail on the Holyhead Deep 80MW project at the time of writing. However, as there are no primary impacts on fish and shellfish expected to arise from this project, there is no pathway for cumulative or in-combination effects to arise with the current Project.

262. At the time of writing it was not possible to find out any more information on the proposed Almwch LNG project. A period of more than five years has elapsed since the consent for this project was renewed yet there has been no recent information released and available online. It is therefore not possible to assess the potential cumulative and in-combination impacts between this project and the current Project at this time.

10.6.7.1. Cumulative Impact 1: Underwater Noise

263. The production of underwater noise from the Wylfa decommissioning project will only arise during the potential explosive decommissioning of the cooling water jetty and associated infrastructure. The underwater noise produced by explosive detonations is typically of high intensity and short duration (<1 second). The noise from underwater explosions in itself can cause mortality in the immediate area and effects at a range of up to 350 m. There is little information on the sub-lethal impacts in fish from explosions. Due to the short temporal scale (single explosion per piece of infrastructure) of the underwater noise produced during the Wylfa decommissioning it is considered unlikely to cause any added impact above the level of impact that may arise during the Project.

264. Marine works associated with the construction of Wylfa Nuclear Power Plant will include both permanent and temporary works. The Project Description states that "*the majority of works will be undertaken within the first two years of the Project's construction phase, though certain works may take up to five years to complete*". As the project is in suspension it is uncertain when or if these works will occur. The Project Description has identified the activities that may generate underwater noise as including drilling, piling (vibratory piling hammer), dredging, rock breaking, vessel noise. Of these, it can be expected that piling using the hydraulic drop hammer would produce the greatest amount of underwater noise. It has not been possible to ascertain any ranges of underwater noise impacts from the construction activities from Wylfa Nuclear Power Plant. If it can be assumed that the piling will produce underwater noise of a similar level to that produced by the current Project, then there is no pathway for overlap of the zone of influence of underwater noise. Indeed, even if the noise levels were higher, it is deemed highly unlikely that the zone of influence would exceed the 17.5 km distance between the two projects.

265. Furthermore, the deposition of dredge material at the Holyhead North dredge site as part of the Wylfa Newydd project will also produce underwater noise. Little is known about the underwater noise generated from deposition at sea therefore as a worst-case scenario the sound levels from cutter suction dredging were used in the Horizon Nuclear Disposal site characterisation report. For the sound levels produced by cutter suction dredging, the maximum range for injury to fish was modelled to be 2 m, and the maximum range of TTS was 13 m. Based on these distances there is no spatial overlap of the acoustic zones of influence produced by the two projects.

266. It is not known when the activities creating underwater noise from the other Projects will occur. Therefore, for the purpose of this assessment, the worst-case scenario of complete temporal overlap between the noise-producing activities of the identified projects and each phase of the Project has been assumed.

267. Following the measurements given above, and taking into account the maximum impact range of worst-case noise produced during the Project activities (50 m, during construction; see **Table 10-24**), it can be concluded that there will be no overlap between the acoustic footprints of the Project with other projects and plans in the area. Furthermore, the footprint over which there will be elevated noise levels is small and represents only a small portion of the greater area available to fish and shellfish species. Therefore, the cumulative impacts from the underwater noise pathway are considered not significant.

10.6.7.2. Cumulative Impact 2: Physical Disturbance and Habitat Loss

268. Another potential cumulative and in-combination impact between the Project and other projects and plans is the physical disturbance and habitat loss. The current Project represents 2,184,932 m^2 (2.18 km^2) of permanent habitat loss during the lifetime of the Project in addition to temporary habitat loss which is anticipated to have a maximum total of 423,499 m^2 (0.42 km^2) during each of the construction and decommissioning phase, and 127,000 m^2 (0.12 km^2) during the operational phase.

269. The seabed footprint of marine infrastructure associated with the existing Power Station at Wylfa is very small as it comprises a single jetty not more than 150 m long. The marine works as part of the construction of the Wylfa Newydd project are in a similar location, adjacent to the coast

at Wylfa on the north Anglesey coast, and are also considered small (extending a maximum of 3 km into the marine zone). Due to the small area and distance from the site it is considered that the cumulative impact of habitat disturbance and loss from these project activities on north Anglesey will have a negligible effect.

270. In addition to construction the Wylfa Newydd project involves dredge disposal at a large site nearer to the MDZ. As part of the plume dispersion modelling, a worst-case scenario of maximum extent of deposition on the seabed (at a thickness of 1 cm) was a total area of 1.8 km^2. This value can also be utilised to represent the maximum habitat loss in the area.

271. In comparison to the amount of comparable habitat identified in the survey area, the overall area of habitat that will be impacted by the additional seabed activities will be small and it is predicted that no significant cumulative impacts should occur.

10.6.7.3. Cumulative Impact 3: Increased Suspended Sediment Concentrations and Sediment Deposition loss

272. The decommissioning work of the existing Wylfa Power Station that are in the marine environment, i.e. the explosive demolition of the jetty, has been identified as having the potential to result in "*substantially elevated levels of suspended sediment in the water column, possibly resulting in smothering of sensitive habitats and species*". NRW that sediment transport modelling be conducted to predict effects, although it is uncertain if this was undertaken and no evidence of this has been found online.

273. As part of the Environmental Statement produced for the application for the Wylfa Newydd Project a detailed assessment of the sediment regime in the area was undertaken. The results can be used to inform the potential extent of impacts from the decommissioning activity of the existing Wylfa Power Station as they are in the same location.

274. The Environmental Statement details that, despite the high amount of wave energy, "*sediment movement is essentially limited to individual bays as rock platforms and headlands provide barriers (natural groynes)*" this prevents the movement of sediment. On this basis it is possible to infer that any increased sediment suspension as a result of marine activities in the Wylfa area will not extend as far as the Morlais zone, which is situated 17.5 km away.

275. Dredge disposal at the Holyhead North/Deep site as part of the Wylfa Newydd project also has the potential to cause localised increase in sediment concentrations and deposition. Modelling of the environmental change and effects on fish and shellfish lead to a conclusion of negligible magnitude, a worst-case medium sensitivity of the receptor (due to commercial fish), and therefore an overall negligible impact due to increased suspended sediment concentration. Similarly, the report concluded a negligible effect on fish and shellfish receptors from smothering due to the negligible magnitude of effect (due to mortality or displacement) and the medium value/sensitivity of the receptor. It was expected that all resuspended sediment would remain wholly contained within the disposal site.

276. Due to the minor adverse impact of increased sediment resulting from the Project, coupled with the negligible effect of the sediment pathways on fish and shellfish concluded from the only nearby project, and the lack of spatial overlap of effects, it can be concluded that the cumulative impacts from increased sediment will not be significant.

10.6.7.4. Cumulative Impact Summary

277. In summary, significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

10.6.8. Inter-Relationships

278. **Table 10-27** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 10-27 Inter-Topic Relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Marine Sediment and Water Quality	Chapter 8	Section 10.5.7.3	Both chapters consider the potential effects of the project on the European Shellfish Water designation.
Benthic and Intertidal Ecology	Chapter 9	Section 10.6.1 and 10.6.5	Both chapters consider the potential effects of the project in an assessment of the impact of invasive non-native species.
Marine Mammals	Chapter 12	Section 10.5.2	Noted that cetaceans may predate on species listed in this chapter; both chapters consider the effects of the project on the prey species directly or as a proxy
Marine Ornithology	Chapter 11	Section 10.5.2	Noted that birds may predate on species listed in this chapter; both chapters consider the effects of the project on the prey species directly or as a proxy
Commercial Fisheries	Chapter 14	Section 10.5.2 and 10.5.3	Noted that commercial fisheries utilise some of the species of fish listed in this chapter; both chapters consider the effects of the project on the fish species directly or as a proxy

10.6.9. Interactions

279. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 10-28**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 10-28 Potential Interaction Between Impacts

Potential interaction between impacts						
Construction/ Repowering/ Decommissioning	1: Underwater noise		2: Physical disturbance of habitats and temporary habitat loss		3: Increased suspended sediment concentration and sediment deposition	
1: Underwater noise	-		Yes		No	
2: Physical disturbance of habitats and temporary habitat loss	Yes		-		Yes	
3: Increased suspended sediment concentration and sediment deposition	No		Yes		-	
Operation	Impact 1: Underwater Noise	Impact 2: Long-term habitat loss	Impact 3: Barrier effects	Impact 4: Increased suspended sediment concentration and sediment deposition	Impact 5: Collision risk	Impact 6: Electromagnetic fields
Impact 1: Underwater Noise	-	Yes	Yes	No	No	No
Impact 2: Long-term habitat loss via placement of project infrastructure (project footprint)	Yes	-	Yes	Yes	Yes	Yes
Impact 3: Barrier effects	Yes	Yes	-	Yes	Yes	Yes
Impact 4: Increased suspended sediment concentration and sediment deposition	No	Yes	Yes	-	Yes	Yes
Impact 5: Collision risk	No	Yes	Yes	Yes	-	No
Impact 6: Electromagnetic fields	No	Yes	Yes	Yes	No	-

10.7. SUMMARY

280. **Table 10-29** presents a summary of the impact assessments undertaken for fish and shellfish receptors in this chapter. Throughout the construction, operation and maintenance, repowering, and decommissioning phases, the impact on fish and shellfish is considered to be of **minor adverse** significance.

Table 10-29 Potential Impacts on Fish and Shellfish Receptors

Phase	Potential Impact	Receptor	Value / sensitivity combined	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction	Impact 1: Underwater noise	All fish species	Medium	Low	Minor adverse	None proposed	Minor adverse
	Impact 2: Physical disturbance of habitats and temporary habitat loss	All fish and shellfish species	Low	Low	Minor adverse	None proposed	Minor adverse
	Impact 3: Increased suspended sediment concentration and sediment deposition	All fish and shellfish species	Medium	Very low	Minor adverse	None proposed	Minor adverse
Operation and Maintenance	Impact 1: Underwater Noise Effects via (a) device operational noise and (b) repowering works	All fish species	Medium	Low	Minor adverse	None proposed	Minor adverse
	Impact 2: Long-term habitat loss via placement of project infrastructure (project footprint) (and via repowering)	All fish and shellfish species	Medium	Low	Minor adverse	None proposed	Minor adverse
	Impact 3: Physical disturbance of habitats and temporary habitat loss (repowering only)	All fish and shellfish species	Medium	Low	Minor adverse	None proposed	Minor adverse
	Impact 4: Increased suspended sediment concentration and sediment deposition (repowering only)	All fish and shellfish species	Medium	Very low	Minor adverse	None proposed	Minor adverse
	Impact 5: Barrier effects	All fish and shellfish species	Low	Medium	Minor adverse	None proposed	Minor adverse

Phase	Potential Impact	Receptor	Value / sensitivity combined	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
	Impact 6: Collision risk	All fish and shellfish species	Low	Negligible	Minor adverse	None proposed	Minor adverse
	Impact 7: Electromagnetic fields	All fish and shellfish species	Low	Low	Minor adverse	None proposed	Minor adverse
Decommissioning	Impact 1: Underwater noise	All fish species	Medium	Low	Minor adverse	None proposed	Minor adverse
	Impact 2: Physical disturbance of habitats and temporary habitat loss	All fish and shellfish species	Low	Low	Minor adverse	None proposed	Minor adverse
	Impact 3: Increased suspended sediment concentration and sediment deposition	All fish and shellfish species	Medium	Very low	Minor adverse	None proposed	Minor adverse

10.8. REFERENCES

ABPmer, 2010. *Collision Risk of Fish with Wave and Tidal Devices*. Commissioned by RPS Group plc on behalf of the Welsh Assembly Government

Angel Shark Project, 2019. *Angel Shark Project Wales Quarterly Reports.* Available online at https://angelsharknetwork.com/wales/ [Accessed February 2019].

Angler's World, 2014. *Understanding north east Atlantic mackerel.* Available online at http://www.anirishanglersworld.com/index.php/2014/01/understanding-north-east-atlantic-mackerel/ [Accessed March 2019]

Aires, C., Gonzales-Irusta, J.M., and Watret, R., 2014. *Updating Fishereis Sensitivity Maps in British Waters.* Scottish Marine and Freshwater Science Report Volume 5 Number 10.

Bark, A., Williams, B., and Knights, B., 2007. Current status and temporal trends in stocks of European eel in England and Wales. *ICES Journal of Marine Science* 64 (7): 1368-1378.

Bennett D.B., 1995. Factors in the life history of the edible crab (*Cancer pagurus* L.) that influence modelling and management. *ICES Marine Science Symposia*, 199: pp.89-98.

Bernardez C., Freire J., and Gonzalez–Gurriaran E., 2000. Feeding of the spider crab *Maja squinado* in rocky subtidal areas of the Ria de Arousa (north-west Spain). *Journal of the Marine Biological Association of the United Kingdom*, 80, 95–102.

Brown C.G. and Bennett D.B., 1980. Population and catch structure of the edible crab (*Cancer pagurus*) in the English Channel. *Journal du Conseil*, 39: pp.88-100.

Centre for Fisheries and Aquaculture Science (CEFAS), 2014. *Classification of bivalve mollusc production areas in England and Wales: Sanitary Survey Report. Anglesey.*

Coull, K.A., Johnstone, R., and Rogers, S.I., 1998. *Fisheries Sensitivity Maps in British Waters*. Published and distributed by UKOOA Ltd.

Ellis, J.R., Armstrong, M.J., Rogers, S.I., and Service, M., 2002. *The distribution, structure and diversity of fish assemblages in the Irish Sea.* Marine Biodiversity in Ireland and Adjacent waters (Conference Paper).

Ellis, J.R., Milligan, S.P., Readdy, L., Tayler, N., and Brown, M.J., 2012. *Spawning and nursery grounds of selected fish species in UK waters*. Science Series Technical Report no. 147. Published by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS).

Environment Agency, 2017. *Salmonid and Freshwater Fisheries Statistics for England and Wales, 2015.*

FAO, 2008. *Marine Resource Fact Sheet: Elasmobranchs – Celtic Sea and West of Scotland*. Available online at http://firms.fao.org/firms/resource/13447/en [Accessed March 2019].

Fiksen, O., Aksnes, D.L., Flyum, M.H., and Giske, J., 2002. The influence of turbidity on growth and survival of fish larvae: a numerical analysis. *Hydrobiologia* 484: pp.49-59.

FishBase, 2019. *Fishbase Species Table*. Available online at https://www.fishbase.de/ [Accessed March 2019]

Harding, H., Bruintjes, R., Radford, A.N., and Simpson, S.D., 2016. Measurement of Hearing in Atlantic salmon (*Salmo salar*) using Auditory Evoked Potentials, and effects of Pile Driving Playback on salmon Behaviour and Physiology. *Scottish Marine and Freshwater Science Report Vol 7 No 11*

Horizon Nuclear Power (HNP), 2018a. *Wylfa Newydd Project: Operational Water Discharge Activity – Environmental Permit Application Appendix F – Fish and Fisheries.*

Horizon Nuclear Power (HNP), 2018b. *Wylfa Newydd Project: 6.4.91 ES Volume D – WNDA Development App. D13-9 – Underwater Noise Baseline and Modelling*.

International Council for the Exploration of the Seas (ICES), 2019. *ICES Advice on fishing opportunities, catch, and effort; Northeast Atlantic Ecoregion*. Factsheets available to download online at http://www.ices.dk/sites/pub/Publication%20Reports/Forms/defaultone.aspx?RootFolder=%2fsites%2fpub%2fPublication%20Reports%2fAdvice%2f2018%2f2018&FolderCTID=0x0120005DAF18EB10DAA049BBB066544D790785 [Accessed March 2019].

International Union for Conservation of Nature (IUCN), 2019. *The IUCN Red List of Threatened Species*. Available online at https://www.iucnredlist.org/ [Accessed March 2019].

Joint Nature Conservation Committee (JNCC), 2016. *Review of the MCZ Features of Conservation Importance. May 2016.*

Kongsberg, 2012. *Underwater noise impact study for tidal turbine development in Inner Sound, Pentland Firth*. *Doc ref: 250123-TR-0003-V3.*

MarLIN, 2019. *The Marine Life Information Network*. Available online at https://www.marlin.ac.uk/ [Accessed March 2019].

Marine Management Organisation (MMO), 2018. *2013 to 2017 UK fleet landings by ICES rectangle*. Available online to download at https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2017 [Accessed March 2019].

Merchant, N.D., Brookes, K.L., Faulkner, R.C., Bicknell, A.W.J., Godley, B.J., & Witt, M.J., 2016. Underwater noise levels in UK waters. *Nature Scientific Reports* 6: 36942.

MMO, 2019. *Map – commercial and recreational bass fishing restrictions.* Available online at https://www.gov.uk/government/publications/bass-industry-guidance-2019 [Accessed March 2019].

National Biodiversity Network (NBN), 2019. *NBN Atlas Species Accounts*. Available online at https://species.nbnatlas.org/ [Accessed February 2019]

National Environment and Rural Communities (NERC), 2006. *National Environment and Rural Communities (NERC) Act 2006, Section 41: Species of Principal Importance in England.*

Nedwell, J.R., Turnpenny, A.W.H, Lovell,J., Parvin,S.J., Workman, R., Spinks, J.A.L & Howell, D., 2007. *A validation of the dB$_{ht}$ as a measure of the behavioural and auditory effects of underwater noise.*

Ocean Ecology, 2018. *Morlais Demonstration Zone (MDZ) Benthic Ecology Characterisation Survey 2018*. Technical report prepared for Mentor Môn. Report Reference OEL_MMNMOR0518_TCR

OSPAR, 2008. *OSPAR List of Threatened and/or Declining Species and Habitats.*

Parker-Humphreys, M., 2004. *Distribution and relative abundance of demersal fishes from beam trawl surveys in the Irish Sea (ICES division VIIa) 1993-2001*. *Science Series Technical Report Number 120.* Published by CEFAS

Pawson, M.G., and Robson, C.F., 1996. *Chapter 5.7. Fish: exploited sea fish*. Chapter in *Coasts and seas of the United Kingdom Region 11 The Western Approaches: Falmouth Bay to Kenfig.*

Pierce, G., 2005. *An overview of Cephalopods relevant to the SEA6 Area.* A report prepared for the Department of Trade and Industry.

Perpetuus tidal energy centre (PTEC), 2014. *Chapter 14: Fish and Shellfish*. A report produced by Royal Haskoning DHV.

Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D. A., Bartol, S., Carlson, T. J., Coombs, S., Ellison, W. T., Gentry, R. L., Halvorsen, M. B., Løkkeborg, S., Rogers, P. H., Southall, B. L., Zeddies, D. G., Tavolga, W. N., 2014. *Sound exposure guidelines for fishes and sea turtles: A technical report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI.* SpringerBriefs in Oceanography, ASA S3/SC1.4TR-2014.

QinetiQ, 2005. *SEA6 Technical report: Underwater ambient noise.* A report for the Department of Trade and Industry

Regnault M., 1994. Effect of air exposure on ammonia excretion and ammonia content of branchial water of the crab *Cancer pagurus*. *Journal of Experimental Zoology*, 268: pp.208-217.

Royal Haskoning DHV, 2018. *Morlais Tidal Array Scoping Report*.

Royal Yachting Association (RYA), 2019. *Marine Conservation Zones.* Available online at https://www.rya.org.uk/knowledge-advice/planning-environment/Pages/marine-conservation-zones.aspx [Accessed March 2019]

Scottish Government, 2019. *Haddock*. Available online at https://www2.gov.scot/Topics/marine/marine-environment/species/fish/demersal/haddock [Accessed March 2019]

Seafish, 2010. *Species Guide: Gurnards.* Available online at https://www.seafish.org/media/379562/seafishspeciesguide_gurnard_201012.pdf [Accessed March 2019].

SeaLifeBase, 2019. *SeaLifeBase*. Available online at https://www.sealifebase.ca/ [Accessed March 2019].

SharkTrust, 2019. *SharkTrust Species Factsheets.* Available online at https://www.sharktrust.org/shared/downloads/factsheets/ [Accessed February 2019].

Subacoustech, 2019. *Morlais tidal project, Holy Island – Underwater noise technical note*. A report prepared for HaskoningDHV Ltd.

Welsh Government, 2016. *Environment (Wales) Act 2016, Section 7.*

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Morlais Project
Environmental Statement

Chapter 11: Marine Ornithology

Volume I

Applicant: Menter Môn Morlais Limited
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Chapter 11: Marine Ornithology
Author: Royal HaskoningDHV

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GLOSSARY OF ABBREVIATIONS

Acronym	Term
BDMPS	Biologically Defined Minimum Population Size
BoCC	Birds of Conservation Concern
CEMP	Construction and Environment Management Plan
CFP	Common Fisheries Policy
CIEEM	Chartered Institute of Ecology and Environmental Management
CPGR	Counterfactual of Population Growth Rate
CPS	Counterfactual of Population Size
CRM	Collision Risk Modelling
DECC	Department of Energy and Climate Change
ECC	Export Cable Corridor
EcIA	Ecological Impact Assessment
EIA	Environmental Impact Assessment
EMEC	European Marine Energy Centre
ERM	Encounter Rate Modelling
ES	Environmental Statement
EU	European Union
JNCC	Joint Nature Conservation Committee
MDZ	Morlais Development Zone
MMO	Marine Management Organisation
MW	Megawatt
NERC	Natural Environment and Rural Communities
NPS	National Policy Statement
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
OfDA	Offshore Development Area
PVA	Population Viability Analysis
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SMP	Seabird Monitoring Programme
SNH	Scottish Natural Heritage
(p)(d)SPA	(proposed) (draft) Special Protection Area
SSSI	Site of Special Scientific Interest
TEC	Tidal Energy Converter
TWG	Technical Working Group
UK SNCBs	United Kingdom Statutory Nature Conservation Bodies
ZoI	Zone of Influence

GLOSSARY OF TERMINOLOGY

Density dependent	Where population growth rates are regulated by the density of a population.

Density independent	Where the growth of a population does not depend on the population density.
Deterministic	Where the values for the dependent variables of the system are completely determined by the parameters of the model.
Offshore Development Area	Morlais Demonstration Zone (MDZ) and Export Cable Corridor (ECC) combined.
Stochastic	Having a random probability distribution or pattern that may be analysed statistically but may not be predicted precisely.

11. MARINE ORNITHOLOGY

11.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) considers the potential impacts of the proposed Morlais project (the Project) on marine ornithology. It provides an overview of the existing baseline environment in respect to marine ornithology within a Zone of Influence (ZoI) around relevant elements of the Project. An Ecological Impact Assessment (EcIA) of the potential impacts of construction, operation / repowering, and decommissioning of the Project based on this baseline environment is then provided. This EcIA also considers transboundary impacts and cumulative impacts of existing and proposed projects in respect of marine ornithology.

2. The Project also has the potential to impact terrestrial ecology, marine mammals and fish receptors. These potential impacts are covered in **Chapter 19, Onshore Ecology** (which also covers terrestrial ornithology), **Chapter 9, Benthic and Intertidal Ecology**, **Chapter 10, Fish and Shellfish Ecology** and **Chapter 12, Marine Mammals**. A range of indirect impacts on marine ornithology receptors are possible; information from Chapter 9, Chapter 10 and Chapter 12 has been used to support assessments of those impacts where relevant.

3. This chapter has been prepared by Royal HaskoningDHV, supported by two years of boat-based ornithological surveys undertaken for the Project by Natural Power.

4. A Habitats Regulations Assessment (HRA) has also been compiled separately to determine whether the Project has the potential to have an adverse effect on the integrity and features of Natura 2000 sites (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).

11.2. POLICY, LEGISLATION AND GUIDANCE

11.2.1. Legislation

5. An overview of the relevant legislative context for the Project is provided in **Chapter 2, Policy and Legislation**.

6. Legislation relevant to marine ornithology is identified in **Table 11-1** along with a summary of relevant measures derived from it.

Table 11-1 Summary of Legislation and Relevant Measures

Legislation	Relevant Measures
Birds Directive - Council Directive 2009/147/EC on the Conservation of Wild Birds	This Directive provides a 'General System of Protection' for all species of naturally occurring wild birds in the EU. The most relevant provisions of the Directive are the identification and classification of Special Protection Areas (SPAs) for rare or vulnerable species listed in Annex I of the Directive and for all regularly occurring migratory species (required by Article 4). It also establishes a general scheme of protection for all wild birds (required by Article 5). The Directive requires national Governments to establish SPAs and to have in place mechanisms to protect and manage them. The SPA protection procedures originally set out in Article 4 of the Birds Directive have been replaced by the Article 6 provisions of the Habitats Directive. The UK has triggered article 50 of the Treaty of European Union and is currently in the process of withdrawing from the European Union (EU). Recent UK Government Guidance

Legislation	Relevant Measures
	(September 2018) states that 'The EU Withdrawal Act 2018 will ensure all existing EU environmental law continues to operate in UK law, providing businesses and stakeholders with certainty as we leave the EU.'
Wildlife and Countryside Act 1981, as amended	The Wildlife and Countryside Act 1981 (as amended) is the principal mechanism for the legislative protection of wildlife in Great Britain. It provides protection for all species of wild birds and their nests and establishes the system of Sites of Special Scientific Interest (SSSI).
The Conservation of Habitats and Species Regulations 2017	The Conservation of Habitats and Species Regulations 2017 (hereafter called the 'Habitats Regulations'), transposes the Birds Directive and the Habitats Directive into national law in the onshore environment and territorial waters out to 12 nautical miles, operating in conjunction with the Wildlife and Countryside Act 1981. The Habitats Regulations place an obligation on 'competent authorities' to carry out an appropriate assessment of any proposal likely to affect a SAC or SPA, to seek advice from Statutory Nature Conservation Bodies (SNCBs), in this case Natural Resources Wales (NRW), and to not approve an application that would have an adverse effect on the integrity of a SAC or SPA (except under very tightly constrained conditions).
The Environment (Wales) Act 2016	This Act replaces Section 40 and Section 42 in the Natural Environment and Rural Communities (NERC) Act 2016. It enables the planning and management of Wales' natural resources in a more proactive, sustainable and joined up way. The Section 7 List of Species and Habitats of Principal Importance for Conservation of Biological Diversity in Wales is used as an input to determine the value of marine ornithology receptors.
The Wellbeing of Future Generations (Wales) Act 2015	The Act establishes seven wellbeing goals, the second of which "A resilient Wales" is described as "*A nation that maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change)*."

11.2.2. Guidance

7. The impact assessment has been prepared with reference to the following guidance:

- CIEEM, 2018. Guidelines for Ecological Impact Assessment in the UK and Ireland. CIEEM, Winchester (CIEEM, 2018);
- SNH, 2016. Assessing collision risk between underwater turbines and marine wildlife (Guidance note). Scottish Natural Heritage (SNH, 2016); and
- UK SNCBs, 2017. Joint SNCB Interim Displacement Advice Note: Advice on how to present assessment information on the extent and potential consequences of seabird displacement from offshore wind farm developments (UK SNCBs, 2017).

11.2.3. Policies and Plans

8. National (UK and Wales) planning policy relevant to marine ornithology is identified in **Table 11-2** along with a summary of relevant measures derived from it.

Table 11-2 Summary of National (UK and Wales) Policies, Plans and Relevant Measures

Legislation	Relevant Measures
Overarching National Policy Statement (NPS) for Energy (NPS	Paragraph 5.3.3 states that the Applicant should ensure that the ES clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity.

Legislation	Relevant Measures
EN-1) (July 2011)	Paragraph 5.3.4 states that the Applicant should also show how the proposed Project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests. Paragraph 5.3.18 states that the Applicant should include appropriate mitigation measures as an integral part of the proposed development.
National Policy Statement for Renewable Energy Infrastructure (NPS EN-3) (July 2011)	EN-3, taken together with the Overarching National Policy Statement for Energy (EN-1), provides the primary basis for decisions by the Infrastructure Planning Commission (IPC) on applications it receives for nationally significant renewable energy infrastructure. Paragraph 1.2.2. states that Applicants should, therefore, ensure that their applications and any accompanying supporting documents and information are consistent with the instructions and guidance in this NPS (EN-3), EN-1 and any other NPSs that are relevant to the application in question.
Planning Policy Wales (updated periodically)	The Welsh Government's objectives for conserving and improving the natural environment are: promote the conservation of landscape and biodiversity, in particular the conservation of native wildlife and habitats, ensure that action in Wales contributes to meeting international responsibilities and obligations for the natural environment, ensure that statutorily designated sites are properly protected and managed, safeguard protected species, and promote the functions and benefits of soils, and in particular their function as a carbon store' There is a clear requirement for pre-planning consent consultation with Natural Resources Wales (NRW) where a planning application or proposal may be 'likely to have a significant effect on sites of more than local importance or on a designated area' or would be 'likely to result in disturbance or harm to a protected species.' Pre-application discussions are recommended for any development proposal likely to have an effect on the wildlife of a given area whether designated or not. For example, paragraph 5.5.1 identifies that the effect of a development proposal on the wildlife 'of any area can be a material consideration' and that 'in such instances and in the interests of achieving sustainable development it is important to balance conservation objectives with the wider economic needs of local business and communities.' There is a requirement for development proposals to include reasonable steps to safeguard or enhance the environmental quality of the land should development take place. Planning Policy Wales requires local planning authorities to 'have regard to the relative significance of international, national and local designations in considering the weight to be attached to nature conservation interests and should take care to avoid placing unnecessary constraints on development.' Statutory designations do not necessarily prohibit development taking place, however, paragraph 5.5.5 states that development proposals 'must be carefully assessed for their effect' on the interests for which the designation is made. There is a presumption against development that is likely to damage a SSSI and it is noted that SSSIs can be damaged by developments that lie either within or beyond the SSSI boundaries and that this could be 'some distance away.' There is specific reference to the duty on all public bodies under the Wildlife and Countryside Act 1981 (as amended by the Countryside Rights of Way Act 2000) to further conserve and enhance the features and reasons for a SSSI being of special interest in the exercise of public body functions which includes local planning authorities. Paragraph 5.4.4. acknowledges that non-statutory designations carry less weight than statutory designations and that at a policy level, local authorities are required to be clear that a non-statutory designation does not 'preclude appropriate socio-economic activities' and if certain features or component characteristics of sites specifically need to be conserved and, as such, require additional protection, this should be explained at a policy level. Species protected under European or UK legislation are identified as a material consideration when considering a development proposal where protected species are present and if the development would 'be likely to result in disturbance or harm to the species or its habitat.' The potential need for ecological survey and assessment of likely

Legislation	Relevant Measures
	impact of a proposed development on a protected species to inform planning decisions is highlighted in paragraph 5.5.11.
TAN-5- Nature Conservation and Planning	Technical Advice Note (TAN) 5 supplements Planning Policy Wales and provides advice about how the land use planning system in Wales 'should contribute to protecting and enhancing biodiversity and geological conservation.' The TAN provides guidance to local planning authorities on: 'the key principles of positive planning for nature conservation; nature conservation and Local Development Plans; nature conservation in development management procedures; development affecting protected internationally and nationally designated sites and habitats; and, development affecting protected and priority habitats and species.' In section 2.4 when deciding planning applications that may affect nature conservation, 'local authorities should contribute to the protection and improvement of the environment…seeking to avoid irreversible harmful effects on the natural environment; ensure that appropriate weight is attached to designated sites of international, national and local importance; protect wildlife and natural features in the wider environment, with appropriate weight attached to priority habitats and species in Biodiversity Action Plans; ensure that all material considerations are taken into account and decisions are informed by adequate information about the potential effects of a development on nature conservation; ensure that the range and population of protected species is sustained; and adopt a stepwise approach to avoid harm to nature conservation, minimise unavoidable harm by mitigation measures, offset residual harm by compensation measures and look for new opportunities to enhance nature conservation; where there may be significant harmful effects local planning authorities will need to be satisfied that any reasonable alternative sites that would result in less or no harm have been fully considered.' At section 3.3.2 regarding Local Development Plans policies the guidance states that a policy should be included in respect of the application of the precautionary principle. Section 4 includes specific and detailed guidance, expanding on the principles set out in 2.4, in respect of the development control process including pre-application discussions, preparing planning applications, requests for further information and ecology in respect of EIA. The broad principles of development control requirements are set out as follows: 'adopting the five-point approach to decision-making – information, avoidance, mitigation, compensation and new benefits; ensuring that planning applications are submitted with adequate information, using early negotiation, checklists, requiring ecological surveys and appropriate consultation; securing necessary measures to protect, enhance, mitigate and compensate through planning conditions and obligation; carrying out effective planning enforcement; and identifying ways to build nature conservation into the design of new development.'
Renewable Energy Policy Wales	The 2012 Welsh Government policy document, Energy Wales: A Low Carbon Transition, updated in 2016, outlines the Welsh Government's approach to utilising the marine environment for renewable energy deployment. The Policy includes the following aim: "*we want to carefully plan and manage the relationship between energy development and our natural environment in line with the ambition of 'Sustaining a Living Wales'*."
UK Post-2010 Biodiversity Framework	The 'UK Post-2010 Biodiversity Framework' succeeds the UK Biodiversity Action Plan. The Framework demonstrates how the work of the four countries and the UK contributes to achieving the Aichi Biodiversity Targets, and identifies the activities required to complement the country biodiversity strategies in achieving the targets.
UK Marine Policy Statement (MPS)	New systems of marine planning are being introduced in the UK. The MPS, adopted under section 44 of the Marine and Coastal Access Act 2009, is the framework for developing and implementing regional Marine Plans. It will contribute to the achievement of sustainable development in the United Kingdom marine area. High level objectives are for the protection, conservation and where appropriate recovery of biodiversity; healthy, resilient and adaptable marine and coastal ecosystems across their natural range; and oceans supporting viable populations of representative, rare, vulnerable and valued species.

Legislation	Relevant Measures
Natural Environment White Paper 2011	The paper was the first White Paper produced by the government in 20 years. The paper contains plans to reconnect nature, connect people and nature for better quality of life and capture and improve the value of nature.
A Green Future: Our 25 Year Plan to Improve the Environment 2018	The plan sets out 10 goals and a range of high-level policies aimed at helping "*the natural world regain and retain good health*". The key policies within the plan relevant for this chapter are: Embedding an 'environmental net gain' principle for development, including housing and infrastructure; Protecting and recovering nature (including improving biosecurity to protect and conserve nature).

9. **Table 11-3** sets out the Marine Policy Statement (MPS) and draft Welsh National Marine Plan (WNMP) policies which are particularly relevant to Marine Ornithology.

Table 11-3 National l Policy Requirements Relevant to Marine Ornithology

Policy Description	Reference	ES Reference
MPS		
Renewable energy developments can potentially have adverse impacts on marine fish and mammals, primarily through construction noise and may displace fishing activity and have direct or indirect impacts on other users of the sea, including mariners. Certain bird species may be displaced by offshore wind turbines, which also have the potential to form barriers to migration or present a collision risk for birds. Their foundation designs are likely to have an effect on hydrodynamics and consequent sediment movement. This includes potential scouring of sediments around the bases of turbines. These and other potential adverse impacts, together with potential mitigation measures, are considered in the National Policy Statement for Renewable Energy Infrastructure (EN-3).	Section 3.3.24	Potential impacts of displacement, collision risk and entanglement are discussed in **Sections 11.6.4.2**, **11.6.5.3** and **11.6.5.4.**
Marine energy deployments, that is wave and tidal deployments, may pose potential risks to the environment if inappropriately sited. However, the level of risk and ecological significance is largely unknown since, in particular, tidal stream and wave technologies are at a relatively early stage of development. Studies of tidal range technologies, including barrages, have indicated that these structures can have adverse impacts on migratory fish and bird species and on the hydrodynamics of the estuarine environments in which they are situated. To underpin the marine planning process further research is needed to develop a better understanding of the potential impacts that marine technologies might have on potentially sensitive environmental features. For example, adaptation and mitigation methods for such impacts may be supported by detailed monitoring programmes and co-ordinated research initiatives, including post deployment of devices.	Section 3.3.25	The potential significance of displacement of birds from the Project site is assessed in **Section 11.6.5.1**.
Draft WNMP		
Proposals should demonstrate how they: · avoid adverse impacts on individual Marine Protected Areas (MPAs) and	ENV_02: Marine Protected Areas	The conservation statuses of bird species

Policy Description	Reference	ES Reference
the coherence of the network as a whole; · have regard to the measures to manage MPAs; and · avoid adverse impacts on non-marine designated sites.		present within the MDZ are presented in **Table 11-9**. Information to Support an HRA is provided in **Document MOR/RHDHV/DOC/0067, Information to Support HRA**.
Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01: Cumulative effects	Cumulative impacts are assessed in **Section 11.6.7** and in **Chapter 26**

10. The Project is seeking consent for a Transport and Works Act Order from the Welsh Government and a Marine Licence from Natural Resources Wales (NRW). Although this Project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP), therefore guidance relevant to NSIPs is considered appropriate to use for this Project. Guidance that is relevant to assessing impacts on marine ornithology for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to marine ornithology include:

- Overarching NPS for Energy (EN-1);
- NPS for Renewable Energy Infrastructure (EN-3); and
- NPS for Electricity Networks Infrastructure (EN-5) (DECC, 2011c).

11. Although NPS EN-3 states "*this NPS does not cover other types of renewable energy generation that are not at present technically viable over 50 MW onshore or over 100 MW offshore such as schemes that generate electricity from tidal stream or wave power*", the relevant requirements of EN-3 have been referred to until a revision to this NPS or a separate NPS is provided for tidal range schemes greater than 100 MW.

12. The specific assessment requirements for marine ornithology, as detailed in NPS EN-1 and EN-3, are summarised in **Table 11-4**, together with an indication of the paragraph numbers of the chapter where each is addressed. Where any part of the NPS has not been followed within the assessment, an explanation as to why the requirement was not deemed relevant, or has been met in another manner, is provided.

Table 11-4 NPS EN-1 and EN-3 Assessment Requirements

EN-1 and EN-3 Assessment Requirements	NPS Reference	ES Reference
'Where the development is subject to EIA [Environmental Impact Assessment] the applicant should ensure that the ES [Environmental Statement] clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on	**NPS EN-1 Section 5.3 Paragraph 5.3.3**	**Section 11.6**

EN-1 and EN-3 Assessment Requirements	NPS Reference	ES Reference
protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the Infrastructure Planning Commission (IPC) consider thoroughly the potential effects of a proposed project.'		
'The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests.'	**NPS EN-1 Section 5.3 Paragraph 5.3.4**	**Section 11.6**
'When considering the application, the IPC will have regard to the Government's biodiversity strategy as (sic) set out in 'Working with the grain of nature', which aims to halt or reverse declines in priority habitats and species; accept the importance of biodiversity to quality of life. The IPC will consider this in relation to the context of climate change. As a general principle, and subject to the specific policies below, development should aim to avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives (as set out in section 4.4 above); where significant harm cannot be avoided, then appropriate compensation measures should be sought. In taking decisions, the IPC should ensure that appropriate weight is attached to designated sites of international, national and local importance; protected species; habitats and other species of principal importance for the conservation of biodiversity; and to biodiversity and geological interests within the wider environment.'	**NPS EN-1 Section 5.3 Paragraph 5.3.5-5.3.8**	**Table 11-12**, **Section 11.6**
'The IPC will have the same regard to potential Special Protection Areas (pSPAs) and Ramsar sites as those sites identified through international conventions and European Directives.'	**NPS EN-1 Section 5.3 Paragraph 5.3.9**	**Document MOR/RHDHV/DOC/0067, Information to Support HRA**
'Many SSSIs are also designated as sites of international importance and will be protected accordingly. Those that are not, or those features of SSSIs not covered by an international designation, should be given a high degree of protection.'	**NPS EN-1 Section 5.3 Paragraph 5.3.10**	**Table 11-12**
'Where a proposed development on land within or outside an SSSI is likely to have an adverse effect on an SSSI (either individually or in combination with other developments), development consent should not normally be granted. Where an adverse effect, after mitigation, on the site's notified special interest features is likely, an exception should only be made where the benefits (including need) of the development at this site, clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest and any broader impacts on the national network of SSSIs.'	**NPS EN-1 Section 5.3 Paragraph 5.3.11**	**Table 11-12**, **Section 11.6**
'The IPC will have regard to sites of regional and local biodiversity and geological interest, which include Regionally Important Geological Sites, Local Nature Reserves and Local Sites when considering applications	**NPS EN-1 Section 5.3 Paragraph 5.3.13**	**Table 11-12**, **Section 11.6**

EN-1 and EN-3 Assessment Requirements	NPS Reference	ES Reference
since they are recognised to have a fundamental role in meeting overall national biodiversity targets.'		
The applicant should include appropriate mitigation measures as an integral part of the proposed development and demonstrate that: ▪ During construction, they will seek to ensure that activities will be confined to the minimum areas required for the works; ▪ During construction and operation best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements; ▪ Habitats will, where practicable, be restored after construction works have finished; and ▪ Opportunities will be taken to enhance existing habitats and, where practicable, to create new habitats of value within the site landscaping proposals.	**NPS EN-1 Section 5.3 Paragraph 5.3.18**	**Section 11.6**
'The scope, effort and methods required for ornithological surveys should have been discussed with the relevant statutory advisor'.	**NPS EN-3 Section 2.6 Paragraph 2.6.102**	**Section 11.3**
'Relevant data from operational offshore wind farms should be referred to in the applicant's assessment'.	**NPS EN-3 Section 2.6 Paragraph 2.6.103**	**Section 11.4.2 and 11.4.3**
'It may be appropriate for assessment to include collision risk modelling for certain species of birds. Where necessary, the assessments carried out by applicants should assess collision risk using survey data collected from the site at the pre-application EIA stage. The IPC will want to be satisfied that the collision risk assessment has been conducted to a satisfactory standard having had regard to the advice from the relevant statutory advisor'.	**NPS EN-3 Section 2.6 Paragraph 2.6.104**	**Appendix 11.3 (Volume III)**
'Aviation and navigation lighting should be minimised to avoid attracting birds, taking into account impacts on safety'.	**NPS EN-3 Section 2.6 Paragraph 2.6.107**	**Section 11.6.4 and 11.6.5**
'Subject to other constraints, wind turbines should be laid out within a site, in a way that minimises collision risk, where the collision risk assessment shows there is a significant risk of collision'.	**NPS EN-3 Section 2.6 Paragraph 2.6.108**	**Section 11.6.5.3**
'Construction vessels associated with offshore wind farms should, where practicable and compatible with operational requirements and navigational safety, avoid rafting seabirds during sensitive periods'.	**NPS EN-3 Section 2.6 Paragraph 2.6.109**	**Section 11.6.4. and 11.6.5**
'The exact timing of peak migration events is inherently uncertain. Therefore, shutting down turbines within migration routes during estimated peak migration periods is unlikely to offer suitable mitigation'.	**NPS EN-3 Section 2.6 Paragraph 2.6.110**	**Section 11.6.5.3**

13. The Project onshore electrical infrastructure falls within the Isle of Anglesey County Council local authority boundaries. **Table 11-5** provides details of the local planning policy documents and the relevant policies in respect of marine ornithology.

Table 11-5 Joint Local Development Plan (Anglesey and Gwynedd) Relevant Policy and Guidance Requirements

Policy/Guidance	Policy/Guidance Purpose
Policy ISA 4: Safeguarding Existing Open Space	To protect open spaces as an invaluable amenity resource
Policy AND 3: Other Renewable Energy and Low Carbon Technologies	Proposals for renewable and low carbon energy technologies, other than wind or solar, which contribute a low carbon future will be permitted, provided that the proposal conforms to the following criteria… "All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced".
Strategic Policy PS 19: Conserving and where appropriate enhancing the Natural Environment	The Councils will manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline, and proposals that have a significant adverse effect on them will be refused unless the need for and benefits of the development in that location clearly outweighs the value of the site or area and national policy protection for that site and area in question. When determining a planning application, consideration will need to be given to the following: 1. Safeguard the Plan area's habitats and species, geology, history, the coastline and landscapes; 2. Protect or where appropriate enhance sites of international, national, regional and local importance and, where appropriate, their settings in line with National Policy; 3. Have appropriate regard to the relative significance of international, national or local designations in considering the weight to be attached to acknowledged interests, ensuring that any international or national responsibilities and obligations are fully met in accordance with National Policy; 4. Protect or enhance biodiversity within the Plan area and enhance and/or restore networks of natural habitats in accordance with the Local Biodiversity Action Plans and Policy AMG 5; 5. Protect or enhance biodiversity through networks of green/ blue infrastructure; 6. Safeguard internationally, nationally and locally protected species; 7. Protect, retain or enhance the local character and distinctiveness of the individual Landscape Character Areas (in line with Policy AMG 2) and Seascape Character Areas (in line with Policy AMG 4); 8. Protect, retain or enhance trees, hedgerows or woodland of visual, ecological, historic cultural or amenity value
Policy AMG 4: Coastal Protection	In considering a proposal on the coast, including the Heritage Coast, there will be a need to ensure that the proposal conforms to the following criteria:-… It does not cause unacceptable harm to:.. "the area's biodiversity interests (including European Protected Areas such as marine Special Areas of Conservation and Special Protected Areas) due to their location, scale, form, appearance, materials, noise, or emissions or due to an unacceptable increase in traffic…"
Policy AMG 5: Local Biodiversity Conservation	Proposals must protect and, where appropriate, enhance biodiversity that has been identified as being important to the local area by:

Policy/Guidance	Policy/Guidance Purpose
	Avoiding significant harmful impacts through the sensitive location of development. . Considering opportunities to create, improve and manage wildlife habitats and natural landscape including wildlife corridors, stepping stones, trees, hedges, woodlands and watercourses. A proposal affecting sites of local biodiversity importance will be refused unless they can conform with all of the following criteria:- ▪ That there are no other satisfactory alternative sites available for the development. ▪ The need for the development outweighs the importance of the site for local nature conservation; ▪ That appropriate mitigation or compensation measures are included as part of the proposal. Where necessary, an Ecological Assessment which highlights the relevant local biodiversity issues should be included with the planning application.
Policy AMG 6: Protecting Sites of Regional or Local Significance	Proposals that are likely to cause direct or indirect significant harm to Local Nature Reserves (LNR), Wildlife Sites (WS) or regionally important geological / geomorphologic sites (RIGS) will be refused, unless it can be proven that there is an overriding social, environmental and/or economic need for the development, and that there is no other suitable site that would avoid having a detrimental impact on sites of local nature conservation value or local geological importance. When a development is granted, it will be necessary to ensure that there are appropriate mitigation measures in place. It will be possible to use planning conditions and/or obligations in order to safeguard the site’s biodiversity and geological importance.

11.3. CONSULTATION

14. An extensive consultation process has occurred prior to and during the preparation of this chapter. This is summarised in **Table 11-6**, with greater detail provided in **Table 11-7**.

Table 11-6 Summary of Consultation Responses

Consultee	Date	Document/Meeting	Agenda/Comments
Natural Resources Wales (NRW) and Sea Mammal Research Unit (SMRU)	16/06/2016	Project overview and PDE	Advice fed into production of 2017 scoping report
RSPB (Royal Society for the Protection of Birds)	17/06/2016	Project overview and PDE	Advice fed into production of 2017 scoping report
NRW	02/08/2016	Seabird and marine mammal survey scope	Advice letter fed into development of survey scopes for seabirds and marine mammals
NRW	24/05/2017	Project update and proposed new consenting route	Project update, summary of survey work undertaken to date, no substantive feedback

Consultee	Date	Document/Meeting	Agenda/Comments
RSPB	26/05/2017	Project update and proposed new consenting route	Project update, summary of survey work undertaken to date, no substantive feedback
Isle of Anglesey County Council (IoACC)	14/06/2017	Scoping Opinion	Advice fed into EIA process
Welsh Government (WG)/NRW	11/07/2018	Scoping Opinion	Advice fed into EIA process
NRW	29/09/2017	Update on progress with bird surveys, discussion regarding further survey effort	Feedback built into the EIA approach for **Chapter 11, Marine Ornithology**.
RSPB	13/12/2017	Update on progress with bird surveys	Feedback built into the EIA approach for **Chapter 11, Marine Ornithology**.
RSPB	24/01/2018	Project update	Project update, no substantive feedback

NRW	13/12/2018	TWG First Meeting	Assessment Approach
			▪ Project background (recap)
			▪ Review of project design envelope
			▪ Species, conservation sites and populations to be included
			▪ Appropriate spatial scale for assessment
			▪ Review species parameters and vulnerability by species/group:
			  ▪ Above water
			  ▪ Submerged
			  ▪ Foraging distances
			▪ Approach to CRM/ERM
			  ▪ Appropriate avoidance rates
			▪ Potential Biological Removal
			▪ Approach to assessment / potential impacts
			▪ Cumulative assessment
			▪ Summary

NRW	19/02/2019	TWG Second Meeting	Assessment Parameters ▪ Overview of Collision Risk Modelling (CRM) and Encounter Rate Modelling (ERM): ▪ Methods, limitations, interpretation, role in EIA ▪ Device parameters and overview of modelling scenarios ▪ Bird input parameters (densities and diving behaviour) and sources of information ▪ Avoidance rates

Consultee	Date	Document/Meeting	Agenda/Comments
			▪ Presentation and review of preliminary results ▪ Plans for future work ▪ Obtaining feedback on work already undertaken and planned
RSPB	17/04/2019	RSPB Project update	Key EIA elements presented: ▪ Key species distribution predicted based on baseline surveys and other existing data ▪ Disturbance at breeding sites ▪ Collision – models, parameters, avoidance rates, data sources – No outputs as yet ▪ Population Viability Analysis (PVA) – No outputs as yet ▪ Habitats Regulations Assessment screening – preliminary outcomes only ▪ Terrestrial Ornithology EIA Key points ▪ Chough distribution ▪ Disturbance at breeding sites ▪ HRA screening – preliminary outputs Key marine ornithology impacts covered in call: ▪ Airborne noise and visual disturbance ▪ Disturbance at breeding sites ▪ Collison risk
NRW	03/05/2019	TWG Third Meeting	Updated on: ▪ Device parameters and grouping ▪ ERM/CRM ▪ Apportioning ▪ Non-breeding season guillemot data ▪ Uncertainty around diving behaviour ▪ PVA for razorbill and guillemot ▪ EIA approach update ▪ Airborne noise and visual disturbance ▪ Monitoring approach ▪ HRA ▪ Terrestrial ornithology
RSPB	31/05/2019	RSPB Project update	Issues discussed included: ▪ Deployment strategy ▪ EIA overview ▪ Airborne noise and visual disturbance ▪ Collision risk ▪ PVA ▪ Monitoring post consent

Consultee	Date	Document/Meeting	Agenda/Comments
			▪ HRA ▪ Onshore ornithology ▪ Seascape, Landscape and Visual Impact Assessment (SLVIA)

Table 11-7 Detailed Consultation Responses

Consultee	Date/Document	Comment	Response
NRW	First TWG Meeting December 2018	NRW agrees in principle with the list of species to be included in the assessment, but we would need to see the raw data from the two years' worth of survey undertaken.	Whilst not part of this chapter, this has been issued to NRW for review and included in processed form within **Appendices 11.1 and 11.2** (**Volume III**).
NRW	First TWG Meeting December 2018	We advise that the applicant could also use Wildfowl and Wetlands Trust (WWT) & European Seabirds At Sea (ESAS) combined data set, Future of the Atlantic Marine Environment (FAME), Biologically Defined Minimum Population Scales (BDMPS) and there will be various other papers and data sources available that show the movement of birds from sites.	The full list of data sources used during the assessment is presented in **Section 11.4**.
NRW	First TWG Meeting December 2018	The applicant needs to consider not just HRA issues bit also EIA issues which will include SSSIs and which features are potentially affected	SSSIs are explicitly referred to in **Sections 11.2** and **11.4.4** and where appropriate, care has been taken to appropriately classify the value of such receptors according to this comment.
NRW	First TWG Meeting December 2018	The list of potential impacts seems comprehensive although the potential impact of lighting on seabirds is missing. We recommend that this potential impact is included for assessment.	This has been considered in impact assessments for construction, operation / repowering and decommissioning in **Section 11.6**.
NRW	First TWG Meeting December 2018	Here the applicant produces definitions for magnitude of effect. These may well not be applicable to sites, with magnitude of effect on an SPA being assessed by looking at the conservation objectives and SSSIs being looked at by levels of population for that SSSI. Also, the magnitude of change could well depend on the rarity of the population, in terms of its status in the UK, Europe or world.	The assignment of values of receptors in **Table 11-8** and **Table 11-10** has taken this comment into account.

Consultee	Date/Document	Comment	Response
NRW	First TWG Meeting December 2018	We believe that the mean- maximum distances provided in Thaxter *et al.* (2012) should be used as a coarse screening filter for sites in the breeding season and that data from papers and FAME/STAR should then be used to provide a more detailed look at where the birds come from. Furness (2015) should be used where applicable to try and allocate birds in non-breeding months.	This approach has been used where more recent information was not available. See **Table 11-11**
NRW	First TWG Meeting December 2018	NRW believes that both the Encounter Rate Model (ERM) and the Collison Risk Model (CRM) should be used, similar to the approach being taken for the marine mammal work.	Noted, both models have been utilised within the assessment. These impacts are assessed in **Section 11.6.6.3** and further detail on the methodology is outlined in **Appendix 11.3** (**Volume III**).
NRW	First TWG Meeting December 2018	NRW does not agree with the different groupings and would like to see more groups which may well have a similarity in the collision risk models. For instance, floating devices may have more contact with diving birds as closer to the surface. NRW feels that the groupings need further consideration.	Noted, the categorisation of devices has been updated and is shown in full in **Chapter 4, Project Description**.
NRW	Second TWG Meeting February 2019	The SNH guidance, Page 3; 2.1 Encounter Rate Model; "states that the resulting encounter rate is expressed in terms of number of animals per month or year which would encounter a turbine." Therefore, month should be used.	Both ERM and CRM calculate a number of collisions per second, which can be multiplied up to any time period that requires assessment. To maximise ecological relevance, collision rates are presented for breeding and non-breeding seasons rather than by month.
NRW	Second TWG Meeting February 2019	As stated in the SNH guidance document (2016); page 14, a range of avoidance rates should be applied to the results of both ERM and CRM to generate a range of estimates of potential collision rates. These are advised to be avoidance rates 0 %, 50 %, 90 %, 95 %, 98 % and 99 %.	Noted, the results of the ERM and CRM have been presented against this range of avoidance rates, with a further two added. (see **Section 11.6.6.3**)
NRW	Second TWG Meeting February 2019	Where there isn't adequate data it is ok to use the correction factors in Stone *et al*. (1995)	Noted, Stone et al. (1995) have been used to correct on-sea species densities where relevant, as outlined in **Appendix 11.2** (**Volume III**).

Consultee	Date/Document	Comment	Response
NRW	Second TWG Meeting February 2019	However, we would like to see information concerning the model selection and also, as stated above, the applicant needs to consider and show how availability bias and watch time has been used.	Noted, information on the methodology is presented in **Appendix 11.3** (**Volume III**).
NRW	Second TWG Meeting February 2019	Could the Guillemot and Razorbill be divided out before the distance analysis and then the correction factors for the area be used? This work should then be worked up into monthly/seasonal population estimates, for the entire development zone plus the buffer explaining how this was extrapolated from the densities and look at how the heterogeneity in densities may affect the estimate.	Area-specific correction factors have been used to generate densities for the entire development zone and 2 km buffer by relevant biological season for guillemot, razorbill and herring gull. These are presented in **Appendix 11.2** (V**olume III**), along with confidence intervals. Other species were not recorded sufficiently frequently during surveys to enable this to occur, so generic correction factors have been used instead.
NRW	Second TWG Meeting February 2019	As stated previously, the applicant has left out a number of significantly large colonies for various species including some SSSIs. They will not be able to allocate birds to colonies until they have done a thorough review of this looking at the up to date data on the Seabird Monitoring Programme (SMP).	This comment has been addressed; see apportioning in **Table 11-11**.
NRW	Second TWG Meeting February 2019	This vulnerability for Manx shearwater was worked out before Shoji's paper showed that Manx shearwaters do dive to greater depths than thought previously and therefore it should be considered to have a higher sensitivity than "Low".	Manx shearwaters have been classified as having medium sensitivity with respect to collision risk (**Section 11.6.6.3.2**).
NRW	Second TWG Meeting February 2019	In terms of the CRM and ERM is the applicant looking at the density of gannets from flight (as gannets most often dive from flight for food) or from birds on the water, or a mixture of both?	Flying densities have been used for ERM/CRM for gannet.
NRW	Third TWG Meeting May 2019	NRW advise that the applicant needs to look not just at Minesto but all other plans or projects that could have an additive effect on a site.	All appropriate plans and projects have been included in **Section 11.6.8**.
NRW	Third TWG Meeting May 2019	Avoidance rates will be presented using the range outlined in SNH (2016).	Noted, the results of the ERM and CRM have been presented against this range of avoidance

Consultee	Date/Document	Comment	Response
		Outcomes of PVA indicate that avoidance of 99% and higher will be important based upon PVA for guillemot and razorbill. For other species lower values are indicated.	rates (see **Section 11.6.6.3**). PVA is included in **Appendix 11.3** (**Volume III**).
NRW	Third TWG Meeting May 2019	NRW requested that all sites should be screened in initially and taken through to AA.	The HRA is presented in **Document MOR/RHDHV/DOC/0067** (**Information to Support HRA**).
NRW	Third TWG Meeting May 2019	NRW raised the potential for active sonar to be used and advise that the applicant needs to consider whether other monitoring could also be available to be used.	A deployment and monitoring strategy will be produced for consultation with the SNCBs.
NRW	Third TWG Meeting May 2019	RHDHV confirmed that an AA will be carried out for chough.	The HRA is presented in **Document MOR/RHDHV/DOC/0067** (**Information to Support HRA**).
Planning Inspectorate	Scoping Report 2018	In accordance with Rule 16 of the EIA Regulations, the ES should provide a description of the likely significant transboundary effects, where relevant.	This is included within **Section 11.7**.
Planning Inspectorate	Scoping Report 2018	It is recommended that the Applicant makes efforts to agree the relevant study areas with NRW and that they are appropriate to ensure any likely significant effects are identified in the ES.	These have been agreed with NRW throughout the TWG meetings.
Planning Inspectorate	Scoping Report 2018	There are number of errors in the Table 8-1 including incorrectly named designated sites and features. The Applicant should ensure that any such errors are omitted from information in the ES. There are a greater number of designated sites listed in Table 8-1 of the Scoping Report than shown on Figure 8-1. The ES should include figures identifying the location of all designated sites discussed in the text and also identify the distance of the designated sites from the Proposed Works	This has been incorporated into this chapter and the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).
Planning Inspectorate	Scoping Report 2018	The potential impacts are duplicated in Table 8-2, although do not always correlate with the potential impacts identified in Table 8-1 (e.g. effects of lighting are noted in Table 8-1 but not Table 8-2). Where relevant the Applicant should ensure consistency between information presented in the ES.	The full list of potential impacts for marine ornithology are presented in **Section 11.6.2**.

Consultee	Date/Document	Comment	Response
Planning Inspectorate	Scoping Report 2018	The ES should provide details of any models used, the input parameters and any assumptions made in the models. Any guidance used to inform the assessment should be detailed within the ES.	A detailed assessment methodology has been presented.
Planning Inspectorate	Scoping Report 2018	Cumulative impacts should be assessed for all aspect chapters where significant effects are likely to occur.	Cumulative impacts for marine ornithology are presented in **Section 11.6.8**.
Planning Inspectorate	Scoping Report 2018	It is recommended that the other projects to be included within the cumulative assessment are discussed, and ideally agreed, with relevant consultees.	The list of projects included within the CIA are available within **Section 11.6.8**.
Planning Inspectorate	Scoping Report 2018	Although produced for Nationally Significant Infrastructure Projects, the Applicant is advised to utilise the approach set out in Planning Inspectorate Advice Note Seventeen: Cumulative effects assessment.	The methodology for CIA in terms of marine ornithology receptors is presented in **Section 11.6.8**.
NRW (for PINS)	Scoping Report 2018	It is important that there is distinction between the EIA and HRA processes; however, the information contained within the ES may be of relevance and may be used within the HRA. We therefore recommend that the ES should include a section containing 'information to inform the HRA'.	This comment has been noted. However, as HRA and EIA issues are distinctly different for the Project, no such section has been incorporated into the ES chapter or wider ES.
NRW (for PINS)	Scoping Report 2018	Without wishing to prejudice the HRA or consenting process, a package of measures that would avoid or mitigate the effects of the proposal and avoid adverse effects on the integrity of European protected sites would appear challenging to achieve in this instance. If this is the case it may be necessary to consider the proposal under Regulation 64 of the above regulations, where the possibility of alternatives to the proposal that would not give rise to adverse effects on the integrity of European protected sites are considered.	The HRA demonstrates that no adverse effect on the integrity of the relevant designated sites is predicted (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**)
NRW (for PINS)	Scoping Report 2018	In our previous EIA scoping responses to Anglesey County Council and NRW's Marine Licensing Team we stated that we agreed with the designated sites, species and receptors identified within section 7 of the scoping report (table 8.1 in current EIA scoping report) to be included within the EIA and HRA. We noted that the Anglesey Terns SPA was not included within the scoping report and	Noted, these errors have been corrected and Anglesey Tern SPA has been assessed in detail within the HRA process (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). The qualifying species of this SPA are of low sensitivity to the

Consultee	Date/Document	Comment	Response
		should be considered as part of any subsequent ES. Table 8.1 has since been changed and now contains numerous errors. We strongly advise that these are rectified prior to the submission of any ES.	Project, though are considered within the EIA.
NRW (for PINS)	Scoping Report 2018	A number of the designated sites included in table 8.1 (and throughout the report) are incorrectly named and there are several examples of duplication, possibly stemming from the fact that some sites have both a Welsh and an English name. Where sites are duplicated, such as is the case for Llyn Dinam SAC, Glannau Ynys Gybi/Holy Island Coast SPA, Glannau Rhoscolyn/Rhoscolyn Coast SSSI and Porth Diana SSSI to name a few, differing (conflicting) levels of potential impacts are often reported.	These errors have been corrected.
NRW (for PINS)	Scoping Report 2018	The 'features' column text for the Anglesey Terns SPA in table 8.1 suggests a single island colony, however, please note that the site comprises 3 separate breeding colonies and extensive areas of surrounding sea. The numbers of breeding pairs provided for the site should be checked for accuracy.	This detail is included within the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).
NRW (for PINS)	Scoping Report 2018	The new power station at Wylfa is mentioned in relation to potential onshore cumulative impacts (see section 10.1.2). We advise that offshore aspects of the power station also need to be considered, including HNP's plans for sediment and rock disposal at Holyhead Deep (this is in addition to the existing use of the disposal ground from Holyhead Port), increased boat traffic / shipping movements and biosecurity. It should also be noted that the HNP Wylfa Newydd development will mostly sit adjacent to the existing power plant rather than use the same site footprint.	Noted, however, due to the suspension of the Wylfa Newydd project, this has not been considered within the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). Should further updates become available, this will be revisited.
NRW (for PINS)	Scoping Report 2018	It's important to note that, in addition to inter-project effects outlined in Section 10, intra-development effects, where multiple development elements have the potential to impact the same receptor, need to be considered throughout the relevant ES chapters and wider EIA process.	Noted, such effects on marine ornithology have been considered in **Section 11.8**.
IACC 2017	Scoping Report 2018	The list of projects to be assessed in terms of cumulative and in-	Noted, the list of projects to be considered for

Consultee	Date/Document	Comment	Response
		combination impacts appears limited. The EIA should consider an agreed list of proposals at an agreed cut-off date before submission of the planning application.	ornithology for CIA are presented in **Section 11.6.8**, and an in-combination assessment has been completed as part of the HRA process (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).
IACC 2017_Revised Scheme	Scoping Report 2018	The proposed development is intended to be located in a sensitive area from the perspective of landscape and biodiversity with a number of European and nationally delegated areas either covering or adjacent to the application site. The whole of the application site is contained within the North Anglesey Marine SAC and Anglesey Terns SPA with the landfall site contained within the Holy Island SSSI. As such, any development proposed in this area must have regard to the sensitive environment and must therefore provide sufficient mitigation where impacts are identified.	The impacts of the Project on these designated sites is presented within this chapter and the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).
NRW	Scoping Report 2018	Guidance provided to the applicant by NRW Technical Experts (TE) to assist with scoping the proposal and EIA does not appear to have been fully used to inform all aspects of the EIA scoping report. We also note that the scoping report has not drawn upon information collated within the Crown Estate’s plan level Habitats Regulation Appraisal for their 2013/14 wave and tidal leasing round. NRW TE has previously provided a guidance note to you on how we considered that this information could be used at an individual demonstration zone level.	Updated guidance provided within the TWG meetings has been used to inform this chapter of the ES. The HRA takes into consideration the plan level HRA compiled on behalf of the Crown Estate (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).
NRW	Scoping Report 2018	We draw your attention to the requirement of Article 6 of Schedule 3 of the MWR which requires you to consider the potential transboundary effects of the project.	Noted, these effects have been considered within **Section 11.7**.
NRW	Scoping Report 2018	In Table 8.2 the potential for underwater noise to directly disturb seabird and diving bird interest features should be assessed in the ES.	Noted, this is not expected to be a critical impact, but is covered within **Section 11.6**.

Consultee	Date/Document	Comment	Response
NRW	Scoping Report 2018	The cumulative assessment should include other proposed and existing Marine Licence applications such as disposal at Holyhead North disposal site. Information on marine licence applications can be found on the Welsh Government Marine Planning Portal or downloaded from Lle. The assessment should also include developments allocated within the statutory development plan, proposals in the ANOB management plan and in the draft Wales National Marine Plan (each of which is supported by an Environmental Report and Habitats Regulations Assessment). Regard should also be given to Natural Resources Wales' emerging Area Statements (Marine and North-West Wales Areas), when published.	Noted, a list of all projects and planned considered within the CIA for marine ornithology is included in **Section 11.6.8**.
NRW	Scoping Report 2018	The consideration of underwater noise cumulative effects should include activities in the wider area, such as navigation and fishing, as well as any other project developments.	Underwater noise from the Project alone was assessed to have negligible impact significance, and was therefore screened out of CIA.
NRW	Scoping Report 2018	It should be noted that the Habitats Regulations Assessment for the Draft Welsh National Marine Plan, which was published in December 2017, was unable to rule out Adverse Effect on Integrity for multiple SPA, SAC and Ramsar sites and features. These conclusions should be taken into account when screening relevant plans or projects under the Habitats Regulations that could have an in-combination effect on those sites and when considering cumulative and synergistic effects under the Environmental Impact Assessment and Strategic Environmental Assessment Regulations.	This has been taken into account during the preparation of the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).
Planning Inspectorate	Scoping Report 2018	The ES should detail the foraging distances used for migratory species, along with references to justify the distances used.	A range of literature has been utilised for the purpose of identifying the likely origin of birds recorded during baseline surveys (**Table 11-11**)

Consultee	Date/Document	Comment	Response
Planning Inspectorate	Scoping Report 2018	Displacement from vicinity of turbine: Table 8-9 of the Scoping Report states that displacement is expected to be both minor and localised, however the report also acknowledges a "lack of understanding on whether operation / repowering of devices cause displacement". The ES should therefore provide further justification to support the conclusions reached. If necessary, further assessment should be undertaken to ensure the validity of the findings. The potential indirect effects from displacement should also be assessed in the ES e.g. energy expenditure from species avoiding the area.	Displacement due to tidal devices is considered in detail in relation to available evidence, and is expected to be minimal (**Section 11.6.6.1**)
Planning Inspectorate	Scoping Report 2018	Statements such as "these species are relatively tolerant of vessel activity" should be corroborated by relevant evidence.	Evidence is provided throughout **Section 11.6**.
Planning Inspectorate	Scoping Response 2018	The ES should consider and assess any potentially significant indirect effects on ornithological receptors, including those resulting from impacts to prey species.	This is covered for construction, operational / repowering and decommissioning Project phases within **Section 11.6**
NRW (for PINS)	Scoping Response 2018	We recommend that the applicant first reviews available baseline data to ascertain which species have been found within the areas of sea/coastal areas potentially affected. For the offshore areas this may include ESAS data (ESAS/WWT in the past).	A full list of the baseline information utilised to inform the assessment of the Project on marine ornithology is presented in **Section 11.5.**
NRW (for PINS)	Scoping Response 2018	We advise that the mean maximum foraging ranges detailed within Thaxter et al (2012) are utilised to determine which breeding colonies could be affected by the proposed development, with particular emphasis on colonies that are features of SPAs and SSSIs. There is no mention of Skomer and Skokholm SPA and the Glannau Aberdaron and Ynys Enlli / Aberdaron Coast and Bardsey Island SPA, for example, designated for Manx shearwater. We would welcome a map which shows the seabird features of designated sites within mean maximum foraging range of the proposed demonstration zone.	This reference has been used, along with others, in assessing the potential origin of marine ornithology receptors (**Table 11-11**).
NRW (for PINS)	Scoping Response 2018	The ES should consider the potential for displacement of food sources from the area in addition to displacement of birds themselves; to date the EIA	This is covered for construction, operational / repowering and decommissioning Project

Consultee	Date/Document	Comment	Response
		scoping report has not addressed this point.	phases within **Section 11.6**.
RSPB	Scoping Response 2018	We note the reference to Thaxter *et al* (2012) who initially set the standard of mean-maximum foraging ranges based on seabird tracking data. However, updated foraging distances are now available and greater than those used by Thaxter. These derive from the Future of the Atlantic Marine Environment (FAME) and Seabird Tracking and Research (STAR) projects. We recommend that reference be made to the FAME/STAR data	This reference has been used, along with others, in assessing the potential origin of marine ornithology receptors (**Table 11-11**).
RSPB	Scoping Response 2018	We understand the on-going offshore ornithological surveys follow an adapted ESAS methodology for tidal development sites. It would be helpful to get confirmation of the distance sampling correction method to deal with reduced visibility of diving birds further from the boat transects. In particular, if there is the intention to use program Distance (or similar) to correct the estimates of density of birds on the water. There is potential to supplement the above information with the use of GPS tags, applied to target species. This technology which has been trialled at a number of seabird colonies in the UK can incorporate remote download systems and thus remove the need to recapture birds.	Full details of the baseline data collection is presented in **Appendix 11.1** (**Volume III**). Distance sampling was carried out using program Distance 7.2. GPS tagging data was not used during baseline data collection. However, tracking data and associated publications have been used in the assessment where relevant.
RSPB	Scoping Response 2018	The potential impact of collision risk between diving birds and moving parts of devices is mentioned in the document. We consider that this operational risk needs further consideration through robust collision risk modelling. Guidance is available from SNH and we would recommend that further advice be sought from NRW on this matter.	ERM and CRM have been used within the assessment, as detailed in **Section 11.6.6.3** and **Appendix 11.3** (**Volume III**).

Consultee	Date/Document	Comment	Response
RSPB	Scoping Response 2018	The scope of the Cumulative Impact Assessment is project focused, although the temporal or 'time frame' boundary is not clearly defined. We recommend the scoping should include developments allocated within the statutory development plan, proposals in the ANOB management plan and in the draft Wales National Marine Plan (each of which is supported by an Environmental Report and Habitats Regulations Assessment). Regard should also be had to Natural Resources Wales' emerging Area Statements (Marine and North-West Wales Areas).	The full list of projects considered within the CIA for marine ornithology are presented in **Section 11.6.8.**
NRW	Scoping Response 2018	There is no mention in the scoping report of potential disturbance and displacement effects of underwater noise on seabird and diving bird species as a result of the project.	Noted. This is not expected to be a critical impact but is covered within **Section 11.6** for marine ornithology and **Chapter 12, Marine Mammals**.
IoACC	Scoping Response 2017	Anglesey Terns SPA was not included in the Scoping Report and should be considered as part of subsequent planning application, along with other identified sites	Anglesey Terns SPA has been considered within the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**), and the qualifying features are considered within the EIA as appropriate.
IoACC	Scoping Response 2017	Consider impact on protected species and demonstrate will not impact on Favourable Conservation Status of European and Nationally protected species Propose and deliver appropriate mitigation /compensation schemes to ensure favourable conservation status.	The HRA demonstrates that no adverse effect on the integrity of the relevant designated sites is predicted (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**)
NRW	Scoping Response 2015	Proposed developments likely to significantly affect European Sites (Special Areas of Conservation (SACs), Special Protection Areas (SPAs), either alone or in combination with other plans or Projects, require special consideration by the Competent Authority (typically the licensing authority) under Regulation 61 of the Habitats Regulations. As a matter of Government policy, the same applies to Ramsar sites.	The HRA demonstrates that no adverse effect on the integrity of the relevant designated sites is predicted (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).

Consultee	Date/Document	Comment	Response
NRW	Scoping Response 2015	The HRA is a two stage process, the first stage being a 'Test of Likely Significant Effect' to establish whether the proposals are likely to result in significant effects on any European sites (and Ramsar sites). If this establishes that significant effects are likely, or there is uncertainty whether significant effects are likely to result, then an appropriate assessment of the effects of the activity in view of the conservation objectives of the site(s) is required. The HRA also needs to consider in-combination effects of the proposed Project with other projects.	For full details of the HRA Screening and Appropriate Assessment, where relevant, see the Project HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).
NRW	Scoping Response 2015	It is difficult to determine from the information provided in the scoping report the potential impacts and the significance of potential impacts, for protected sites. The EIA should concentrate on impacts both direct and indirect on marine and coastal sites and those adjacent to the cable route and any land-based infrastructure.	The full list of potential impacts on marine ornithology are presented in **Section 11.6.2**.
NRW	Scoping Response 2015	The scoping report appears to have gone beyond the stated 50km area of search by including seabird SPAs as far as Pembrokeshire. We agree that these SPAs should be included as they are within the mean maximum foraging range of some of the classified features, especially gannet (640km) and Manx shearwater (400km).	The full list of the potential origin of marine ornithology receptors is presented in **Table 11-11**, and the European sites included in the HRA is presented in that document (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).
NRW	Scoping Response 2015	Within Table 7.1 Habitats Directive sites in Ireland and also in other areas around the Irish Sea are not mentioned in the table. In view of the international nature of the Habitats Directive, designated sites in other countries should also be considered.	The full list of the potential origin of marine ornithology receptors is presented in **Table 11-11**, which includes SPAs from the Republic of Ireland. The list of European sites included in the HRA is presented in that document (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).
NRW	Scoping Response 2015	The largest guillemot colony in North Wales, namely Carreg y Llam SSSI has been omitted from the list of protected sites. This SSSI with its notified feature of breeding guillemot should be added for consideration.	This site has not been included in the baseline environment, because the latest information on the at-sea distribution of guillemots and razorbills

Consultee	Date/Document	Comment	Response
			(Cleasby *et al*., 2018) indicates that 100 % of birds at the site of the Project originate from the South Stack and Penlas Seabird Monitoring Programme Master Site sub-colonies.
NRW	Scoping Response 2015	The EIA should include assessment of the potential for birds to collide with structures that are lit at night	Noted, this is not expected to be a critical impact, but is covered within **Section 11.6.5.1.3**.
NRW	Scoping Response 2015	We consider that the use of boat-based surveys would enable true densities of seabirds to be ascertained to enable accurate predictions of impact to satisfy the requirements of both EIA and HRA.	Boat-based surveys were carried out monthly for two years, as detailed in **Appendix 11.1** (**Volume III**).
NRW	Scoping Response 2015	In the first row of Potential Impacts Table 7.8, we consider that there is also potential for birds to impact structures in normal flight at night or (especially) in strong winds/ storms. This potential impact should be included in the EA.	This impact pathway has not been screened into the EIA as there is no evidence that suggests marine ornithology receptors would be susceptible to collisions in flight with the surface elements of tidal device.
NRW	Scoping Response 2015	Key areas of concern for ornithology which must be assessed in the EIA include: ▪ Collision risk ▪ Disturbance/Habitat Exclusion/Displacement ▪ Sedimentary Processes and Pollution ▪ Indirect impacts (i.e. to birds, fish and marine mammals due to habitat loss for prey, depletion, displacement or aggregation of prey)	A full list of the potential impacts considered for marine ornithology is presented in **Section 11.6**, and includes all these areas of concern.
NRW	Scoping Response 2015	RSPB research into potential effects of wave and tidal stream devices on birds recommends that, due to the paucity of systematic data, the longevity of birds, inter-annual and weather dependant variations, at least two years of pre-application data are collected, covering all seasons and including both breeding and non-breeding populations.	Boat-based surveys were carried out monthly for a two year period, as detailed in **Appendix 11.1** (**Volume III**).

Consultee	Date/Document	Comment	Response
NRW	Scoping Response 2015	We recommend early engagement with all of those organisations with an interest in ornithology to gain advice on survey methods.	Details of consultation undertaken is presented in this section of the chapter.
NRW	Scoping Response 2015	There is potential not only to mitigate for the adverse impacts of the development, but also to enhance the biodiversity of the development site and its vicinity. This should be addressed in the ES. Mitigation/enhancement measures if required could include: ▪ Time-related restrictions on construction, in relation to nesting periods. ▪ The use of sympathetic land management	Where required, mitigation is presented in **Section 11.6**.

11.4. METHODOLOGY

11.4.1. Study Area

15. The study area for the boat-based bird surveys (**Section 11.4.3**), was the Morlais Demonstration Zone (MDZ) plus a 2 km buffer, including the Export Cable Corridor (ECC) (**Appendix 11.1, Volume III**). This reflects the fact that most effects that occur during the construction, operation / repowering and decommissioning of the Project will be localised in nature, with the ZoI of the majority of effects predicted to occur within the MDZ and ECC.

16. For breeding seabirds, mean maximum foraging ranges (Thaxter et al., 2012) were used to identify the colonies that birds recorded within the MDZ and 2 km buffer during the boat-based bird surveys could have originated from. For birds recorded outside their respective breeding seasons (**Table 11-9**), when many species of seabird disperse and/or migrate from their breeding colonies, Furness (2015) was used to identify the populations from which individuals recorded during surveys at this time of year originated.

11.4.2. Data Sources – Desk Study

17. A desk study has drawn on both peer reviewed scientific literature and “grey literature” such as project submissions and reports. It includes information on seabird ecology and distribution, and the potential impacts of tidal stream development on marine ornithology. The key topics for which the literature has been examined include (but are not limited to):

- Bird population estimates (Banks et al., 2007; Frost et al., 2018; Furness, 2015; Musgrove et al., 2011; NRW, 2015a; O’Brien et al., 2010; Perrins et al., 2012; Stroud et al., 2016; Wernham et al., 2002);
- Bird ecology (Coulson, 2011; Cramp, 1985; Cramp and Simmons, 1983, 1977; Dean, 2012; Furness et al., 2018; Harris and Wanless, 2011; Robinson, 2019; Thaxter et al., 2010);

- Bird distribution, foraging and migration (Cleasby et al., 2018; Clewley et al., 2017; Cox et al., 2016; Dean et al., 2012, 2015; Frederiksen et al., 2012b; Guilford et al., 2008; Hobson and Welch, 1992; Oppel et al., 2018; Perrow et al., 2011; Schwemmer and Garthe, 2008; Shoji et al., 2015; Thaxter et al., 2012; Wakefield et al., 2013, 2017; Wernham et al., 2002; Wilson et al., 2014);
- Bird diving behaviour (including nocturnal activity) (Cox et al., 2016; Garthe et al., 2000; MBIEG, 2019; Regular et al., 2010, 2011; Robbins, 2017; Shoji et al., 2016, 2015; Thaxter et al., 2009); and
- Potential impacts of marine development on birds (APEM, 2017; Dierschke et al., 2016; Furness et al., 2012; Furness and Wade, 2012; Garthe and Hüppop, 2004; Gill et al., 2018; Harwood et al., 2017; Leopold et al., 2013; MMO, 2018; Vallejo et al., 2017; Vanermen et al., 2015).

18. Information on statutory sites and their interest features has been drawn from the web-based resource Multi-Agency Geographic Information for the Countryside (MAGIC).

11.4.3. Data Sources – Site-Specific Surveys and Reports

19. Two years of baseline seabird surveys of the MDZ and 2 km buffer were undertaken between November 2016 and October 2018. This comprised of 24 surveys which provided coverage of all ecological seasons.

20. Surveys were undertaken by means of boat-based visual surveys, using a transect method. Thirteen parallel transects were followed on all surveys. The survey methodology was based on published guidance (Camphuysen et al., 2004).

21. Full details of the survey programme and the data collected are available in **Appendix 11.1** (**Volume III**). Density estimates derived from these surveys that are used in the assessment are available in **Appendix 11.2** (**Volume III**).

11.4.4. Impact Assessment Methodology

22. The generic methodology utilised for impact assessment in this chapter is described in detail in **Chapter 5, EIA Methodology**. Where required, the methodology has been adapted to make it more specific to marine ornithology receptors and aligned with the key guidance document produced for the impact assessment of ecological receptors (CIEEM, 2018).

23. The impact assessment uses the “source-pathway-receptor” model. The model identifies likely environmental impacts resulting from the proposed construction, operation /repowering and decommissioning of the offshore infrastructure associated with the Project. This process provides a transparent impact assessment route between impact sources and potentially sensitive receptors. The parameters of this model are defined as follows:

    - Source – the origin of a potential impact (noting that one source may have several pathways and receptors) e.g. an activity such as cable installation and a resultant effect such as re-suspension of sediments;
    - Pathway – the means by which the effect of the activity could impact a receptor e.g. for the example above, re-suspended sediment could settle and smother the sea bed; and

- Receptor – the element of the receiving environment that is impacted e.g. for the above example, bird prey species living on or in the sea bed are unavailable to foraging birds.

24. The information presented in **Table 11-8** has been used to determine the importance of marine ornithology receptors recorded in the MDZ and 2 km buffer, and where relevant, the breeding colonies or other populations from which these receptors may originate.

Table 11-8 Definitions of Receptor Importance Levels for Marine Ornithology Receptors

Importance Level	Definition
High	A regularly occurring, nationally significant population / number of any internationally or nationally important species Internationally protected species (e.g. listed on Annex I of the Birds Directive) that are listed as a qualifying interest feature of an internationally protected site An internationally designated site (SPA and/or Ramsar site) or candidate site or an area (e.g. pSPA or dSPA)
Medium	Species which are regionally important or internationally rare Species listed on Section 7 List of Species of Principal Importance for Wales Species on Birds of Conservation Concern (BoCC) Red List (Eaton et al., 2015) A nationally designated site (SSSI)
Low	Species which are locally important or nationally rare Species on BoCC Amber List (Eaton et al., 2015) Species that are occasionally recorded within the study area in low numbers compared to other regions
Negligible	Species which are not considered to be particularly important or rare Species that are infrequently recorded within the study area in very low numbers compared to other areas or regions

25. There are no further deviations from the methodology described in **Chapter 5, EIA Methodology**.

11.5. EXISTING ENVIRONMENT

11.5.1. Species Recorded

26. In total, 34 species of bird were recorded within the MDZ and 2 km buffer during the boat-based surveys, of which 16 were seabirds recorded on the sea and in flight. These were Arctic tern *Sterna paradisaea*, Atlantic puffin *Fratercula arctica* (“puffin”), black-headed gull *Chroicocephalus ridibundus*, black-legged kittiwake *Rissa tridactyla* (“kittiwake”), common gull *Larus canus*, common tern *Sterna hirundo*, great black-backed gull *Larus marinus*, common guillemot *Uria aalge* (“guillemot”), herring gull *Larus argentatus*, lesser black-backed gull *Larus fuscus*, Manx shearwater *Puffinus puffinus*, northern fulmar *Fulmarus glacialis* (“fulmar”), northern gannet *Morus bassanus* (“gannet”), razorbill *Alca torda*, red-throated diver *Gavia stellata* and shag *Phalacrocorax aristotelis*. In addition, one seaduck species was recorded on the sea and in flight; eider *Somateria mollissima*.

27. There were a further five species of seabird recorded in flight only. These were cormorant *Phalacrocorax carbo*, Mediterranean gull *Larus melanocephalus*, great skua *Stercorarius skua*, sooty shearwater *Puffinus griseus* and Sandwich tern *Thalasseus sandvicensis*, along with a single species of seaduck; common scoter *Melanitta nigra*.

28. Great skua and sooty shearwater have been scoped out of further assessment. These species were observed on a single survey each across 24 boat-based surveys, and this, along with the fact that these species are not known to breed or winter in the area in which the Project is situated (Stroud et al., 2016), means that they will not be susceptible to impacts during the construction, operation / repowering or decommissioning of the Project.

29. There were a further 11 bird species recorded during the boat-based surveys that were recorded in flight only, irregularly, and are not species that would be routinely expected to utilise the subtidal habitat within the MDZ or 2 km buffer in the course of their normal behaviour. These are seven species of passerine, house martin *Delichon urbicum*, meadow pipit *Anthus pratensis*, pied wagtail *Motacilla alba*, redwing *Turdus iliacus*, starling *Sturnus vulgaris*, swallow *Hirundo rustica* and sand martin *Riparia riparia*, one species of swan, whooper swan *Cygnus cygnus*, one species of raptor, peregrine *Falcus peregrinus* and two species of wader, dunlin *Calidris alpina* and whimbrel *Numenius phaeopus*. All of these species are excluded from further assessment as they are not considered to be sensitive to impacts due to the construction, operation / repowering or decommissioning of the Project.

30. The remaining species (the marine ornithology receptors) will be assessed for impacts due to the construction, operation / repowering and decommissioning of the Project as they are considered to be at potential risk either due to their abundance or potential sensitivity to the predicted impacts.

11.5.2. Marine Ornithology Receptors Breeding and Non-Breeding Seasons

31. Impacts on the marine ornithology receptors have been assessed in relation to relevant biological seasons (Furness, 2015). These include overlapping months in some instances due to variation in the timing of migration for birds which breed at different latitudes (i.e. individuals from breeding sites in the north of the species' range may still be on spring migration when individuals farther south have already commenced breeding). For each species, the assessment of impacts in different seasons used the full "breeding" and "non-breeding" periods listed in **Table 11-9**.

Table 11-9 Definition of the Breeding, Migration and Winter Seasons for Marine Ornithology Receptors included in the EcIA, as per Furness (2015) unless otherwise stated

Species	Breeding	Migration-free breeding	Migration - autumn	Migration-free winter	Migration - spring	Non-breeding
Arctic tern	May-early Aug	June	Jul-early Sept	Oct-Mar	Apr-May	Sept-Apr
Black-headed gull (Cramp and Simmons, 1983)	-	Apr-Aug	-	-	-	Sept-Mar
Common gull (Cramp and Simmons, 1983)	-	Apr-Aug	-	-	-	Sept-Mar
Common scoter (Cramp and Simmons, 1977)	May-Aug	-	-	-	-	Sept-Apr
Common tern	May-Aug	Jun-mid Jul	Late Jul-early Sept	Oct-Mar	Apr-May	Sept-Apr

Species	Breeding	Migration-free breeding	Migration - autumn	Migration-free winter	Migration - spring	Non-breeding
Cormorant	-	Apr-Aug	-	-	-	Sept-Mar
Eider (Cramp and Simmons, 1977)	Apr-Jun	-	-	-	-	Jul-Mar
Fulmar	Jan-Aug	Apr-Aug	Sep-Oct	Nov	Dec-Mar	Sept-Dec
Gannet	Mar-Sept	Apr-Aug	Sept-Nov	-	Dec-Mar	Oct-Feb
Great black-backed gull	Late Mar-Aug	May-Jul	Aug-Nov	Dec	Jan-Apr	Sept-Mar
Guillemot	Mar-Jul	Mar-Jun	Jul-Oct	Nov	Dec-Feb	Aug-Feb
Herring gull	Mar-Aug	May-Jul	Aug-Nov	Dec	Jan-Apr	Sept-Feb
Kittiwake	Mar-Aug	May-Jul	Aug-Dec	-	Jan-Apr	Sept-Feb
Lesser black-backed gull	Apr-Aug	May-Jul	Aug-Oct	Nov-Feb	Mar-Apr	Sept-Mar
Manx shearwater	Apr-Aug	Jun-Jul	Aug-early Oct	Nov-Feb	Late Mar-May	Sept-Mar
Mediterranean gull (assumed as per black-headed gull)	-	Apr-Aug	-	-	-	Sept-Mar
Puffin	Apr-early Aug	May-Jun	Late Jul-Aug	Sept-Feb	Mar-Apr	Mid Aug-Mar
Razorbill	Apr-Jul	Apr-Jun	Aug-Oct	Nov-Dec	Jan-Mar	Aug-Mar
Red-throated diver	Mar-Aug	May-Aug	Sept-Nov	Dec-Jan	Feb-Apr	Sept-Feb
Sandwich tern	Apr-Aug	June	Jul-Sept	Oct-Feb	Mar-May	Sept-Mar
Shag	Feb-Aug	Mar-Jul	Aug-Oct	Nov	Dec-Feb	Sept-Jan

11.5.3. Marine Ornithology Receptors Conservation Status

32. The conservation status of the identified marine ornithology receptors is summarised in **Table 11-10**.

Table 11-10 Conservation Status of Marine Ornithology Receptors Recorded in the MDZ and 2 km Buffer to be Considered by EcIA

	Conservation status				
Species	**Annex 1 (EU Birds Directive)**	**Schedule 1 (Wildlife & Countryside Act)**	**BoCC Amber (Eaton et al. 2015)**	**BoCC Red (Eaton et al. 2015)**	**Section 7 (Environment (Wales) Act)**
Arctic tern	✓		✓		
Black-headed gull			✓		✓
Common gull			✓		
Common scoter		✓		✓	✓
Common tern	✓		✓		
Cormorant					
Eider			✓		
Fulmar			✓		
Gannet			✓		

	Conservation status				
Species	**Annex 1 (EU Birds Directive)**	**Schedule 1 (Wildlife & Countryside Act)**	**BoCC Amber (Eaton et al. 2015)**	**BoCC Red (Eaton et al. 2015)**	**Section 7 (Environment (Wales) Act)**
Great black-backed gull			✓		
Guillemot			✓		
Herring gull				✓	✓
Kittiwake				✓	
Lesser black-backed gull			✓		
Manx shearwater			✓		
Mediterranean gull	✓	✓	✓		
Puffin				✓	
Razorbill			✓		
Red-throated diver	✓	✓			
Sandwich tern			✓		
Shag				✓	

11.5.4. Species Densities

33. Species densities and 90 % confidence intervals for breeding and non-breeding seasons (**Table 11-9**) are presented in **Appendix 11.2** (**Volume III**). These were calculated using Distance correction (Buckland et al., 2001) for those species where the numbers of observations made this possible; guillemot, razorbill and herring gull. For species where this was not possible, generic published corrections to account for missed birds were applied (Stone et al., 1995). Any observations made to group level (e.g. auk species for guillemot and razorbill) were proportionally allocated to a species.

11.5.5. Connectivity of Breeding and Wintering Sites to MDZ

34. Sites which may have connectivity to the MDZ and ECC include colonies supporting breeding seabirds and coastal and/or marine bird interests, which are typically overwintering aggregations.

35. For the breeding period (**Table 11-9**), the potential for connectivity to known breeding populations has been considered. Published mean maximum foraging distances (Thaxter et al., 2012) have been used in conjunction with data from the Seabird 2000 and Seabird Monitoring Programme (SMP) databases (JNCC, 2018, 2010) to identify colonies that are within the mean maximum foraging range of the MDZ/ECC. For some species for which hundreds (or more) of small breeding locations within the mean maximum foraging range are known (e.g. herring gull), the search for breeding locations was restricted to the Gwynedd area. Where relevant, other datasets have also been consulted to provide further insight into the distribution of foraging seabirds at sea. In particular, work concerning the at-sea distributions of four species (guillemot, razorbill, kittiwake and shag) (Cleasby et al., 2018; Wakefield et al., 2017) is considered the best available information for these species and is used to assess connectivity in preference to other methods where clear associations to particular colonies were detected in the datasets. Published methodology on apportioning (SNH, 2018) has also been used where appropriate to

estimate the proportions of species recorded in the MDZ likely to originate from particular breeding colonies.

36. **Table 11-11** provides an overview of this information for the marine ornithology receptors. The location of designated sites relative to the MDZ is shown on **Figure 11-1** (**Volume II**).

Table 11-11 Marine Ornithology Receptors and their Possible Origin

Species	Breeding (B) or Non-breeding (NB)	Site of Origin	Approximate % of MDZ population from site	Justification
Arctic tern	B	Anglesey Terns SPA	100	(JNCC, 2018, 2010; Thaxter et al., 2012)
Black-headed gull	B/NB	Non-designated local population	100	-
Common gull	B/NB	Non-designated local population	100	-
Common scoter	NB	Non-designated local population	100	(Natural England and Countryside Council for Wales, 2010)
Common tern	B	Anglesey Terns SPA	100	(JNCC, 2018, 2010; Thaxter et al., 2012)
Cormorant	B/NB	Non-designated local population	100	-
Eider	NB	Non-designated local population	100	-
Fulmar	B	South Stack and Penlas SMP sub-colonies	66.27	(JNCC, 2018, 2010; Thaxter et al., 2012)
		Other colonies (<1 % of birds in MDZ per colony)	33.73	
	NB	UK Western Waters plus Channel BDMPS	100	(Furness, 2015)
Gannet	B	Grassholm SPA	54.15	(JNCC, 2018, 2010; SNH, 2018; Thaxter et al., 2012)
		Ailsa Craig SPA	34.08	
		Scare Rocks SSSI	5.04	
		Saltee Islands SPA	3.62	
		Ireland's Eye SPA	3.11	
Great black-backed gull	B	Puffin Island SSSI	71.15	(JNCC, 2018, 2010; Ratcliffe et al., 2000; SNH, 2018)
		South Stack and Penlas SMP sub-colonies	9.76	
		The Skerries SSSI	5.75	
		Valley Wetlands	5.05	
		Other colonies (<3 % of birds in MDZ per colony)	8.29	

Species	Breeding (B) or Non-breeding (NB)	Site of Origin	Approximate % of MDZ population from site	Justification
	NB	Southwest and Channel BDMPS	100	(Furness, 2015)
Guillemot	B	South Stack and Penlas SMP sub-colonies	100	(Cleasby et al., 2018; Wakefield et al., 2017), Ornithology TWG pers. comm
	NB	UK Western Waters BDMPS	100, of which more than published % likely to be from South Stack and Penlas SMP sub-colonies	(Furness, 2015), Ornithology TWG pers. comm.
Herring gull	B	South Stack and Penlas SMP sub-colonies	77.92	(SNH, 2018; Thaxter et al., 2012)
		The Skerries	9.48	
		Other colonies (<5 % of birds in MDZ per colony)	12.60	
	NB	UK Western Waters BDMPS	100	(Furness, 2015)
Kittiwake	B	Lambay Island SPA	16.20	(SNH, 2018; Thaxter et al., 2012)
		Howth Head Coast SPA	12.68	
		Ynys Moelfre	12.19	
		Carreg y Llam SSSI	11.94	
		Bray Head North	10.84	
		Great Orme's Head SSSI	7.98	
		St Tudwal's Islands SSSI	5.76	
		Orme's Head SSSI	5.05	
		Other colonies (<5 % of birds in MDZ per colony)	17.35	
Lesser black-backed gull	B	South Stack and Penlas SMP sub-colonies	30.49	(JNCC, 2018, 2010; SNH, 2018; Thaxter et al., 2012)
		Ynys Traws	27.79	
		The Skerries	15.38	
		Ribble and Alt Estuaries SPA	9.06	
		Puffin Island	5.18	

Species	Breeding (B) or Non-breeding (NB)	Site of Origin	Approximate % of MDZ population from site	Justification
		Other colonies (<5 % of birds in MDZ per colony)	12.10	
Manx shearwater	B	Skomer, Skokholm and the Seas off Pembrokeshire SPA	55.88	(JNCC, 2018, 2010; SNH, 2018; Thaxter et al., 2012)
		Aberdaron Coast and Bardsey Island SPA	41.56	
		Other colonies (<1 % of birds in MDZ per colony)	2.55	
Mediterranean gull	B/NB	Non-designated local population	100	-
Puffin	B	South Stack and Penlas SMP sub-colonies	80.90	(JNCC, 2018, 2010; SNH, 2018; Thaxter et al., 2012)
		Gwylan Islands SSSI	12.03	
		Bardsey Island SSSI	2.61	
		Other colonies (<1 % of birds in MDZ per colony)	4.46	
Razorbill	B	South Stack and Penlas SMP sub-colonies	100	(Cleasby et al., 2018; Wakefield et al., 2017), Ornithology TWG pers. comm
	NB	UK Western Waters BDMPS	100, of which more than published % likely to be from South Stack and Penlas SMP sub-colonies	(Furness, 2015), Ornithology TWG pers. comm.
Red-throated diver	NB	Non-designated local population	100	(Natural England and Countryside Council for Wales, 2010; NRW, 2015b)
Sandwich tern	B	Anglesey Terns SPA	100	(Thaxter et al., 2012)
Shag	B	South Stack and Penlas SMP sub-colonies	100	(Cleasby et al., 2018; Wakefield et al., 2017)
	NB	SW England and Wales BDMPS	100	(Furness, 2015)

11.5.6. Anticipated Trends in Baseline Condition

37. The two key drivers of seabird population size and trends in western Europe are climate change (Burthe et al., 2014; Frederiksen et al., 2012a, 2004; JNCC, 2016; Sandvik et al., 2012, 2005), and fisheries activities (Carroll et al., 2017; Foster et al., 2017; Frederiksen et al., 2004;

Sydeman et al., 2017; Tasker et al., 2000). Pollutants including oil, persistent organic pollutants, plastics, alien mammal predators at colonies, disease, and loss of nesting habitat also affect seabird populations, but are generally much less important and often more local factors (JNCC, 2016; Votier et al., 2008, 2005).

38. Trends in breeding seabird populations and colonies are generally better known and understood than trends in numbers and distribution at sea. Breeding numbers are regularly monitored at many UK seabird colonies (JNCC, 2018), and in the British Isles there have been three comprehensive censuses of breeding seabirds (Mitchell et al., 2004), with a fourth census ongoing 2015-2019. Breeding numbers of many seabird species in the British Isles are declining, especially in the northern North Sea (Foster and Marrs, 2012; JNCC, 2016; MacDonald et al., 2015). In Wales, populations of many seabird species have seen stable or increasing trends, including guillemot, razorbill, puffin, Arctic tern and Sandwich tern (Bladwell et al., 2018). However, declines have been measured in Wales for other species, such as common tern, kittiwake, shag and gannet.

39. Climate change is likely to be the strongest influence on seabird populations in coming years, with anticipated deterioration in conditions for breeding and survival for most species of seabirds (Burthe et al., 2014; Capuzzo et al., 2017; MacDonald et al., 2015). Further declines in numbers of many UK seabird populations are therefore anticipated in the short, medium and long term under a scenario with continuing climate change due to increasing levels of greenhouse gases in the atmosphere.

40. In general, important prey fish stock for seabirds during the breeding season have been depleted by high levels of fishing effort (Lindegren et al., 2018). It is possible that differences in the levels of fishing activity, and/or the slightly different prey items favoured by some species in different locations around the UK has enabled some populations to continue to expand whilst others have declined (Anderson et al., 2014), though the mechanisms controlling population growth and decline are complex and likely influenced by a combination of many factors.

41. Fisheries management will have a strong influence on future seabird populations. The Common Fisheries Policy (CFP) Landings Obligation ("discard ban") will further reduce food supply for scavenging seabirds such as great black-backed gull, lesser black-backed gull, herring gull, fulmar, kittiwake and gannet (Bicknell et al., 2013; Foster et al., 2017; Votier et al., 2013). Other recent changes in fisheries management that aid recovery of predatory fish stock biomass are likely to further reduce food supply for seabirds that feed primarily on small fish such as sandeels, which are a key prey item of a range of predatory fish (Frederiksen et al., 2007; MacDonald et al., 2015).

42. The following paragraphs briefly consider the possible impacts of these factors on some of the marine ornithology receptors.

43. Fulmars, terns, common guillemot, razorbill and puffin appear to be highly vulnerable to climate change, and this, coupled with increasing pressure on the habitats favoured by such species, means that numbers are likely to decline over the coming decades (Burthe et al., 2014). Declines in shag numbers are likely to continue as they are adversely affected by climate change, and will also suffer due to low abundance of prey species and especially by stormy and wet weather

conditions in winter which are predicted to increase as a result of climate change (Burthe et al., 2014; Frederiksen et al., 2008).

44. Most red-throated divers and common scoters wintering in the western British Isles originate from breeding areas at high latitudes in Greenland (Furness, 2015), which may possibly decrease in future if warming conditions make other more northern areas more favourable as a wintering area for those species so that they do not need to migrate as far as UK waters.

45. Future decreases in kittiwake breeding numbers are likely to be particularly pronounced, as it has been demonstrated that kittiwakes are very sensitive to climate change (Carroll et al., 2015; Frederiksen et al., 2012a), and to fishery impacts on sandeel stocks near breeding colonies (Carroll et al., 2017; Frederiksen et al., 2004). The species will also lose the opportunity to feed on fishery discards as the discard ban comes into effect.

46. It is likely that further redistribution of breeding herring gulls and lesser black-backed gulls will occur into urban environments (Rock and Vaughan, 2013), although it is unclear how the balance between terrestrial and marine feeding by these gulls may alter over coming years.

47. Gannet numbers may continue to increase as they have in many parts of the UK over recent years, but evidence suggests that this increase is slowing (Murray et al., 2015), and it is therefore likely that numbers may peak in the near future. In Wales, declines are already apparent (Bladwell et al., 2018). While the fisheries discard ban will reduce discard availability to gannets in European waters, in recent years increasing proportions of adult gannets have wintered in west African waters rather than in UK waters, possibly because there are large amounts of fish discarded by west African trawl fisheries and decreasing amounts available in the North Sea (Garthe et al., 2012; Kubetzki et al., 2009). The apparent flexible behaviour and diet of gannets may reduce their vulnerability to changes in fishery practices or to climate change impacts on fish communities relative to other seabird species.

48. Some anthropogenic impacts on seabirds are amenable to effective mitigation (Brooke et al., 2017; Ratcliffe et al., 2009), but the scale of efforts to reduce these impacts on seabird populations has been small by comparison with the major influences of climate change and fisheries. The conclusion must therefore be that with the possible exception of gannet, numbers of almost all other seabird species across many areas of the UK will most likely be on a downward trend over the next few decades, due to population declines, redistributions, or a combination of both.

49. The EcIA of marine ornithology receptors is therefore carried out against a wider backdrop of recent declining baseline populations of a number of receptor species on a national and international level, with further declines expected in the years to come. Marine ornithology receptors that have experienced growing or stable populations in recent years are viewed by the assessment as possibly being more robust to predicted impacts. Where a receptor species is declining, the assessment considers whether a given impact is likely to exacerbate a decline in the relevant reference population and prevent a receptor species from recovery should environmental conditions become more favourable. For example, seabird populations around much of the UK are expected to experience food shortages due to depletion of fish stocks in the future, potentially affecting the robustness of those populations to environmental change.

50. Climate change has been identified as the strongest influence on future seabird population trends. In this context it is noted that a key component of global strategies to reduce climate change is the development of low-carbon renewable energy developments such as tidal stream energy.

11.5.7. Assignment of Value to Marine Ornithology Receptors

51. The information described above has been used to assign an importance level to each marine ornithology receptor species according to criteria outlined in **Table 11-8** This is presented in **Table 11-12**.

Table 11-12 Importance Levels Assigned to Marine Ornithology Receptors for Project EcIA

Species	Importance Level Assigned
Arctic tern	High
Common tern	
Gannet	
Guillemot	
Kittiwake	
Manx shearwater	
Puffin	
Razorbill	
Sandwich tern	
Black-headed gull	Medium
Common scoter	
Herring gull	
Lesser black-backed gull	
Red-throated diver	
Shag	
Common gull	Low
Cormorant	
Fulmar	
Great black-backed gull	
Mediterranean gull	
Eider	Negligible

11.6. IMPACT ASSESSMENT

11.6.1. Introduction

52. The following assessment provides details of all direct and indirect impacts identified during scoping and those which have been noted as the EIA has progressed. Impacts have been assessed within the stage of the Project at which they will occur (construction, operation / repowering and decommissioning).

53. At the beginning of each section relating to a particular impact pathway, pertinent information and assumptions relating to this impact which have been taken from **Chapter 4, Project Description**, are presented.

11.6.2. Embedded Mitigation

54. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible.

55. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process (see **Chapter 4, Project Description** for further details). A range of different information sources has been considered as part of embedding mitigation into the design of the project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

56. Embedded mitigation relevant to Marine Ornithology is as follows;

- The PDE for tidal devices defined using parameters available from established tidal device technologies, which has been assumed will be developed sufficiently for commercial use at time of deployment. These have been incorporated in the modelling outlined in **Section 11.6.6.3**.

11.6.3. Overview of Potential Impacts

57. Potential impacts to be included within the EcIA have been agreed through consultation on a Ornithological Assessment Approach document with NRW during Ornithology TWG meetings. They are as follows:

- During the construction, and installation phase:
    1. Direct effects due to airborne noise and visual disturbance and displacement to birds in and immediately adjacent to the MDZ due to installation of tidal device foundations and hubs (due to activities such as drilling, or installation of anchors or gravity base structures), construction activities (e.g. activities such as seabed preparation, inter array, export, and cable tail installation and protection), and vessel activity;
    2. Direct effects due to disturbance and displacement at breeding sites (e.g. by vessels moving to and from the site, along the routes of export cables and tails, and near the export cable landfall itself);
    3. Indirect effects due to changes in prey availability (due to underwater noise resulting in disturbance, temporary loss of seabed habitat due to increased suspended sediment concentrations and sediment re-deposition, or permanent loss due to installation of seabed mounted devices and other infrastructure); and
    4. Direct and indirect effects due to changes in water quality (due to increased suspended sediments, or accidental release of contaminants from vessels).
- During the operation and maintenance (O&M) and repowering phase:
    5. Direct effects due to airborne noise and visual disturbance and displacement to birds in and immediately adjacent to the MDZ due to maintenance and repowering

activities (e.g. activities such as cable reburial and additional cable protection), vessel activity and operational tidal devices (including the presence of artificial lighting during darkness);

6. Indirect effects due to changes in prey availability (due to underwater noise resulting in disturbance and displacement, temporary loss of seabed habitat due to increased suspended sediment concentrations and sediment re-deposition underwater noise, disturbance and displacement, loss of seabed habitat, introduction of hard substrate such as foundations, cable and scour protection, or changes to water quality and electromagnetic fields;
7. Direct and indirect effects due to changes in water quality (due to increased suspended sediments, or any accidental release of contaminants from tidal devices or vessels);
8. Direct effects due to collision risk with tidal devices; and
9. Direct effects due to entanglement with tidal devices or the moorings associated with them.

- During the decommissioning phase:

10. Impacts comparable to those listed for the construction and installation phase are anticipated.

58. It should be noted that due to the nature of the Project, construction and operation / repowering phases will overlap much of the time during the lifespan of the Project, meaning that potential impacts could be additive. This has been accounted for by the assessment.

11.6.4. Impacts Screened Out

59. A number of potential impacts were considered for inclusion in the impact assessment but were screened out on the basis that no impacts will occur on marine ornithology receptors. A summary justification is provided in the following paragraphs.

60. Direct impacts due to habitat loss following the installation of tidal devices will occur. However, the extent of direct habitat loss is typically likely to be very low in comparison to the foraging range of the marine ornithology receptors (Cleasby et al., 2018; Oppel et al., 2018; Thaxter et al., 2012). Any direct impact on marine ornithology receptors is considered to be imperceptible and this impact is therefore screened out.

61. Direct impacts due to underwater noise during construction and operation / repowering have been screened out of the assessment. Percussive piling will not be used any stage of the Project in the marine environment, and there is no suggestion from other marine projects that the levels of noise produced by other activities which may occur during the Project could produce sufficient underwater noise to result in impacts on marine ornithology receptors.

62. Barrier effects relating to offshore wind farms and birds in flight has been studied in detail (Dierschke et al., 2016; Masden et al., 2010, 2009). Because the vast majority of infrastructure associated with the Project will occur underwater, and any floating devices will only protrude a maximum of six metres from the surface of the sea (as opposed to 100 m+ in the case of offshore

wind farms), it is not predicted that the Project will cause barrier effects on marine ornithology receptors.

11.6.5. Potential Impacts During Construction and Installation

11.6.5.1. Airborne Noise and Visual Disturbance / Displacement

11.6.5.1.1. Introduction

63. The construction and installation phase of the Project has the potential to affect marine ornithology receptors through disturbance and displacement due to airborne noise and visual disturbance, leading to displacement of birds from subtidal construction sites.

64. Any impacts resulting from this impact pathway would be spatially restricted to subtidal areas within close proximity to the activities, and temporally restricted to the duration of construction activity.

65. Impacts are based on the following predicted average levels of vessel activity, although there will variations in the level of effort over the period of works beyond the average:

- 1 x vessel group in Abraham's Bosom area (ECC) installing cable tails; one-off event of 20 days per cable, up to nine cables, assuming no more than one cable installation per year;
- 1 x vessel group in ECC installing export cables; up to nine events (one per cable) of 20 days each (simultaneous with cable protection installation); assuming no more than one cable installation per year;
- 1 x vessel group in ECC installing export cable protection; up to nine events (one per cable) of 12 days each (simultaneous with export cable installation); assuming no more than one cable installation per year;
- 1 x vessel group in MDZ installing inter-array cables; approximately 111 days per year for ten years;
- 1 x vessel group in MDZ installing hubs; active anywhere in MDZ for up to 180 days per year for up to ten years; and
- 2 x vessel groups in MDZ installing devices; active anywhere in MDZ all year round.

66. Based on information provided in **Chapter 4, Project Description**, it is assumed that up to four vessels or groups of vessels operating in close proximity to one another, could be present within the MDZ at any one time. In the ECC, it is predicted that a maximum of three groups of vessels could be present at any time. As a worst case, the EcIA assumes activity to be continuous because seabed drilling at night during construction and installation is possible.

67. As activities are expected to occur in the MDZ for much of the 37 year lifespan of the Project, this impact is considered to consist of a large number of short term, temporary and reversible impacts over an overall time period which is defined as long term.

68. As activities are expected to occur in the ECC for a small number of days each year, for up to a maximum of ten years, this impact is considered to consist of a modest number of short term, temporary and reversible impacts over an overall time period which is defined as medium term.

11.6.5.1.2. Receptor Sensitivity

69. There is substantial interspecific variation in the sensitivity of marine ornithology receptors to airborne noise and visual disturbance stimuli. In order to focus the assessment, a detailed literature review was carried out regarding susceptibility to disturbance and displacement, which fed into a screening exercise to identify those species most likely to be at risk (**Table 11-13**).

Table 11-13 Screening Exercise Undertaken for Potential Disturbance and Displacement Impacts During Construction of the Project

Species	Sensitivity to Disturbance and Displacement[1]	Screening Result (In or Out)	Justification
Arctic tern	Low	Out	Low susceptibility to disturbance
Black-headed gull	Low	Out	Low susceptibility to disturbance
Common gull	Low	Out	Low susceptibility to disturbance
Common scoter	Very High	Out	Only recorded occasionally (5/24 surveys), always in flight, and usually in coastal locations
Common tern	Low	Out	Low susceptibility to disturbance
Cormorant	High	Out	Only recorded occasionally (2/24 surveys) in very low numbers, always in flight
Eider	Unknown	Out	Recorded on only one baseline survey
Fulmar	Low	Out	Low susceptibility to disturbance
Gannet	Low	Out	Low susceptibility to disturbance
Great black-backed gull	Low	Out	Low susceptibility to disturbance
Guillemot	Medium	In	Potentially susceptible to disturbance and abundant in MDZ; screened in
Herring gull	Low	Out	Low susceptibility to disturbance
Kittiwake	Low	Out	Low susceptibility to disturbance
Lesser black-backed gull	Low	Out	Low susceptibility to disturbance
Manx shearwater	Low	Out	Low susceptibility to disturbance
Mediterranean gull	Low	Out	Low susceptibility to disturbance
Puffin	Medium	In	Potentially susceptible to disturbance and abundant in MDZ; screened in
Razorbill	Medium	In	Potentially susceptible to disturbance and relatively abundant; screened in
Red-throated diver	Very High	In	Recorded infrequently (8/24 surveys) and in low numbers but screened in on a precautionary basis due to sensitivity to impact
Sandwich tern	Low	Out	Low susceptibility to disturbance
Shag	Medium	In	Recorded infrequently (8/24 surveys) and in low numbers but screened in on a

Species	Sensitivity to Disturbance and Displacement[1]	Screening Result (In or Out)	Justification
			precautionary basis due to sensitivity to impact
Notes [1]based on information contained in literature			

70. Based on information from the literature review, there is potential for disturbance and displacement of guillemot, puffin, razorbill, red-throated diver and shag. All other marine ornithology receptors have been assigned a "negligible" sensitivity level according to the definitions in **Chapter 5, EIA Methodology**.

71. Guillemot and razorbill both fall into the "medium" sensitivity category with respect to disturbance and displacement by boat and helicopter traffic (Bradbury et al., 2014; Furness et al., 2013, 2012; Garthe and Hüppop, 2004). Puffin is considered slightly less sensitive than guillemot and razorbill, and shag slightly more sensitive, whilst red-throated diver is considered to be very sensitive (Furness et al., 2013, 2012; Garthe and Hüppop, 2004).

72. On this basis, the following sensitivities to this impact pathway have been allocated according to the definitions in **Chapter 5, EIA Methodology**:

- **Medium** for red-throated diver and shag;
- **Low** for guillemot, puffin and razorbill; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

11.6.5.1.3. Magnitude of Impact

73. Various papers have presented scoring systems for disturbance factors applied to seabird species for offshore wind farms (Furness et al., 2013; Furness and Wade, 2012; Garthe and Hüppop, 2004) and other marine energy developments (Furness et al., 2012). The approach uses information in the scientific and 'grey' literature, as well as expert opinion to identify disturbance ratings for individual species (of which much evidence relate to disturbance from vessel activities), alongside scores for habitat flexibility and conservation importance. These factors were used to define an index value that highlights the sensitivity of a species to disturbance and displacement. In the case of several of these examples, extensive peer-review on the initial ratings was employed to ensure that consensus from the wider ornithological research community was reached.

74. Studies examining the effects of the construction and operation / repowering of a range of offshore wind farms (APEM, 2017; Dierschke et al., 2016; Gill et al., 2018; Leopold et al., 2013; Vallejo et al., 2017; Vanermen et al., 2015) have been consulted to assess potential disturbance and displacement impacts, along with a wider review of the impact of a range of marine activities (MMO, 2018).

75. Rather than resulting in direct harm to the bird and loss from the population, disturbance and displacement by airborne noise and visual disturbance will result in affected birds temporarily

redistributing at sea and moving to an area where they are undisturbed, with birds expected to return to the area once activities have ceased.

76. Lighting of construction sites, vessels and other structures at night may potentially be a source of attraction (phototaxis), for some species, or displacement in others. The areas affected would be very small and restricted to subtidal construction areas; for this reason, it is considered that in general, the marine ornithology receptors would be insensitive to this impact. Phototaxis can be a serious hazard for fledglings of some seabird species, predominantly shearwaters (Deppe et al., 2017; Raine et al., 2007; Rodríguez et al., 2017, 2014), but occurs over short distances (typically hundreds of metres) in response to bright white light close to breeding colonies, and once a year when fledglings are departing their breeding colonies. Construction sites associated with the Project would be far enough removed from any Manx shearwater breeding colonies (approximately 45 km) for as to render the likelihood of this impact occurring negligible.

77. The levels at which this impact could result in direct mortality to these species has been quantitatively assessed based on a method advocated for displacement by offshore wind farms (UK SNCBs, 2017), using the maximum recorded MDZ densities in relevant seasons presented in **Appendix 11.2** (**Volume III**). The use of maximum recorded densities ensures that this is a worst case, highly precautionary approach to the assessment of this impact.

78. On a highly precautionary basis, it is predicted that guillemot, puffin and razorbill on the sea may be disturbed or displaced from an area within 300 m of each group of construction vessels, shags on the sea from 500 m of each group of construction vessels, and red-throated divers on the sea from 2 km of each group of construction vessels. These distances are based upon the following sources: professional judgement; information on the numbers of birds recorded on the sea in the vicinity of the survey vessel during baseline surveys both here and at many projects elsewhere (i.e. within 300 m); and published literature on disturbance (Camphuysen et al., 2004; Furness et al., 2013, 2012).

79. The method of the UK SNCBs (2017) requires that estimates of % displacement from the disturbance zone and % of mortality within displaced birds are made. The assessment has been based on recent estimates used during the assessment of impacts for offshore wind farms (e.g. the East Anglia TWO offshore wind farm, (Scottish Power Renewables, 2019)), adjusted to account for the differing scale and likely impact magnitude of the activities occurring during the construction of the Project, which will utilise smaller vessels than the offshore wind projects, and will not utilise percussive piling. When selecting these values, the fact that there is existing vessel traffic using the MDZ (**Chapter 15, Shipping and Navigation**) and the wider area, which based on the results of the baseline surveys (**Appendices 11.1 and 11.2, Volume III**) and latest colony counts and population trends in the local area (JNCC, 2018), does not appear to result in high seabird mortality, has also been considered.

80. **Table 11-14** presents the average numbers of birds within the total displacement zone of four groups of construction vessels, based on maximum single density recorded in the MDZ and 2 km buffer zone for the relevant season (**Table 11-9**), along with the selected displacement and mortality values.

Table 11-14 Numbers of Species Screened into Disturbance and Displacement Assessment that will Occur Within Construction Vessel Disturbance Zone, Assuming Seven Groups of Vessels on Site Simultaneously, Based on Maximum Densities in MDZ and 2 km Buffer (MDZ only for guillemot and razorbill), and % Displacement and Mortality Values Used for Assessment

Species	Disturbance distance (km)	Birds in disturbance zone (breeding)	Birds in disturbance zone (non-breeding)	% of birds in disturbance zone displaced	% of mortality in displaced birds
Guillemot	0.3	100.10	13.16	30-70	0-5
Puffin	0.3	0.77	0	30-70	0-5
Razorbill	0.3	12.19	8.92	30-70	0-5
Red-throated diver	2	24.01		100	0-5
Shag	0.5	2.12	0	60-100	0-5

81. Total levels of seabird mortality anticipated as a result of airborne noise and visual disturbance during the construction of the Project in both the MDZ and ECC are presented in **Table 11-15**.

82. During the breeding season (**Table 11-9**), mortality due to displacement is predicted only for guillemot, a maximum of 4 birds at 70 % displacement and 5 % mortality. Outside the breeding season (**Table 11-9**), mortality is predicted only for red-throated diver (a maximum of 1 bird at 100 % displacement and 5 % mortality) due to this impact pathway.

Table 11-15 Anticipated Seabird Mortality Levels Predicted Due to Airborne Noise and Visual Disturbance in the MDZ and ECC During Construction of the Project (based on parameters presented in Table 11-14)

Species	Mortality in a single breeding season	Mortality in a single non-breeding season
Guillemot	0-4	0
Puffin	0	0
Razorbill	0	0
Red-throated diver	0	1
Shag	0	0

83. Due to the very low levels of mortality predicted as a result of airborne noise and visual disturbance during construction in the MDZ and ECC, an impact magnitude of **Low negative** is considered appropriate for guillemot, with a **Negligible** impact magnitude considered appropriate for all other species.

11.6.5.1.4. Impact Significance

84. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Minor adverse** for guillemot; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull puffin, razorbill, red-throated diver, Sandwich tern and shag.

11.6.5.2. Disturbance at Breeding Sites

11.6.5.2.1. Introduction

85. The construction phase of the Project has the potential to affect marine ornithology receptors at nearby breeding colonies due to airborne noise and visual disturbance caused by vessels laying inter array cables and export cables working within the MDZ, and vessels working in the ECC, where array export cables will be installed. Part of the ECC is within the Abraham's Bosom bay, which is where the Project export cable tails will be installed, and the cables will make landfall. There is also potential for disturbance to occur at breeding locations due to airborne noise and visual disturbance from terrestrial and intertidal based activities at the landward side of the cable landfall.

86. Any impacts from cable laying activities (both subtidal and at the landward (including intertidal) side of the landfall) would be will be spatially restricted to areas within close proximity to the activities, and temporally restricted to the duration of construction activity.

87. Impacts are based on the following predicted levels of vessel activity:

- 1 x vessel group in Abraham's Bosom area (ECC) installing cable tails; one-off event of 20 days per cable, up to nine cables, assuming no more than one cable installation per year;
- 1 x vessel group in ECC installing export cables; up to nine events (one per cable) of 20 days each (simultaneous with cable protection installation); assuming no more than one cable installation per year;
- 1 x vessel group in ECC installing export cable protection; up to nine events (one per cable) of 12 days each (simultaneous with export cable installation); assuming no more than one cable installation per year;
- 1 x vessel group in MDZ installing inter-array cables; approximately 111 days per year for ten years;
- 1 x vessel group in MDZ installing hubs; active anywhere in MDZ for up to 180 days per year for up to ten years; and
- 2 x vessel groups in MDZ installing devices; active anywhere in MDZ all year round.

88. Based on information provided in **Chapter 4, Project Description**, it is assumed that up to four vessels or groups of vessels operating in close proximity to one another, could be present within the MDZ at any one time. In the ECC, it is predicted that a maximum of three groups of vessels could be present at any time. As a worst case, the EcIA assumes activity to be continuous because seabed drilling at night during construction and installation is possible.

89. As activities are expected to occur in the MDZ for much of the 37 year lifespan of the Project, this impact is considered to consist of a large number of short term, temporary and reversible impacts over an overall time period which is defined as long term.

90. As activities are expected to occur in the ECC for a small number of days each year, for up to a maximum of ten years, this impact is considered to consist of a modest number of short term, temporary and reversible impacts over an overall time period which is defined as medium term.

91. For the purposes of this assessment it is assumed that terrestrial and intertidal works at the landward side of the landfall could occur during a period of 18 months. All landfall locations (**Chapter 4, Project Description**) are in excess of 500 m from the nearest seabird colony (Abraham's Bosom).

11.6.5.2.2. Receptor Sensitivity

92. There are a wide range of disturbance and/or standoff distances for seabird colonies in published literature, including a standoff distance of 180 m for mixed tern/skimmer colonies disturbed by pedestrians and boats (Rodgers Jr. and Smith, 1995), a maximum flight initiation distance of 78 m for yellow-legged gull colonies to pedestrian approach (Martinez-Abrain et al., 2008), and a 100 m standoff distance between tern colonies and motor boats (Burger, 1998). A mixed colony of fulmars, shags, herring gulls, kittiwakes, guillemots, razorbills and puffins in Scotland demonstrated virtually no reaction behaviourally or reproductively to flights by fixed-wing aircraft within 100 m of the colony (Dunnet, 1977). A range of marine codes suggest that safe standoff distances for seabird colonies around the UK range from several tens of metres up to 200 m.

93. A more detailed study found that individuals within mixed seabird colonies where guillemot was the most abundant species elicited a range of disturbance responses due to close passing vessels (Rojek et al., 2007). Nearly all vessel disturbances to guillemots and cormorants occurred at vessel distances of less than 100 m from the colony. Of all recorded disturbance events, 78 % occurred when boats approached within 50 m of the colony, and all flushing events occurred due to vessels within 75 m of the colony. Heads up responses occurred occasionally when boats approached to within 200 m. This reaction does not necessarily result in the loss of eggs or chicks but can lead to flushing if the disturbance source continues or worsens.

94. Flushing during incubation or chick-rearing can lead to egg or chick loss because of displacement from the breeding site and abandonment (either temporary or permanent), egg breakage or predation. The effects of flushing on birds that are not attending eggs or chicks include disruption of courtship, nest-site defence or prospecting activities.

95. Based on the existing literature it is concluded that the presence of construction vessels will only result in effects on seabirds at breeding colonies if vessels regularly approach them to distances of less than approximately 300 m, which is considered a highly precautionary position on the basis of the information described above. There are several seabird colonies that could potentially be sensitive to this impact (based on distance to the Project), which are classified differently depending on the source material used. According to the SMP, there are sub-colonies located at Gogarth, Abrahams Bosom, and South Stack (**Table 11-8**). The RSPB reports colonies within the South Stack reserve slightly differently, with guillemots and razorbills being recorded in 2018 at Penlas North, Mousetrap Buttress, Redwall Buttress, South of Bridge, North of Bridge, and South Stack Island. Whilst not detailed here, the RSPB counts reported herring gull (338 individuals), fulmar (27 individuals), lesser black-backed gull (73 individuals), cormorant (10 individuals), kittiwake (5 individuals), and puffin (5 individuals).

96. It is considered that all breeding seabird locations on the Holy Island Coast are medium value receptors.

97. The latest counts for the three seabird colonies identified above are provided in **Table 11-16**.

Table 11-16 Latest Colony Counts at Breeding Seabird Colonies Closest to MDZ from SMP Database and RSPB

Colony (and RSPB colonies that lie within it in brackets)	Approximate Central Grid Reference Based on SMP Data	Latest Count Date in SMP	Results of latest SMP Count (individuals on land)	Results of June 2018 RSPB Count (mean of minimum five counts; individuals on land)
Abraham's Bosom (Penlas)	SH 20907 81489	June 2016	Guillemot (315) Razorbill (83) Fulmar (2) Herring gull (2)	Razorbill (11)
South Stack and Penlas RSPB (South of Bridge, Mousetrap Buttress, Redwall Buttress, South Stack Island)	SH 20599 82004	May 2018	Guillemot (5,243) Razorbill (994) Herring gull (106) Fulmar (11) Lesser black-backed gull (9) Shag (8) Kittiwake (7) Puffin (7)	Guillemot (9,690) – of which 3,398 were on South Stack island Razorbill (1,297) – of which 133 were on South Stack island
Gogarth (North of Bridge)	SH 21513 83286	June 2016	Herring gull (26) Razorbill (18) Cormorant (13) Guillemot (7) Fulmar (5) Shag (5) Lesser black-backed gull (3)	Razorbill (28)

98. For simplicity, the JNCC SMP notation will be used for these colonies for the remainder of this assessment. However, because of the larger number of visits, it is possible that RSPB auk counts within the reserve may be more accurate than those contained within the SMP.

99. The approximate distance between the colonies and various working areas is provided in **Table 11-17**. The relative location of colonies to the nearest working areas is shown on **Figure 11-2** (**Volume II**).

Table 11-17 Approximate Distances between MDZ, ECC, and Key Breeding Seabird Colony Locations within the South Stack and Penlas SMP Master Site

Colony	Approximate Distance to MDZ (m) (nearest boundary)	Approximate Distance to Export Cable Corridor (m) (nearest boundary)	Approximate Distance to Cable Tail Work Area (m) (nearest boundary)	Approximate Distance to Landward Landfall Location (m) (nearest boundary)
Abraham's Bosom	950	0	0-500	500 (minimum)
South Stack and Penlas RSPB	770	20	>1000	>1000
Gogarth	700	270	>1000	>1000

100. Provided that construction vessels are aware of the location of seabird colonies, do not propose to operate within 300 m of colony locations for extended periods (i.e. periods of several days without working elsewhere), and follow best practice for operating in relatively close proximity to such features, which will be included in a Construction and Environment Management Plan (CEMP), it is concluded that the Abraham's Bosom, South Stack and Penlas RSPB and Gogarth seabird colonies will have a **Negligible** sensitivity to cable laying and associated vessels working within the MDZ and ECC during the construction phase of the Project according to the definitions in **Chapter 5, EIA Methodology**.

101. If there are vessels which are involved in the installation of export cables or the export cable tails within 300 m of the Gogarth, Abrahams Bosom and South Stack seabird colonies during the breeding season for extended periods of time, then the sensitivity of the breeding colonies increases to **Medium**, based on the definitions provided in **Chapter 5, EIA Methodology**. The core breeding seasons are considered to be March to July for Abraham's Bosom (whilst breeding fulmar are present, they are present in low numbers only and are highly tolerant of vessel activity (Furness et al., 2012; Garthe and Hüppop, 2004)), and February to August for South Stack and Gogarth based on the species present at the last count (JNCC, 2018). During the non-breeding season, the sensitivity is **Negligible**, as most of the individuals associated with the colony will not be present, and the consequences of birds being flushed when not incubating an egg or raising a chick are significantly lower than in the breeding season.

102. Due to the distance between the landward landfall location and the Gogarth, Abrahams Bosom and South Stack seabird colonies (at least 500 m), these colonies will have a **Negligible** sensitivity to works at this location.

11.6.5.2.3. Magnitude of Impact

103. Any impacts resulting from the activities in the export cable corridor would be short-term, temporary and reversible in nature, lasting only for the duration of construction activity. Despite this, a severe one-off disturbance event at a seabird colony has the potential to cause a serious population-level effect.

104. Provided that construction vessels are aware of the location of seabird colonies, do not operate within 300 m of these locations during the breeding season, and follow best practice for operating in relatively close proximity to such features, which will be included in a Construction and Environment Management Plan (CEMP), it is concluded that vessels working within the MDZ and ECC will not cause any impacts on seabird breeding colonies during the construction phase of the Project. This applies to all inter array cable works, and export cable works occurring within the MDZ. The impact magnitude is therefore **Negligible**. This also applies to the non-breeding season.

105. Any vessel operating within 300 m of a breeding seabird colony during the breeding season has the potential to cause a **Medium negative** impact magnitude.

106. Due to the distance between the landward landfall location and the and the Gogarth, Abrahams Bosom and South Stack seabird colonies, along with the nature of the activities that will occur, the magnitude of impact of works at this location is **Negligible**.

11.6.5.2.4. Impact Significance

107. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Medium adverse** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating within 300 m of the colonies during the breeding season; and
- **Negligible** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating in excess of 300 m from the colonies, within 300 m during the non-breeding season, and works at the landward landfall.

11.6.5.2.5. Mitigation and Residual Impact

108. Based on the species known to breed at each of the potentially affected colonies (**Table 11-16**), and excluding any species understood to possess a "low" sensitivity to disturbance and displacement when at sea (**Table 11-13**), it is considered that it is appropriate to prohibit all vessel activities within 300 m of each of these colonies during the breeding season (**Table 11-9**) unless an ecological professional present states it is acceptable to proceed, which may be the case depending on the species present, the breeding stage, or the nature of vessel activities. This breeding period is considered to be March to July for Abraham's Bosom and February to August for South Stack and Gogarth based on the presence of shag at the last count for the latter two colonies (JNCC, 2018).

109. If this measure is adopted, then the magnitude of impact can be reduced from "medium" to "low" during the breeding season as works will not be permitted where an ecological professional considers sensitivity to be too high to enable works (e.g. works within 300 m may not be able to occur when most individuals at a colony are in the incubation stage). The residual impact significance is therefore **Minor adverse**.

11.6.5.3. Other Impacts

11.6.5.3.1. Introduction

110. Indirect impacts on marine ornithology receptors may occur during the construction phase if there are impacts on prey species and/or the habitats of prey species. These include those resulting from the production of underwater noise and the generation of suspended sediments that may alter the behaviour, abundance or availability of prey species for seabirds. There is also the possibility of pollution incidents due to ejection of contaminants or accidents involving construction vessels, which could result in potential indirect (prey effects) and direct (direct contact) impacts on marine ornithology receptors. Both are covered in this section.

11.6.5.3.2. Receptor Sensitivity

111. Underwater noise may cause fish and mobile invertebrates to avoid construction areas and their immediate surroundings, and also affect their physiology and behaviour. Suspended sediments may cause fish and mobile invertebrates to avoid construction areas and their immediate surroundings and may smother and hide immobile benthic prey in a localised area. These mechanisms may result in less prey being available within the construction area and immediate surrounding area to foraging seabirds. Pollution events may cause localised injury or mortality to seabirds or their prey species in the immediate vicinity of the source of the pollution. All of these effects, if they occurred, would be extremely localised.

112. Generally speaking, seabirds are mobile animals. In the breeding season they adopt a central place foraging strategy from the nest, restricting their foraging areas to enable them to successfully provision their chicks. In the non-breeding season, birds may be sedentary, remaining in the area where they bred, dispersive, or fully migratory. The high mobility of seabirds means that they are able to utilise alternative areas of habitat should an area of habitat within their range become unavailable. Habitat flexibility is also an important criterion in determining the ability of a particular species to find alternative foraging habitat, and whilst a qualitative measure, it has been reviewed by several sources (Furness et al., 2012; Furness and Wade, 2012; Garthe and Hüppop, 2004).

113. **Table 11-18** presents habitat flexibility of the marine ornithology receptors (Furness et al., 2012), along with sensitivity to these impacts using the definitions in **Chapter 5, EIA Methodology**, based on expert judgement.

Table 11-18 Habitat Flexibility and Sensitivity of Marine Ornithology Receptors to Indirect (Prey and Pollution) and Direct Pollution Impacts

Species	Habitat Flexibility (Scored 1-5 by Furness et al., (2012), where 1 is the most flexible)	Predicted Sensitivity to Localised Prey or Pollution Events
Common scoter	4	**Low**
Eider	4	
Red-throated diver	4	
Arctic tern	3	
Common tern	3	
Cormorant	3	
Guillemot	3	
Puffin	3	
Razorbill	3	
Sandwich tern	3	
Shag	3	
Black-headed gull	2	**Negligible**
Common gull	2	
Great black-backed gull	2	
Kittiwake	2	
Mediterranean gull	2 (assumed same as black-headed gull)	
Fulmar	1	

Species	Habitat Flexibility (Scored 1-5 by Furness et al., (2012), where 1 is the most flexible)	Predicted Sensitivity to Localised Prey or Pollution Events
Gannet	1	
Herring gull	1	
Lesser black-backed gull	1	
Manx shearwater	1	

11.6.5.3.3. Magnitude of Impact

114. With regard to noise impacts, **Chapter 10, Fish and Shellfish Ecology** and **Chapter 14, Commercial Fisheries** discuss the potential impacts upon fish relevant to marine ornithology as prey species. For species such as herring, sprat and sandeel, which are prey items of several marine ornithology receptors, the impact magnitude of underwater noise effects (physical injury or behavioural changes) and habitat loss during construction is considered to be minor or negligible. With regard to the definitions of impact magnitude given in **Chapter 5, EIA Methodology**, it is concluded that the magnitude of impact on seabirds occurring in or around the Project during the construction phase is **Negligible**. This applies to direct effects on the marine ornithology receptors themselves (**Section 11.6.4**), and their prey.

115. With regard to changes to the seabed and to suspended sediment levels, **Chapter 7, Metocean Conditions and Coastal Processes** and **Chapter 9, Benthic and Intertidal Ecology** discuss the nature of any change and impacts on the seabed and benthic habitats which host or support seabird prey species. The maximum envisaged effect associated with sediment plumes arising from the construction phase occurs during the foundation installation activities, which will cause only very minor increases in suspended sediment concentration; less than 1 mg/l a short distance from the release point, over a distance of several hundred metres. The effects will be temporary and fully reversible, with a return to very low background concentrations occurring rapidly upon cessation of installation activities. Other than at the immediate release point, such a change would be immeasurable. It is concluded that the magnitude of impact on seabirds occurring in or around the Project during the construction phase is **Negligible**.

116. Any pollution incidents, which are considered to be unlikely to occur, will result in the contamination of a small area (likely no more than several hundreds of metres) of subtidal habitat with a small amount of pollution. Measures will be in place to rapidly collect or disperse any such contamination, meaning that its presence will be temporary and reversible. As a result, based on the definitions of impact magnitude given in **Chapter 5, EIA Methodology**, the magnitude of impact is considered to be **Negligible**.

11.6.5.3.4. Impact Significance

117. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, guillemot, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull, puffin, razorbill, red-throated diver, Sandwich tern and shag.

11.6.6. Potential Impacts During Operation / Repowering

11.6.6.1. Airborne Noise and Visual Disturbance / Displacement

11.6.6.1.1. Introduction

118. The operational / repowering phase of the Project has the potential to affect bird populations in the marine environment through disturbance due to airborne noise and visual disturbance, leading to displacement of birds from subtidal habitats occupied by arrays of tidal devices. This could be due to the presence of the devices themselves, or maintenance activities on the devices, inter array cables or export cables.

119. With respect to tidal devices, any impacts resulting from this impact pathway would be spatially restricted to subtidal areas within close proximity to the devices, and temporally restricted to the duration of operation / repowering (up to 37 years; long term). A maximum of 130 surface emergent devices may be deployed in total. The worst-case height above sea level for any tidal device will be 6 m.

120. It is expected that annual inspections of all cables will occur for the first three years after installation, reducing to every two years thereafter. Up to ten major cable repairs of five days each may be required throughout the Project life of 37 years. Devices will be visited up to 15 times annually. The assessment therefore assumes that during operation / repowering, approximately four groups of vessels may be present in the MDZ and ECC (the OfDA) at any one time. This is in addition to the vessel groups expected to be present fulfilling construction requirements (**Section 11.6.5.1**).

11.6.6.1.2. Receptor Sensitivity

121. There is limited information available on whether the presence of operational tidal devices causes disturbance and displacement effects on birds, although available literature suggests that either no, or very limited displacement impacts occur as a result of their presence (Lieber et al., 2019; Royal Haskoning, 2011).

122. Robbins (2017) provides an overview of five years of bird observations collected from the Fall of Warness tidal energy test site at the European Marine Energy Centre (EMEC). During that study, a number of species were frequently recorded which are also frequently present in the MDZ. It was noted that species recorded by Robbins (2017) occupied the ecological niches that would be expected based on their known ecology (e.g. guillemots and razorbills showing a preference for pelagic waters). This suggests that bird behaviour had likely remained as would be expected despite the deployment of the tidal devices. In addition, birds that have been classified as particularly susceptible to disturbance by vessel traffic on disturbance by man-made structures at sea (Furness et al., 2013, 2012; Garthe and Hüppop, 2004) such as red-throated diver and shag were also frequently recorded at the site. This suggests that disturbance and displacement effects due to the presence of tidal devices are lower than similar effects caused by vessels.

123. Furness et al. (2012) classified seabird species by their potential for disturbance by marine structures, where a score of one represented minimal risk, and five moderate risk. None of the marine ornithology receptors were scored above three.

124. Of the bird species recorded during the baseline surveys (**Appendix 11.1, Volume III**), cormorant and shag have been observed elsewhere using man-made structures as roosting platforms (Dierschke et al., 2016; Furness et al., 2012; Kahlert et al., 2004; Roycroft et al., 2004). The presence of structures effectively enables extension of the foraging range of these species, enabling them to utilise foraging areas which were previously beyond their maximum range. There is no evidence available regarding the use of surface piercing tidal devices for this purpose, but it is assumed that they will be used in a similar way. Other groups of species that may be attracted into operational arrays due to the presence of roosting platforms are gulls (Dierschke et al., 2016; Roycroft et al., 2007, 2004) and terns (Christensen et al., 2004).

125. Lighting of tidal devices and other structures at night may potentially be a source of attraction (phototaxis) or displacement. The areas affected would mainly be restricted to array areas with the exception of transiting vessels associated with the Project, which would be less common at night. Because the lighting would only affect an extremely localised area, it is considered that in general, the marine ornithology receptors would be insensitive to this impact. Phototaxis can be a serious hazard for fledglings of some seabird species, predominantly shearwaters (Deppe et al., 2017; Raine et al., 2007; Rodríguez et al., 2017, 2014), but occurs over short distances (typically hundreds of metres) in response to bright white light close to breeding colonies, and generally only once a year, when fledglings are departing their breeding colonies. Operational arrays of tidal devices within the MDZ would be far enough removed from any Manx shearwater breeding colonies (approximately 45 km) to render the likelihood of this impact occurring negligible.

126. Combining this information with the results of the screening exercise undertaken in **Table 11-13** results in the following sensitivity classifications with respect to the tidal devices themselves:

- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, guillemot, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull, puffin, razorbill, red-throated diver, Sandwich tern and shag.

127. With respect to vessel activity, it is assumed on a highly precautionary basis that exactly the same levels of impact and mortality are predicted due to operational phase activities as is the case for construction. This is detailed in **Section 11.6.5.1**. The sensitivity levels are as follows:

- **Medium** for red-throated diver and shag;
- **Low** for guillemot, puffin and razorbill; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

11.6.6.1.3. Magnitude of Impact

128. Whilst the assessment of receptor sensitivity for this impact pathway draws on literature focusing on the impacts of offshore wind farms, it is not considered that the disturbance and displacement impacts caused by an array of tidal energy converters will be comparable to that of an offshore wind farm due to the obvious differences in physical characteristics between the two above the surface of the sea. Given the very small or even complete absence of tidal devices from the

surface of the sea, a more accurate comparison in terms of displacement effects is probably something more akin to a gill net or a buoy. The well documented bycatch of seabirds (Bicknell et al., 2013; Croxall et al., 2012; Žydelis et al., 2013, 2009), indicates such submerged, or largely submerged structures do not readily disturb birds sufficiently to prevent their entanglement. This assessment also considers that any very minor displacement effects that may occur would likely only be temporary as birds are expected to habituate to the presence of tidal devices.

129. It is concluded from the review of responses of the presence of man-made structures by a range of species in **Section 11.6.6.1.2** that the following magnitudes of impact are appropriate:

- **Low beneficial** for cormorant and shag; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, eider, fulmar, gannet, guillemot, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull, puffin, razorbill, red-throated diver and Sandwich tern.

130. Regarding maintenance activities, any impacts will be spatially restricted to subtidal areas within close proximity to the activities, and temporally restricted to the duration of the activity. These impacts are therefore short-term, temporary and reversible. Rather than resulting in harm to the bird or loss from the population, disturbance and displacement by airborne noise and visual disturbance will result in affected birds temporarily redistributing at sea and moving to an area where they are undisturbed, with birds expected to return to the area once activities have ceased.

131. For the purposes of the assessment it is assumed that levels of activity associated with the operation of the Project are comparable to those anticipated during construction, and as the two project phases are expected to run simultaneously for much of the Project lifespan, the magnitude of impact is the same as detailed in **Section 11.6.5.1.3**. This is:

- **Low negative** for guillemot; and
- **Negligible** for all other species.

11.6.6.1.4. Impact Significance

132. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Minor adverse** for guillemot; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, puffin, Manx shearwater, Mediterranean gull, razorbill, red-throated diver, Sandwich tern and shag.

11.6.6.2. Disturbance at Breeding Sites

11.6.6.2.1. Introduction

133. The operational / repowering phase of the Project has the potential to affect marine ornithology receptors at nearby breeding colonies due to airborne noise and visual disturbance caused by maintenance vessels in the MDZ and ECC.

134. It is expected that annual inspections of all cables will occur for the first three years after installation, reducing to every two years thereafter. Up to ten major cable repairs of five days each may be required throughout the Project life of 37 years. Devices will be visited up to 15 times annually. The assessment therefore assumes that during operation / repowering, approximately four groups of vessels may be present in the MDZ and ECC (the OfDA) at any one time during the lifespan of the Project.

11.6.6.2.2. Receptor Sensitivity

135. Provided that construction vessels are aware of the location of seabird colonies, do not operate within 300 m of colony locations during the breeding season in the absence of prior ecological advice, and follow best practice for operating in relatively close proximity to such features, it is concluded that the Abraham's Bosom, South Stack and Penlas RSPB and Gogarth seabird colonies will have a **Negligible** sensitivity to cable laying and associated vessels working within the MDZ and ECC during the operational / repowering phase of the Project according to the definitions in **Chapter 5, EIA Methodology**.

136. If there are vessels which are involved in the maintenance of export cables or the export cable tails within 300 m of the Gogarth, Abrahams Bosom and South Stack seabird colonies, then the sensitivity of the breeding colonies increases to **Medium**, based on the definitions provided in **Chapter 5, EIA Methodology**. The core breeding seasons are considered to be March to July for Abraham's Bosom (whilst breeding fulmar are present, they are present in low numbers only and are highly tolerant of vessel activity (Furness et al., 2012; Garthe and Hüppop, 2004)), and February to August for South Stack and Gogarth based on the presence of shag at the last count (JNCC, 2018).

11.6.6.2.3. Magnitude of Impact

137. Any impacts resulting from the activities in the export cable corridor would be short-term, temporary and reversible, lasting only for the duration of maintenance activity. Despite this, a severe one-off disturbance event at a seabird colony has the potential to cause a serious population-level effect.

138. Provided that vessels are aware of the location of seabird colonies, do not operate within 300 m of these locations during the breeding season, and follow best practice for operating in relatively close proximity to such features, it is concluded that vessels working within the MDZ and ECC will not cause any impacts on seabird breeding colonies during the construction phase of the Project. The impact magnitude is therefore **Negligible**.

139. Any vessel operating within 300 m of a breeding seabird colony during the breeding season has the potential to cause a **Medium negative** impact magnitude.

11.6.6.2.4. Impact Significance

140. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Medium adverse** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating within 300 m from the colonies; and
- **Negligible** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating in excess of 300 m from the colonies.

11.6.6.2.5. Mitigation and Residual Impact

141. Based on the species known to breed at each of the potentially affected colonies (**Table 11-16**), and excluding any species understood to possess a "low" sensitivity to disturbance and displacement when at sea (**Table 11-13**), it is considered that it is appropriate to prohibit all vessel activities within 300 m of each of these colonies during the breeding season (**Table 11-9**) unless an ecological professional present states it is acceptable to proceed, which may be the case depending on the species present, the breeding stage, or the nature of vessel activities. This breeding period is considered to be March to July for Abraham's Bosom and February to August for South Stack and Gogarth based on the presence of shag at the last count for the latter two colonies (JNCC, 2018).

142. If this measure is adopted, then the magnitude of impact can be reduced from "medium" to "low" during the breeding season as works will not be permitted where an ecological professional considers sensitivity to be too high to enable works (e.g. works within 300 m may not be able to occur when most individuals at a colony are in the incubation stage). The residual impact significance is therefore **Minor adverse**.

11.6.6.3. Collision Risk with Tidal Devices

11.6.6.3.1. Introduction

143. The operational / repowering phase of the Project has the potential to affect marine ornithology receptor populations through collision between diving birds and the tidal energy convertors (TEC) within tidal devices. This is currently a theoretical risk (Furness et al., 2012; McCluskie et al., 2012; SNH, 2016), and no actual effect has yet been demonstrated.

144. For the operational / repowering phase of the Project, collision risk for all regularly diving seabird species recorded on the sea within the MDZ has been assessed using two methods, Encounter Rate Modelling (ERM) and Collision Risk Modelling (CRM), as per published guidance (SNH, 2016) and discussions with the Ornithology TWG during the preparation of this chapter. Full details of the methods, the input parameters, the tidal device deployment scenarios selected for modelling, and detailed outputs are provided in **Appendix 11.3** (**Volume III**). It should be noted that as per SNH (2016), it is acknowledged that the ERM and CRM methods will provide at best, an order of magnitude estimate of collision risk. For several reasons explored in detail in **Appendix 11.3** (**Volume III**), it is also expected that both ERM and CRM provide results that are likely to give a precautionary estimate of theoretical collision risk.

145. For each species, the possibility of a significant proportion of birds at risk of collision being from a single colony, which substantially increases the risk of population level effects on that particular colony (**Table 11-11**), was also considered if ERM/CRM outputs indicated that the species was particularly vulnerable to collision. Where this was identified as a possible issue, the outputs from ERM/CRM have then been used as an input for Population Viability Analysis (PVA) for these colonies. Details of PVA methodology, input parameters and outputs are given in **Appendix 11.3** (**Volume III**).

146. There is considerable uncertainty regarding avoidance rates for several reasons. Firstly, it is expected that animals of relatively small size such as diving seabirds might be swept past moving tidal device blades while entrained within the tidal stream (Wilson et al., 2007). Secondly, given that the rotation speed of tidal stream turbines is generally much lower than wind turbines (where collisions are assumed to result in 100 % collision mortality) (Fraenkel, 2006), and dive and swim speeds of seabirds are much lower than their flight speeds (Alerstam et al., 2007; Bruderer and Boldt, 2001; Robbins, 2017), and that the profiles of tidal device blades are generally ‘blunt’ in profile in contrast to those of wind turbines, it is considered highly unlikely that the strike force of a collision would result in a trauma sufficient to cause injury or death in all collision events (Wilson et al., 2007). This may be particularly applicable to collisions occurring near the centre of rotor, downward strikes occurring on dive descents, and upward strikes occurring on dive ascent. Finally, no information exists on the ability of seabirds to avoid collisions with tidal turbines at any range. It should be noted that the burst speed of some species of diving birds relative to the speed of tidal device turbine blades is thought to be much higher when compared to the equivalent relationships between flying birds and wind turbines (Fraenkel, 2006; Wilson et al., 2007). This suggests that such close-range avoidance behaviour will be more successful in diving seabirds than may be the case for flying birds at wind farms.

147. For balance, it should also be noted that some information suggests that narrow fields of view and/or inability to see great distances underwater may increase the potential vulnerability of diving birds to collision with objects underwater (Martin and Wanless, 2015; White et al., 2007). That being said, no extensive reports of underwater collisions between seabirds and underwater objects have been reported. Whilst seabird bycatch due to entanglement of seabirds in fishing nets is a widely reported issue (Žydelis et al., 2013, 2009), this is considered a separate phenomenon to the theoretical risk of underwater collision presented here.

148. It is recognised that the models used here, and the comparability of their outputs to potential real-world impacts, will be shaped enormously by the avoidance rate that is selected. As suggested by SNH (2016) and agreed with the Ornithology TWG, the avoidance rates 0 %, 50 %, 90 %, 95 %, 98 % and 99 % have been presented, along with higher rates of 99.5 % and 99.9 %. Based on the recommended default collision risk for onshore wind of 98 %, and detail provided above which indicates that higher avoidance rates are appropriate for tidal energy devices, the impact assessment focuses on avoidance rates of between 95 % and 99.9 %.

11.6.6.3.2. Receptor Sensitivity

149. Birds recorded on the water in the MDZ during boat-based surveys (**Appendix 11.1, Volume III**) during relevant seasons (**Table 11-9**), which are known to habitually dive to the depth where there is a risk of collision with TECs will be sensitive to potential collision impacts. These species have been identified by an extensive literature review into their diving capabilities and foraging

activities (**Appendix 11.3, Volume III)**. The species identified are guillemot (breeding and non-breeding), puffin (breeding), razorbill (breeding and non-breeding), red-throated diver (non-breeding), Manx shearwater (breeding), gannet (breeding) and shag (breeding). Whilst it is possible that cormorant (and possibly shag) numbers in the MDZ may increase during operation due to the roosting opportunities provided by floating infrastructure, collision risk cannot be calculated for this species due to the fact it was not recorded on the sea in the MDZ during baseline surveys. For the purposes of this assessment, sensitivity and magnitude have been set at the same level as shag, as the most similar species included in the assessment to cormorant.

150. In addition to species receptors, colonies have been assigned a sensitivity where it is expected that a high proportion of a given species that is sensitive to this impact pathway will be present within the MDZ.

151. Sensitivities to collision, according to the definitions provided in **Chapter 5, EIA Methodology** are as follows:

- **High** for the South Stack and Penlas SMP sub-colonies, as it is expected to be the origin of 100 % of MDZ populations of three diving birds (guillemot, razorbill and shag);
- **Medium** for gannet, guillemot, Manx shearwater, puffin, razorbill, red-throated diver and shag (as well as cormorant, which has not been modelled due to no birds being recorded on the water in the MDZ during boat-based surveys); and
- **Negligible** for all other marine ornithology receptors species listed in **Table 11-10**, as their diving habits identified in the literature mean that they will not routinely occur in the rotor swept zone of tidal devices.

11.6.6.3.3. Magnitude of Impact

152. Collision between a diving seabird and a TEC could occur anywhere within an operational tidal array during the operational / repowering phase, which could last for a total of up to 37 years (i.e. long term). As described above, the likelihood of collisions actually resulting in mortality is somewhat unknown, reflected in a range of avoidance rates being presented for the species of interest (SNH, 2016).

153. Whilst not presented for the purposes of keeping the chapter to a reasonable length, collision estimates using the upper and lower confidence intervals associated with each density are accounted for when assigning magnitudes of impact across the scenarios below.

11.6.6.3.3.1. 240 MW Full Deployment Scenario

154. Several tidal device parameter envelopes, identified by alphanumeric codes, have been considered, each representing a realistic worst case for that particular type of device (**Appendix 11.3, Volume III**). For a 240 MW full deployment of a variety of devices (**Appendix 11.3, Volume III**), the annual number of collisions estimated for each species by time period (breeding and non-breeding season is presented in **Table 11-19**.

Table 11-19 Number of Predicted Collisions in a Single Season (Mean of ERM and CRM) for Diving Species Recorded in MDZ by Appropriate Time Period, at a Range of Different Avoidance Rates, for a Deployment Scale of 240 MW

Species	Time Period (B/NB)	Avoidance Rate (%)							
		0	**50**	**90**	**95**	**98**	**99**	**99.5**	**99.9**
Gannet	B	14	7	2	1	1	1	1	0
Guillemot	B	21,034	10,517	2,103	1,052	421	210	105	21
	NB	5,739	2,869	574	287	115	57	29	6
Manx shearwater	B	186	93	19	9	4	2	1	0
Puffin	B	94	47	9	5	2	1	0	0
Razorbill	B	6,483	3,241	648	324	130	65	32	6
	NB	6,469	3,234	647	323	129	65	32	6
Red-throated diver	NB	612	306	61	31	12	6	3	1
Shag	B	16	8	2	1	0	0	0	0

155. To examine the significance of the values in **Table 11-19**, the predicted number of collisions in a season was compared to the probable reference population (**Table 11-11**). On the basis of information regarding the likely components of an avoidance rate (**Section 11.6.6.3.2** and **Appendix 11.3, Volume III**), the assessment focuses on avoidance rates between 95 % and 99.9 % (**Table 11-20**).

Table 11-20 Collision Rates at 95-99.9 % Avoidance Rates (Mean of ERM and CRM) Relative to Relevant Reference Populations, at a Deployment Scale of 240 MW for a Single Season

Species	Time Period (B/NB)	Reference Population (individual birds) (Table 11-11)	Probable Number of Collisions per Season	As % of Reference Population
Gannet	B	138,474	0 - 1	0 - 0.001
Guillemot	B	7,457	–21 - 1,052	0.28 – 14.11
	NB	1,139,220	–6 - 287	0 - 0.03
Manx shearwater	B	673,350	0 - 9	0 - 0.001
Puffin	B	1,746	0 - 5	0 - 0.29
Razorbill	B	1,467	6 - 324	0.41 - 22.09
	NB	341,422 (Nov-Dec) 606,914 (Aug-Oct and Jan-Mar)	6 - 323	0.002 - 0.09
Red-throated diver	NB	1,676	1 - 31	0.06 - 1.85
Shag	B	26	0 - 1	0 - 3.85

156. Depending on the proportion of guillemots in the MDZ from the South Stack and Penlas SMP sub-colonies versus the wider UK Western Waters BDMPS during the non-breeding season, the upper limit of non-breeding season collisions of 234 birds (at 95 % avoidance) could represent between 0 % to 3.10 % of the South Stack and Penlas SMP sub-colonies breeding adult population, depending on the dispersal rate of birds from this colony following the breeding season. The upper, worst case value of 3.10 % is only applicable if no guillemots disperse from the colony during the non-breeding season, and all collisions involve birds from this colony, which seems highly unlikely. This calculation is highly precautionary as it does not include the

non-breeding component of the SSSI population in the overall population size, and assumes all mortalities are breeding adults.

157. Due to the potentially high number of collisions predicted for guillemot and razorbill, in addition to the fact that 100 % of the MDZ population originates from the same colony, a PVA was carried out on the population of the South Stack and Penlas SMP sub-colonies for both species during the breeding season (encompassing the Gogarth, South Stack and Abraham's Bosom sub-colonies), using the same avoidance rates presented above. PVAs considered the combined predicted effects of mortality from collisions and displacement from operational arrays. Details of this process are provided in **Appendix 11.3** (**Volume III**).

158. CPGR and the CPS after 25 years of deployment are presented for guillemot and razorbill **Table 11-21** and **Table 11-22** respectively.

159. The use of avoidance rates of between 98 % and 99.9 % suggests that the guillemot population would continue to increase from present day levels if a 240 MW array consisting of the devices listed at **Chapter 4, Project Description** and **Appendix 11.3** (**Volume III**) was deployed and operated for 25 years. At the lowest avoidance rate (95 %), at 25 years under these conditions, the model predicts an overall guillemot population of <10 % of when compared with unimpacted conditions predicted after 25 years, and also when compared to the population at the latest colony count. At 98 % avoidance, the population after 25 years would be 40.5 % of what is predicted under unimpacted conditions, which would be slightly less birds than were present at the latest colony count. Avoidance rates of 99 % or higher result in a population of at least 69.2 % the size of the predicted baseline population, and up to 95.6 % in the case of a 99.9 % avoidance rate.

Table 11-21 CPGR and CPS (25 year) Metrics for PVA for South Stack and Penlas SMP Sub-Colonies for Guillemot During the Breeding Season, 240 MW Deployment

Avoidance Rate	Growth Rate	Population After 25 Years (total individual breeding adults)	Counterfactual of Growth Rate	Counterfactual of 25 Year Population	25 Year Population Relative to Current Population
Baseline	1.037	18,353	N/A	N/A	2.461
95 %	0.911	438	0.893	0.024	0.059
98 %	1.004	7,437	1.000	0.405	0.996
99 %	1.023	12,691	1.021	0.692	1.700
99.5 %	1.031	15,461	1.030	0.842	2.071
99.9 %	1.035	17,539	1.035	0.956	2.350

160. The guillemot population of the South Stack and Penlas SMP sub-colonies has been increasing since at least the early 1980's, but there is some evidence based on more recent counts that the population is unlikely to continue to grow indefinitely at the rate seen between the 1980's and the present day (JNCC, 2018). Whilst the reason for this is unclear, if colony growth is constrained in the medium term in its baseline state (i.e. in the absence of the Project), then it is possible that the differences between the different impact scenarios considered in the assessment and the predicted baseline may be smaller in reality than suggested by the PVA,

though as stated above, CPGR and CPS are still useful indicators despite this. In addition, this model is considered precautionary because the starting population of 7,457 was that according to the latest SMP count (5,565) (**Table 11-16**) multiplied by an appropriate k-value (1.34) (Harris et al., 2015). Had the more recent RSPB count been available when the model had been run, the starting population would have been 12,984 (i.e. 9,690 x 1.34) (**Table 11-16**). This population is approximately 75 % larger than the starting population used by the PVA. The larger starting population would result in a population which may possess greater resilience with respect to additional mortality.

161. At an avoidance rate of 95 %, it is predicted that deployment of a 240 MW array consisting of the devices listed at **Chapter 4, Project Description** would result in the extinction of the razorbill population within the South Stack and Penlas SMP master site after several years of operation, with a similar outcome in terms of population level predicted at 98 % avoidance. At an avoidance rate of 99 %, the population after 25 years of deployment would be 33.6 % of that predicted under unimpacted conditions, which is less birds than were recorded at the latest colony count. The use of avoidance rates of 99.5 % and 99.9 % results in increases in populations from the last colony count after 25 years of deployment, but 69.1 % and 92.9 % of what would be expected under unimpacted conditions.

Table 11-22 CPGR and CPS (25 year) Metrics for PVA for South Stack and Penlas SMP Sub-Colonies for Razorbill During the Breeding Season, 240 MW Deployment

Avoidance Rate	Growth Rate	Population After 25 Years (total individual breeding adults)	Counterfactual of Growth Rate	Counterfactual of 25 Year Population	25 Year Population Relative to Current Population
Baseline	1.037	3,430	N/A	N/A	2.338
95 %	0.233	0	0.226	0.000	0.000
98 %	0.889	77	0.859	0.022	0.052
99 %	0.990	1,152	0.957	0.336	0.785
99.5 %	1.019	2,371	0.985	0.691	1.616
99.9 %	1.032	3,186	0.997	0.929	2.172

162. Like guillemot, the razorbill population at the South Stack and Penlas SMP sub-colonies has been increasing since at least the early 1980's, but there is some evidence based on more recent counts that the population is unlikely to continue to grow at the rate seen between the 1980's and the present day indefinitely (JNCC, 2018). Whilst the reason for this is unclear, if colony growth is constrained in the medium term in its baseline state (i.e. in the absence of the Project), then it is possible that the differences between the different impact scenarios considered in the assessment and the predicted baseline may be smaller in reality than suggested by the PVA, though as stated above, CPGR and CPS are still useful indicators despite this. As with guillemot, the latest counts from the RSPB suggest a larger starting population (1,790) than the 1,467 derived from SMP data (**Table 11-16**). This population is approximately 34 % larger than the starting population used by the PVA. The larger starting population would result in a population which may possess greater resilience with respect to additional mortality.

163. The following magnitudes of impact due to collision at a 240 MW deployment scale are considered appropriate, based on expert opinion, considering the wider backdrop of an increasing auk population in Wales (**Section 11.5.6)**, and assuming that 95 % avoidance rates are used on a precautionary basis:

- **Very high negative** for guillemot (breeding), razorbill (breeding), and the South Stack and Penlas SMP sub-colonies;
- **Medium negative** for guillemot (non-breeding) and razorbill (non-breeding);
- **Low negative** for, puffin (breeding) and red-throated diver (non-breeding); and
- **Negligible** for gannet (breeding), Manx shearwater (breeding), shag (breeding) and cormorant (presumed), as well as all non-diving marine ornithology receptors.

164. Whilst the above magnitudes of impact are used by the assessment for precautionary reasons, a change to 99 % avoidance rate would result in the following magnitudes of impact being assigned:

- **High negative** for razorbill (breeding), and the South Stack and Penlas SMP sub-colonies;
- **Medium negative** for guillemot (breeding); and
- **Negligible** for gannet (breeding), guillemot (non-breeding), Manx shearwater (breeding), puffin (breeding), razorbill (non-breeding) and red-throated diver (non-breeding) shag (breeding) and cormorant (presumed), as well as all non-diving marine ornithology receptors (**Table 11-11**).

11.6.6.3.3.2. 40 MW Worst Case Scenario

165. A 40 MW worst case scenario has been considered in order to reflect the expected scale of a first commercial level phase of deployment within the Project. Several tidal device parameter envelopes, identified by alphanumeric codes, have been considered, each representing a realistic worst case for that particular type of device (**Appendix 11.3, Volume III**). The impact of different device envelopes varies considerably between species, depending largely on whether they are deep or shallow diving birds; the allocation of species to a particular definition is described in **Appendix 11.3** (**Volume III**). For a 40 MW single device initial phase of deployment for the Project (which is a level of deployment considered appropriate to assess for all devices except for 2F and 9F, and therefore these devices are excluded), the annual number of collisions for each species by time period (breeding and non-breeding seasons (**Table 11-9**), for the device envelope that resulted in the most collisions for that species, is presented in **Table 11-23**. It should be noted that this represents a worst case and other devices resulted in less collisions, details of which are presented in **Appendix 11.3** (**Volume III**).

Table 11-23 Number of Predicted Collisions in a Single Season (Mean of ERM and CRM) for Diving Species Recorded in MDZ by Appropriate Time Period, at a Range of Different Avoidance Rates, for a Worst-Case Device Envelope Scenario at a Deployment Scale of 40 MW

Species	Time Period (B/NB)	Device	Avoidance Rate (%)							
			0	50	90	95	98	99	99.5	99.9
Gannet	B	1F/3F	2	1	0	0	0	0	0	0
Guillemot	B	4F	4,952	2,476	495	248	99	50	25	5

Species	Time Period (B/NB)	Device	Avoidance Rate (%)							
			0	50	90	95	98	99	99.5	99.9
	NB		1,063	531	106	53	21	11	5	1
Manx shearwater	B	1F	35	17	3	2	1	0	0	0
Puffin	B	3F	22	11	2	1	0	0	0	0
Razorbill	B	3F	1,517	758	152	76	30	15	8	2
	NB		1,513	757	151	76	30	15	8	2
Red-throated diver	NB	3F	151	76	15	8	3	2	1	0
Shag	B	4F/6S	4	2	0	0	0	0	0	0

166. To examine the significance of the values in **Table 11-23** in the context of relevant populations of each species, the predicted number of collisions in a season was compared to the probable reference population (the BDMPS or population of colonies in **Table 11-11**). On the basis of information regarding the likely components of an avoidance rate and the precautionary values input into the models (**Section 11.6.6.3.2** and **Appendix 11.3, Volume III**), the assessment focuses on avoidance rates between 95 % and 99.9 % (**Table 11-24**).

Table 11-24 Collision Rates at 95 to 99.9 % Avoidance Rates (Mean of ERM and CRM) Relative to Relevant Reference Populations, for a Worst-Case Device Envelope Scenario at a Deployment Scale of 40 MW, in a Single Season

Species	Time Period (B/NB)	Reference Population (individual birds) (Table 11-11)	Probable Number of Collisions per Season	As % of Reference Population
Gannet	B	138,474	0	0
Guillemot	B	7,457	5 - 248	0.07 - 3.33
	NB	1,139,220	1 - 53	0.0001 - 0.005
Manx shearwater	B	673,350	0 - 2	0 - 0.0003
Puffin	B	1,746	0 - 1	0 - 0.06
Razorbill	B	1,467	2 - 76	0.14 - 5.18
	NB	341,422 (Nov-Dec) 606,914 (Aug-Oct and Jan-Mar)	2 - 76	0 - 0.02 (max)
Red-throated diver	NB	1,676	0 - 8	0 - 0.48
Shag	B	26	0	0

167. It is recognised that the behaviour of non-breeding guillemot is dispersive rather than migratory (Furness, 2015). This means that because the MDZ is situated in close proximity to breeding colonies for these species within the South Stack and Penlas SMP sub-colonies, the proportion of non-breeding birds present in and around the MDZ that are from these colonies may be higher than suggested in Furness (2015). Depending on the proportion of guillemots in the MDZ from the South Stack and Penlas SMP sub-colonies versus the wider UK Western Waters BDMPS during the non-breeding season, the upper limit of non-breeding season collisions of 53 birds (at 95 % avoidance) could represent between 0 % to 0.8 % of the South Stack and Penlas SMP sub-colonies breeding adult population, depending on the dispersal rate of birds from this colony following the breeding season. The upper, worst case value of 0.8 % is only applicable if no guillemots disperse from the colony during the non-breeding season and all collisions are birds

from this colony, which is implausible. This calculation is highly precautionary as it does not include the non-breeding component of the population in the overall population size.

168. Due to the potentially high number of collisions predicted for guillemot and razorbill, in addition to the understanding that 100 % of the MDZ population originates from the same SMP master colony, a PVA was carried out on the population of the South Stack and Penlas SMP sub-colonies for both species during the breeding season (encompassing the Gogarth, South Stack and Abraham's Bosom sub-colonies), using the same avoidance rates presented above. PVAs considered the combined predicted effects of mortality from collisions and displacement from operational arrays and due to construction and operational / repowering vessel traffic. Details of this process are provided in **Appendix 11.3** (**Volume III**).

169. Counterfactual of Population Growth Rates (CPGR) and the Counterfactual of Population Size (CPS) after 25 years of deployment are presented for guillemot and razorbill in **Table 11-25** and **Table 11-26** respectively. Whilst this is shorter than the operational lifespan of 37 years, no array will be deployed continuously for this length of time. CPGR is the ratio of the predicted population annual growth rate with and without the Project impacts, and CPS is the ratio of the predicted end-point population size with and without the Project impacts at 25 years of operation. These metrics have been demonstrated to have low sensitivity to the mis-specification of input parameters (e.g. demographic rates) and to the underlying assumptions of the population models from which the PVAs are derived (Cook and Robinson, 2016; Jitlal et al., 2017).

170. The use of avoidance rates of between 95 % and 99.9 % suggests that the guillemot population of the South Stack and Penlas SMP sub-colonies would continue to grow (population growth rate >1) compared to the latest colony count if a 40 MW array consisting of devices which cause the largest impact on this species was deployed and operated for 25 years. At the lowest avoidance rate (95 %), after 25 years under these conditions, the PVA predicts an overall guillemot population of 63.7 % when compared with the predicted unimpacted conditions after 25 years. Avoidance rates of 98 % or higher result in a population of at least 85.1 % the size of the predicted unimpacted population, or above.

Table 11-25 CPGR and CPS (25 year) Metrics for PVA for South Stack and Penlas SMP Sub-Colonies for Guillemot During the Breeding Season, 40 MW Worst-Case Deployment

Avoidance Rate	Growth Rate	Population After 25 Years (total individual breeding adults)	Counterfactual of Growth Rate	Counterfactual of 25 Year Population	25 Year Population Relative to Current Population
Baseline	1.037	18,353	N/A	N/A	2.461
95 %	1.018	11,686	0.982	0.637	1.566
98 %	1.030	15,615	0.994	0.851	2.092
99 %	1.033	16,485	0.997	0.918	2.209
99.5 %	1.035	17,445	0.998	0.951	2.337
99.9 %	1.036	17,909	0.999	0.976	2.399

171. The guillemot population of the South Stack and Penlas SMP sub-colonies has been increasing since at least the early 1980's, but there is some evidence based on more recent counts that

the population is unlikely to continue to grow indefinitely at the rate seen between the 1980's and the present day (JNCC, 2018). Whilst the reason for this is unclear, if colony growth is constrained in the medium term in its baseline state (i.e. in the absence of the Project), then it is possible that the differences between the different impact scenarios considered in the assessment and the predicted baseline may be smaller in reality than suggested by the PVA, though as stated above, CPGR and CPS are still useful indicators despite this. In addition, this model is considered precautionary because the starting population of 7,457 was that according to the latest SMP count (5,565) (**Table 11-16**) multiplied by an appropriate k-value (1.34) (Harris et al., 2015). Had the more recent RSPB count been available when the model had been run, the starting population would have been 12,984 (i.e. 9,690 x 1.34) (**Table 11-16**). This population is approximately 75 % larger than the starting population used by the PVA. The larger starting population would result in a population which may possess greater resilience with respect to additional mortality.

172. Regarding the PVA for razorbill, the use of avoidance rates of between 98 % and 99.9 % suggests that the population would continue to grow compared to the latest colony count if a 40 MW array consisting of devices which cause the largest impact on this species was deployed and operated for 25 years. At the lowest assessed avoidance rate (95 %), after 25 years under these conditions, the PVA predicts an overall razorbill population of 24.1 % when compared with the predicted unimpacted conditions after 25 years, or 56.4 % of the population at the latest colony count. Avoidance rates of 99 % or higher result in a population of at least 86.1 % the size of the predicted baseline population, or above, whilst at an avoidance rate of 98 %, the population is expected to be 71.3 % of the baseline prediction after 25 years of Project operation.

Table 11-26 CPGR and CPS (25 year) Metrics for South Stack and Penlas SMP Sub-Colonies for Razorbill During the Breeding Season, 40 MW Worst-Case Deployment

Avoidance Rate	Growth Rate	Population After 25 Years (total individual breeding adults)	Counterfactual of Growth Rate	Counterfactual of 25 Year Population	25 Year Population Relative to Current Population
Baseline	1.035	3,430	N/A	N/A	2.338
95 %	0.977	827	0.945	0.241	0.564
98 %	1.021	2,446	0.987	0.713	1.667
99 %	1.028	2,953	0.994	0.861	2.013
99.5 %	1.031	3,140	0.996	0.915	2.140
99.9 %	1.033	3,266	0.998	0.952	2.226

173. Like guillemot, the razorbill population at the South Stack and Penlas SMP sub-colonies has been increasing since at least the early 1980's, but there is some evidence based on more recent counts that the population is unlikely to continue to grow indefinitely at the rate seen between the 1980's and the present day (JNCC, 2018). Whilst the reason for this is unclear, if colony growth is constrained in the medium term in its baseline state (i.e. in the absence of the Project), then it is possible that the differences between the different impact scenarios considered in the assessment and the predicted baseline may be smaller in reality than suggested by the PVA, though as stated above, CPGR and CPS are still useful indicators despite this. As with guillemot, the latest counts from the RSPB suggest a larger starting

population (1,790) than the 1,467 derived from SMP data (**Table 11-16**). This population is approximately 34 % larger than the starting population used by the PVA. The larger starting population would result in a population which may possess greater resilience with respect to additional mortality.

174. The following precautionary magnitudes of impact due to collision at a 40 MW deployment scale are considered appropriate, based on expert opinion, considering the wider backdrop of an increasing auk population in Wales (**Section 11.5.6)**, and assuming that 95 % avoidance rates are used on a precautionary basis:

- **High negative** for razorbill (breeding), and the South Stack and Penlas SMP sub-colonies;
- **Medium negative** for guillemot (breeding);
- **Low negative** for guillemot (non-breeding), razorbill (non-breeding) and red-throated diver non-breeding, year round); and
- **Negligible** for gannet (breeding), Manx shearwater (breeding), puffin (breeding) and shag (breeding), as well as cormorant (presumed), and all non-diving marine ornithology receptors (**Table 11-11**).

175. Whilst the above magnitudes of impact are used by the assessment for precautionary reasons, a change to 99 % avoidance rate would result in the following magnitudes of impact being assigned:

- **Low negative** for guillemot (breeding), razorbill (breeding), and the South Stack and Penlas SMP sub-colonies; and
- **Negligible** for gannet (breeding), guillemot (non-breeding), Manx shearwater (breeding), puffin (breeding), razorbill (non-breeding) and red-throated diver (non-breeding) and shag (breeding), as well as cormorant (presumed), and all non-diving marine ornithology receptors (**Table 11-11**).

11.6.6.3.4. Impact Significance

11.6.6.3.4.1. 240 MW Full Deployment Scenario

176. The impact significance for marine ornithology receptors for this impact, assuming a 95 % avoidance rate, which has been selected due to uncertainty in whether a higher avoidance rate is applicable, is as follows:

- **Major adverse** for guillemot (breeding), razorbill (breeding) and the South Stack and Penlas SMP sub-colonies;
- **Moderate adverse** for guillemot (non-breeding) and razorbill (non-breeding);
- **Minor adverse** for gannet (breeding), guillemot (non-breeding), Manx shearwater (breeding), puffin (breeding), razorbill (non-breeding), red-throated diver (non-breeding) and shag (breeding); and
- **Negligible** for all non-diving marine ornithology receptors.

11.6.6.3.4.2. 40 MW Worst Case Scenario

177. The impact significance for marine ornithology receptors for this impact, assuming a 95 % avoidance rate, which has been selected due to uncertainty in whether a higher avoidance rate is applicable, is as follows:

- **Major adverse** for razorbill (breeding) and the South Stack and Penlas SMP sub-colonies;
- **Moderate adverse** for guillemot (breeding);
- **Minor adverse** for gannet (breeding), guillemot (non-breeding), Manx shearwater (breeding), puffin (breeding), razorbill (non-breeding), red-throated diver (non-breeding) and shag (breeding); and
- **Negligible** for all non-diving marine ornithology receptors.

11.6.6.3.5. Mitigation and Residual Impact

11.6.6.3.5.1. 240 MW Full Deployment Scenario

178. To enable the consent of a maximum deployment of 240 MW of tidal devices as described in **Chapter 4, Project Description,** surveillance of key receptors supported by empirical information is required to give confidence that no significant impacts are occurring. An important aim will be refinement of CRM / ERM models to allow demonstration that predicted collisions are at a level that would not result in an ecologically significant adverse effect on razorbill and guillemot (e.g. demonstrating avoidance rates of at least 99.5 % for breeding guillemot, and 99.9 % for breeding razorbill).

179. A phased approach to deployment will allow collection of surveillance and empirical data required to give confidence that no significant adverse effects are apparent and refine estimates of avoidance rates and other parameters of the ERM and CRM models. As the key adverse impacts which constrain deployment would be on guillemot and razorbill breeding at the South Stack and Penlas SMP sub-colonies, these colonies would be the focus of attention. A monitoring strategy, developed as part of an Environmental Mitigation and Monitoring Plan (EMMP) would include three principal aims; monitoring bird use of the MDZ area and in particular in the vicinity of TECs (e.g. coastal vantage point watches, boat or aerial surveys), monitoring seabird colonies with connectivity to the Project (recording numbers, breeding success and survival rates), and recording the behaviour of birds in the immediate vicinity of TECs (e.g. through underwater sonar/video devices attached to TECs) and/or (if possible due to practical issues such as the ability to safely access colonies for bird capture and tag deployment) deployment of tags recording locations and diving behaviour of guillemots and razorbills from the South Stack and Penlas SMP sub-colonies. The EMMP when developed, would also include mitigation and monitoring plans for marine mammal receptors, with further details discussed in **Chapter 12, Marine Mammals.**

180. The general goals of the monitoring strategy would be to provide finer scale information on distribution, densities, diving depths and bird behaviour in the vicinity of TECs, throughout the day and night, refine the accuracy of / reduce uncertainty in input parameters and avoidance rates for ERM/CRM.

181. This monitoring work would be undertaken in conjunction with SNCBs under appropriate licensing arrangements.

182. Further information on the proposed monitoring is described in **Document MOR/RHDHV/DOC/0072, Outline Environment Mitigation and Monitoring Plan**.

183. The EMMP will aim to demonstrate refinement of CRM / ERM models and use other methods and approached such as design of array location and layout to reduce risk, such that the predicted collisions are at a level that would not result in an ecologically significant adverse effect on razorbill and guillemot (e.g. setting of avoidance to at least 99.5 % for breeding guillemot, and 99.9 % for breeding razorbill), the magnitude of impact could be revised to "low adverse" for both species, as well as the South Stack and Penlas SMP sub-colonies. This would result in a residual impact significance of **Minor adverse** for all three receptors.

11.6.6.3.5.2. 40 MW Worst Case Scenario

184. To enable the consent of an initial 40 MW commercial deployment of tidal devices, it may be necessary to collect data and maintain surveillance of receptor groups in order to increase confidence in the assessments undertaken. For example, the collection of further empirical information may allow refinement of CRM / ERM models such that the predicted collisions can be demonstrated to be at a level that would not result in an ecologically significant adverse effect on razorbill and guillemot (e.g. demonstrating avoidance rates of at least 98 % or greater for guillemot, and 99 % or greater for razorbill).

185. The intention of the Project is to install a first commercial phase of development at around 40 MW, as detailed in **Chapter 25, Socio-economics, Tourism and Recreation**. To build out to that scale and beyond to 240 MW will require several years, and within that timeframe the establishment of monitoring and mitigation measures through an Environmental Mitigation and Management Plan (EMMP) is proposed. The EMMP would also support mitigation and management requirements identified within **Chapter 12, Marine Mammals**. Before the first deployment and between subsequent deployments, detailed information on the behaviour of guillemot and razorbill breeding at the South Stack and Penlas SMP sub-colonies will be collected using three principal methods; coastal vantage point watches, colony counts, and a dual deployment of bird-borne time-depth-temperature recorders and GPS recorders on as large a sample size of the South Stack and Penlas SMP sub-colonies population as is permitted (and is possible due to practical issues such as the ability to safely access colonies for bird capture and tag deployment). Other methods such as boat-based surveys will be considered.

186. The general goals of the tagging would be to provide finer scale distribution information and densities to feed into refined ERM/CRM, and the production of depth distributions for diving guillemot and razorbill, which would also feed into refined ERM/CRM. Finally, information enabling more accurate modelling of nocturnal diving behaviour, and the risk that birds undertaking these behaviours are subject to with regard to collision with tidal devices.

187. This monitoring work would be undertaken in conjunction with SNCBs under appropriate licensing arrangements. Other methods (for example the use of sonar data for diving birds) will be considered for inclusion in the monitoring programme where their deployment could provide useful information.

188. Further information on the proposed monitoring is described in **Document MOR/RHDHV/DOC/0072, Outline Environment Mitigation and Monitoring Plan**.

189. Should the proposed monitoring work be successful in justifying the setting of avoidance rates to the required levels, the magnitude of impact could be revised to "low negative" for both species, as well as the South Stack and Penlas SMP sub-colonies. This would result in a residual impact significance of **Minor adverse** for all three receptors.

11.6.6.4. Entanglement with Tidal devices

11.6.6.4.1. Introduction

190. The operational / repowering phase of the Project has the potential to affect bird populations in the marine environment through birds becoming entangled in tidal devices, resulting in mortality through drowning or possible injury. This could occur at considerable depth, or nearer the surface in the case of moorings of floating or surface emergent tidal devices.

191. Any impacts resulting from this impact pathway would be spatially restricted to subtidal areas adjacent to devices, and temporally restricted to the duration of operation (up to 35 years; long term). A maximum of 130 surface emergent devices may be deployed in total.

11.6.6.4.2. Receptor Sensitivity

192. The sensitivity of each of the marine ornithology receptors to entanglement has been assessed using the classification of species in Furness et al. (2012) according to their apparent drowning risk. A score of one was defined as extremely low risk, whilst a score of five was defined as moderate risk. These classifications have been used to screen out species not considered susceptible to this impact pathway (**Table 11-27**).

Table 11-27 Screening Exercise Undertaken for Potential Entanglement Impacts During the Operation / Repowering of the Project

Species	Drowning Risk[1]	Screening Result (In or Out)	Justification
Arctic tern	1	Out	Low susceptibility to drowning
Black-headed gull	1	Out	Low susceptibility to drowning
Common gull	1	Out	Low susceptibility to drowning
Common scoter	4	Out	Only recorded occasionally (5/24 surveys), always in flight, and usually in coastal locations
Common tern	1	Out	Low susceptibility to drowning
Cormorant	4	In	Only recorded occasionally (2/24 surveys) in very low numbers, always in flight, but screened in as attraction into MDZ possible due to provision of roosting platforms by tidal devices
Eider	4	Out	Recorded on only one baseline survey
Fulmar	1	Out	Low susceptibility to drowning
Gannet	2	Out	Low susceptibility to drowning
Great black-backed gull	1	Out	Low susceptibility to drowning
Guillemot	4	In	Potentially susceptible to drowning and abundant in MDZ; screened in

Species	Drowning Risk[1]	Screening Result (In or Out)	Justification
Herring gull	1	Out	Low susceptibility to drowning
Kittiwake	1	Out	Low susceptibility to drowning
Lesser black-backed gull	1	Out	Low susceptibility to drowning
Manx shearwater	1	Out	Low susceptibility to drowning
Mediterranean gull	1	Out	Low susceptibility to drowning
Puffin	3	In	Potentially susceptible to drowning and abundant in MDZ; screened in
Razorbill	4	In	Potentially susceptible to drowning and relatively abundant in MDZ; screened in
Red-throated diver	4	In	Recorded infrequently (8/24 surveys) and in low numbers but screened in on a precautionary basis due to sensitivity to impact
Sandwich tern	1	Out	Low susceptibility to drowning
Shag	4	In	Recorded infrequently (8/24 surveys) and in low numbers, but screened in as attraction into MDZ possible due to provision of roosting platforms by tidal devices
Notes [1]Furness et al., (2012)			

193. Whilst the risk of drowning is less than moderate for all marine ornithology receptors according to Furness et al., (2012), there is potential for entanglement impacts on cormorant, guillemot, puffin, razorbill, red-throated diver and shag. The conclusions of the screening assessment are supported by a review of literature relating to bycatch of seabirds (Žydelis et al., 2013, 2009).

194. The following sensitivities to this impact pathway have been allocated according to the definitions in **Chapter 5, EIA Methodology**:

- **Medium** for cormorant, guillemot, puffin, razorbill, red-throated diver and shag; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

11.6.6.4.3. Magnitude of Impact

195. Any impacts resulting from this impact pathway will be spatially restricted to the areas occupied by the tidal devices themselves, and temporally restricted to the duration of their operation (i.e. long term). The consequence of entanglement is likely to be a fatality of the bird involved and a consequent permanent reduction in the relevant population.

196. Whilst seabird bycatch in gill nets is known to be a major issue for seabird populations (Žydelis et al., 2013, 2009), the design of a tidal energy converter means that they pose a much lower risk to seabirds with respect to entanglement and drowning. There are no loose cables or lines associated with the devices, and anchor chains and cables are substantial and not light enough to loop or coil. The structures themselves are designed to be hydrodynamic, and not offer surfaces for entanglement.

197. On the basis of the available information, the magnitude of impact is therefore considered to be:

- **Low negative** for cormorant, guillemot, puffin, razorbill, red-throated diver and shag; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

11.6.6.4.4. Impact Significance

198. The impact significance for marine ornithology receptors for this impact is as follows:

- **Minor adverse** for cormorant, guillemot, puffin, razorbill, red-throated diver and shag; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

11.6.6.5. Other Impacts

11.6.6.5.1. Introduction

199. Indirect impacts on marine ornithology receptors may occur during the operational / repowering phase if there are impacts on prey species and the habitats of prey species. These include those resulting from the production of underwater noise and the generation of suspended sediments that may alter the behaviour or availability of prey species for seabirds. There is also the possibility of pollution incidents due to ejection of contaminants or accidents involving tidal devices, and/or vessels. As well as resulting in potential indirect effects on seabirds, direct impacts due to direct contact with contaminants is possible and is also covered in this section.

11.6.6.5.2. Receptor Sensitivity

200. Underwater noise may cause fish and mobile invertebrates to avoid the construction area and its immediate surroundings, and also affect their physiology and behaviour. Suspended sediments may cause fish and mobile invertebrates to avoid the construction area and its immediate surroundings and may smother and hide immobile benthic prey in a localised area. These mechanisms may result in less prey being available within the MDZ and immediate surrounding area to foraging seabirds. Pollution events may cause localised injury or mortality to seabirds or their prey species in the immediate vicinity of the source of the pollution.

201. Generally speaking, seabirds are mobile animals. In the breeding season they adopt a central place foraging strategy, restricting their foraging areas to enable them to successfully provision their chicks. In the non-breeding season, birds may be sedentary, remaining in the area where they bred, dispersive, or fully migratory. The mobility of seabirds means that they are able to utilise alternative areas of habitat should an area of habitat within their range become unavailable. Habitat flexibility is also an important criterion in determining the ability of a particular species to find alternative foraging habitat, and whilst a qualitative measure, it has been reviewed by several sources (Furness et al., 2012; Furness and Wade, 2012; Garthe and Hüppop, 2004).

202. The sensitivities of ornithological receptors for these impacts during construction, presented in **Table 11-18** remain relevant for the operational / repowering phase of the Project. This means that Arctic tern, common tern, common scoter, cormorant, eider, guillemot, puffin, razorbill, red-throated diver, Sandwich tern and shag are considered to have “low” sensitivity, and black-headed gull, common gull, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater and Mediterranean gull a **Negligible** sensitivity.

11.6.6.5.3. Magnitude of Impact

203. With regard to noise impacts, **Chapter 10, Fish and Shellfish Ecology** and **Chapter 14, Commercial Fisheries** discuss the potential impacts upon fish relevant to marine ornithology as prey species. For species such as herring, sprat and sandeel, which are prey items of several seabirds that are being assessed in this EcIA, the impact magnitude of underwater noise effects (physical injury or behavioural changes) and habitat loss during operation / repowering is considered to be minor or negligible. With regard to the definitions of impact magnitude given in **Chapter 5, EIA Methodology**, it is concluded that the magnitude of impact on seabirds occurring in or around the Project during the operational phase is **Negligible**. This applies to direct effects on seabirds themselves, and their prey.

204. With regard to changes to the seabed and to suspended sediment levels, **Chapter 7, Metocean Conditions and Coastal Processes** and **Chapter 9, Benthic and Intertidal Ecology** discuss the nature of any change and impacts on the seabed and benthic habitats, which host seabird prey species. The maximum envisaged effect associated with sediment plumes arising from the construction phase will cause only very minor increases in suspended sediment concentration; typically less than 1 mg/l a short distance from the release point, over a distance of several hundred metres. During the operational / repowering phase the same value has been assumed, which is considered to be a highly precautionary approach. The effects will be temporary and fully reversible, with a return to very low background concentrations occurring rapidly upon cessation of installation activities. Other than at the immediate release point, such a change would be immeasurable. It is concluded that the magnitude of impact on seabirds occurring in or around the Project during the operational / repowering phase is **Negligible**.

205. Any pollution incidents, which are considered to be unlikely to occur, will result in the contamination of a small area (likely no more than several hundreds of metres) of subtidal habitat with a small amount of pollution. Measures will be in place to rapidly collect or disperse any such contamination, meaning that its presence will be temporary and reversible. Tidal devices contain very small amounts of potential pollutant in the form of lubricant. Based on the definitions of impact magnitude given in **Chapter 5, EIA Methodology**, the magnitude of impact is considered to be negligible.

11.6.6.5.4. Impact Significance

206. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Negligible** for Arctic tern, black-headed gull, common gull, common tern, common scoter, cormorant, eider, fulmar, gannet, great black-backed gull, guillemot, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull, puffin, razorbill, red-throated diver, Sandwich tern and shag.

11.6.7. Potential Impacts During Decommissioning

11.6.7.1. Introduction

207. Any effects generated during the decommissioning phase of the Project are expected to be similar to those generated during the construction phase (Section 11.6.5). This is because decommissioning is assumed involve a reverse of the construction phase through the removal of some structures and materials installed. The duration of the decommissioning phase is assumed to be similar to the construction.

208. It is anticipated that any future activities would be programmed in close consultation with the relevant statutory marine and nature conservation bodies, to allow any future guidance and best practice to be incorporated to minimise any potential impacts.

209. The following sections briefly summarise the predicted impact significance of the activities proposed during decommissioning and are identical to those expected during construction. Further background and detail is provided in **Section 11.6.5**.

11.6.7.2. Airborne Noise and Visual Disturbance

210. The impact significance for marine ornithology receptors for airborne noise and visual disturbance during decommissioning is as follows:

- **Minor adverse** for guillemot, puffin, razorbill, red-throated diver and shag; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

11.6.7.3. Disturbance at Breeding Sites

211. The impact significance for marine ornithology receptors for disturbance at breeding sites during decommissioning is as follows:

- **Medium adverse** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating within 300 m from the colonies; and
- **Negligible** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating in excess of 300 m from the colonies.

212. Based on the species known to breed at each of the potentially affected colonies (**Table 11-16**), and excluding any species understood to possess a "low" sensitivity to disturbance and displacement when at sea (**Table 11-13**), it is considered that it is appropriate to prohibit all vessel activities within 300 m of each of these colonies during the breeding season. This is considered to be March to July for Abraham's Bosom and February to August for South Stack and Gogarth based on the species present at the last count (JNCC, 2018).

213. If this measure is adopted, then the receptor sensitivity can be reduced from "medium" to "low" as most of the individuals will not be present outside the breeding season. The magnitude of

impact can also be reduced from "medium" to "low" based on the definitions provided in **Chapter 5, EIA Methodology**. The residual impact significance is **Minor adverse**.

11.6.7.4. Other Impacts

214. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, guillemot, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull, puffin, razorbill, red-throated diver, Sandwich tern and shag.

11.6.8. Cumulative Impacts

11.6.8.1. Screening for Cumulative Impacts

215. The potential effects from the Project that were screened in for assessment for the Project alone were further screened for the potential for cumulative effects with other projects. This process is detailed in **Table 11-28**.

Table 11-28 Cumulative Impact Assessment Screening

Impact	Potential for Cumulative Impact	Confidence of Prediction[1]	Justification
Airborne noise and visual disturbance	Yes	High	The likelihood that there would be a cumulative impact is low because the impact as a result of the Project occurs on a small spatial scale and it is dependent on a spatial co-incidence of disturbance / displacement from other plans or projects. However, one such project has been identified, therefore a more detailed assessment will be carried out for construction and operational / repowering impacts.
Disturbance at breeding sites	No	High	The likelihood that there would be a cumulative impact is low because it would be dependent on a spatial co-incidence of disturbance / displacement from other plans or projects during either construction or operation / repowering of the Project, of which none have been identified.
Collision risk with tidal devices	Yes	High	There is a sufficient likelihood of a cumulative impact to justify a quantitative cumulative impact assessment during the operational / repowering period of the Project. Cumulative impact due to collision risk from offshore wind farms has been screened out, as the collision risk to species as a result of the project that are also susceptible to collision with wind turbines (i.e. gannet) is very low (<3 birds per year under all deployment scenarios). All other species assessed as being at risk of collision during the

Impact	Potential for Cumulative Impact	Confidence of Prediction[1]	Justification
			operation / repowering of the Project are known not to be susceptible to collision with wind turbines.
Entanglement with tidal devices	No	High	The likelihood that there would be a cumulative impact is low because the impact as a result of the project is small in scale and magnitude, especially when compared to the wider issue of seabird bycatch.
Other impacts	No	High	The likelihood that there would be a cumulative impact is low because the impact as a result of the Project occurs on a small spatial scale and it is dependent on a temporal and spatial co-incidence of similar impacts from other plans or projects, of which none have been identified or are considered likely.
Notes [1]Indicates the degree of confidence; medium / low reflects lower confidence in older assessments which used variable methods.			

216. Two potential effects, airborne noise and visual disturbance, and collision risk (excluding offshore wind farms), were screened in for cumulative assessment.

11.6.8.2. Projects Considered for Cumulative Impacts

217. The classes of projects that could potentially be considered for the cumulative assessment of marine ornithology receptors include offshore wind farms, other marine renewable energy projects, marine aggregate extraction, oil and gas exploration and extraction, port and harbour projects, subsea cables and pipelines and commercial shipping. The identification of projects to include in the cumulative assessment of offshore ornithological receptors has been based on approved plans, constructed projects, approved but as yet unconstructed projects, projects for which an application has been made, is currently under consideration and may be consented. In addition, other “foreseeable” projects are included: those for which an application has not been made but have been the subject of consultation by the developer, or those are listed in plans that have clear delivery mechanisms. For such projects, the absence of robust or relevant data could preclude a quantitative cumulative assessment being carried out.

218. For airborne noise and visual disturbance, only projects occurring locally that involve activities in subtidal habitat are considered to have the potential to cause cumulative impacts in conjunction with the Project (**Table 11-29**). Any projects which have been ongoing since the collection of baseline data (e.g. Holyhead Harbour Maintenance Dredging) are not considered on the basis that they form part of the baseline.

219. Only other marine energy projects (i.e. those with contributions to underwater collision risk) are considered to have potential to contribute to cumulative collision risk (**Table 11-30**). Cumulative impact due to collision risk from offshore wind farms has been screened out, as the collision risk to species as a result of the Project that are also susceptible to collision with wind turbines (i.e. gannet) is very low (approximately zero to three birds per year based on a 240 MW deployment), and the reference population very large (**Section 11.6.6.3**). All other species assessed as being at risk of collision during the operation / repowering of the Project are known to not be

particularly susceptible to collision with wind turbines during flight (Dierschke et al., 2016), due mainly to the low flight heights they favour at sea (Furness et al., 2013; Garthe and Hüppop, 2004).

Table 11-29 Summary of Projects Considered in CIA for Airborne Noise and Visual Disturbance Impact Pathway

Project	Status	Distance from Nearest Part of Project (km)	Data Status	Justification for Inclusion
Holyhead Deep Phase I	In April 2017, a Marine Licence was granted for the first 0.5 MW installation	2	Complete for marine ornithology receptors	Consented project that does not yet form part of the baseline
Holyhead Deep Phase II	Scoping Report submitted in 2017; EIA presumed to be in preparation	2	No information available	Possible project that does not yet form part of the baseline
Holyhead Port Expansion	Scoping Report submitted 28/04/17; EIA in preparation	2	Draft, unpublished assessment available	Possible project that does not yet form part of the baseline

Table 11-30 Summary of Projects Considered in CIA for Underwater Collision Risk Impact Pathway

Project	Status	Distance from Nearest Part of Project (km)	Data Status	Justification for Inclusion
Holyhead Deep Phase I	In April 2017, a Marine Licence was granted for the first 0.5 MW installation	2	Complete for marine ornithology receptors	Consented project that does not yet form part of the baseline
Holyhead Deep Phase II	Scoping Report submitted in 2017; EIA presumed to be in preparation	2	No information available	Possible project that does not yet form part of the baseline
Bardsey Sound	An Agreement for Lease was awarded pre-May 2018. The project would include up to 20 100 kW turbines	50	None available	Possible project that does not yet form part of the baseline
Argyll Tidal Demonstration	Marine licence secured in 2015, status of works unknown	225	Complete for marine ornithology receptors	Consented project that does not yet form part of the baseline
Fair Head Marine Renewable Tidal Array	Environmental Statement presented. Target to be operational by 2021	228	Complete for marine ornithology receptors	Consented project that does not yet form part of the baseline
Sound of Islay Demonstration Site	Consented – construction programme not known	268	Complete for marine ornithology receptors	Consented project that does not yet form part of the baseline

Project	Status	Distance from Nearest Part of Project (km)	Data Status	Justification for Inclusion
West Islay Tidal Energy Farm	Consented – construction programme not known but scheduled for completion by 2022	268	Complete for marine ornithology receptors	Consented project that does not yet form part of the baseline

11.6.8.3. Cumulative Impact of Airborne Noise and Visual Disturbance

220. The assessment for the Project alone has identified a Minor adverse impact significance for guillemot due to airborne noise and visual disturbance during the construction and operation / repowering of the Project. Although between zero and approximately six guillemots could be lost due to this impact each year, this is not considered to represent a significant proportion of the local, regional or national population of this species.

221. The Environmental Statement for the “Holyhead Deep Phase I” project suggested that disturbance of guillemot to some extent is certain to occur during the construction and installation of the Project, but due to the relatively low numbers of birds present (<1 % of the regional breeding population), the impact was judged to be of negligible significance. The same conclusion was reached for the operational / repowering phase of the Project.

222. For the “Holyhead Deep Phase II” project, no information was available.

223. For the “Holyhead Port Expansion” project, no information was available.

224. As a result of these findings, the magnitude of this cumulative impact on guillemot (judged to be of **High** value and **Low** sensitivity) is considered to be **Negligible**, resulting in a **Negligible** cumulative impact significance.

11.6.8.4. Cumulative Impact of Collision Risk

11.6.8.4.1. Gannet

225. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for gannet (breeding) due to underwater collision.

226. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for gannet (breeding) due to underwater collision.

227. For the “Holyhead Deep Phase I”, “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects, the impact significance for gannet as a result of collision was defined as negligible.

228. For the “Holyhead Deep Phase II” project, no information was available.

229. For the “Bardsey Sound” project, no information was available.

230. As a result of these findings, the magnitude of this cumulative impact on gannet (judged to be of **High** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.2. Guillemot

231. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for guillemot (breeding and non-breeding) due to underwater collision subject to mitigation in the form of a deployment and monitoring strategy.

232. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for guillemot (breeding and non-breeding) due to underwater collision subject to mitigation in the form of a deployment and monitoring strategy.

233. For the “Holyhead Deep Phase I” project, it was considered that collisions of this species were likely to occur, and the impact significance was defined as negligible and not significant.

234. For the “Holyhead Deep Phase II” project, no information was available.

235. For the “Bardsey Sound” project, no information was available.

236. As the “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects are located well in excess of the known foraging range for this species (Cleasby et al., 2018; Oppel et al., 2018; Thaxter et al., 2012) at the South Stack and Penlas SMP subcolonies, cumulative impacts for these projects are not considered relevant to breeding guillemot. Whilst the impacts may be relevant to the non-breeding UK Western Waters BDMPS population, this is unlikely due to the size of that population and the scale of these developments.

237. As a result of these findings, the magnitude of this cumulative impact on guillemot (judged to be of **High** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.3. Manx Shearwater

238. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for Manx shearwater (breeding) due to underwater collision.

239. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for Manx shearwater (breeding) due to underwater collision.

240. For the “Holyhead Deep Phase I”, “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects, the impact significance for Manx shearwater as a result of collision was defined as negligible.

241. For the “Holyhead Deep Phase II” project, no information was available.

242. For the “Bardsey Sound” project, no information was available.

243. As a result of these findings, the magnitude of this cumulative impact on Manx shearwater (judged to be of **High** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.4. Puffin

244. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for puffin (breeding) due to underwater collision.

245. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for puffin (breeding) due to underwater collision.

246. For the “Holyhead Deep Phase I” project, the impact significance for puffin of collision was defined as negligible.

247. For the “Holyhead Deep Phase II” project, no information was available.

248. For the “Bardsey Sound” project, no information was available.

249. As the “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects are located well in excess of the known foraging range for this species, cumulative impacts for these projects are not considered relevant.

250. As a result of these findings, the magnitude of this cumulative impact on puffin (judged to be of **High** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.5. Razorbill

251. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for razorbill (breeding and non-breeding) due to underwater collision following mitigation.

252. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for razorbill (breeding and non-breeding) due to underwater collision following mitigation.

253. For the “Holyhead Deep Phase I” project, it was considered that collisions of this species were likely to occur, and the impact significance was defined as negligible and not significant.

254. For the “Holyhead Deep Phase II” project, no information was available.

255. For the “Bardsey Sound” project, no information was available.

256. As the “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects are located well in excess of the known foraging range for this species (Cleasby et al., 2018; Oppel et al., 2018; Thaxter et al., 2012), cumulative impacts for these projects are not considered relevant to breeding razorbill. However, the impacts may be relevant to the non-breeding UK Western Waters

BDMPS population. For all projects, the impact significance for razorbill of collision was defined as negligible .As the “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects are located well in excess of the known foraging range for this species (Cleasby et al., 2018; Oppel et al., 2018; Thaxter et al., 2012), cumulative impacts for these projects are not considered relevant to breeding razorbill. However, the impacts may be relevant to the non-breeding UK Western Waters BDMPS population. For all projects, the impact significance for razorbill of collision was defined as negligible.

257. As a result of these findings, the magnitude of this cumulative impact on razorbill (judged to be of **High** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.6. Red-Throated Diver

258. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for red-throated diver (non-breeding) due to underwater collision.

259. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for red-throated diver (non-breeding) due to underwater collision.

260. For the “Holyhead Deep Phase I”, “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects, the impact significance for red-throated diver as a result of collision is assumed to be negligible as it was generally not considered as being at risk of collision and therefore not assessed in detail.

261. For the “Holyhead Deep Phase II” and “Bardsey Sound” projects, no information was available.

262. As a result of these findings, the magnitude of this cumulative impact on red-throated diver (judged to be of **Medium** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.7. Shag

263. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for shag (breeding and non-breeding) due to underwater collision. Zero collisions per year were predicted assuming an avoidance rate of 95 % or greater.

264. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for shag (breeding and non-breeding) due to underwater collision. Between zero and one collisions per year were predicted assuming an avoidance rate of 95 % or greater.

265. For the “Holyhead Deep Phase I” project, this species was not assessed for collision risk. It is therefore assumed that the impact significance is negligible.

266. For the “Holyhead Deep Phase II” project, no information was available.

267. As the “Bardsey Sound”, “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects are located well in excess of the known foraging range for this species (Cleasby et al., 2018; Oppel et al., 2018; Thaxter et al., 2012), and there is no spatial overlap of the relevant BDMPS (Furness, 2015), cumulative impacts for these projects are not considered relevant for this species.

268. As a result of these findings, the magnitude of this cumulative impact on shag (judged to be of **Medium** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.7. TRANSBOUNDARY IMPACTS

269. With regard to the potential for transboundary cumulative impacts, there is clearly potential for underwater collisions beyond UK territorial waters. However, any proposed marine energy development in Ireland is relatively small, and/or located on the west and north coasts. Since the spatial scale and hence seabird populations sizes for a transboundary assessment would be much larger, it is apparent that the scale of development expected would make no material difference to the assessment. For this reason, a quantitative assessment has not been carried out.

11.8. INTER-RELATIONSHIPS

270. The construction, operation / repowering and decommissioning phases of the Project would cause a range of effects on marine ornithology receptors. The magnitude of these effects has been assessed individually using expert knowledge and judgement, drawing from a wide scientific knowledge base that includes project-specific surveys and previously acquired knowledge of the bird ecology of the relevant geographical area (from published scientific papers and books, and ‘grey’ literature).

271. Impacts to marine ornithology receptors may be inter-related with other receptor groups. This is considered to be the case for impacts through effects on habitats and prey species only. For direct disturbance/displacement and collision risk there is considered to be no potential for interaction with other receptor groups.

272. Inter-relationships are summarised in **Table 11-31**, which indicates where assessments carried out in other chapters have been used to inform the offshore ornithology assessment.

Table 11-31 Inter-Topic Relationships

Impact	Related Chapter(s)	Relevant Section(s) in Chapter	Justification
Impacts on prey species and their habitats during construction	Chapter 7, Metocean and Coastal Processes Chapter 10, Fish and Shellfish Ecology	Section 11.6.5.3	Potential impacts on benthic ecology and fish and shellfish during construction could affect the prey
Impacts on prey species and their habitats during operation / repowering		Section 11.6.6.5	

Impact	Related Chapter(s)	Relevant Section(s) in Chapter	Justification
Impacts on prey species and their habitats during decommissioning	Chapter 14, Commercial Fisheries	Section 11.6.7.4	resource for marine ornithology receptors

11.9. INTERACTIONS

273. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts. The worst case impacts assessed within the chapter take these interactions into account and therefore the impact assessments are considered conservative and robust. For clarity, the areas of interaction between impacts that have been classified as greater than negligible impact significance are presented in **Table 11-32** for construction and **Table 11-33** for operation / repowering. The potential for interactions of impacts anticipated during decommissioning are as per the construction impacts in **Table 11-32**.

Table 11-32 Potential for Interactions Between Impacts During Construction

	Airborne Noise and Visual Disturbance	Disturbance at Breeding Sites
Airborne Noise and Visual Disturbance	-	Unlikely, due to the use of appropriate vessel standoff zones around breeding colonies during the breeding season
Disturbance at Breeding Sites	Unlikely, due to the use of appropriate vessel standoff zones around breeding colonies during the breeding season	-

Table 11-33 Potential for Interactions Between Impacts During Operation / Repowering

	Airborne Noise and Visual Disturbance	Disturbance at Breeding Sites	Collision Risk with Tidal Devices	Entanglement with Tidal Devices
Airborne Noise and Visual Disturbance	-	Unlikely, due to the use of appropriate vessel standoff zones around breeding colonies during the breeding season	Possible interaction reflected by inclusion of mortality due to both pathways in PVA; possible attraction effects on shag and cormorant causing elevated collision risk than currently reported	No potential for significant synergistic effect
Disturbance at Breeding Sites	Unlikely, due to the use of appropriate vessel standoff zones around breeding colonies during the breeding season	-	No potential for significant synergistic effect	No potential for significant synergistic effect

	Airborne Noise and Visual Disturbance	Disturbance at Breeding Sites	Collision Risk with Tidal Devices	Entanglement with Tidal Devices
Collision Risk with Tidal Devices	Possible interaction reflected by inclusion of mortality due to both pathways in PVA; possible attraction effects on shag and cormorant causing elevated collision risk than currently reported	No potential for significant synergistic effect	-	Possible, but risk of collision much higher than risk of entanglement, so synergistic effect not considered significant
Entanglement with Tidal Devices	No potential for significant synergistic effect	No potential for significant synergistic effect	Possible, but risk of collision much higher than risk of entanglement, so synergistic effect not considered significant	-

11.10. SUMMARY

274. This chapter provides an assessment of the potential impacts on marine ornithology receptors that may arise from marine-based activities during construction, operation / repowering and decommissioning of the Project. It describes the relevant components of the proposed Project; the consultation that has been held with stakeholders; the scope and methodology of the assessment; the avoidance and mitigation measures that have been embedded through project design; the baseline data on birds and important sites and habitats for birds acquired through desk study and survey (**Appendices 11.1 and 11.2, Volume III**) and assesses the potential impacts on marine ornithology receptors.

275. Detailed consultation with regard to the overall approach to the impact assessment on marine ornithology receptors has informed this assessment through the Ornithology TWG, which involved NRW.

276. A survey area covering the MDZ and a 2 km buffer was surveyed using a boat-based methodology over 24 months. The results of these surveys have been used to estimate the abundance and assemblage of birds using or passing across the area.

277. The impacts that could potentially arise for marine ornithology receptors during the construction, operation / repowering and decommissioning of the Project were discussed within Ornithology TWG meetings. As a result of those discussions, the potential impacts that required detailed assessment were identified as follows:

- During construction and installation:
    - Airborne noise and visual disturbance;
    - Disturbance at breeding sites; and

    - Other impacts, which consist of indirect impacts due to effects on prey and/or their habitats, as well as direct and indirect impacts through pollution events.
- During operation:
    - Airborne noise and visual disturbance;
    - Disturbance at breeding sites;
    - Collision with tidal devices;
    - Entanglement with tidal devices; and
    - Other impacts, which consist of indirect impacts due to effects on prey and/or their habitats, as well as direct and indirect impacts through pollution events.
- During decommissioning:
    - Airborne noise and visual disturbance;
    - Disturbance at breeding sites; and
    - Other impacts, which consist of indirect impacts due to effects on prey and/or their habitats, as well as direct and indirect impacts through pollution events.

278. During the construction and maintenance and decommissioning phases of the proposed Project, no impacts have been assessed to be greater than of minor adverse significance for any marine ornithology receptors.

279. During operation / repowering, underwater collision effects assessed for two scenarios have the potential to result in effects assessed to be greater than minor adverse significance, assuming a precautionary avoidance rate of 95 %. At a 40 MW worst case scenario, major adverse effects are predicted for razorbill (breeding) and the South Stack and Penlas SMP sub-colonies, and moderate adverse effects are predicted for guillemot (breeding). At an indicative 240 MW scenario, major adverse effects are predicted on guillemot (breeding), razorbill (breeding) and the South Stack and Penlas SMP sub-colonies, and moderate adverse for guillemot (non-breeding) and razorbill (non-breeding). The use of higher avoidance rates than 95 % results in a reduction in impact significance to a minor adverse level for all of the receptors listed above. However, to justify this position, a phased deployment approach, along with a detailed, multiyear monitoring program to collect further information to support the use of a higher avoidance rate would be required.

280. No other impacts predicted for any marine ornithology receptors during the operation / repowering phase of the Project have been assessed to be greater than minor adverse impact significance.

281. Two potential effects of the Project were screened in for cumulative impact assessment; airborne noise and visual disturbance (construction and operation / repowering) and collision risk. Other potential effects were screened out due to their temporary, small scale/magnitude and/or localised nature, and given the distances to other activities in the region it was concluded that there is no pathway for cumulative interaction.

282. A screening process was also carried out for potential plans and projects that might affect marine ornithology receptors cumulatively with the Project. These projects include offshore wind farms,

other marine renewable energy projects, marine aggregate extraction, oil and gas exploration and extraction, port and harbour projects, subsea cables and pipelines and commercial shipping. The risk to all marine ornithology receptors from cumulative displacement and collisions is assessed as no greater than minor adverse significance.

283. The potential for collisions and displacement from marine energy developments outside UK territorial waters (transboundary) to contribute to cumulative impacts was considered. Due to the scale of marine energy development currently proposed (both of the Project, and other projects), and the distances between them, transboundary impacts are not considered to be significant.

284. The identified impacts for the Project alone are summarised in **Table 11-34**, and no additional impact significance was found due to cumulative impacts for construction/operational airborne noise and visual disturbance, or collision.

Table 11-34 Summary of Impacts Identified for Marine Ornithology Receptors

Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction & Installation						
Airborne Noise and Visual Disturbance	Guillemot	High/Med	Low	Minor adverse	None	Minor adverse
	All other species	Various	Negligible	Negligible		Negligible
Disturbance at Breeding Sites	Abraham's Bosom	High/Negligible for activity >300 m from colony, medium if within <300 m. Low sensitivity if outside the breeding season within <300m	Negligible for activity >300 m from colony, medium if within <300 m	Medium adverse if <300 m during breeding season, otherwise negligible	No works within 300 m of any colony during breeding season	Negligible
	South Stack and Penlas RSPB					
	Gogarth					
Other Impacts	All species	Various/low or negligible	Negligible	Negligible	None	Negligible
Operation / repowering						
Airborne Noise and Visual Disturbance	Guillemot	High/Med	Low	Minor adverse	None	Minor adverse
	Cormorant	Low/High	Low	Minor beneficial		Minor beneficial
	All other species	Various	Negligible	Negligible		Negligible
	Shag	Med/Med	Low	Minor beneficial		Minor beneficial
Disturbance at Breeding Sites	Abraham's Bosom	High/Negligible for activity >300 m from colony, medium if within <300 m. Low sensitivity if outside the breeding season within <300m	Negligible for activity >300 m from colony, medium if within <300 m	Medium adverse if <300 m during breeding season, otherwise negligible	No works within 300 m of any colony during breeding season	Negligible
	South Stack and Penlas RSPB					
	Gogarth					
Collision risk with tidal devices (40 MW Worst	South Stack and Penlas SMP sub-colonies	High/High	High	Major adverse	Monitoring programme enabling use of higher	Minor adverse

Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Case, 95 % avoidance rate)					avoidance rate, plus phased deployment	
	Gannet	High/Med	Negligible	Minor adverse	None	
	Guillemot		Medium	Moderate adverse	Monitoring programme enabling use of higher avoidance rate, plus phased deployment	
	Manx shearwater		Low	Minor adverse	None	
	Puffin					
	Razorbill		High	Major adverse	Monitoring programme enabling use of higher avoidance rate, plus phased deployment	
	Red-throated diver	Med/Med	Low	Minor adverse	None	
	Shag		Negligible			
	All other species	Various/Neg		Negligible		Negligible
Collision risk with tidal devices (240 MW Indicative Array, 95 % avoidance rate)	South Stack and Penlas SMP sub-colonies	High/High	Very High	Major adverse	Monitoring programme enabling use of higher avoidance rate, plus phased deployment	Minor adverse
	Gannet	High/Med	Negligible	Minor adverse	None	
	Guillemot		Very High	Major adverse	Monitoring programme enabling use of higher avoidance rate, plus phased deployment	
	Manx shearwater		Low	Minor adverse	None	
	Puffin					
	Razorbill		Very High	Major adverse	Monitoring programme enabling use of higher	

Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
					avoidance rate, plus phased deployment	
	Red-throated diver	Med/Med	Low	Minor adverse	None	
	Shag		Negligible			
	All other species	Various/Neg		Negligible		Negligible
Entanglement with Tidal devices	Cormorant	Low/Med	Low	Minor adverse	None	Minor adverse
	Guillemot	High/Med				
	Puffin					
	Razorbill					
	Red-throated Diver	Med/Med				
	Shag					
	All other species	Various/Neg	Negligible	Negligible	None	Negligible
Other Impacts	All species	Various/low or negligible	Negligible	Negligible	None	Negligible
Decommissioning						
Airborne Noise and Visual Disturbance	Guillemot	High/Med	Low	Minor adverse	None	Minor adverse
	Puffin					
	Razorbill					
	Red-throated diver	Med/Very High				
	Shag	Med/Med				
	All other species	Various	Negligible	Negligible		Negligible
Disturbance at Breeding Sites	Abraham's Bosom	High/Negligible for activity >300 m from colony, medium if within <300 m. Low sensitivity if outside the breeding season within <300m	Negligible for activity >300 m from colony, medium if within <300 m	Medium adverse if <300 m during breeding season, otherwise negligible	No works within 300 m of any colony during breeding season	Negligible
	South Stack and Penlas RSPB					

Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
	Gogarth					
Other Impacts	All species	Various/low or negligible	Negligible	Negligible	None	Negligible

11.11. REFERENCES

Alerstam, T., Rosén, M., Bäckman, J., Ericson, P.G.P., Hellgren, O., 2007. Flight Speeds among Bird Species: Allometric and Phylogenetic Effects. PLOS Biology 5, e197. https://doi.org/10.1371/journal.pbio.0050197

Anderson, H.B., Evans, P.G.H., Potts, J.M., Harris, M.P., Wanless, S., 2014. The diet of Common Guillemot Uria aalge chicks provides evidence of changing prey communities in the North Sea. Ibis 156, 23–34. https://doi.org/10.1111/ibi.12099

APEM, 2017. Mainstream Kittiwake and Auk Displacement Report (APEM Scientific Report No. P000001836).

Banks, A.N., Burton, N.H.K., Calladine, J.R., Austin, G.E., 2007. Winter gulls in the UK: population estimates from the 2003/04-2005/06 Winter Gull Roost Survey (BTO Research Report No. 456).

Bicknell, A.W.J., Oro, D., Camphuysen, K. (C. J.), Votier, S.C., 2013. Potential consequences of discard reform for seabird communities. Journal of Applied Ecology 50, 649–658. https://doi.org/10.1111/1365-2664.12072

Bladwell, S., Noble, D.G., Taylor, R., Cryer, J., Galliford, H., Hayhow, D.B., Kirby, W., Smith, D., Vanstone, A., Wotton, S.R., 2018. The state of birds in Wales 2018. RSPB, BTO, NRW and WOS, Cardiff.

Bradbury, G., Trinder, M., Furness, B., Banks, A.N., Caldow, R.W.G., Hume, D., 2014. Mapping Seabird Sensitivity to Offshore Wind Farms. PLOS ONE 9, e106366. https://doi.org/10.1371/journal.pone.0106366

Brooke, M. de L., Bonnaud, E., Dilley, B.J., Flint, E.N., Holmes, N.D., Jones, H.P., Provost, P., Rocamora, G., Ryan, P.G., Surman, C., Buxton, R.T., 2017. Seabird population changes following mammal eradications on islands. Animal Conservation 21, 3–12. https://doi.org/10.1111/acv.12344

Bruderer, B., Boldt, A., 2001. Flight characteristics of birds: I. radar measurements of speeds. Ibis 143, 178–204. https://doi.org/10.1111/j.1474-919X.2001.tb04475.x

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L., Thomas, L., 2001. Introduction to Distance Sampling: Estimating Abundance of Biological Populations. Oxford University Press, Oxford.

Burger, J., 1998. Effects of Motorboats and Personal Watercraft on Flight Behavior over a Colony of Common Terns. The Condor 100, 528–534. https://doi.org/10.2307/1369719

Burthe, S.J., Wanless, S., Newell, M.A., Butler, A., Daunt, F., 2014. Assessing the vulnerability of the marine bird community in the western North Sea to climate change and other anthropogenic impacts. Marine Ecology, Progress Series 507, 277–295. https://doi.org/10.3354/meps10849

Camphuysen, C.J., Fox, A.D., Leopold, M.F., Krag Petersen, I., 2004. Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the U.K. A comparison of ship and aerial sampling methods for marine birds, and their applicability to offshore wind farm assessments (No. COWRIE – BAM-02-2002). Royal Netherlands Institute for Sea Research.

Capuzzo, E., Lynam, C.P., Barry, J., Stephens, D., Forster, R.M., Greenwood, N., McQuatters-Gollop, A., Silva, T., Leeuwen, S.M., Engelhard, G.H., 2017. A decline in primary production in the North Sea over 25 years, associated with reductions in zooplankton abundance and fish stock recruitment. Global Change Biology 24, e352–e364. https://doi.org/10.1111/gcb.13916

Carroll, M., Butler, A., Owen, E., Ewing, S., Cole, T., Green, J., Soanes, L., Arnould, J., Newton, S., Baer, J., Daunt, F., Wanless, S., A. Newell, M., Robertson, G., A. Mavor, R., Bolton, M., 2015. Effects of sea temperature and stratification changes on seabird breeding success. Climate Research 66, 75–89. https://doi.org/10.3354/cr01332

Carroll, M.J., Bolton, M., Owen, E., Anderson, G.Q.A., Mackley, E.K., Dunn, E.K., Furness, R.W., 2017. Kittiwake breeding success in the southern North Sea correlates with prior sandeel fishing mortality. Aquatic Conservation: Marine and Freshwater Ecosystems 27, 1164–1175. https://doi.org/10.1002/aqc.2780

Christensen, T.K., Hounisen, J.P., Clausager, I., Petersen, I.K., 2004. Visual and radar observations of birds in relation to collision risk at the Horns Rev offshore wind farm: Annual status report 2003 (Report commissioned by Elsam Engineering A/S 2003). National Environmental Research Institute, Denmark.

CIEEM, 2018. Guidelines for Ecological Impact Assessment in the UK and Ireland. CIEEM, Winchester.

Cleasby, I.R., Owen, E., Wilson, L.J., Bolton, M., 2018. Combining habitat modelling and hotspot analysis to reveal the location of high density seabird areas across the UK (Research Report No. 63). RSPB Centre for Conservation Science.

Clewley, G.D., Scragg, E.S., Thaxter, C.B., Burton, N.H.K., 2017. Assessing the habitat use of Lesser Black-backed Gulls (Larus fuscus) from the Bowland Fells SPA ANNEX 1 – 2017 update (BTO Research Report No. 694a). BTO, Thetford.

Cook, A.S.C.P., Robinson, R.A., 2016. Testing sensitivity of metrics of seabird population response to offshore wind farm effects (JNCC Report No. 553). JNCC.

Coulson, J.C., 2011. The Kittiwake. T. and A.D. Poyser, London.

Cox, S.L., Miller, P.I., Embling, C.B., Scales, K.L., Bicknell, A.W.J., Hosegood, P.J., Morgan, G., Ingram, S.N., Votier, S.C., 2016. Seabird diving behaviour reveals the functional significance of shelf-sea fronts as foraging hotspots. Royal Society Open Science 3. https://doi.org/10.1098/rsos.160317

Cramp, S. (Ed.), 1985. Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. Volume 4: Terns to Woodpeckers. Oxford University Press.

Cramp, S., Simmons, K.E.L. (Eds.), 1983. Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. Volume 3: Waders to Gulls. Oxford University Press.

Cramp, S., Simmons, K.E.L. (Eds.), 1977. Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. Volume 1: Ostrich to Ducks. Oxford University Press.

Croxall, J.P., Butchart, S.H.M., Lascelles, B., Stattersfield, A.J., Sullivan, B., Symes, A., Taylor, P., 2012. Seabird conservation status, threats and priority actions: a global assessment. Bird Conservation International 22, 1–34. https://doi.org/10.1017/S0959270912000020

Dean, B., 2012. The at-sea behaviour of the Manx shearwater (Thesis submitted for the degree of Doctor of Philosophy). University of Oxford, Oxford.

Dean, B., Freeman, R., Kirk, H., Leonard, K., Phillips, R., M Perrins, C., Guilford, T., 2012. Behavioural mapping of a pelagic seabird: Combining multiple sensors and a hidden Markov model reveals the distribution of at-sea behaviour. Journal of the Royal Society Interface 10. https://doi.org/10.1098/rsif.2012.0570

Dean, B., Kirk, H., Fayet, A., Shoji, A., Freeman, R., Leonard, K., Perrins, C., Guilford, T., 2015. Simultaneous multi-colony tracking of a pelagic seabird reveals cross-colony utilization of a shared foraging area. Marine Ecology Progress Series 538, 239–248. https://doi.org/10.3354/meps11443

Deppe, L., Rowley, O., Rowe, L.K., Shi, N., McArthur, N., Gooday, O., Goldstien, S.J., 2017. Investigation of fallout events in Hutton's shearwaters (Puffinus huttoni) associated with artificial lighting. Notornis 64, 181–191.

Dierschke, V., Furness, R.W., Garthe, S., 2016. Seabirds and offshore wind farms in European waters: Avoidance and attraction. Biological Conservation 202, 59–68. https://doi.org/10.1016/j.biocon.2016.08.016

Dunnet, G.M., 1977. Observations on the effects of low-flying aircraft at seabird colonies on the coast of Aberdeenshire, Scotland. Biological Conservation 12, 55–63. https://doi.org/10.1016/0006-3207(77)90057-X

Eaton, M.A., Aebischer, N.J., Brown, A., Hearn, R., Lock, L., Musgrove, A.J., Noble, D.G., Stroud, D.A., Gregory, R.D., 2015. Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. British Birds 108, 708–746.

Foster, S., Marrs, S., 2012. Trend Note: Seabirds in Scotland (Note). Scottish Natural Heritage.

Foster, S., Swann, R.L., Furness, R.W., 2017. Can changes in fishery landings explain long-term population trends in gulls? Bird Study 64, 90–97. https://doi.org/10.1080/00063657.2016.1274287

Fraenkel, P.L., 2006. Tidal Current Energy Technologies. Ibis 148, 145–151. https://doi.org/10.1111/j.1474-919X.2006.00518.x

Frederiksen, M., Anker-Nilssen, T., Beaugrand, G., Wanless, S., 2012a. Climate, copepods and seabirds in the boreal Northeast Atlantic – current state and future outlook. Global Change Biology 19, 364–372. https://doi.org/10.1111/gcb.12072

Frederiksen, M., Daunt, F., Harris, M.P., Wanless, S., 2008. The demographic impact of extreme events: stochastic weather drives survival and population dynamics in a long-lived seabird. Journal of Animal Ecology 77, 1020–1029. https://doi.org/10.1111/j.1365-2656.2008.01422.x

Frederiksen, M., Furness, R., Wanless, S., 2007. Regional variation in the role of bottom-up processes in controlling sandeel abundance in the North Sea. Marine Ecology Progress Series 337, 279–286. https://doi.org/10.3354/meps337279

Frederiksen, M., Moe, B., Daunt, F., Phillips, R.A., Barrett, R.T., Bogdanova, M.I., Boulinier, T., Chardine, J.W., Chastel, O., Chivers, L.S., Christensen-Dalsgaard, S., Clément-Chastel, C., Colhoun, K., Freeman, R., Gaston, A.J., González-Solís, J., Goutte, A., Grémillet, D., Guilford, T., Jensen, G.H., Krasnov, Y., Lorentsen, S.-H., Mallory, M.L., Newell, M., Olsen, B., Shaw, D., Steen, H., Strøm, H., Systad, G.H., Thórarinsson, T.L., Anker-Nilssen, T., 2012b. Multicolony tracking reveals the winter distribution of a pelagic seabird on an ocean basin scale. Diversity and Distributions 18, 530–542. https://doi.org/10.1111/j.1472-4642.2011.00864.x

Frederiksen, M., Wanless, S., Harris, M.P., Rothery, P., Wilson, L.J., 2004. The role of industrial fisheries and oceanographic change in the decline of North Sea black-legged kittiwakes. Journal of Applied Ecology 41, 1129–1139. https://doi.org/10.1111/j.0021-8901.2004.00966.x

Frost, T.M., Austin, G.E., Calbrade, N.A., Mellan, H.J., Hearn, R.D., Stroud, D.A., Wotton, S.R., Balmer, D.E., 2018. Waterbirds in the UK 2016/17: The Wetland Bird Survey. BTO/RSPB/JNCC, Thetford.

Furness, R., 2015. Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS). Natural England Commissioned Report 164.

Furness, R.W., Garthe, S., Trinder, M., Matthiopoulos, J., Wanless, S., Jeglinski, J., 2018. Nocturnal flight activity of northern gannets Morus bassanus and implications for modelling collision risk at offshore wind farms. Environmental Impact Assessment Review 73, 1–6. https://doi.org/10.1016/j.eiar.2018.06.006

Furness, R.W., Wade, H.M., 2012. Vulnerability of Scottish seabirds to offshore wind turbines. Marine Scotland Science.

Furness, R.W., Wade, H.M., Masden, E.A., 2013. Assessing vulnerability of marine bird populations to offshore wind farms. Journal of Environmental Management 119, 56–66. https://doi.org/10.1016/j.jenvman.2013.01.025

Furness, R.W., Wade, H.M., Robbins, A.M.C., Masden, E.A., 2012. Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. ICES Journal of Marine Science 69, 1466–1479. https://doi.org/10.1093/icesjms/fss131

Garthe, S., Benvenuti, S., Montevecchi, W.A., 2000. Pursuit plunging by northern gannets (Sula bassana) feeding on capelin (Mallotus villosus). Proc Biol Sci 267, 1717. https://doi.org/10.1098/rspb.2000.1200

Garthe, S., Hüppop, O., 2004. Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. Journal of Applied Ecology 41, 724–734. https://doi.org/10.1111/j.0021-8901.2004.00918.x

Garthe, S., Ludynia, K., Hüppop, O., Kubetzki, U., Meraz, J.F., Furness, R.W., 2012. Energy budgets reveal equal benefits of varied migration strategies in northern gannets. Marine Biology 159, 1907–1915. https://doi.org/10.1007/s00227-012-1978-6

Gill, P., Elston, D., Grant, M., Sales, D., Clough, R., McMyn, I., 2018. Operational and Construction Monitoring and Analysis of Nine Years of Ornithological Data at Greater Gabbard Offshore Wind Farm.

Guilford, T.C., Meade, J., Freeman, R., Biro, D., Evans, T., Bonadonna, F., Boyle, D., Roberts, S., M. PERRINS, C., 2008. GPS tracking of the foraging movements of Manx Shearwaters Puffinus puffinus breeding on Skomer Island, Wales. Ibis 150, 462–473. https://doi.org/10.1111/j.1474-919X.2008.00805.x

Harris, M.P., Heubeck, M., Newell, M.A., Wanless, S., 2015. The need for year-specific correction factors (k values) when converting counts of individual Common Guillemots Uria aalge to breeding pairs. Bird Study 62, 276–279. https://doi.org/10.1080/00063657.2015.1017444

Harris, M.P., Wanless, S., 2011. The Puffin. T. and A.D. Poyser, London.

Harwood, A.J.P., Perrow, M.R., Berridge, R.J., Tomlinson, M.L., Skeate, E.R., 2017. Unforeseen Responses of a Breeding Seabird to the Construction of an Offshore Wind Farm, in: Köppel, J. (Ed.), Wind Energy and Wildlife Interactions. Springer International Publishing.

Hobson, K.A., Welch, H.E., 1992. Observations of Foraging Northern Fulmars (Fulmarus Glacialis) in the Canadian High Arctic. Arctic 45. https://doi.org/10.14430/arctic1387

Jitlal, M., Burthe, S., Freeman, S., Daunt, F., 2017. Testing and Validating Metrics of Change Produced by Population Viability Analysis (PVA) (Vol. 8 No. 23), Scottish Marine and Freshwater Science.

JNCC, 2018. Seabird Monitoring Programme Online Database (Online Database). JNCC.

JNCC, 2016. Seabird Population Trends and Causes of Change: 1986-2015 Report. JNCC, Peterborough.

JNCC, 2010. Seabird 2000 census data (1998-2002). JNCC, Peterborough.

Kahlert, J., Petersen, I.K., Fox, A.D., Desholm, M., Clausager, I., 2004. Investigations of birds during construction and operation of Nysted offshore wind farm at Rødsand: Annual status report 2003 (Report Commissioned by Energi E2 A/S 2004). National Environmental Research Institute.

Kubetzki, U., Garthe, S., Fifield, D., Mendel, B., Furness, R., 2009. Individual migratory schedules and wintering areas of northern gannets. Marine Ecology Progress Series 391, 257–265. https://doi.org/10.3354/meps08254

Leopold, M.F., van Bemmelen, R.S.A., Zuur, A.F., 2013. Responses of Local Birds to the Offshore Wind Farms PAWP and OWEZ off the Dutch mainland coast (No. C151/12). IMARES - Institute for Marine Resources & Ecosystem Studies, Texel.

Lieber, L., Nimmo-Smith, W.A.M., Waggitt, J.J., Kregting, L., 2019. Localised anthropogenic wake generates a predictable foraging hotspot for top predators. Communications Biology 2, 123. https://doi.org/10.1038/s42003-019-0364-z

Lindegren, M., Van Deurs, M., MacKenzie, B.R., Worsoe Clausen, L., Christensen, A., Rindorf, A., 2018. Productivity and recovery of forage fish under climate change and fishing: North Sea sandeel as a case study. Fisheries Oceanography 27, 212–221. https://doi.org/10.1111/fog.12246

MacDonald, A., Heath, M., Edwards, M., Furness, R., Pinnegar, J.K., Wanless, S., Speirs, D., Greenstreet, S., 2015. Climate driven trophic cascades affecting seabirds around the British Isles. Oceanography and Marine Biology - An Annual Review 53, 55–79. https://doi.org/10.1201/b18733-3

Martin, G.R., Wanless, S., 2015. The visual fields of Common Guillemots Uria aalge and Atlantic Puffins Fratercula arctica: foraging, vigilance and collision vulnerability. Ibis 157, 798–807. https://doi.org/10.1111/ibi.12297

Martinez-Abrain, A., Oro, D., Conesa, D., Jiminez, J., 2008. Compromise between seabird enjoyment and disturbance: the role of observed and observers. Environmental Conservation 35, 104–108. https://doi.org/10.1017/S0376892908004748

Masden, E.A., Haydon, D.T., Fox, A.D., Furness, R.W., 2010. Barriers to movement: Modelling energetic costs of avoiding marine wind farms amongst breeding seabirds. Marine Pollution Bulletin 60, 1085–1091. https://doi.org/10.1016/j.marpolbul.2010.01.016

Masden, E.A., Haydon, D.T., Fox, A.D., Furness, R.W., Bullman, R., Desholm, M., 2009. Barriers to movement: impacts of wind farms on migrating birds. ICES Journal of Marine Science 66, 746–753. https://doi.org/10.1093/icesjms/fsp031

MBIEG, 2019. Improved understanding of underwater collision risks of marine renewable energy devices for birds while diving. A report produced by British Trust for Ornithology for the Marine Management Organisation on behalf of the Marine Biodiversity Impacts Evidence Group (No. MMO Project No: 1139).

McCluskie, A.E., Langston, R.H.W., Wilkinson, N.I., 2012. Birds and wave & tidal stream energy: an ecological review (RSPB Research Report No. 42). RSPB.

Mitchell, P.I., Newton, S.F., Ratcliffe, N., Dunn, T.E., 2004. Seabird Populations of Britain and Ireland. T. and A.D. Poyser, London.

MMO, 2018. Displacement and habituation of seabirds in response to marine activities (No. MMO 1139). Marine Management Organisation.

Murray, S., Harris, M.P., Wanless, S., 2015. The status of the gannet in Scotland in 2013-14. Scottish Birds 35, 3–18.

Musgrove, A.J., Austin, G.E., Hearn, R.D., Holt, C.A., Stroud, D.A., Wotton, S.R., 2011. Overwinter population estimates of British waterbirds. British Birds 104, 364–397.

Natural England, Countryside Council for Wales, 2010. Departmental Brief: Liverpool Bay / Bae Lerpwl Special Protection Area.

NRW, 2015a. Proposal to extend and reclassify Ynys Feurig, Cemlyn Bay and The Skerries Special Protection Area and rename it as Anglesey Terns Special Protection Area (Departmental Advice to Welsh Government).

NRW, 2015b. Northern Cardigan Bay/Gogledd Bae Ceredigion Draft Special Protection Area (Advice to the Welsh Government).

O'Brien, S., J. Wilson, L., Webb, A., A. Cranswick, P., 2010. Revised estimate of numbers of wintering Red-throated Divers Gavia stellata in Great Britain: Capsule An estimated 17 000 Red-throated Divers winter around Great Britain. Bird Study 55, 152–160. https://doi.org/10.1080/00063650809461517

Oppel, S., Bolton, M., Carneiro, A.P.B., Dias, M.P., Green, J.A., Masello, J.F., Phillips, R.A., Owen, E., Quillfeldt, P., Beard, A., Bertrand, S., Blackburn, J., Boersma, P.D., Borges, A., Broderick, A.C., Catry, P., Cleasby, I., Clingham, E., Creuwels, J., Crofts, S., Cuthbert, R.J., Dallmeijer, H., Davies, D., Davies, R., Dilley, B.J., Dinis, H.A., Dossa, J., Dunn, M.J., Efe, M.A., Fayet, A.L., Figueiredo, L., Frederico, A.P., Gjerdrum, C., Godley, B.J., Granadeiro, J.P., Guilford, T., Hamer, K.C., Hazin, C., Hedd, A., Henry, L., Hernández-Montero, M., Hinke, J., Kokubun, N., Leat, E., Tranquilla, L.M., Metzger, B., Militão, T., Montrond, G., Mullié, W., Padget, O., Pearmain, E.J., Pollet, I.L., Pütz, K., Quintana, F., Ratcliffe, N., Ronconi, R.A., Ryan, P.G., Saldanha, S., Shoji, A., Sim, J., Small, C., Soanes, L., Takahashi, A., Trathan, P., Trivelpiece, W., Veen, J., Wakefield, E., Weber, N., Weber, S., Zango, L., Daunt, F., Ito, M., Harris, M.P., Newell, M.A., Wanless, S., González-Solís, J., Croxall, J., 2018. Spatial scales of marine conservation management for breeding seabirds. Marine Policy 98, 37–46. https://doi.org/10.1016/j.marpol.2018.08.024

Perrins, C.M., Wood, M., Garroway, C., Boyle, D., Oakes, O., Revera, R., Collins, P., Taylor, C., 2012. A whole-island census of the Manx Shearwaters Puffinus puffinus breeding on Skomer Island in 2011. Seabird 25, 1–13.

Perrow, M.R., Skeate, E.R., Gilroy, J., 2011. Visual tracking from a rigid-hulled inflatable boat to determine foraging movements of breeding terns. Journal of Field Ornithology 82, 68–79. https://doi.org/10.1111/j.1557-9263.2010.00309.x |

Raine, H., Borg, J.J., Raine, A., Bairner, S., Cardona, M.B., 2007. Light pollution and its effect on Yelkouan Shearwaters in Malta; causes and solutions (EU LIFE Yelkouan Shearwater Project Report). Birdlife Malta.

Ratcliffe, N., Mitchell, I., Varnham, K., Verboven, N., Higson, P., 2009. How to prioritize rat management for the benefit of petrels: a case study of the UK, Channel Islands and Isle of Man. Ibis 151, 699–708. https://doi.org/10.1111/j.1474-919X.2009.00949.x

Ratcliffe, N., Phillips, R.A., Gubbay, S., 2000. Foraging ranges of UK seabirds from their breeding colonies and its implications for creating marine extensions to colony SPAs. RSPB.

Regular, P., Davoren, G., Hedd, A., Montevecchi, W., 2010. Crepuscular foraging by a pursuit-diving seabird: Tactics of common murres in response to the diel vertical migration of capelin. Marine Ecology Progress Series 415, 295–304. https://doi.org/10.3354/meps08752

Regular, P.M., Hedd, A., Montevecchi, W.A., 2011. Fishing in the dark: a pursuit-diving seabird modifies foraging behaviour in response to nocturnal light levels. PloS one 6, e26763–e26763. https://doi.org/10.1371/journal.pone.0026763

Robbins, A.M.C., 2017. Seabird ecology in high-energy environments: approaches to assessing impacts of marine renewables. University of Glasgow, Glasgow.

Robinson, R.A., 2019. BirdFacts: profiles of birds occurring in Britain & Ireland (BTO Research Report No. 407). British Trust for Ornithology, Thetford.

Rock, P., Vaughan, I.P., 2013. Long-term estimates of adult survival rates of urban Herring Gulls Larus argentatus and Lesser Black-backed Gulls Larus fuscus. Ringing & Migration 28, 21–29. https://doi.org/10.1080/03078698.2013.811179

Rodgers Jr., J.A., Smith, H.T., 1995. Set-Back Distances to Protect Nesting Bird Colonies from Human Disturbance in Florida. Conservation Biology 9, 89–99. https://doi.org/10.1046/j.1523-1739.1995.09010089.x

Rodríguez, A., Burgan, G., Dann, P., Jessop, R., Negro, J.J., Chiaradia, A., 2014. Fatal Attraction of Short-Tailed Shearwaters to Artificial Lights. PLOS ONE 9, e110114. https://doi.org/10.1371/journal.pone.0110114

Rodríguez, A., Dann, P., Chiaradia, A., 2017. Reducing light-induced mortality of seabirds: High pressure sodium lights decrease the fatal attraction of shearwaters. Journal for Nature Conservation 39, 68–72. https://doi.org/10.1016/j.jnc.2017.07.001

Rojek, N.A., Parker, M.W., Carter, H.R., McChesney, G.J., Mcchesney, G., 2007. Aircraft and vessel disturbances to Common Murres Uria aalge at breeding colonies in central California, 1997-1999. Marine Ornithology 35, 61–69.

Royal Haskoning, 2011. SeaGen Environmental Monitoring Programme Final Report (Report for Marine Current Turbines).

Roycroft, D., Kelly, T.C., Lewis, L.J., 2007. Behavioural interactions of seabirds with suspended mussel longlines. Aquaculture International 15, 25–36. https://doi.org/10.1007/s10499-006-9065-y

Roycroft, D., Kelly, T.C., Lewis, L.J., 2004. Birds, seals and the suspension culture of mussels in Bantry Bay, a non-seaduck area in Southwest Ireland. Estuarine, Coastal and Shelf Science 61, 703–712. https://doi.org/10.1016/j.ecss.2004.07.012

Sandvik, H., Erikstad, K.E., Sæther, B.-E., 2012. Climate affects seabird population dynamics both via reproduction and adult survival. Marine Ecology Progress Series 454, 273–284.

Sandvik, H., Erikstand, K.E., Barratt, R.T., Yoccoz, N.G., 2005. The effect of climate on adult survival in five species of North Atlantic seabirds. Journal of Animal Ecology 74, 817–831. https://doi.org/10.1111/j.1365-2656.2005.00981.x

Schwemmer, P., Garthe, S., 2008. Regular habitat switch as an important feeding strategy of an opportunistic seabird species at the interface between land and sea. Estuarine, Coastal and Shelf Science 77, 12–22. https://doi.org/10.1016/j.ecss.2007.08.017

Scottish Power Renewables, 2019. East Anglia TWO Offshore Windfarm: Chapter 12 Ornithology, Preliminary Environmental Information Volume 1 (No. EA2- DEVWF- ENV- REP- IBR- 000807).

Shoji, A., Dean, B., Kirk, H., Freeman, R., Perrins, C.M., Guilford, T., 2016. The diving behaviour of the Manx Shearwater Puffinus puffinus. Ibis 158, 598–606. https://doi.org/10.1111/ibi.12381

Shoji, A., Elliot, K., Fayet, A., Boyle, D., Perrins, C., Guilford, T., 2015. Foraging behaviour of sympatric razorbills and puffins. Mar Ecol Prog Ser 520, 257–267.

SNH, 2018. Interim Guidance on Apportioning Impacts from Marine Renewable Developments to Breeding Seabird Populations in Special Protection Areas (Guidance note). Scottish Natural Heritage.

SNH, 2016. Assessing collision risk between underwater turbines and marine wildlife (Guidance note). Scottish Natural Heritage.

Stone, C.J., Webb, A., Barton, C., Ratcliffe, N., Reed, T.C., Tasker, M.L., Camphuysen, C.J., Pienkowski, M.W., 1995. An atlas of seabird distribution in north-west European waters. JNCC, Peterborough.

Stroud, D.A., Bainbridge, I.P., Maddock, A., Anthony, S., Baker, H., Buxton, N., Chambers, D., Enlander, I., Hearn, R.D., Jennings, K.R., Mavor, R., Whitehead, S., Wilson, J.D., 2016. The status of UK SPAs in the 2000s: the Third Network Review. JNCC, Peterborough.

Sydeman, W.J., Thompson, S.A., Anker-Nilssen, T., Arimitsu, M., Bennison, A., Bertrand, S., Boersch-Supan, P., Boyd, C., Bransome, N.C., Crawford, R.J.M., Daunt, F., Furness, R.W., Gianuca, D., Gladics, A., Koehn, L., Lang, J.W., Logerwell, E., Morris, T.L., Phillips, E.M., Provencher, J., Punt, A.E., Saraux, C., Shannon, L., Sherley, R.B., Simeone, A., Wanless, R.M., Wanless, S., Zador, S., 2017. Best practices for assessing forage fish fisheries-seabird resource competition. Fisheries Research 194, 209–221. https://doi.org/10.1016/j.fishres.2017.05.018

Tasker, M.L., Camphuysen, C.J., Cooper, J., Garthe, S., Montevecchi, W.A., Blaber, S.J.M., 2000. The impacts of fishing on marine birds. ICES Journal of Marine Science 57, 531–547. https://doi.org/10.1006/jmsc.2000.0714

Thaxter, C., Lascelles, B., Sugar, K., Cook, A., Roos, S., Bolton, M., Langston, R., Burton, N., 2012. Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Biological Conservation 156. https://doi.org/10.1016/j.biocon.2011.12.009

Thaxter, C.B., Daunt, F., Hamer, K.C., Watanuki, Y., Harris, M.P., Grémillet, D., Peters, G., Wanless, S., 2009. Sex-specific food provisioning in a monomorphic seabird, the common guillemot Uria aalge: nest defence, foraging efficiency or parental effort? Journal of Avian Biology 40, 75–84. https://doi.org/10.1111/j.1600-048X.2008.04507.x

Thaxter, C.B., Wanless, S., Daunt, F., Harris, M.P., Benvenuti, S., Watanuki, Y., Grémillet, D., Hamer, K.C., 2010. Influence of wing loading on the trade-off between pursuit-diving and flight in common guillemots and razorbills. J. Exp. Biol. 213, 1018. https://doi.org/10.1242/jeb.037390

UK SNCBs, 2017. Joint SNCB Interim Displacement Advice Note: Advice on how to present assessment information on the extent and potential consequences of seabird displacement from Offshore Wind Farm (OWF) developments.

Vallejo, G.C., Grellier, K., Nelson, E.J., McGregor, R.M., Canning, S.J., Caryl, F.M., McLean, N., 2017. Responses of two marine top predators to an offshore wind farm. Ecology and Evolution 7, 8698–8708. https://doi.org/10.1002/ece3.3389

Vanermen, N., Onkelinx, T., Courtens, W., Van de walle, M., Verstraete, H., Stienen, E.W.M., 2015. Seabird avoidance and attraction at an offshore wind farm in the Belgian part of the North Sea. Hydrobiologia 756, 51–61. https://doi.org/10.1007/s10750-014-2088-x

Votier, S., Hatchwell, B., Beckerman, A., H McCleery, R., M Hunter, F., Pellatt, J., Trinder, M., R Birkhead, T., 2005. Oil pollution and climate have wide-scale impacts on seabird demographies. Ecology Letters 8, 1157–1164. https://doi.org/10.1111/j.1461-0248.2005.00818.x

Votier, S., R Birkhead, T., Oro, D., Trinder, M., J Grantham, M., Clark, J., H McCleery, R., Hatchwell, B., 2008. Recruitment and survival of immature seabirds in relation to oil spills and climate variability. Journal of Animal Ecology 77, 974–983. https://doi.org/10.1111/j.1365-2656.2008.01421.x

Votier, S.C., Bicknell, A., Cox, S.L., Scales, K.L., Patrick, S.C., 2013. A Bird's Eye View of Discard Reforms: Bird-Borne Cameras Reveal Seabird/Fishery Interactions. PLOS ONE 8, e57376. https://doi.org/10.1371/journal.pone.0057376

Wakefield, E.D., Bodey, T.W., Bearhop, S., Blackburn, J., Colhoun, K., Davies, R., Dwyer, R.G., Green, J.A., Grémillet, D., Jackson, A.L., Jessopp, M.J., Kane, A., Langston, R.H.W., Lescroël, A., Murray, S., Le Nuz, M., Patrick, S.C., Péron, C., Soanes, L.M., Wanless, S., Votier, S.C., Hamer, K.C., 2013. Space Partitioning Without Territoriality in Gannets. Science 341, 68. https://doi.org/10.1126/science.1236077

Wakefield, E.D., Owen, E., Baer, J., Carroll, M.J., Daunt, F., Dodd, S.G., Green, J.A., Guilford, T., Mavor, R.A., Miller, P.I., Newell, M.A., Newton, S.F., Robertson, G.S., Shoji, A., Soanes, L.M., Votier, S.C., Wanless, S., Bolton, M., 2017. Breeding density, fine-scale tracking, and large-scale modeling reveal the regional distribution of four seabird species. Ecological Applications 27, 2074–2091. https://doi.org/10.1002/eap.1591

Wernham, C., Toms, M., Marchant, J.H., Clark, J., Siriwardena, G., Baillie, S.R., 2002. The Migration Atlas: Movements of the Birds of Britain and Ireland. T. and A.D. Poyser, London.

White, C.R., Day, N., Butler, P.J., Martin, G.R., 2007. Vision and Foraging in Cormorants: More like Herons than Hawks? PLOS ONE 2, e639. https://doi.org/10.1371/journal.pone.0000639

Wilson, B., Batty, R.S., Daunt, F., Carter, C., 2007. Collision risks between marine renewable energy devices and mammals, fish and diving birds (Report to the Scottish Executive). Scottish Association for Marine Science.

Wilson, L.J., Black, J., Brewer, M.J., Potts, J.M., Kuepfer, A., Win, I., Kober, K., Bingham, C., Mavor, R., Webb, A., 2014. Quantifying usage of the marine environment by terns Sterna sp. around their breeding colony SPAs (JNCC Report No. 500). JNCC.

Žydelis, R., Bellebaum, J., Osterblom, H., Vetemaa, M., Schirmeister, B., Stipniece, A., Dagys, M., van Eerden, M., Garthe, S., 2009. Bycatch in gillnet fisheries - An overlooked threat to waterbird populations. Biological Conservation 142, 1269–1281.

Žydelis, R., Small, C., French, G., 2013. The incidental catch of seabirds in gillnet fisheries: A global review. Biological Conservation 162, 76–88. https://doi.org/10.1016/j.biocon.2013.04.002

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Morlais Project
Environmental Statement

Chapter 12: Marine Mammals

Volume I

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TABLE OF ABBREVIATIONS

Acronym	Definition
AA	Appropriate Assessment
AC	Alternating Current
ADCP	Acoustic Doppler Current Profilers
ADD	Acoustic Deterrent Device
AIS	Automatic Identification System
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
BND	Bottlenose Dolphin
BSI	British Standards Institution
CBD	Convention on Biological Diversity
CCW	Countryside Council for Wales
CD	Common Dolphin
CEDA	Central Dredging Association
Cefas	Centre for the Environment and Fisheries and Aquaculture Science
CES	Coastal East Scotland
CGNS	Celtic and Greater North Seas
CH	Carmel Head
CI	Confidence Interval
CIA	Cumulative Impact Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CIS	Celtic and Irish Sea
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CODA	Cetacean Offshore Distribution and Abundance in the European Atlantic
CRM	Collision Risk Model
CRoW	The Countryside and Rights of Way Act
CSIP	Cetaceans Stranding's Investigation Programme
CV	Coefficient of Variation
CWC	Coastal West Channel
CWSH	Coastal West Scotland and the Hebrides`
dB	Decibel
DC	Direct Current
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DGU	Deep Green Utility units
DP	Dynamic Positioning
EC	European Commission
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment

EMEC	European Marine Energy Centre
EMF	Electromagnetic Fields
EMMP	Environmental Management and Monitoring Plan
EPS	European Protected Species
ERM	Encounter Risk Model
ES	Environmental Statement
EU	European Union
FCS	Favourable Conservation Status
FPSO	Floating Production, Storage and Offloading
GBS	Gravity Based Structures
GNS	Greater North Sea
GPS	Global Positioning System
GS	Grey Seal
HB	Holyhead Harbour
HD	High-definition
HF	High Frequency Cetaceans
HNP	Horizon Nuclear Power
HP	Harbour Porpoise
HRA	Habitats Regulations Assessment
HS	Harbour Seal
HVDC	High-Voltage Direct Current
HWDT	Hebridean Whale and Dolphin Trust
Hz	Hertz
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
IPC	Infrastructure Planning Commission
IPPC	Integrated Pollution Prevention and Control
IS	Irish Sea
IWC	International Whaling Commission
JCP	Joint Cetacean Protocol
JNCC	Joint Nature Conservation Committee
kg	Kilogram
kHz	Kilohertz
km	Kilometre
km/h	Kilometre per hour
km^2	Kilometre square
kV	Kilovolt
kW	Kilowatt
LAT	Lowest Astronomical Tide
LCL	Lower 95% Confidence Limit
LF	Low Frequency Cetaceans
m	Metre
m/s	Metres per second

m^2	Metre squared
m^3	Metre cubed
MCA	Maritime and Coastguard Agency
MDZ	Morlais Development Zone
MF	Mid Frequency Cetaceans
MHWS	Mean High Water Spring tide
MM	Menter Môn
MMMP	Marine Mammal Mitigation Protocol
MMOs	Marine Mammal Observers
MPCP	Marine Pollution Contingency Plan
MU	Management Unit
MW	Mega Watt
nm	Nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Policy Statements
NRW	Natural Resource Wales
NS	North Sea
NSIP	Nationally Significant Infrastructure Project
O&M	Operation and Maintenance
OCSW	Offshore Channel and South West England
ORJIP	Offshore Renewables Joint Industry Programme
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment 1992
OW	Oceanic Waters
OWF	Offshore Wind Farm
PAM	Passive Acoustic Monitoring
PCoD	Population Consequences of Disturbance
PDE	Project Design Envelope
PE	Parabolic Equation
PL	Port Lynas
pSAC	potential Special Protection Areas
PTEC	Perpetuus Tidal Energy Centre
PTS	Permanent Threshold Shift
PW	Phocid Pinnipeds (underwater)
RD	Risso’s Dolphin
RMS	Root Mean Square
RNLI	Royal National Lifeboat Institute
SAC	Special Area of Conservation
SAMS	Scottish Association of Marine Sciences
SCANS	Small Cetaceans in the European Atlantic and North Sea
SCOS	Special Committee on Seals

SEA	Strategic Environmental Assessment
SEL	Sound Exposure Level
SEL_{cum}	Cumulative Sound Exposure Level
SL	Source Level
SMRU	Sea Mammal Research Unit
SNCBs	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage
SoCG	Statement of Common Ground
SoS	Secretary of State
SPL	Sound Pressure Level
SPL_{peak}	Peak Sound Pressure Level
SS	South Stack
SW	South West
TEC	Tidal Energy Converter
TGL	Tidal Generation Ltd
TPOD	Automatic Acoustic Data Loggers
TTS	Temporary Threshold Shift
TWG	Technical Working Group
UCL	Upper 95% Confidence Limits
UK	United Kingdom
VP	Vantage Point
WADZ	West Anglesey Demonstration Zone
WODA	World Organisation of Dredging Associations
WS	West Scotland

GLOSSARY OF TERMINOLOGY

Body width (m)	Body width of animal. Body width is usually around ¼ of the body length.
Dive profile	The variation of depth with elapsed time during a dive
Length (m)	Total length of animal (m) from tip to tail.

12. MARINE MAMMALS

12.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) describes the existing environment with regard to marine mammals which includes cetaceans (whales, dolphins and porpoises) and pinnipeds (seals) and assesses the potential impacts of the proposed Morlais Demonstration Zone (MDZ) and Export Cable Corridor (ECC) (hereafter referred to as 'the Project') during the construction, operation and maintenance (O&M), and decommissioning phases. Where appropriate, mitigation measures and residual impacts are presented.

2. This chapter of the ES was prepared by Royal HaskoningDHV and incorporates survey data collected by Natural Power and SEACAMS and density estimates analysed by SEACAMS.

3. This chapter also considers information from, and refers to, the following chapters within the ES:

- **Chapter 2**, Policy and Legislation;
- **Chapter 4**, Project Description;
- **Chapter 5**, Environmental Impact Assessment (EIA) Methodology;
- **Chapter 8**, Marine Water and Sediment Quality;
- **Chapter 9**, Benthic and Intertidal Ecology;
- **Chapter 10**, Fish and Shellfish Ecology; and
- **Chapter 15**, Shipping and Navigation.

4. This chapter is supported by the following Appendices:

- **Appendix 11.1**: Natural Power (2018) Morlais Demonstration Zone Bird and Marine Mammal Surveys 24-Month Technical Report;
- **Appendix 12.1**: SEACAMS (2019) Investigating methods to estimate harbour porpoise *(Phocoena phocoena*) density off West Anglesey;
- **Appendix 12.2**: Additional collision risk assessments;
- **Appendix 12.3**: Assessment of the potential for population level effects on marine mammals; and
- **Appendix 12.4**: Subacoustech (2019) Underwater noise technical note.

5. This chapter is also supported by the following documents:

- Marine Mammals - Statement of Common Ground – Menter Môn and Natural Resources Wales (**Document MOR/RHDHV/DOC/0070**);
- Information to Support Habitat Regulations Assessment (HRA) (**Document MOR/RHDHV/DOC/0067**); and
- Outline Environmental Management and Monitoring Plan (EMMP) (**Document MOR/RHDHV/DOC/0072**).

12.2. LEGISLATION, POLICY AND GUIDANCE

12.2.1. Legislation

12.2.1.1. The Habitats Directive

6. The European Union Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (hereafter called the Habitats Directive) gives regulation to the conservation and management of natural habitats, wild fauna (except birds) and flora in Europe. Its primary aim is to maintain or restore natural habitats and wild species at a favourable conservation status.

7. Annex II of the Habitats Directive lists species for which member states are expected to establish a “consistent network of special areas of conservation”. This list includes harbour porpoise *Phocoena phocoena*, bottlenose dolphin *Tursiops truncatus* along with the grey seal *Halichoerus grypus* and harbour seal *Phoca vitulina* all of which are relevant to the Project.

8. Although not legally binding, the European Commission’s Guidance document on the strict protection of animal species of Community interest under the Habitats Directive (European Commission (EC) 2007) states that:

   “*In order to assess a disturbance, consideration must be given to its effect on the conservation status of the species at population level and biogeographic level in a Member State. For instance, any disturbing activity that affects the survival chances, the breeding success or the reproductive ability of a protected species or leads to a reduction in the occupied area should be regarded as a “disturbance” in terms of Article 12”.*

9. The Habitats Directive protects all species of cetaceans under Annex IV as European Protected Species (EPS), being classed as endangered, vulnerable or rare, and grey and harbour seals are protected under Annex V which requires their exploitation or removal from the wild to be subject to management measures. Harbour porpoise, bottlenose dolphin and both seal species are additionally listed under Annex II, which requires member states to designate sites, identified as being key areas for their life and reproduction, as Special Areas of Conservation (SACs).

10. Article 12 of the Habitats Directive requires member states to establish stricter protection for species within their natural range; prohibiting all forms of deliberate capture or killing, deliberate disturbance (particularly during breeding and rearing periods, hibernations and migration) and the deterioration or destruction of breeding and resting sites.

12.2.1.2. The Habitats Regulations

11. The Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (collectively referred to as ‘the Habitats Regulations 2017’) transpose the Habitats Directive into national law. The Habitats Regulations place an obligation on ‘competent authorities’ to carry out an Appropriate Assessment (AA) of any proposal likely to have a significant effect on a Natura 2000 site, to seek advice from Statutory Nature Conservation Bodies (SNCBs) and to reject an application that would have an adverse effect on the integrity of a Natura 2000 site except under very tightly constrained conditions.

12. All cetacean species are listed under Schedule 2 and defined as EPS and all seals are listed under Schedule 4 (animals which may not be captured or killed in certain ways).

- Under the Habitats Regulations 2017 a person is guilty of an offence if that person:
- Deliberately captures, injures or kills a wild animal belonging to a species with EPS status;
- Deliberately disturbs such animal; or
- Damages or destroys any resting or breeding place of such animal.

13. However, there is a provision to apply for an EPS licence where any of the above is expected to occur, provided there is no satisfactory alternative, and there will be no long-term detrimental effects. This is especially relevant to marine mammals and the likelihood of disturbance due to marine activities.

14. As in the Habitats Directive, there is a requirement to create SACs for species listed under Annex II (i.e. harbour porpoise, bottlenose dolphin, grey and harbour seals) and to advise on what marine operations may adversely affect the integrity of the site.

15. There are a number of provisions within the regulations that protect marine species from harmful activities. EPS, as listed under Annex IV of the Habitats Directive, are protected from:

- The deliberate capture, injury, killing;
- Any disturbance that is likely to result in a significant impact to the ability of any species group to survive, breed, rear or nurture their young, to disrupt a species' hibernation or migrations, or to affect significantly the local distributions or abundance of the species; and
- Damage or destroy any breeding or resting site.

12.2.1.3. Summary of relevant legislation

16. **Table 12-1** provides an overview of national and international legislation in relation to marine mammals.

Table 12-1 National and international legislation in relation to marine mammals

Legislation	Level of Protection	Species	Overview
Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS)	International	Odontocetes	Formulated in 1992, this agreement has been signed by 10 European countries bordering the Baltic and North Seas (including the English Channel) and includes the United Kingdom (UK). Under the Agreement, provision is made for the protection of specific areas, monitoring, research, information exchange, pollution control and increasing public awareness of small cetaceans.
The Berne Convention 1979	International	All cetaceans, grey seal and harbour seal	The Convention conveys special protection to those species that are

Legislation	Level of Protection	Species	Overview
			vulnerable or endangered. Appendix II (strictly protected fauna): 19 species of cetacean. Appendix III (protected fauna): all remaining cetaceans, grey and harbour seal. Although an international convention, it is implemented within the UK through the Wildlife and Countryside Act 1981.
The Bonn Convention 1979	International	All cetaceans	Protects migratory wild animals across all, or part of their natural range, through international co-operation, and relates particularly to those species in danger of extinction. One of the measures identified is the adoption of legally binding agreements, including ASCOBANS.
Oslo and Paris Convention for the Protection of the Marine Environment 1992 (OSPAR)	International	Bowhead whale *Balaena mysticetus*, northern right whale *Eubalaena glacialis*, blue whale *Balaenoptera musculus*, and harbour porpoise	OSPAR has established a list of threatened and/or declining species in the North East Atlantic. These species have been targeted as part of further work on the conservation and protection of marine biodiversity under Annex V of the OSPAR Convention. The list seeks to complement, but not duplicate, the work under the European Commission (EC) Habitats and Birds directives and measures under the Berne Convention and the Bonn Convention.
International Convention for the Regulation of Whaling 1956	International	All cetacean species	This Convention established the International Whaling Commission (IWC) who regulates the direct exploitation and conservation of large whales (in particular sperm whale and large baleen whales) as a resource and the impact of human activities on cetaceans. The regulation considered scientific matters related to small cetaceans, in particular the enforcing a moratorium on commercial whaling which came into force in 1986.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 1975	International	All cetacean species	Prohibits the international trade in species listed in Appendix 1 (including sperm whales, northern right whales, and baleen whales) and allows for the controlled trade of all other cetacean species.
Convention on Biological Diversity (CBD) 1993	International	All marine mammal species	Requires signatories to identify processes and activities that are likely to have impacts on the conservation of and sustainable use of biological diversity, inducing the introduction of appropriate procedures requiring an EIA and mitigation procedures.

Legislation	Level of Protection	Species	Overview
The Conservation of Habitats and Species Regulations 2017 and The Conservation of Offshore Marine Habitats and Species Regulations 2017	National	All cetaceans, grey and harbour seal	'The Habitats Regulations 2017'. Provisions of The Habitats Regulations are described further above. It should be noted that the Habitats Regulations apply onshore, within the territorial seas and to marine areas within UK jurisdiction, beyond 12 nautical miles (nm).
The Wildlife and Countryside Act 1981 (as amended)	National	All cetaceans	All cetaceans listed on Schedule 5 are fully protected within UK territorial waters. The Act protects them from killing or injury, sale, destruction of a particular habitat (which they use for protection or shelter) and disturbance. Short-beaked common dolphin *Delphinus delphis*, bottlenose dolphin and harbour porpoise are listed on Schedule 6 of the Act. Under the Act these species are prohibited from being used as a decoy to attract other animals. The Act also prohibits the use of vehicles in immediate pursuit to take, kill or drive them, it prevents nets, traps or electrical devices from being set in such a way that would injure them and prevents the use of nets or sounds to trap or snare them.
The Countryside and Rights of Way Act (CRoW) 2000	National	All cetaceans	Under the CRoW Act 2000, it is an offence to intentionally or recklessly disturb any wild animal included under Schedule 5 of the Wildlife and Countryside Act.
Conservation of Seals Act 1970	England and Wales	Grey and harbour seal	Provides closed seasons, during which it is an offence to take or kill any seal, except under licence or in certain circumstances (grey seal: 1 September to 31 December; harbour seal: 1 June to 31 August).

12.2.2. Policy and Plans

17. An overview of the relevant policy and plans for the Project is provided in **Chapter 2, Policy and Legislation**, this includes:

- National Policy Statements;
- Marine Policy Statement;
- Welsh National Marine Plan;
- Planning Policy Wales; and
- Anglesey and Gwynedd Joint Local Development Plan.

18. **Table 11-2** in **Chapter 11 Marine Ornithology** outlines the National (UK and Wales) planning policy, plans and measures that are also relevant to marine mammals.

19. The assessment of potential impacts upon marine mammals has been made with specific reference to the relevant National Policy Statements (NPS)[1]. These are the principal decision-making documents for Nationally Significant Infrastructure Projects (NSIP).

20. The Overarching NPS for Energy (EN-1) sets out the UK Government's policy for delivery of major energy infrastructure, with generic considerations which are further considered in the technology-specific NPSs such as the NPS for Renewable Energy Infrastructure (EN-3). Although, NPS EN-3 states "*this NPS does not cover other types of renewable energy generation that are not at present technically viable over 50 MW onshore or over 100 MW offshore such as schemes that generate electricity from tidal stream or wave power*.", therefore relevant requirements have been referred to until a revision to this NPS or a separate NPS is provided for tidal range schemes greater than 100 MW.

21. The specific assessment requirements for marine mammals, as detailed in NPS EN-1 and EN-3, are summarised in **Table 12-2**, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 12-2 NPS EN-1 and EN-3 Assessment Requirements

NPS Requirement	NPS Reference	ES Reference
'Where the development is subject to EIA [Environmental Impact Assessment] the applicant should ensure that the ES [Environmental Statement] clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the Infrastructure Planning Commission (IPC) [now the Planning Inspectorate and the Secretary of State (SoS)] consider thoroughly the potential effects of a proposed project.'	**NPS EN-1 Section 5.3 Paragraph 5.3.3**	**Section 12.6**
'The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests.'	**NPS EN-1 Section 5.3 Paragraph 5.3.4**	**Section 12.6.2 and EMMP** (**Document MOR/RHDHV/DOC/0072**)
'When considering the application, the IPC will have regard to the Government's biodiversity strategy as (sic) set out in 'Working with the grain of nature', which aims to halt or reverse declines in priority habitats and species; accept the importance of biodiversity to quality of life. The IPC will consider this in relation to the context of climate change. As a general principle, and subject to the specific policies below, development should aim to avoid significant harm to	**NPS EN-1 Section 5.3 Paragraph 5.3.5-5.3.8**	**Section 12.6.2 and EMMP** (**Document MOR/RHDHV/DOC/0072**)

[1] https://www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure

NPS Requirement	NPS Reference	ES Reference
biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives (as set out in section 4.4 above); where significant harm cannot be avoided, then appropriate compensation measures should be sought. In taking decisions, the IPC should ensure that appropriate weight is attached to designated sites of international, national and local importance; protected species; habitats and other species of principal importance for the conservation of biodiversity; and to biodiversity and geological interests within the wider environment.'		
'The most important sites for biodiversity are those identified through international conventions and European Directives. The Habitats Regulations provide statutory protection for these sites but do not provide statutory protection for potential Special Protection Areas (pSPAs) before they have been classified as a Special Protection Area. For the purposes of considering development proposals affecting them, as a matter of policy the Government wishes pSPAs to be considered in the same way as if they had already been classified.'	**NPS EN-1 Section 5.3 Paragraph 5.3.9**	**Information to Support HRA (Document MOR/RHDHV/DOC/0067)**
The applicant should include appropriate mitigation measures as an integral part of the proposed development and demonstrate that: • during construction, they will seek to ensure that activities will be confined to the minimum areas required for the works; • during construction and operation best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements; • habitats will, where practicable, be restored after construction works have finished; and • opportunities will be taken to enhance existing habitats and, where practicable, to create new habitats of value within the site landscaping proposals.'	**NPS EN-1 Section 5.3 Paragraph 5.3.18**	**Section 12.6.2 and EMMP** (**Document MOR/RHDHV/DOC/0072**)
Where necessary, assessment of the effects on marine mammals should include details of: • likely feeding areas; • known birthing areas/haul out sites; • nursery grounds; • known migration or commuting routes; • duration of the potentially disturbing activity including cumulative/in-combination effects with other plans or projects; • baseline noise levels; • predicted noise levels in relation to mortality, permanent threshold shift (PTS) and temporary threshold shift (TTS); and • operational noise.	**NPS EN-3 Paragraph 2.6.92**	**Section 12.5 and Section 12.6**

NPS Requirement	NPS Reference	ES Reference
The IPC [now SoS] should be satisfied that the preferred methods of construction, in particular the construction method needed for the proposed foundations and the preferred foundation type, where known at the time of application, are designed so as to reasonably minimise significant disturbance effects on marine mammals. Unless suitable noise mitigation measures can be imposed by requirements to any development consent the IPC [now SoS] may refuse the application.	**NPS EN-3 Paragraph 2.6.94**	**Chapter 4; Section 12.6, including Section 12.6.2**
The conservation status of marine European Protected Species and seals are of relevance to the IPC [now SoS].	**NPS EN-3 Paragraph 2.6.95**	**Section 12.5 and Information to Support HRA (Document MOR/RHDHV/DOC/0067)**
Monitoring of the surrounding area before and during the piling procedure can be undertaken.	**NPS EN-3 Paragraph 2.6.97**	**Section 12.4.2 and EMMP** (**Document MOR/RHDHV/DOC/0072**)
During construction, 24-hour working practices may be employed so that the overall construction programme and the potential for impacts to marine mammal communities is reduced in time.	**NPS EN-3 Paragraph 2.6.98**	**Section 12.6, including Section 12.6.1**

22. **Table 12-3** sets out other national and regional policies which are particularly relevant to the Project.

Table 12-3 National and Regional Policy Requirements Relevant to Marine Mammals

Policy Description	Reference	ES Reference
MPS		
Noise resulting from a proposed activity or development in the marine area or in coastal and estuarine waters can have adverse effects on biodiversity although knowledge of the extent of impacts is limited and there are few systematic monitoring programmes to verify adverse effects. Man-made sound emitted within the marine environment can potentially affect marine organisms in various ways. It has the potential to mask biologically relevant signals; it can lead to a variety of behavioural reactions, affect hearing organs and injure or even kill marine life. Manmade sound sources of primary concern with regard to disturbance of marine life are explosions, shipping, seismic surveys, offshore construction and offshore industrial activities, for example dredging, drilling and piling, sonar of various types and acoustic deterrent devices.	Section 2.6.3.1	Underwater noise modelling has been undertaken to inform the impact assessment for construction and operation of the Project. Impact assessment is presented in **Sections 12.6.3.1** to **12.6.3.4**, and **12.6.4.1** to **12.6.4.3**.
Renewable energy developments can potentially have adverse impacts on marine fish and mammals, primarily through construction noise and may displace fishing activity and have direct or indirect impacts on other users of the sea, including mariners. Certain bird species may be displaced by offshore wind turbines, which also have the potential to form barriers to migration or present a collision risk for birds. Their foundation designs are likely to have an effect on hydrodynamics and consequent sediment movement. This includes potential scouring of	Section 3.3.24	See above

Policy Description	Reference	ES Reference
sediments around the bases of turbines. These and other potential adverse impacts, together with potential mitigation measures, are considered in the National Policy Statement for Renewable Energy Infrastructure (EN-3).		
Marine energy deployments, that is wave and tidal deployments, may pose potential risks to the environment if inappropriately sited. However, the level of risk and ecological significance is largely unknown since, in particular, tidal stream and wave technologies are at a relatively early stage of development. Studies of tidal range technologies, including barrages, have indicated that these structures can have adverse impacts on migratory fish and bird species and on the hydrodynamics of the estuarine environments in which they are situated. To underpin the marine planning process further research is needed to develop a better understanding of the potential impacts that marine technologies might have on potentially sensitive environmental features. For example, adaptation and mitigation methods for such impacts may be supported by detailed monitoring programmes and co-ordinated research initiatives, including post deployment of devices.	Section 3.3.25	Collision risk with tidal devices during operation of the Project is discussed in **Section 12.6.4.5.**
Draft WNMP		
Proposals should demonstrate how they: · avoid adverse impacts on individual Marine Protected Areas (MPAs) and the coherence of the network as a whole; · have regard to the measures to manage MPAs; and · avoid adverse impacts on non-marine designated sites.	ENV_02: Marine Protected Areas	The conservation importance of marine mammal species in the vicinity of the MDZ is presented in **Section 12.5**. Information to support an HRA is presented in Document MOR/RHDHV/DOC/0067.
Proposals should demonstrate that they have considered man-made noise impacts on the marine environment and, in order of preference: a) avoid adverse impacts; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding	ENV_05: Underwater noise	Underwater noise modelling has been undertaken to inform the impact assessment for construction and operation of the Project. Impact assessment is presented in **Sections 12.6.3.1** to **12.6.3.4**, and **12.6.4.1** to **12.6.4.3**.
Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01: Cumulative effects	Cumulative impacts are assessed in **Section 12.6.6** and in **Chapter 26**
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
All impacts on landscape character, heritage assets and natural resources have been adequately mitigated,	Policy ADN 3: Other Renewable Energy	The impact assessment is included within **Section**

Policy Description	Reference	ES Reference
ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced	and Low Carbon Technologies	**12.6** and includes mitigation measures to reduce impact significance.

12.2.3. Guidance

23. The principal guidance documents used to inform the assessment of potential impacts on marine mammals, include, but are not limited to:

- The Protection of Marine EPS from Injury and Disturbance: Draft Guidance for the Marine Area in England and Wales and the UK Offshore Marine Area (Joint Nature Conservation Committee (JNCC) *et al*., 2010).
- Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (Chartered Institute of Ecology and Environmental Management (CIEEM), 2016).
- Environmental Impact Assessment for offshore renewable energy projects – guide (British Standards Institution (BSI), 2015).
- Approaches to Marine Mammal Monitoring at Marine Renewable Energy Developments Final Report (Sea Mammal Research Unit Ltd (SMRU Ltd) on behalf of The Crown Estate, 2010).
- Guidelines for Data Acquisition to Support Marine Environmental Assessments of Offshore Renewable Energy Projects (Centre for the Environment and Fisheries and Aquaculture Science (Cefas), 2012).
- Assessing collision risk between underwater turbines and marine wildlife. Scottish Natural Heritage (SNH) (2016) guidance note.
- Guidance to inform marine mammal site characterisation requirements at wave and tidal stream energy sites in Wales (Sparling *et al*., 2015).
- Defining Project Envelopes for Marine Energy Projects: Review and Tidal Energy Test Facility and Marine Mammals Case Study (Sparling and Smith, 2019, unpublished).

12.2.3.1. EPS Guidance

24. JNCC *et al*. (2010) provides draft guidance concerning the Regulations on the deliberate disturbance of marine EPS, provides an interpretation of the regulations in greater detail, including for pile driving operations (JNCC, 2010a), seismic surveys (JNCC, 2017a) and the use of explosives (JNCC, 2010b).

25. The draft guidance provides advice on activities at sea that could potentially cause deliberate injury or disturbance to marine mammals and summarises information and sensitivities of the species to which these regulations apply. The guidance refers to the European Commission's Guidance document (EC, 2007) stating that, there must be some ecological impact in order for significant disturbance to occur.

26. The draft guidance provides the following interpretations of deliberate injury and disturbance offences under both the Habitats Regulations and Offshore Regulations (now the Habitats Regulations 2017), as detailed in the paragraphs below:

"Deliberate actions are to be understood as actions by a person who knows, in light of the relevant legislation that applies to the species involved, and the general information delivered to the public, that his action will most likely lead to an offence against a species, but intends this offence or, if not, consciously accepts the foreseeable results of his action;

Certain activities that produce loud sounds in areas where EPS could be present have the potential to result in an injury offence, unless appropriate mitigation measures are implemented to prevent the exposure of animals to sound levels capable of causing injury."

27. For the purposes of marine users, the draft guidance states that a disturbance which can cause offence should be interpreted as:

"Disturbance which is significant in that it is likely to be detrimental to the animals of an EPS or significantly affect their local abundance or distribution."

28. The draft guidelines further states that a disturbance offence is more likely where an activity causes persistent noise in an area for long periods of time, and a disturbance offence is more likely to occur when there is a risk of:

- Animals incurring sustained or chronic disruption of behaviour scoring five or more in the Southall *et al*. (2007) behavioural response severity scale; or
- Animals being displaced from the area, with redistribution significantly different from natural variation.

29. The JNCC *et al*. (2010) draft guidance highlights that sporadic "trivial disturbance" should not be considered as a disturbance offence under Article 12.

30. In order to assess whether a disturbance could be considered non-trivial in relation to the objectives of the Directive, JNCC *et al*. (2010) suggest that consideration should be given to the definition of the Favourable Conservation Status (FCS; see **Section 12.2.3.2**) of a species given in Article 1(i) of the Habitats Directive. There are three parameters that determine when the conservation status of a species can be taken as favourable:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable element of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future.
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

31. Therefore, any action that could increase the risk of a long-term decline of the population, increase the risk of a reduction of the range of the species, and/or increase the risk of a reduction of the size of the habitat of the species can be regarded as a disturbance under the Regulations.

For a disturbance to be considered non-trivial, the disturbance to marine EPS would need to be likely to at least increase the risk of a certain negative impact on the species at FCS.

32. JNCC *et al*. (2010) do not provide guidance as to what would constitute a 'significant group' or proportion of the population, but provide some discussion on how to assess whether the numbers potentially affected could be of concern for a population's FCS.

33. JNCC *et al*. (2010) state that:

"In any population with a positive rate of growth, or a population remaining stable at what is assumed to be the environmental carrying capacity, a certain number of animals can potentially be removed as a consequence of anthropogenic activities (e.g. through killing, injury or permanent loss of reproductive ability), in addition to natural mortality, without causing the population to decrease in numbers, or preventing recovery, if the population is depleted. Beyond a certain threshold however, there could be a detrimental effect on the population".

34. Further discussion on the use of thresholds for significance and the permanent or temporary nature of any disturbance is considered by defining the magnitude of potential effect in this assessment (**Section 12.4.4**). Consideration of any potential essential habitat or geographical structuring of EPS is provided in the Existing Environment section (**Section 12.5**) of this chapter.

35. In order to assess the number of individuals from a species that could be removed from the regional population through injury or disturbance without compromising the FCS, the EIA considers:

- The numbers affected in relation to the best and most recent estimate of population size; and
- The threshold for potential impact on the FCS, which will depend on:
  - The species' / populations' life-history;
  - The species' FCS assessment in UK waters; and
  - Other pressures encountered by the population (cumulative effects).

36. One of the key parameters for consideration within this assessment is the population size. The EPS Guidance advises that the best available abundance estimates could be used as a baseline population size, taking account of any evidence of regional population structuring (JNCC *et al*., 2010).

37. An EPS licence is required if the risk of injury or disturbance to cetacean species is assessed as likely under the Habitats Regulations 2017.

38. If a licence is required, an application must be submitted, the assessment of which comprises three tests, namely:

- Whether the activity falls within one of the purposes specified in Regulation 55 of the Habitats Regulations. Only the purpose of "preserving public health or public safety or other imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment" is of relevance to marine mammals in this context;

- That there are no satisfactory alternatives to the activity proposed (that would not incur the risk of offence); and
- That the licensing of the activity will not result in a negative impact on the species'/ population's FCS.

39. Under the definitions of 'deliberate disturbance' in the Habitats Regulations, chronic exposure and / or displacement of animals could be regarded as a disturbance offence.

40. If required, the EPS licence application will be submitted post-consent. At this time, the project design envelope will have been further refined, as well as full details of the mitigation and monitoring measures that will be in place.

12.2.3.2. Favourable Conservation Status (FCS)

41. Member states report back to the European Union (EU) every six years on the Conservation Status of marine EPS. Based on the most recent 2007-2012 reporting by the Joint Nature and Conservation Committee (JNCC, 2013), seven species of the 11 cetacean species were assessed as having a 'favourable' Conservation Status (**Table 12-4**).

42. Four of 11 cetacean species were assessed as having an 'unknown' Conservation Status (JNCC, 2013). This is a result of a lack of recent population estimates that encompassed their natural range in UK and adjacent waters and / or having no evidence to determine long-term trends in population abundance.

43. Another 17 species were considered to be uncommon, rare or very rare in occurrence, so it was not possible to ascertain their Conservation Status (JNCC, 2013).

Table 12-4 FCS assessment of cetacean species in Annex IV of the Habitats Directive occurring in UK and adjacent waters (JNCC, 2013)

Species	FCS assessment
Atlantic white-sided dolphin *Lagenorhynchus acutus*	Favourable
Bottlenose dolphin *Tursiops truncatus*	Favourable
Common dolphin *Delphinus delphis*	Favourable
Fin whale *Balaenoptera physalus*	Favourable
Harbour porpoise *Phocoena phocoena*	Favourable
Killer whale *Orcinus orca*	Unknown
Long-finned pilot whale *Globicephala melas*	Unknown
Minke whale *Balaenoptera acutorostrata*	Favourable
Risso's dolphin *Grampus griseus*	Unknown
Sperm whale *Physeter macrocephalus*	Unknown
White-beaked dolphin *Lagenorhynchus albirostris*	Favourable

12.3. CONSULTATION

44. Details on the consultation for the Project are provided in **Chapter 6, Consultation**. Scoping and consultation have been on-going throughout the EIA and have supported the scope of the baseline characterisation work and ensuring that the requirements of the regulators and their

advisors are met. **Table 12-5** summarises relevant marine mammal consultation responses received prior to and during preparation of the ES and which were considered in this Chapter. A full list of consultation responses and how they have been taken into account in finalising the Project is presented in **Chapter 6, Consultation**.

45. A “statement of common ground” (SoCG) and technical working group (TWG) approach has been used for the management of key issues, with technical experts from Natural Resources Wales (NRW) and Royal HaskoningDHV on behalf of Menter Môn. **Table 12-5** includes the key points from the SoCG and marine mammal TWG meetings.

Table 12-5 Summary of marine mammal consultation responses

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Scoping comments	Study area: The Scoping Report has utilised an initial search area of up to 50 km. The Applicant is recommended to agree the study area with NRW, noting NRW’s comments (see Appendix 1 of this Scoping Opinion) of the need to utilise the relevant marine mammal management units.	The relevant marine mammal management units have been used for each species as outlined in **Section 12.4.1**.
Planning Inspectorate	2018 Scoping comments	Underwater noise: The ES should set out the noise levels at which effects on marine mammals and basking sharks occur and explain how these levels have been derived.	The underwater noise assessment, including the thresholds and criteria are presented in **Section 12.6.3.1.1**.
Planning Inspectorate	2018 Scoping comments	Disturbance: Disturbance from the presence of construction and operational vessels should be assessed, where significant effects are likely.	The potential disturbance from the presence of vessels during construction has been assessed in **Section12.6.3.3** and for operational vessels in **Section 12.6.4.3**.
Planning Inspectorate	2018 Scoping comments	Displacement: The potential for displacement from underwater noise has been acknowledged in the Scoping Report; however, the resultant indirect effects have not been considered e.g. energy expenditure in avoiding the area. This should be assessed within the ES.	The potential for displacement from underwater noise has been assessed in **Section 12.6.3** and **12.6.4**.
Planning Inspectorate	2018 Scoping comments	EIA Baseline Characterisation: The Scoping Report has not proposed any site specific surveys to inform the baseline and it is unclear whether the marine mammal surveys which have been undertaken alongside the offshore ornithological surveys cover the application site. The Applicant should consider the applicability of existing data to the Proposed Works and application site. It is recommended that the sufficiency of any existing data, and the need for any site specific surveys, is discussed with NRW.	The baseline characterisation takes into account the site specific marine mammal surveys undertaken by Natural Power and SEACAMS, as outlined in **Section 12.4.2**.

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Scoping comments	Collision Risk: The Scoping Report states that collision risk would be determined through a literature review of similar studies and the results taken from SeaGen and the MeyGen projects. Therefore, it is assumed that site specific collision risk modelling will not be undertaken. However, the Scoping Report fails to provide the information necessary to obviate the need for collision risk modelling taking into account the chosen device(s) and the location of the Proposed Works. The ES should ensure that impacts which may result in likely significant effects to these species are assessed, including those from collision risk. The Applicant should make effort to discuss and agree the approach to the assessment with NRW. If reliance is placed on existing information to demonstrate an absence of likely significant effect, the ES should explain why the studies referenced are applicable to the Proposed Works.	In **Section 12.6.4.4.1**, site specific collision risk modelling has been undertaken for a range of different devices based on the SNH (2016) ERM and CRM models.
Planning Inspectorate	2018 Scoping comments	Underwater baseline noise: The Applicant's attention is drawn to the existence of the Defra Marine Noise Registry which could inform the baseline noise environment.	The marine noise registry data was checked, however no ambient underwater noise levels were available for the MDZ area. Therefore, information from other studies has been included, as outlined in **Section 12.6.3.1.1**.
Planning Inspectorate	2018 Scoping comments	EMF: The Scoping Report has identified the potential for EMF to affect benthic ecology and migratory fish; however, no reference has been made to potential impacts from EMF on marine mammals. Any likely significant effects to marine mammals from EMF should be assessed within the ES.	The potential effects of EMF have been assessed in **Section 12.6.4.9**.
Planning Inspectorate	2018 Scoping comments	Changes to prey resource: Potential impacts from a decrease in water quality has been identified as a potential impact for fish and shellfish. The resultant indirect impacts for marine mammals, basking sharks and reptiles should be assessed.	The potential changes to prey resources during construction have been assessed in **Section 12.6.3.8** and during operation in **Section 12.6.4.12**.
NRW	2018 Scoping comments	In section 8.1.1.2 it states that "due to the wide ranging nature of offshore ecological receptors such as … marine mammal receptors, an initial search of up to 50 km has been used for these receptors". We advise that with regard to marine mammals, rather than the 50 km search area proposed, the relevant marine mammal management units provide the appropriate spatial extent for screening in marine mammal protected sites (including	The relevant marine mammal management units have been used for each species as outlined in **Section 12.4.1**.

Consultee	Date/Document	Comment	Response
		SSSIs where appropriate) (see IAMMWG, 2015).	
NRW	2018 Scoping comments	For Annex II marine mammal species, the Welsh SACs within the relevant management units are as follows: Harbour porpoise Management Unit: Celtic & Irish Sea Welsh SACs with harbour porpoise as a feature within the Management Unit: North Anglesey Marine West Wales Marine Bristol Channel Approaches Bottlenose dolphin Management Unit: Irish Sea Welsh SACs with bottlenose dolphin as a feature within the Management Unit: Pen Llyn a'r Sarnau Cardigan Bay Grey Seal Management Unit: South and West England and Wales Welsh SACs with grey seal as a feature within the Management Unit: Pen Llyn a'r Sarnau Cardigan Bay Pembrokeshire Marine	As outlined in **Section 12.5.8**, these sites have been assessed in the information for the HRA (**Document MOR/RHDHV/DOC/0067**).
NRW	2018 Scoping comments	Please note that that the series of Harbour Porpoise SACs in the UK are now officially adopted by Europe and must be formally considered in HRA. Sites outside of Welsh waters (e.g. in Irish, English, Northern Irish, Scottish waters) should also be screened in based on their presence in the relevant management unit.	All designated sites within the relevant MUs, including harbour porpoise SACs, have been considered in the HRA screening (**Document MOR/RHDHV/DOC/0067**).
NRW	2018 Scoping comments	The nearshore and inshore waters of the Anglesey coast are important for cetaceans and seals. We advise that the scope of the ES assessment must consider the impacts of all stages of the development (construction, operation and decommissioning) on the following marine mammal species: harbour porpoise, common dolphin, Risso's dolphin, grey seal, minke whale and bottlenose dolphin.	As outlined in **Section 12.5** and agreed with NRW at the second marine mammal TWG meeting in February 2019, the ES assessment considers the impacts of all stages of the development (construction, operation and decommissioning) on the following marine mammal species: harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale and grey seal.
NRW	2018 Scoping comments	Some species might present a high risk and require a more quantitative approach to assessment than others, for example bottlenose dolphin, grey seal, harbour	Where possible, all assessments in the ES have been based on a quantitative approach.

Consultee	Date/Document	Comment	Response
		porpoise, which are all SAC species from nearby sites.	This has been put into the context of the SAC sites in the information for the HRA (**Document MOR/RHDHV/DOC/0067**).
NRW	2018 Scoping comments	Please note that bottlenose dolphin in the demonstration zone area are likely to be from Cardigan Bay SAC and Pen Llyn ar Sarnau SACs in the Irish Sea Management Unit (not just Cardigan Bay SAC).	This has been taken into account in the assessments for the ES (see **Section 12.5.2**) and in the information for the HRA (**Document MOR/RHDHV/DOC/0067**).
NRW	2018 Scoping comments	There are regionally important grey seal pupping sites on Anglesey, including on Holy Island (see Westcott and Stringell 2003). An NRW commissioned census of grey seal pupping abundance and distribution has recently been completed and indicates at least a doubling of pup production in North Wales (Banga *et al*. 2018 in prep – this paper might be available in time for consideration within the ES).	Grey seal pupping sites on Anglesey have been taken into account (as outlined in **Section 12.5.6**), based on Clarke *et al*. (2018). Grey Seal Pup Production and Distribution in North Wales.
NRW	2018 Scoping comments	The use of the demonstration zone and surrounding area by marine mammals will need to be assessed both spatially and temporally. The spatial extent of activities and operations and marine mammal protected sites should be guided by the relevant marine mammal management units (IAMMWG, 2015).	**Section 12.5**, outlines the distribution and occurrence for each species, including the relevant MUs. Where relevant, the potential impacts in **Section12.6** have been assessed both spatially and temporally.
NRW	2018 Scoping comments	Table 8.5 currently presents very broad appraisal of the potential impacts to be assessed; we consider that a more detailed list of possible impact pathways needs to be considered and presented in the ES. Where a particular impact is ruled out as being not significant, it is important that the decision is based on clear evidence. The impact pathways identified in the ES should also be considered in the cumulative impact assessment and HRA, where appropriate. We recommend that the ORJIP Ocean Energy Forward Look provides a useful start for prioritising impact pathways and evidence needs (see http://www.orjip.org.uk/documents).	**Section 12.6.1** provides details on the potential impacts and possible pathways assessed in the ES and **Section 12.4.4** outlines the EIA methodology. The impact pathways have also considered, where appropriate, in the cumulative impact assessment (**Section 12.6.6**) and in the information for the HRA (**Document MOR/RHDHV/DOC/0067**). Determining the potential impacts and pathways took into account numerous information sources, including ORJIP (2017) Ocean Energy Forward Look.

Consultee	Date/Document	Comment	Response
NRW	2018 Scoping comments	At this stage, the key issues would appear to relate to displacement, disturbance and collision during operation and noise impacts during construction, operation and decommissioning. There, however, be will be other impacts to consider, including indirect effects on prey species and cumulative effects.	**Section 12.6.1** provides an overview of the potential impacts that have been assessed for marine mammals, including potential changes in prey availability (**Section 12.6.3.8** and **12.6.4.12**) and cumulative impacts (**Section 12.6.6**).
NRW	2018 Scoping comments	We advise that it is likely that the key issue of collision risk during operation will need to be considered in quantitative detail. The potential for population level effects on marine mammals will need to be considered where significant impact pathways have been identified. For the assessment of marine mammal collision risk, we advise that the use of modelling frameworks such as the Population Consequences of Disturbance (PCoD) or toll quotas such as Potential Biological Removal should be considered.	In **Section 12.6.4.4.1**, site specific collision risk modelling has been undertaken for a range of different devices based on the SNH (2016) ERM and CRM models. The potential for population level effects on marine mammals have been assessed, where significant impact pathways have been identified, in **Appendix 12.3**.
NRW	2018 Scoping comments	We advise that the Sparling et al 2015 publication “Guidance to inform marine mammal site characterisation requirements at wave and tidal stream energy sites in Wales” should be followed to assist in determining the level of baseline characterisation required to inform the ES.	Sparling *et al*. (2015) and other guidance and information sources have been taken into consideration in **Sections 12.5** and **12.6**.
NRW	2018 Scoping comments	Note that although a literature review and results of collision risk analysis from similar studies (e.g. SeaGen and the MeyGen projects) will be informative, we advise that there will likely be a need to adapt present models to fit the chosen device(s) and unique location characteristics (open tidal site).	In **Section 12.6.4.4.1**, site specific collision risk modelling has been undertaken for a range of different devices based on the SNH (2016) ERM and CRM models.
NRW	2018 Scoping comments	The proposed baseline underwater noise monitoring survey should be undertaken in line with the latest relevant guidelines.	Noise data were collected by SEACAMS for the MDZ and have been used in the characterisation of the site.
NRW	2018 Scoping comments	No information is provided in the scoping report on the proposed approach to assessing potential underwater noise effects. This should follow the latest guiding principles for the assessment of the impacts of underwater noise. This includes applying an appropriate acoustic model, published exposure criteria or acoustic thresholds and relevant noise sources and model input data. The limitations and constraints of any approach should be set out.	The underwater noise assessment, including the thresholds and criteria are presented in **Section 12.6.3.1.1**. The underwater noise assessments also include, where possible, a general review of the latest available scientific

Consultee	Date/Document	Comment	Response
		The noise assessment should also include a general review of the latest available scientific evidence of the observed responses of marine mammals to different types of underwater sound for context.	evidence of the observed responses of marine mammals to different types of underwater sound for context.

NRW	1st Marine Mammal TWG meeting 27th November 2018
	
	and
	
	2nd Marine Mammal TWG meeting 19th February 2019
		▪ Species to be considered in baseline environment;
		▪ Data sources;
		▪ Density estimates and reference populations;
		▪ Construction and installation impacts to be assessed;
		▪ Operation and Maintenance (O&M) impacts to be assessed;
		▪ Decommissioning impacts to be assessed;
		▪ Potential cumulative impacts and in-combination effects impacts to be assessed;
		▪ Impact assessment methodology; and
		▪ Assessment approach for:
		  ▪ Underwater noise;
		  ▪ Vessel collision risk;
		  ▪ Disturbance at seal haul-out site;
		  ▪ Changes to water quality;
		  ▪ EMF effects;
		  ▪ Changes in prey availability;
		  ▪ Risk of entanglement;
		  ▪ Barrier effects;
		  ▪ Collision risk assessment, including use of ERM and CRM, approach to determining parameters in models; avoidance rates and thresholds.
		  ▪ Population modelling
			Full details of the key discussions undertaken within the first and second TWG meetings are provided within the Statements of Common Ground (SoCG) (**Document MOR/RHDHV/DOC/0070**)

NRW	3rd Marine Mammal TWG meeting 10th May 2019	▪ Density estimates and reference populations. ▪ Marine Mammal SACs and Reference Populations. ▪ Sensitivity of marine mammal populations in Welsh waters based on Sparling et al. (2015). ▪ List of potential impacts assessed for construction, operation and decommissioning. ▪ Overview of approach to assessments and presentation of results. ▪ PCoD update	Full details of the key discussions undertaken within the first and second TWG meetings are provided within the Statements of Common Ground (SoCG) (**Document MOR/RHDHV/DOC/0070**)

Consultee	Date/Document	Comment	Response
NRW	NRW Response 22.05.19 (CAS-84017-M9P0)	We have a particular concern about the collision risk figures presented for cetaceans (all of which are European Protected Species) and seals. Note that harbour porpoise, bottlenose dolphin and grey seal are qualifying features of several Special Areas of Conservation in Welsh waters. It is important to note that the evidence for the potential impacts of marine mammal collision with tidal devices with the potential to cause injury or fatalities is severely limited. We note that mitigation for collision risk is proposed by the use of monitoring systems (such as active sonar; passive acoustics; cameras) and deterrents such as Acoustic Deterrent Devices as part of an adaptive management plan. However, based on the information that we have seen so far and the evidence currently available to us regarding these methods, we cannot be fully confident that the proposed mitigation will be effective. As such we may not be able to conclude that significant adverse effects on the integrity of European protected sites could be ruled out without reasonable scientific doubt or that the project would not be detrimental to the favourable conservation status of European Protected Species. We may need to consider further measures as a fail-safe if the above mitigation fails, such as a shutdown of operations when a certain number of collisions occur, as part of the consent conditions. We note the ‘one dolphin scenarios’ presented on slide 38 of the Morlais Marine Mammal TWG 3rd Meeting presentation document and recommend that further consideration is given to an initial test phase of deployment of the scale given in the lower table, subject to us being satisfied with the predicted collision risk figures for the other cetacean and seal species with this approach. We acknowledge that this would generate up to 17.65MW, which is much less than the intended first phase of 40MW. A smaller test phase with reduced collision risk for cetacean and seal species could potentially offer a solution to allow progress if sufficient monitoring was put in place via an adaptive management plan to inform whether relevant Marine Licence conditions could be discharged before further devices were deployed. In addition, we wish to reiterate the advice from our EIA Scoping Opinion (paragraph 0.6 of Scoping opinion SC1804, issued on 11/07/18) that, without wishing to prejudice the HRA or consenting processes, should it not be possible to identify a package of measures that would avoid or mitigate the effects of the proposal and avoid adverse effects on the	Taking into account NRW’s comments, the collision risk assessments in the ES (**Section 12.6.4.4.1**) and information for the HRA (**Document MOR/RHDHV/DOC/0067**) are based on the less than one bottlenose dolphin collision risk scenarios. The assessments are based on indicative scenarios for the combination of different types of devices where the collision risk is predicted to be less than one bottlenose dolphin (based on the scenarios with the current maximum MW). Each stage of deployment would only progress based on these scenarios and that the regular reviewing of the monitoring and mitigation indicated that there was no increased collision risk. The approach will be to deploy to a level where the risk is less than one bottlenose dolphin. This deployment will then be monitored with mitigation, such as the use of ADDs if animals come too close to the tidal devices and arrays. The next phase of deployment would only proceed when a review of the monitoring and requirements for mitigation (e.g. how often ADDs were activated), indicates that there is no increased collisions risk. This would be done through the adaptive management and mitigation plan (EMMP) and in consultation with NRW. Therefore, the assessments, including the in-combination

Consultee	Date/Document	Comment	Response
		integrity of European protected sites it may be necessary to consider the proposal under Regulation 64 of the Conservation of Habitats and Species Regulations (“IROPI”).	assessment, is based on the scenarios for less than one bottlenose dolphin, as this would be the worst-case scenario. It is important to note that the output of the devices (MW) used in the assessments have been based on the current minimum rating, as a worst-case scenario and prior to deployment it is expected that the rating (MW) for the devices deployed could be higher for devices of the same or similar parameters. Further assessments will be conducted prior to deployment as part of the adaptive management and mitigation plan (EMMP). For information, indicative assessments for additional collision risk scenarios are presented in **Appendix 12.2** (**Volume III**).

12.4. METHODOLOGY

12.4.1. Study Area

46. Marine mammals are highly mobile and transitory in nature; therefore, it is necessary to examine species occurrence not only within the proposed MDZ, but also over the wider region. For each species of marine mammal, the following study areas have been defined based on the relevant Management Units (MUs), current knowledge and understanding of the biology of each species; taking into account the feedback received during consultation.

- Harbour porpoise Celtic and Irish Seas (CIS) MU;
- Bottlenose dolphin Irish Sea (IS) MU;
- Minke whale Celtic and Greater North Seas (CGNS) MU;
- Risso’s dolphin Celtic and Greater North Seas (CGNS) MU;
- Common dolphin Celtic and Greater North Seas (CGNS) MU;
- Grey seal South and West England and Wales MU and the OSPAR region; and
- Harbour seal in Wales and the OSPAR region.

47. MUs provide an indication of the spatial scales at which effects of plans and projects alone, and in-combination, need to be assessed for the key cetacean species in UK waters, with consistency across the UK (Inter-Agency Marine Mammal Working Group (IAMMWG), 2015). The study areas, MUs and reference populations used in the assessment have been determined based on the most relevant information and scale at which potential impacts from the proposed Project alone and cumulatively with other plans and projects.

48. The status and activity of marine mammals known to occur within or adjacent to the MDZ is considered in the context of regional population dynamics at the relevant scale, depending on the data available for each species and the extent of the agreed reference population.

12.4.2. Data Sources – Site-Specific Surveys and Reports

49. Marine mammal data for the MDZ have been collected by:

- Morlais Natural Power boat surveys data (visual surveys, shared platform with bird surveys): 24 boat surveys from November 2016 to October 2018 (**Appendix 11.1, Volume III**); and
- SEACAMS boat surveys data (visual and acoustic): 18 boat surveys from January 2015 to December 2016 (**Appendix 12.1, Volume III**).

12.4.2.1. Natural Power Surveys

50. Twenty-four surveys were conducted during two years of baseline marine mammal surveys of the Morlais Demonstration Zone (MDZ) between November 2016 and October 2018.

12.4.2.1.1. Survey Vessel

51. The surveys were all undertaken using the vessel Seekat C. The vessel is operated by SeeKat Marine Charters of Amlwch, north Anglesey. The SeeKat C is a Maritime and Coastguard Agency (MCA) Category 2 survey boat and has the following attributes:

- A forward-facing viewing platform with an unobstructed view;
- An observer eye height of greater than 5 m above sea level; and
- Capable of completing surveys at a speed of 5-15 knots (undertaken at 8-12 knots).

12.4.2.1.2. Survey Area

52. The surveyed area was designed to cover the whole of the MDZ (‘the Site’) plus a buffer area around the Site of 2 km (1.08nm) (the ‘survey area’). Note, however, that parts of the buffer on the east side actually encompass land.

53. The survey area was surveyed using 13 parallel transects, of varying length, orientated in a west-east direction. This transect orientation, being approximately perpendicular to the coast, ensured that each transect comprised a similar depth profile. Transects were spaced 0.92 km (0.5nm) apart, which is the minimum transect separation distance specified by boat-based survey guidelines (e.g. Camphuysen *et al*., 2004).

54. Whilst slightly under the recommended 15 transects for robust Distance analysis (Buckland *et al*., 2004), this spacing maximised survey coverage across the MDZ and 2 km buffer. The total length of all transects was 101.94 km (55.04nm). The location of the Site, together with the survey transects are illustrated in **Plate 12-1**.

12.4.2.1.3. Survey Timing

55. The surveys were scheduled to be undertaken on a monthly basis: i.e. one survey per calendar month for two years. On occasion, there were months where a survey was not possible due to poor weather or logistical constraints. Surveys were not undertaken in February, June or October 2017, or in September 2018. These surveys were completed as soon as possible in subsequent months to ensure that the full suite of 24 surveys were carried out within the two year period.

56. Each survey was carried out on a single day and took between five and six hours to complete. The direction along which transects were surveyed was alternated from north to south (Transect 1 to 13) and from south to north (Transect 13 to 1), to build temporal variation into the baseline dataset collected.

57. Surveys were largely undertaken during appropriate weather conditions, considered to be sea state three of less, swell height of <0.5m or less, and visibility of more than 500m.

58. For further details on survey effort, survey methods, data analysis and survey results see **Appendix 11.1** (**Volume III**).

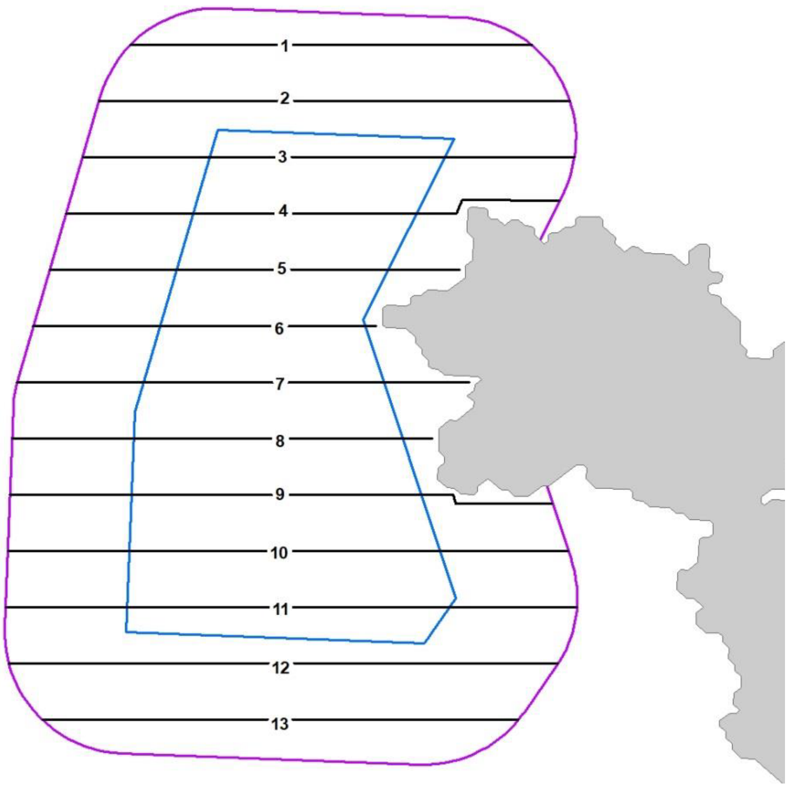

Plate 12-1 Location of Morlais Demonstration Zone (MDZ), the 2 km buffer survey area and transect layout used for Natural Power surveys (Source: Natural Power, 2018)

12.4.2.2. SEACAMS Surveys

59. Eighteen surveys were conducted between January 2015 and December 2016.

12.4.2.2.1. Survey Area and Design

60. The survey site (**Plate 12-2**) covers an area that includes the West Anglesey Demonstration Zone (WADZ) boundary, now the MDZ, as well as a buffer zone. A series of 10 zig zag transect lines were designed to provide even and maximum coverage of the survey area (**Plate 12-2**). Spacing between transect lines is approximately one kilometre. The orientation of the lines were designed so that transects cut across the predominant current direction as shown by a SEACAMS hydrodynamic model in order to minimise fluctuations in speed over ground caused by strong current speeds.

61. Surveys were conducted on days where predominantly Beaufort Sea state was force two or less. These are known to be favourable conditions to collect visual data on harbour porpoise, the target species. The aimed intensity of surveys was one per month, where 1-2 transects were completed at an average speed of 10 knots. Surveys were conducted in all seasons.

12.4.2.2.2. Survey Vessel

62. The surveys were also all undertaken using the 11 metre catamaran ‘Seekat C’, equipped with twin 280hp diesel engines was chartered for surveys. On the roof of the vessel are two purpose-built platforms for up to four observers (two primary and two independent observers). The primary observer platform reaches an eye height of approximately 4.5 metres with slight fluctuations depending on observer height. The eye height of the independent observer platform is approximately 5.5 metres. A wind breaker between the two platforms is used during surveys allowing independence between observers.

63. For further details on survey effort, visual and acoustic survey methods, data analysis and survey results see **Appendix 12.1**.

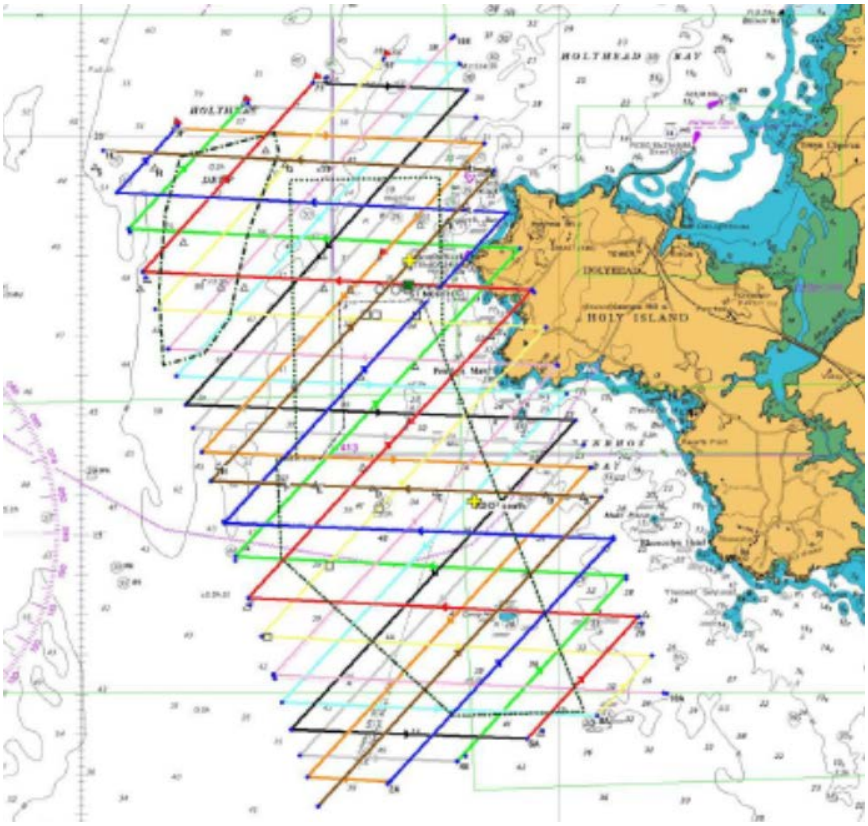

Plate 12-2 SEACAMS survey area and transect lines. One zig zag transect is represented by each colour

12.4.3. Data Sources – Desk Study

64. In addition to the site-specific surveys, a range of other relevant data sources and information has been reviewed to provide information on the marine mammal species that could be present in and around the proposed Morlais site, this includes, but is not limited to:

- Small Cetaceans in the European Atlantic and North Sea (SCANS-III) data (Hammond *et al*., 2017).
- ObSERVE aerial surveys (Rogan *et al*., 2018);
- Sea Watch Foundation sightings (Sea Watch Foundation, 2019);
- Management Units (MUs) for cetaceans in UK waters (Inter-Agency Marine Mammal Working Group (IAMMWG), 2015).
- The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area (Heinänen and Skov, 2015).
- Revised Phase III data analysis of Joint Cetacean Protocol (JCP) data resources (Paxton *et al*., 2016).
- UK seal at sea density estimates and usage maps (Russell *et al*., 2017).
- Special Committee on Seals (SCOS) annual reporting of scientific advice on matters related to the management of seal populations (SCOS, 2017).
- All relevant NRW reports, for example, Clarke *et al*. (2018). Grey Seal (*Halichoerus grypus*) Pup Production and Distribution in North Wales.

- Atlas of the Marine Mammals of Wales. Countryside Council for Wales (CCW) Monitoring Report No. 68 (Baines and Evans, 2012).
- UK Offshore Energy Strategic Environmental Assessment. OWESEA3 March 2016 (Department of Energy and Climate Change (DECC), 2016).
- Minesto Deep Green Holyhead Deep Project Environmental Statement and Habitats Regulations Assessment Report (Minesto, 2016).
- Horizon Wylfa Newydd Power Station baseline information, Environmental Statement and information for Habitats Regulations Assessment (Horizon Nuclear Power (HNP), 2018a, b).

12.4.4. Impact Assessment Methodology

65. The general EIA methodology is set out within **Chapter 5, EIA Methodology**. In principle, a matrix approach has been used to assess impacts following best practice and EIA guidance. Each potential impact has been identified using expert judgement and through consultation with NRW. An assessment of the significance has then made based on the sensitivity, value and magnitude of effect.

12.4.4.1. Sensitivity

66. The sensitivity of a receptor is determined through its ability to accommodate change and on its ability to recover if it is negatively affected. The sensitivity level of marine mammals to each type of impact is justified within the impact assessment and is dependent on the following factors:

- Adaptability – The degree to which a receptor can avoid or adapt to an effect;
- Tolerance – The ability of a receptor to accommodate temporary or permanent change without a significant adverse effect;
- Recoverability – The temporal scale over and extent to which a receptor will recover following an effect; and
- Value – A measure of the receptor's importance and rarity (as reflected in the species conservation status and legislative importance, see **section 12.4.4.2**).

67. The sensitivity to potential impacts of lethality, physical injury, auditory injury or hearing impairment, as well as behavioural disturbance or auditory masking will be considered for each species, using available evidence including published data sources. **Table 12-6** defines the levels of sensitivity and what they mean for the receptor.

Table 12-6 Definitions of sensitivity levels for marine mammals

Sensitivity	Definition
High	Individual receptor has very limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Medium	Individual receptor has limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Low	Individual receptor has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact.

Sensitivity	Definition
Negligible	Individual receptor is generally tolerant to and can accommodate or recover from the anticipated impact.

12.4.4.2. Value

68. In addition, the 'value' of the receptor forms an important element within the assessment, for instance, if the receptor is a protected species. It is important to understand that high value and high sensitivity are not necessarily linked. A receptor could be of high value (e.g. an Annex II species), but have a low or negligible physical/ecological sensitivity to an effect. Similarly, low value does not equate to low sensitivity and is judged on a receptor by receptor basis.

69. In the case of marine mammals, a large number of species fall within legislative policy; all cetaceans in UK waters are EPS and, therefore, are internationally important. Harbour porpoise, bottlenose dolphin, grey seal and harbour seals are also afforded international protection through the designation of Natura 2000 sites. As such, all species of marine mammal can be considered to be of high value.

70. The value will be considered, where relevant, as a modifier for the sensitivity assigned to the receptor, based on expert judgement. **Table 12-7** provides definitions for the value afforded to a receptor based on its legislative importance.

Table 12-7 Definitions of value levels for marine mammals

Value	Definition
High	Internationally or nationally important
Medium	Regionally important or internationally rare
Low	Locally important or nationally rare
Negligible	Not considered to be or particular important or rare

12.4.4.3. Magnitude

71. The significance of the potential impacts is also based on the intensity or degree of impact to the baseline conditions and is categorised into four levels of magnitude: high; medium; low; or negligible, as defined in **Table 12-8**.

72. The thresholds defining each level of magnitude of effect for each impact have been determined using expert judgement, current scientific understanding of marine mammal population biology and JNCC *et al*. (2010) draft guidance on disturbance to EPS species. The magnitude of each effect is calculated or described in a quantitative or qualitative way within the assessment.

73. The number of animals that can be 'removed' from a population through injury or disturbance will vary between species, but is largely dependent on the growth rate of the population; populations with low growth rates can sustain the removal of a smaller proportion of the population. The JNCC *et al*. (2010) draft guidance provides some indication on how many animals may be removed from a population without causing detrimental effects to the population at FCS. The JNCC *et al*. (2010) draft guidance also provides limited consideration of temporary effects, with guidance reflecting consideration of permanent displacement. As such this guidance has been considered in defining the thresholds for magnitude of effects.

74. Temporary effects are considered to be of medium magnitude at greater than 5% of the reference population being affected within a year. JNCC *et al*. (2010) draft guidance considered 4% as the maximum potential growth rate in harbour porpoise, and the ‘default’ rate for cetaceans. Therefore, beyond natural mortality, up to 4% of the population could theoretically be permanently removed before population growth would be halted. In assigning 5% to a temporary impact in this assessment, consideration is given to uncertainty of the individual consequences of temporary disturbance.

75. Permanent effects to greater than 1% of the reference population being affected within a year are considered to be high magnitude in this assessment. The assignment of this level is informed by the JNCC *et al*. (2010) draft guidance (suggesting 4% as the ‘default maximum growth rate for cetaceans) but also reflects the large amount of uncertainty in the potential individual and population level consequences of permanent effects.

Table 12-8 Definitions of magnitude levels for marine mammals

Value	Definition
High	Permanent irreversible change to exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that more than 1% of the reference population are anticipated to be exposed to the effect. OR Long-term effect for 10 years or more (but not permanent, e.g. limited to lifetime of the project). Assessment indicates that more than 5% of the reference population are anticipated to be exposed to the effect. OR Temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that more than 10% of the reference population are anticipated to be exposed to the effect.
Medium	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that between 0.01% and 1% of the reference population anticipated to be exposed to effect. OR Long-term effect for 10 years or more (but not permanent, e.g. limited to lifetime of the project). Assessment indicates that between 1% and 5% of the reference population are anticipated to be exposed to the effect. OR Temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that between 5% and 10% of the reference population anticipated to be exposed to effect.
Low	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that between 0.001% and 0.01% of the reference population anticipated to be exposed to effect. OR Long-term effect for 10 years or more (but not permanent, e.g. limited to lifetime of the project).

Value	Definition
	Assessment indicates that between 0.01% and 1% of the reference population are anticipated to be exposed to the effect. OR Intermittent and temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that between 1% and 5% of the reference population anticipated to be exposed to effect.
Negligible	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that 0.001% or less of the reference population anticipated to be exposed to effect. OR Long-term effect for 10 years or more (but not permanent, e.g. limited to lifetime of the project). Assessment indicates that 0.01% or less of the reference population are anticipated to be exposed to the effect. OR Intermittent and temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that 1% or less of the reference population anticipated to be exposed to effect.

12.4.4.4. Impact Significance

76. Following the identification of receptor sensitivity and the magnitude of the effect, the impact significance is determined using expert judgement. The probability of the impact occurring is also considered in the assessment process. If doubt exists concerning the likelihood of occurrence or the prediction of an impact, a precautionary approach is taken to assign a higher level of probability to adverse effects.

77. The matrix (provided in **Table 12-9**) is used as a framework to aid determination of the impact assessment. Definitions of impact significance are provided in **Table 12-10**. For the purposes of this assessment and specifically the marine mammal assessment, major and moderate impacts are considered to be significant. However, whilst minor impacts would not be considered significant in their own right, they may contribute to significant impacts cumulatively or through inter-relationships.

Table 12-9 Impact significance matrix

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Table 12-10 Definitions of impact significance for marine mammals

Value	Definition
High	Very large or large changes (either adverse or beneficial) to a receptor (or receptor group), which is important at a population (national or international) level because of the contribution to achieving national or regional objectives, or, a change expected to result in exceedance of statutory objectives and / or breaches of legislation.
Medium	Intermediate or large changes (either adverse or beneficial) to a receptor (or receptor group), which may be an important consideration at national or regional population level. Potential to result in exceedance of statutory objectives and / or breaches of legislation.
Low	Small changes (either adverse or beneficial) to a receptor (or receptor group), which may be raised as local issues but is unlikely to be important at a regional population level.
Negligible	No discernible change in receptor (or receptor group).

78. If mitigation is required or proposed, the assessment will also take into the mitigation to provide the post-mitigation residual impact. If the impact does not require mitigation (or none is possible) the residual impact will remain the same.

12.4.5. Cumulative Impact Assessment

79. The cumulative impact assessment (CIA) identifies areas where the predicted impacts of the construction, operation, maintenance and decommissioning of the proposed Project could interact with impacts from different plans or projects within the same region and impact sensitive receptors.

80. For this assessment, the stages of project development have been considered within the cumulative impact assessment. This was based on guidance issued by JNCC and Natural England in September 2013 and the Planning Inspectorate (2015) Advice Note 17. The assessment therefore takes into consideration: built and operational projects; projects under construction; projects that have been consented (but construction has not yet commenced); projects that have an application submitted to the appropriate regulatory body that have not yet been determined; projects that the regulatory body are expecting to be submitted for determination (e.g. projects listed under the Planning Inspectorate programme of projects); and projects that have been identified in relevant strategic plans or programmes.

81. The types of plans and projects taken into consideration, where relevant, include:

- Other marine renewable (wave and tidal) developments;
- Offshore windfarms;
- Aggregate extraction and dredging;
- Licenced disposal sites;
- Shipping and navigation;
- Sub-sea cables and pipelines;
- Port and harbour developments;
- Coastal developments; and
- Oil and gas development and operation, including seismic surveys.

82. The CIA is a two-part process in which an initial list of potential projects is identified with the potential to interact with the proposed Project based on the mechanism of interaction and spatial

extent of the reference population for each marine mammal receptor. The list of projects is then refined based on the level of information available for this list of projects to enable further assessment.

83. The plans and projects screened in to the CIA are:

- Located in the relevant marine mammal population reference area (defined for individual species in the assessment sections); and
- Have potential construction, operational and decommissioning activities which could result in potential cumulative impacts with the construction, operation and decommissioning of the proposed Morlais project.

84. The CIA will consider projects, plans and activities which have sufficient information available to undertake the assessment. Insufficient information will preclude a meaningful quantitative assessment, and it is not appropriate to make assumptions about the detail of future projects in such circumstances.

85. Commercial fisheries have the potential to cause a cumulative impact on marine mammals, through both the direct impact of by-catch, the indirect impact through the loss of marine mammal prey species (from commercial fisheries) and the disturbance from underwater noise (from vessel presence). However, by-catch by commercial fisheries is recognised as a historic and continuing cause of marine mammal mortality and will therefore be a factor in shaping the size of the current Management Unit (MU) populations. The available prey has also been influenced by historic and continuing commercial fishing.

86. Noise and disturbance from vessels associated with established activities such as ferry routes, commercial shipping routes and commercial fisheries, are also considered to be part of the baseline conditions.

87. This approach is in accordance with the Planning Inspectorate Advice Note 17 Cumulative Effects Assessment, which states that:

“Where other projects are expected to be completed before construction of the proposed NSIP and the effects of those projects are fully determined, effects arising from them should be considered as part of the baseline”.

12.4.6. Transboundary Impact Assessment

88. The potential for transboundary impacts has been addressed by considering the reference populations, MUs, seal telemetry and potential linkages to non-UK sites.

89. The assessment of the effect on the integrity of the transboundary European sites as a result of impacts on the designated marine mammal populations will be undertaken and presented in the Report to inform the HRA.

12.5. EXISTING ENVIRONMENT

90. A review of the Atlas of Marine Mammals of Wales indicates that nineteen marine mammal species have been recorded in Welsh waters since 1990 (Baines and Evans, 2012). The most

regular visitors are harbour porpoise, bottlenose dolphin, grey seal, common dolphin, Risso's dolphin and minke whale. Species recorded more rarely include fin whale, sei whale and humpback whale. Grey seal are also regularly recorded around Wales (Baines and Evans, 2012; SCOS, 2017).

91. The Sea Watch Foundation collate volunteer cetacean sightings from around the UK's coastline. The most recent sightings between October 2018 and February 2019 from around the Welsh coastline have recorded predominantly bottlenose dolphin and harbour porpoise, while other cetacean species that have been sighted included Risso's dolphin and common dolphin (Sea Watch Foundation, 2019). Around Anglesey, the majority of sightings have been of harbour porpoise, bottlenose dolphin, Risso's dolphin and common dolphin (Sea Watch Foundation, 2019).

92. A large-scale survey for cetaceans in European Atlantic waters was conducted in summer 2016 (SCANS-III) in all European shelf waters (Hammond *et al*., 2017). The survey was split into survey areas, or blocks, with the MDZ being located within the SCANS-III survey block E, which recorded harbour porpoise, bottlenose dolphin, Risso's dolphin and minke whale to be present (Hammond *et al*., 2017).

93. The available data from the site specific survey (**Section 12.4.2**) and other data sources (**Section 12.4.3**), indicates that marine mammal species that could be present in and around the MDZ are:

- Harbour porpoise;
- Bottlenose dolphin;
- Risso's dolphin;
- Common dolphin;
- Minke whale;
- Grey seal; and
- Harbour seal.

94. The marine mammal species included in the assessment were agreed with NRW at the second marine mammal technical working group (TWG) meeting in February 2019. **Section 12.5.10** provides a summary of the relevant density estimates and reference populations used in the assessments.

12.5.1. Harbour porpoise

12.5.1.1. Distribution and Occurrence

95. Harbour porpoise distribution is generally restricted to the temperate and sub-arctic waters of the Northern Hemisphere, mainly on the continental shelf at depths of 20-200m and primarily within water temperatures ranging from 11 to 14^{o}C (DECC, 2016; Reid *et al*., 2003).

96. Harbour porpoise are widely distributed throughout the Celtic and Irish Seas during most months of the year (Reid *et al*., 2003; Mackey *et al*., 2004; Baines and Evans, 2012; Hammond *et al*., 2013, 2017; Rogan *et al*., 2018). Their occurrence is not evenly distributed in Welsh waters with

apparent hotspots at the south-west coast of the Lleyn Peninsula, southern Cardigan Bay, in the vicinity of Strumble Head and the west and north Pembrokeshire Coast and Islands (Skomer and Ramsey) and in the Bristol Channel off the south coast of Wales around the Gower Peninsula and in Swansea Bay (Baines and Evans, 2012).

97. Harbour porpoise are typically widely distributed throughout Cardigan Bay, with detections in both inshore and offshore waters. Harbour porpoise clusters were observed in the southern part of Cardigan Bay SAC around Cemaes Head, Pembrokeshire, and harbour porpoise are regularly spotted offshore in both Cardigan Bay and Pen Llŷn a'r Sarnau SACs (Feingold and Evans, 2014b).

98. Localised hotspots also appear to exist off the north and north-west coast of Anglesey, in particular around Point Lynas and South Stack, including Holyhead Deep (Baines and Evans, 2012; Evans *et al*., 2015). Harbour porpoise are likely to be present at these locations throughout the year, with little seasonal variation (Baines and Evans, 2012; Evans *et al*., 2015).

99. During the site-specific surveys for the Wylfa Newydd Development Area, harbour porpoise were the most frequently reported cetacean (HNP, 2018a). The sightings were generally concentrated to the east of the Wylfa Newydd Development Area, in areas in the vicinity of Middle Mouseand Point Lynas. The Vantage Point (VP) surveys indicated that the survey area covered from Wylfa Head, had the highest number of individuals recorded.

100. Heinänen and Skov (2015) provided detailed analyses of 18 years of Joint Cetacean Protocol (JCP) survey data. The model results for the Celtic and Irish Seas indicate that most important factors for probability of presence of harbour porpoise in this MU during summer are increasing current speeds up to 0.4m/s and with increasing eddy activity. In winter, the same response to current speed is observed, although there are lower probabilities with high current speeds (Heinänen and Skov, 2015). The responses to water depth indicate that high densities of harbour porpoise are associated with the shallowest areas (areas shallower than 40m) in summer and high probability of presence in the same areas in winter. During summer, high densities are often associated with sandy-gravelly sediments, with rather low densities in muddy areas (Heinänen and Skov, 2015).

101. The Heinänen and Skov (2015) study identified several persistent high density areas off Wales. Three coastal areas off west Wales (Pembrokeshire and Cardigan Bay), and north-west Wales (Anglesey, Lleyn Peninsula), and part of the Bristol Channel (Camarthen Bay). The distribution of harbour porpoise during the site-specific surveys of the MDZ and 2 km buffer conducted by Natural Power (**Appendix 11.1**), as calculated by the Distance analysis, indicates that the greatest abundance of porpoise occurred in the north of the survey area (**Plate 12-3**).

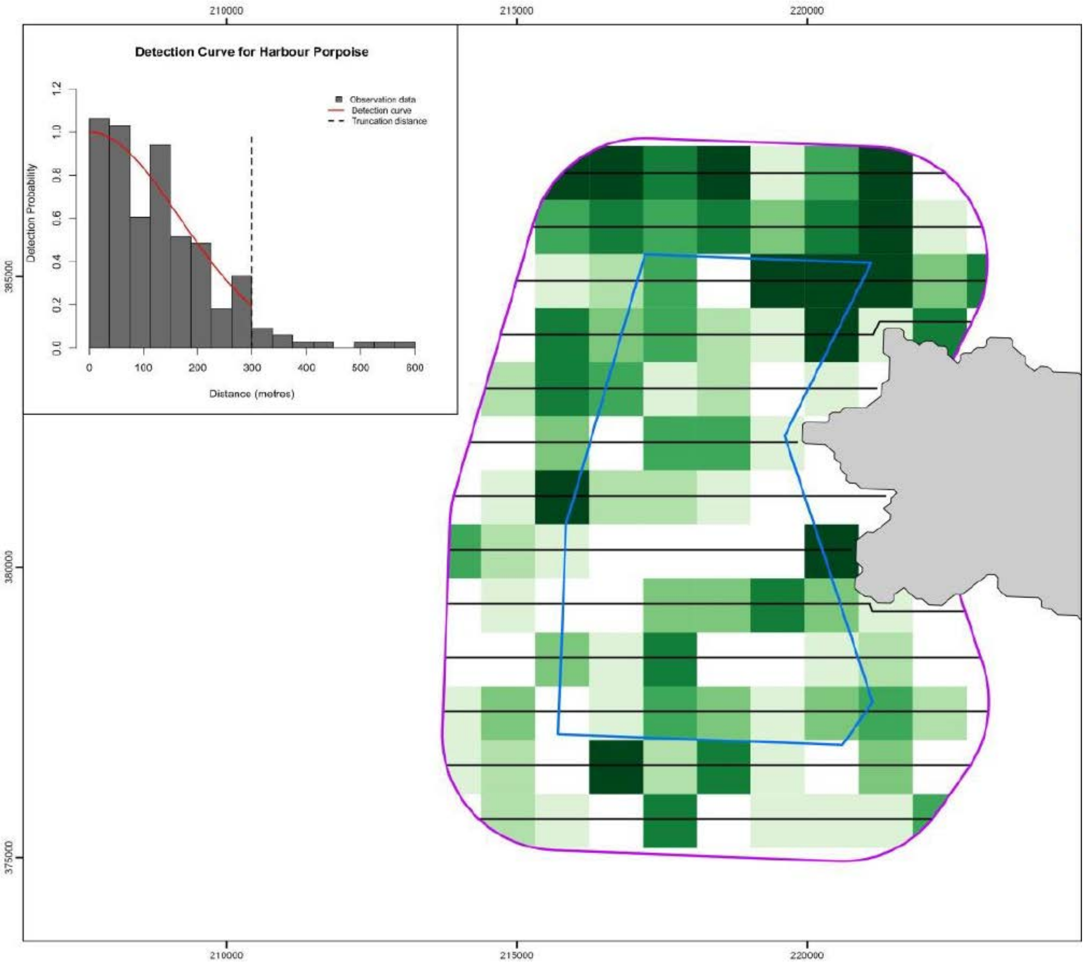

Plate 12-3 Density of harbour porpoise calculated using Distance analysis (and associated detection curve) from Natural Power site specific surveys

12.5.1.2. Abundance and Density Estimates

12.5.1.2.1. Celtic and Irish Seas Management Unit

102. Harbour porpoise within the eastern North Atlantic are generally considered to be part of a continuous biological population that extends from the French coastline of the Bay of Biscay to northern Norway and Iceland (Tolley and Rosel, 2006; Fontaine *et al*., 2007, 2014; IAMMWG, 2015). However, for conservation and management purposes, it is necessary to consider this population as smaller Management Units (MUs). MUs provide an indication of the spatial scales at which effects of plans and projects alone, and in-combination, need to be assessed for the key cetacean species in UK waters, with consistency across the UK (IAMMWG, 2015).

103. The Inter-Agency Marine Mammal Working Group (IAMMWG) defined three MUs for harbour porpoise: The North Sea (NS); West Scotland (WS) and the Celtic and Irish Sea (CIS) (comprising ICES area VI and VII, except VIId). The MDZ is located in the Celtic and Irish Seas MU (**Plate 12-4**), which has an estimated harbour porpoise abundance of 104,695 (CV = 0.32; 95% CI = 56,774-193,065; IAMMWG, 2015), this was based on the SCANS-II survey (Hammond *et al*., 2013) and CODA surveys (Macleod *et al*., 2009).

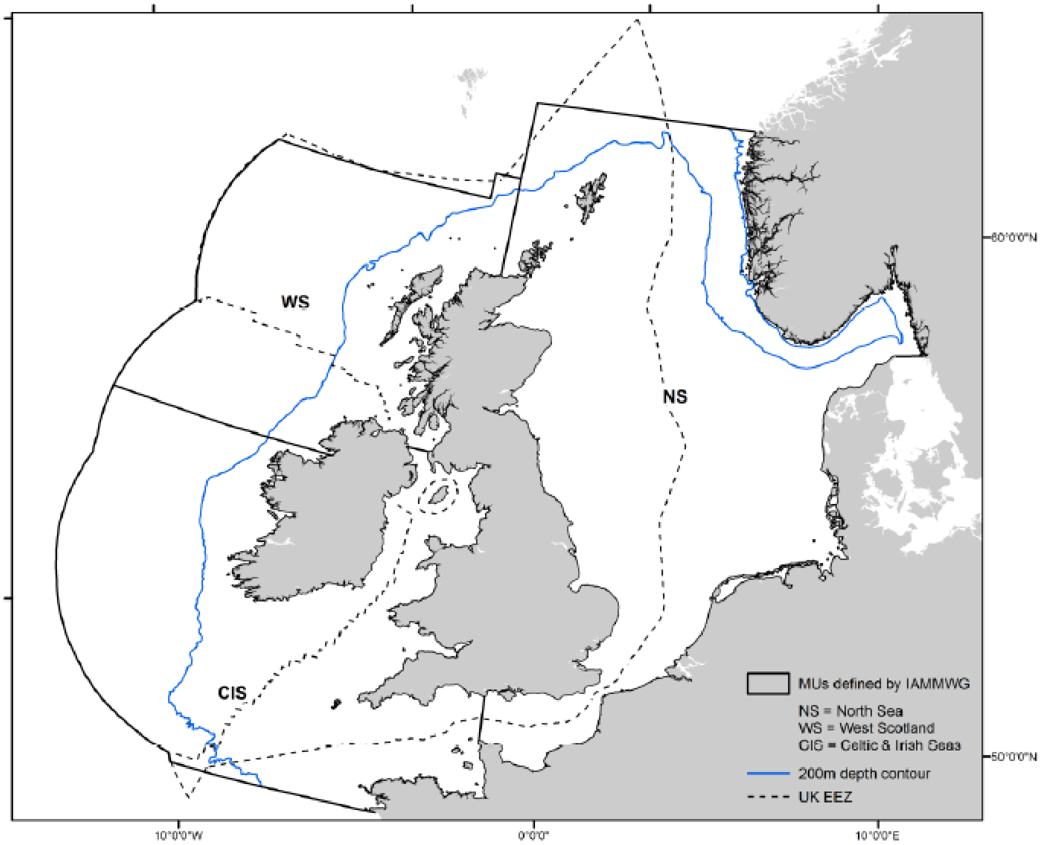

Plate 12-4 Harbour Porpoise Management Units (Source: IAMMWG, 2015)

104. Information provided by NRW (NRW comments on 1st marine mammal TWG meeting), indicates that the abundance estimate for the Celtic and Irish Seas MU based on the original SCANS-II (2005) data was 107,384 (CV = 0.30) and the abundance estimate based on the revised SCANS-II (2005) data was 98,807 (CV = 0.30; 95% CI = 57,315-170,336). The abundance estimate for the Celtic and Irish Seas MU based on the SCANS-III and ObSERVE survey was not available at the time of writing. It was therefore agreed with NRW at the 2nd marine mammal TWG meeting on the 19th February 2019, that the published IAMMWG (2015) abundance estimate for the Celtic and Irish Seas MU was the most appropriate to use in the assessments.

105. For the assessments, the CIS MU has been used as the reference population. This is appropriate to take into account the wide range and distances covered by harbour porpoise. As stated in the North Anglesey Marine / Gogledd Môn Forol SAC Selection Assessment Document "*as a wide-ranging species, the animals within the North Anglesey Marine / Gogledd Môn Forol site cannot be considered isolated in relation to the rest of the population. Animals within the site are part of the wider MU population*" (JNCC and NRW, 2017).

12.5.1.2.2. Joint Cetacean Protocol (JCP) Data

106. The Revised Phase-III Data Analysis of the Joint Cetacean Protocol (JCP) (Paxton *et al*., 2016) and The Identification of Discrete and Persistent Areas of Relatively High Harbour Porpoise Density in the Wider UK Marine Area (Heinänen and Skov, 2015) analyse harbour porpoise abundance and distributions in UK waters. Both projects used numerous data sources collated by the JCP.

107. The two projects, through the use of complex modelling produced distribution maps and estimates of density for harbour porpoise in UK waters. The JCP report specifically aimed to examine abundance and changes in abundance which can be used to assist in environmental impact assessments (Paxton *et al*., 2016). The analyses helped identify discrete and persistent areas of high harbour porpoise density in the UK marine area using habitat mapping; the aim of this project was to assist in the identification of potential harbour porpoise SACs (Heinänen and Skov, 2015).

108. The results of the two projects produced broadly similar modelled densities of harbour porpoise; however, derivation of the results using different modelling approaches resulted in some key differences (JNCC, 2016). For example, the Heinänen and Skov (2015) report uses associations between observed numbers and habitat characteristics and is therefore more likely to provide a realistic picture of harbour porpoise density where effort is low (Paxton *et al*., 2016).

109. As such, JNCC have provided some advice on the use of the outputs in analyses for environmental impact assessments. JNCC (2016) concluded that the Heinänen and Skov (2015) density surfaces better represent the expected distribution and abundance of harbour porpoise for any given area of interest and should, therefore, be used preferentially. The densities from the Heinänen and Skov (2015) report are not currently available for wider use and, in the interim, JNCC advice that the JCP Phase-III density surfaces for harbour porpoise may be used.

110. The revised JCP Report (2016) defines a set of Developer Areas of which are important areas for the development of offshore renewable energy. The closest developer area for harbour porpoise is the Irish Sea Developer Area (with an estimate of 2.2-5.9% of CIS reference population). Other Developer Areas included within the MU are Isle of Wight (0.2-0.8% of CIS MU), Atlantic Array (7.9-18.6% of CIS MU), Strangford Loch (0.2-0.7% of CIS MU) and Solway Firth (0.8-2.2% of CIS MU) (Paxton *et al*., 2016).

12.5.1.2.3. SCANS Data

111. In July 2005, SCANS-II surveyed the entire European Atlantic continental shelf to generate robust estimates of abundance for harbour porpoise and other cetacean species (shown on **Plate 12-5**). For the entire SCANS-II survey area, harbour porpoise abundance in the summer of 2005 was estimated to be 375,358 (CV = 0.197; Hammond *et al*., 2013). The SCANS-II survey estimated that the abundance of harbour porpoise in survey block O (an area of 45,417 km^2), which is located in the Irish Sea and includes the MDZ, was 15,230 individuals (CV = 0.35) and the density was estimated to be 0.335 harbour porpoise per km2 (CV = 0.35) (Hammond *et al*., 2013).

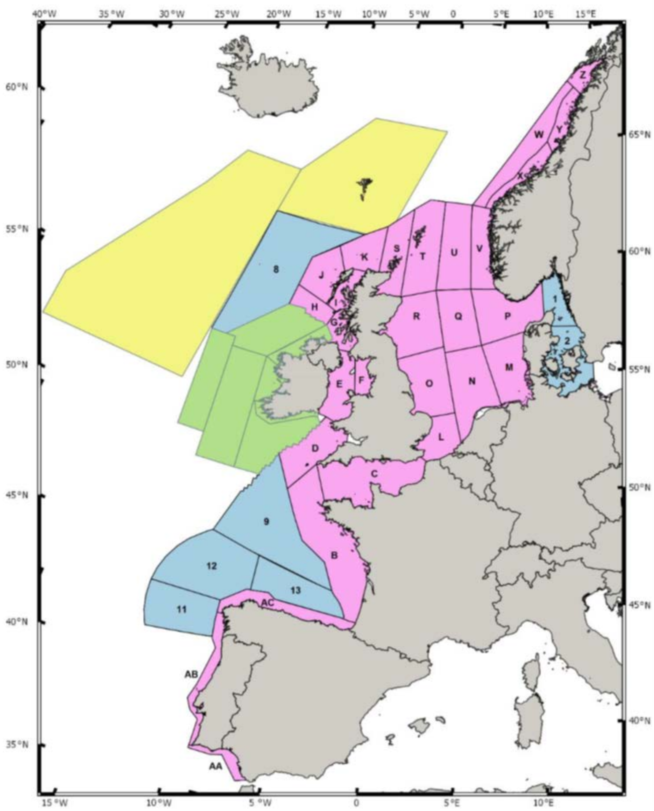

Plate 12-5 Area covered by SCANS-III and adjacent surveys[2] (Source: Hammond *et al*., 2017)

112. SCANS-III in the summer of 2016 surveyed all European Atlantic waters from the Strait of Gibraltar in the south to 62°N in the north and extending west to the 200 nautical miles (nm) limits of all EU Member States (Hammond *et al*., 2017). The survey area was not the same as for SCANS-II. For the entire SCANS-III survey area, harbour porpoise abundance in the summer of 2016 was estimated to be 466,569 with an overall estimated density of 0.381/ km^2 (CV = 0.154; 95% CI = 345,306-630,417; Hammond *et al*., 2017).

113. Estimates for harbour porpoise in the Celtic and Irish Seas ICES Assessment Unit (partial coverage only) during the SCANS-III survey was an abundance of 26,700 and density of 0.11/ km^2 (CV = 0.25; 95% CI = 16,055 – 42,128; Hammond *et al*., 2017).

114. The SCANS-III survey estimated that the abundance of harbour porpoise in survey block E (**Plate 12-5**; surface area of 34,870 km^2), which is located in the Irish Sea and includes the MDZ, was 8,320 individuals and the density was estimated to be 0.239 harbour porpoise per km^2, with a mean group size of 1.31 (CV = 0.28; 95% CI = 4,643 – 14,354; Hammond *et al*., 2017).

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[2] SCANS-III areas = pink lettered blocks were surveyed by air; blue numbered blocks were surveyed by ship. Adjacent survey = blocks coloured green to the south, west and north of Ireland which were surveyed by the Irish ObSERVE project and blocks coloured yellow which were surveyed by the Faroe Islands as part of the North Atlantic Sightings Survey in 2015

In the adjacent area, survey block F (**Plate 12-5**; surface area of 12,322 km^2), the estimated abundance was 1,056 harbour porpoise, with an estimated density of 0.086/ km^2 and mean group size of 1.00 (CV = 0.38; 95% CI = 342-2,010; Hammond *et al*., 2017).

12.5.1.2.4. ObSERVE Data

115. Extensive aerial surveys of Ireland's offshore waters (ObSERVE surveys) were conducted in the summer and winter of 2015 and 2016, with additional surveys conducted in inshore/coastal areas in the summer and winter of 2016. The study area covered waters overlying and beyond Ireland's continental shelf and was divided into five survey strata in 2015, with three smaller inshore strata added in 2016 (**Plate 12-6**). Within each stratum, two zig-zag transects were surveyed, designed to provide equal coverage probability (Rogan *et al*., 2018).

116. During the surveys, harbour porpoises were recorded over a large spatial area during the summer months, but a more coastal distribution was indicated in winter. Harbour porpoises were more commonly sighted in summer, with overall harbour porpoise abundance estimates of 35,975 individuals in summer (CV: 0.09) and 20,571 in winter (CV: 0.23) (Rogan *et al*., 2018).

117. The ObSERVE aerial surveys provide density estimates for the Irish Sea off the Irish Coast (Rogan *et al*., 2018). For stratum 5 (**Plate 12-6**), which covered the east coast of Ireland, the density estimates were 0.696 and 1.046 harbour porpoise per km^2 during the summer 2015 and 2016 periods, respectively; and during the winter periods were 0.867 and 0.924 harbour porpoise per km^2 in 2015 and 2016, respectively (as provided in **Section 12.5.1.2.7**).

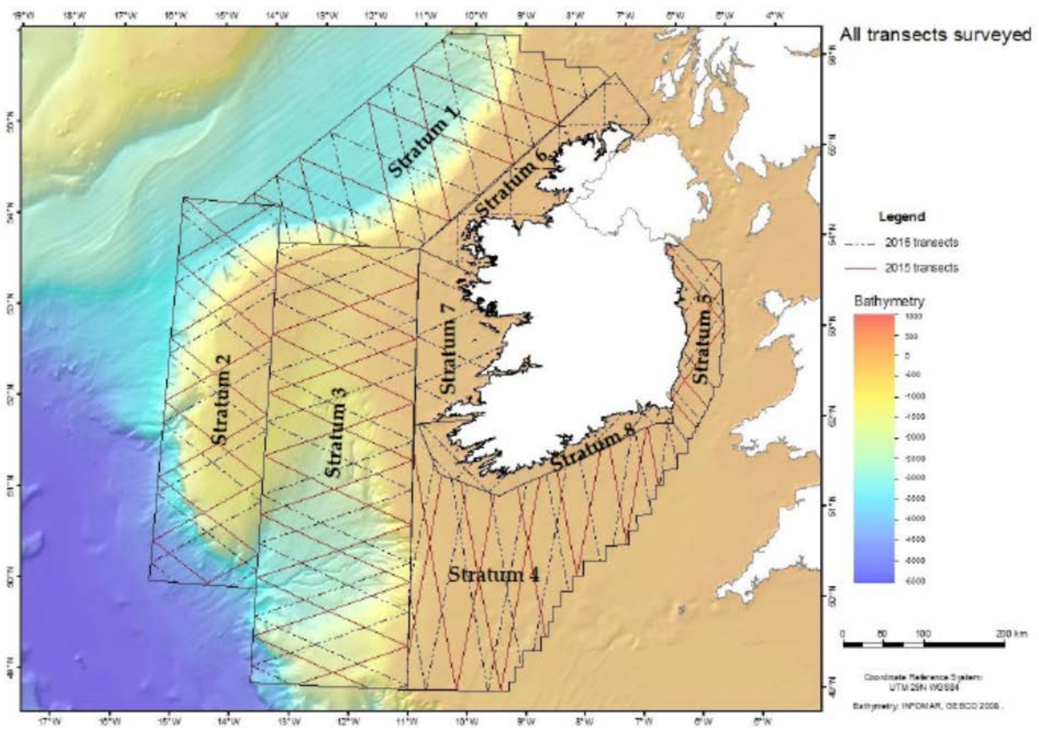

Plate 12-6 ObSERVE aerial transect lines flown in summer and winter 2015 and 2016 in relation to bathymetry (Source: Rogan *et al*., 2018)

12.5.1.2.5. Cardigan Bay

118. Harbour porpoise abundance estimates for the whole of Cardigan Bay between 2011 and 2013 have more than halved over the three years with an estimated 1074 in 2011, 565 in 2012 and 410 individuals in 2013 (Feingold and Evans, 2014b).

119. However, within Cardigan Bay SAC, harbour porpoise abundance estimates have changed little over the years, the only exception being in 2011 (**Plate 12-7**). The relatively high estimate in 2011 (340), reflects the very high CV due to low effort coverage, and the number of actual observations was low (n=20) whereas the estimates for 2012-13 are similar to those obtained in earlier years (2005-07).

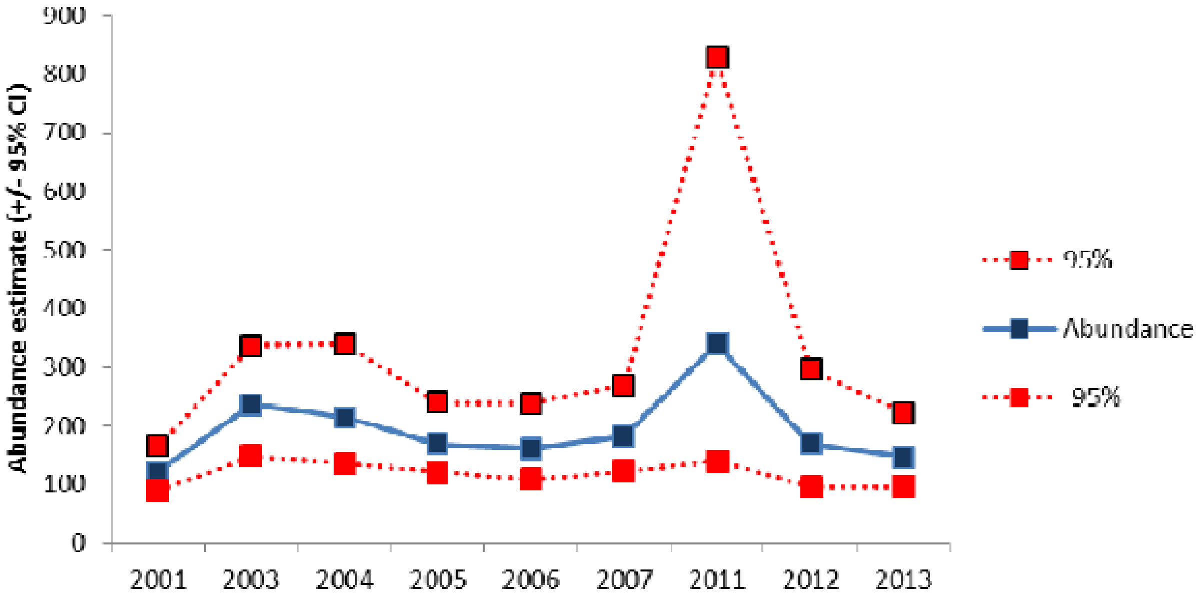

Plate 12-7 Abundance estimates of harbour porpoise in Cardigan Bay SAC, 2001-13 (Source: Feingold and Evans, 2014b)

12.5.1.2.6. North Anglesey Survey Data

120. Two dedicated studies of the harbour porpoise population around the north coast of Anglesey have been undertaken that cover some of the MDZ.

121. Shucksmith *et al*. (2009) conducted dedicated harbour porpoise surveys between 2002 and 2004 covering an area of approximately 489 km^2 extending from the east of Point Lynas to the west of South Stack on the north coast of Anglesey. In the three year study, visual and acoustic methods were used to detect the animals along 31 transects extending out from the shore between May and September. Shucksmith *et al*. (2009) assumed a g(0) of 1, where g(0) is the probability of detecting an animal on track line during the survey. If all animals were detected then g(0) would be 1, if half the animals were missed (e.g. they were under the water and not surfacing) then g(0) would be 0.5. In reality the g(0) for harbour porpoise is never as high as 1, so the Shucksmith *et al*. (2009) data likely represents an underestimate for this species. Shucksmith *et al*. (2009) estimated that the minimum number of harbour porpoise off the north

coast of Anglesey was 309 individuals (CV = 0.20), with an estimated density of 0.63 individuals per km^2. When g(0) is 0.5 is applied to the data, based on a precautionary scenario that half of the harbour porpoise were submerged, the estimated maximum abundance is 618 individuals, with a density estimate of 1.26 individuals per km^2.

122. The harbour porpoise study area used by Shucksmith *et al*. (2009) was split in to five sectors: South Stack (SS); Holyhead Harbour (HB); Carmel Head (CH); Middle Mouse (MM); and Point Lynas (PL). The Morlais Development Zone is located in the South Stack sector, where the estimated abundance was 207 harbour porpoise with an estimated density of 2.54/ km^2, based on g(0) is 0.5. However, it is important to note that 75% of all detections were made within 5 km of the shoreline in this sector and that harbour porpoise in the SS area were more randomly distributed compared to other areas, such as Point Lynas, where they tend to concentrate around specific features (Shucksmith *et al*., 2009).

123. Gordon *et al*. (2011) undertook cetacean surveys off the north-west coast of Anglesey at two locations, Carmel Head and South Stack. The visual and towed hydrophone acoustic surveys, passive acoustic monitoring from static acoustic loggers and visual observations from shore authors were conducted in July and August 2009. Based on acoustic detection rates and assuming a group size of 1.5 (mean of primary and tracker observers mean group sizes), an effective survey strip width of 186m and using no g(0) correction (i.e. they assumed they had seen all of the animals), they estimated that the overall density of harbour porpoise in the two survey areas (Carmel Head and South Stack) to be 0.38 individuals km^2. After applying their expected g(0) of 0.68, the density estimate was 0.56 individuals km^2.

124. Gordon *et al*. (2011) also deployed five automated acoustic data loggers (TPODS) to the north of the Holyhead Deep site around the Skerries and Carmel Head in summer 2009. They confirmed relatively high detection rates of harbour porpoise in the area, with detections every day (and night) of the study. Activity levels were reported to be highest at night, probably due to diurnal patterns in prey availability (Gordon *et al*., 2011).

12.5.1.2.7. Site-Specific Survey Data

125. During the Natural Power boat surveys of the MDZ and 2 km buffer, harbour porpoise was the most frequently sighted cetacean species and comprised 93% of all marine mammals recorded. The total number of observations of harbour porpoise from the 24 months of surveys was 233 individuals (range 0-76 per survey). January 2017 and April 2018 resulted in the highest encounter rates (number of on-effort marine mammal encounters per km survey effort) for harbour porpoise, with 0.255 and 0.177 encounters per km survey effort, respectively (**Appendix 11.1**, **Volume III**).

126. There were sufficient records of harbour porpoise (170) to allow Distance analysis to be undertaken. Within the Site, harbour porpoise peaked at an estimated 1.00 animals/ km^2 during the January 2017 survey (35 individuals). However, it should be noted that although detectability of animals available for detection is accounted for in this analysis, these figures still represent a minimum estimate since the assumption of g(0) = 1 (i.e. all animals were observed and recorded) will provide an underestimate (**Appendix 11.1**, **Volume III**). The harbour porpoise abundance and density estimates for the Natural Power surveys are provided in **Table 12-11**.

127. Over the course of the 24 Natural Power surveys all tidal conditions were encountered within the survey area. The data indicates that the greatest number of porpoises were present mid-tide, when then the tide was rising (**Appendix 11.1**, **Volume III**).

Table 12-11 Harbour porpoise abundance and density estimates (animals/ km^2), lower 95% (confidence limits (LCL) - upper 95% confidence limits (UCL); coefficient of variation (%CV)) derived from distance sampling (Appendix 11.1; Natural Power, 2018).

Survey Month	Abundance (LCL- UCL)	Density (LCL – UCL;%CV)
November 2016	Site = 6 (1 - 39) Buffer = 26 (11 - 63)	Site = 0.17 (0.02 – 1.11; 98.78) Buffer = 0.40 (0.16 – 0.96; 42.71)
December 2016	Site = 0 Buffer = 10 (4 - 27)	Site = 0 Buffer = 0.15 (0.05 – 0.41; 49.09)
January 2017	Site = 35 (13 - 97) Buffer = 3 (1 - 21)	Site = 1.00 (0.36 – 2.76; 46.6) Buffer = 0.64 (0.26 – 1.57; 42.98)
February 2017	Site = 18 (6 - 51) Buffer = 3 (1 - 21)	Site = 0.50 (0.17 – 1.46; 49.37) Buffer = 0.05 (0.01 – 0.32; 103.75)
March 2017	Site = 9 (3 - 28) Buffer = 0	Site = 0 Buffer = 0.25 (0.08 – 0.79; 53.54)
April 2017	Site = 3 (0 - 19) Buffer = 32 (15 - 68)	Site = 0.08 (0.01 – 0.54; 97.19) Buffer = 0.50 (0.23 – 1.05; 35.7)
May 2017	Site = 0 Buffer = 0	Site = 0 Buffer = 0
June 2017	Site = 9 (3 - 26) Buffer = 35 (19 - 67)	Site = 0.25 (0.08 – 0.75; 50.63) Buffer = 0.54 (0.29 – 1.03; 30.35)
July 2017	Site = 9 (3 - 26) Buffer = 13 (4 - 39)	Site = 0.25 (0.08 – 0.75; 50.82) Buffer = 0.20 (0.07 – 0.60; 54.12)
August 2017	Site = 3 (0 - 21) Buffer = 3 (1 - 21)	Site = 0.08 (0.01 – 0.59; 102.84) Buffer = 0.05 (0.01 – 0.32; 103.39)
October 2017	Site = 6 (1 - 25) Buffer = 3 (1 - 20)	Site = 0.05 (0.01 – 0.31; 102.17) Buffer = 0.17 (0.04 – 0.71; 69.52)
November 2017	Site = 6 (1 - 25) Buffer = 16 (5 - 53)	Site = 0.04 (0.04 – 0.71; 69.52) Buffer = 0.25 (0.08 – 0.81; 58.94)
December 2017	Site = 0 Buffer = 13 (4 - 41)	Site = 0 Buffer = 0.20 (0.06 – 0.63; 57.5)
January 2018	Site = 0 Buffer = 10 (2 - 41)	Site = 0 Buffer = 0.15 (0.03 – 0.63; 74.72)
February 2018	Site = 3 (0 - 19) Buffer = 19 (10 - 36)	Site = 0.08 (0.01 – 0.54; 97.19) Buffer = 0.30 (0.16 – 0.56; 29.83)
March 2018	Site = 23 (11 - 50) Buffer = 32 (11 - 95)	Site = 0.67 (0.31 – 1.42; 34.11) Buffer = 0.50 (0.17 – 1.46; 53.22)
April 2018	Site = 3 (0 - 19) Buffer = 10 (2 - 39)	Site = 0.08 (0.01 – 0.54; 97.19) Buffer = 0.15 (0.04 – 0.60; 71.01)
May 2018	Site = 6 (1 - 23) Buffer = 10 (4 - 25)	Site = 0.15 (0.06 – 0.39; 46.25) Buffer = 0.15 (0.06 – 0.39; 46.25)

Survey Month	Abundance (LCL- UCL)	Density (LCL – UCL;%CV)
June 2018	Site = 15 (6 - 37) Buffer = 10 (3 - 29)	Site = 0.42 (0.16 – 1.06; 42.65) Buffer = 0.05 (0.05 – 0.45; 54.32)
July 2018	Site = 6 (1 - 24) Buffer = 10 (3 - 29)	Site = 0.17 (0.04 – 0.67; 66.74) Buffer = 0.05 (0.05 – 0.45; 54.92)
August 2018	Site = 3 (0 - 21) Buffer = 16 (7 - 39)	Site = 0.08 (0.01 – 0.59; 102.55) Buffer = 0.25 (0.10 – 0.59; 41.9)
September 2018	Site = 9 (3 - 25) Buffer = 13 (4 - 42)	Site = 0.25 (0.09 – 0.73; 49.26) Buffer = 0.20 (0.06 – 0.64; 58.6)
October 2018	Site = 12 (5 - 28) Buffer = 6 (2 - 25)	Site = 0.33 (0.14 – 0.81; 40.18) Buffer = 0.10 (0.03 – 0.38; 68.86)

128. Dedicated harbour porpoise surveys have been conducted off West Anglesey as part of the SEACAMS project which includes the Morlais site (**Plate 12-2**). The boat surveys collected visual and acoustic data. Eighteen surveys were completed between January 2015 and December 2016, totalling 25 transects, 884 km of effort on transects covering an area of 707 km^2.

129. The SEACAMS data (**Appendix 12.1**, **Volume III**), provides a range of relative and absolute density estimates calculated for harbour porpoise off Holy Island, Anglesey. The relative density of individuals is estimated to be 0.43 animals per km^2 (CV=0.18). Correcting for incomplete detection on the track line to compensate for under-estimation, density ranges from 0.714 (CV=0.33) to 0.852 (CV=0.33) individuals per km^2, with a mid-point of 0.783 harbour porpoise per km^2 (**Table 12-12**).

130. The SEACAMS density estimate is consistent with the density estimate range from the Natural Power Morlais site surveys of 0.5-1/ km^2 (Natural Power, 2018; **Appendix 11.1**, **Volume III**).

131. The SEACAMS density estimate is higher than the SCANS-III density estimate of 0.239/ km^2 (CV = 0.28) for the Irish Sea area covered by SCANS-III survey block E (Hammond *et al*., 2017). The SEACAMS survey was conducted close to the coast and in high energy waters, both of which are known to be preferred by harbour porpoise (e.g. Shucksmith *et al*., 2005). The increased number of harbour porpoise closer to shore is reflected in the higher density estimates from the shore based surveys conducted by Shucksmith *et al*. (2009) on the North Anglesey Coast and South Stack (**Table 12-12**).

132. For the assessments, the density estimate of 0.783 harbour porpoise per km^2 has been used, based on the SEACAMS data. This was agreed with NRW at the 2nd marine mammal TWG meeting on the 19th February 2019.

Table 12-12 Harbour porpoise density estimates

Area	Density Estimate	Source
West Anglesey (**Plate 12-2**)	0.714/ km^2 to 0.852/ km^2 (CV=0.33) mid-point = **0.783/ km^2**	SEACAMS (Veneruso *et al*., 2019)
Morlais site surveys* **(Plate 12-1**)	0.5-1/ km^2	Natural Power (2018)

Area	Density Estimate	Source
SCANS-III Block E (**Plate 12-5**)	0.239/ km^2 (CV = 0.28)	Hammond *et al*. (2017)
North Anglesey Coast	1.26/ km^2 (CV = 0.25)	Shucksmith *et al*. (2009)
North Anglesey Coast (South Stack)	2.534/ km^2 (CV = 0.23)	Shucksmith *et al*. (2009)
ObSERVE aerial surveys – stratum 5 Summer 2015 (**Plate 12-6**)	0.696/ km^2 (CV=0.35)	Rogan *et al*. (2018)
ObSERVE aerial surveys – stratum 5 Winter 2015/16 (**Plate 12-6**)	0.867/ km^2 (CV=0.46)	Rogan *et al*. (2018)
ObSERVE aerial surveys – stratum 5 Summer 2016 (**Plate 12-6**)	1.046/ km^2 (CV=0.46)	Rogan *et al*. (2018)
ObSERVE aerial surveys – stratum 5 Winter 2016/17 (**Plate 12-6**)	0.924/ km^2 (CV=0.3)	Rogan *et al*. (2018)
Celtic and Irish Seas (CIS) MU (**Plate 12-4**)	0.858/ km^2 (entire CIS MU) 0.758/ km^2 (UK portion of CIS MU)	IAMMWG (2015)

*Natural Power Morlais site surveys: The precautionary estimate would be 1/ km^2 = the maximum calculated on site, but the mode and median are both 0.17 – which is considerably lower (19 of the 24 samples are below 0.25; 22 of the 24 samples are below 0.5). Therefore, a value of 0.5/ km^2, is a precautionary estimate for 22 of the 24 months.

Table 12-13 Harbour porpoise abundance estimates

Area	Abundance Estimate	Source
Celtic and Irish Seas (CIS) MU (**Plate 12-4**)	**104,695** (95% CI = 56,774-193,065)	IAMMWG (2015)
UK portion of Celtic and Irish Seas (CIS) MU (**Plate 12-4**)	47,229 (95% CI = 25,611-87,094)	IAMMWG (2015)
Celtic/Irish Seas (partial coverage only; **Plate 12-5**)	26,700 (95% CI =16,055-42,128)	Hammond *et al*. (2017)
SCANS-III Block E (**Plate 12-5**)	8,320 (95% CI = 4,643-14,354)	Hammond *et al*. (2017)
North Anglesey Coast	618 (95% CI = 406-909)	Shucksmith *et al*. (2009)
North Anglesey Coast (South Stack)	207 (95% CI = 140-329)	Shucksmith *et al*. (2009)
ObSERVE aerial surveys – stratum 5 Summer 2015 (**Plate 12-6**)	7,734 (95% CI = 5,248 – 11,398)	Rogan *et al*. (2018)

Area	Abundance Estimate	Source
ObSERVE aerial surveys – stratum 5 Winter 2015/16 (**Plate 12-6**)	9,636 (95% CI = 5,634 – 16,483)	Rogan *et al*. (2018)
ObSERVE aerial surveys – stratum 5 Summer 2016 (**Plate 12-6**)	11,625 (95% CI = 8,726 – 15,486)	Rogan *et al*. (2018)
ObSERVE aerial surveys – stratum 5 Winter 2016/17 (**Plate 12-6**)	10,264 (95% CI = 7,555 – 13,943)	Rogan *et al*. (2018)
JCP estimate for Celtic and Irish Seas Management Unit	21,714 (95% CI = 20,639.97 23,914.07)	JCP data (Paxton *et al*., 2016)

12.5.1.3. Habitat

133. In coastal waters, aggregations of harbour porpoise are often associated at local sites with strong tidal features, such as headlands, sounds between islands, areas with upwelling, tidal races and rips, often close to reefs and small islands, where prey are probably concentrated into patches providing favourable foraging conditions (Gaskin, 1992; Read and Westgate, 1997; Pierpoint, 2001, 2008; Marubini *et al*., 2009; Shucksmith *et al*., 2009). By-catch data from Ireland suggests that harbour porpoise occur regularly offshore, with records from up to 220 km from land (Rogan and Berrow, 1996) and they have also been sighted in deep water areas beyond the shelf edge (Northridge *et al*., 1995; MacLeod *et al*., 2003).

134. The north coast of Anglesey is characterised by many overlaying rocks and a broken, uneven seabed comprising pinnacles and gullies leading to rapid changes in seabed relief (Gordon *et al.,* 2011). This type of topography, in combination with the area's strong currents, precipitates a range of fine-scale oceanic tidal features with which harbour porpoises are commonly associated (Shucksmith *et al.,* 2009).

135. As outlined in **Chapter 7, Metocean Conditions and Coastal Processes**, most of the sea bed in the MDZ comprises large areas of outcropping bedrock with minimal relief above surrounding bed levels. Secondary bathymetric features include a large, generally symmetric, sand ridge north of South Stack which extends to the northwest for approximately 1 km (within the offshore cable corridor). Within Abraham's Bosom (a bay towards the landfall), the bathymetry is smoother, representing the surface of an area of sediment on top of the bedrock, bounded by rock outcrops to the north and south.

12.5.1.4. Diet

136. The diet of the harbour porpoise consists of a wide variety of fish, including pelagic schooling fish, as well as demersal and benthic species, especially Gadoids, Clupeids and Ammodytes. Other prey species such as cephalopods, other molluscs, crustaceans and polychaetes have also been recorded. The diet varies geographically, seasonally, annually, overtime and differences in diet between sexes or age classes may also exist, reflecting changes in available food resources (Berrow and Rogan, 1995; Kastelein *et al*., 1997; Börjesson *et al*. 2003; Santos and Pierce 2003; Santos *et al*., 2004).

137. The main prey fish species of harbour porpoise typically include sandeels Ammodytidae, whiting *Merlangius merlangus*, herring *Clupea harengus*, sprat *Sprattus sprattus*, cod *Gadus morhua*, haddock *Melanogrammus aeglefinus*, saithe *Pollachius virens*, pollack *Pollachius pollachius*, Norway pout *Trisopterus esmarkii* as well as flat fish such as flounder *Platichthys flesus* and sole *Solea solea* (Rogan and Berrow, 1996; Reid *et al*., 2003; Santos and Pierce, 2003; Santos *et al*., 2004).

138. Taking into account the fish species recorded in the area in **Chapter 10, Fish and Shellfish Ecology**, prey species of harbour porpoise in and around the MDZ is likely to include: sandeel, whiting, cod, mullet species, pollack, herring, sprat, Atlantic mackerel *Scomber scombrus*, horse mackerel *Trachurus Trachurus*, flounder and sole

139. Harbour porpoise tend to concentrate their movements in small focal regions (Johnston *et al*., 2005), which often approximate to particular topographic and oceanographic features and are associated with prey aggregations (Raum-Suryan and Harvey, 1998; Johnston *et al*., 2005; Keiper *et al*., 2005; Tynan *et al*., 2005). Consequently, habitat use is highly correlated with prey density rather than any particular habitat type. However, JNCC (2017a) states that for the Gogledd Môn Forol/North Anglesey Marine SAC, it is unknown which features of the habitat are the most important drivers of the association with prey or what the main prey species of harbour porpoise within the site are.

140. Harbour porpoise have relatively high daily energy demands and need to consume between 4% and 9.5% of their body weight in food per day (Kastelein *et al*., 1997). If a harbour porpoise does not capture enough prey to meet its daily energy requirements it has been estimated that it can rely on stored energy (primarily blubber) for three to five days, depending on body condition (Kastelein *et al*., 1997).

141. A study by Wisnlewska *et al*. (2016) using high-resolution movement and prey echo recording tags on five wild harbour porpoise has shown that porpoises forage nearly continuously day and night, attempting to meet their metabolic demands foraging on small prey.

12.5.1.5. Movements and Seasonal Occurrence

142. The seasonal movements and migratory patterns of harbour porpoise are not well understood. Harbour porpoise may reside within an area for an extended period of time, although onshore / offshore migrations and movements parallel to the shore are also thought to occur (Northridge *et al*., 1995; Bjørge and Tolley, 2002). Seasonal movements are thought to coincide with prey availability and the calving and mating seasons.

143. Harbour porpoise are highly mobile and satellite telemetry work in Danish waters has shown an individual moving more than 1,000 km from Danish waters to east of the Shetland Islands (Teilmann *et al*., 2004). In Danish waters, harbour porpoise have been shown to concentrate their movements in relatively large areas, ranging from approximately 400 to 1,600 km^2 (Teilmann *et al*., 2004). In the western North Atlantic, individuals are known to range over quite large areas, covering as much as 11,289 km^2 within a single month (Johnston *et al*., 2005).

144. Although harbour porpoise are highly mobile and utilise extensive areas over which they range, they tend to occupy small core areas or focal regions for short periods and then make rapid

movements over periods of hours to days across larger scales to other restricted areas (Johnston *et al.,* 2005; Fontaine *et al.,* 2007), which often correspond with reliable feeding opportunities (Marubini *et al*., 2009).

145. In many coastal localities, there can be distinct seasonal peaks in harbour porpoise sightings. The sightings of harbour porpoise in the Irish Sea typically peak during the summer months (in particular June to August) (Evans *et al*., 2015).

146. A study into the temporal and seasonal changes in the distribution of harbour porpoise off the North Cornwall coast revealed the highest peaks in harbour porpoise detections occurred from late December to early March. This trend was shown to be a negative correlation with Sea Surface Temperatures (SST), i.e. as sea temperatures decreased, harbour porpoise detection rates increased. Harbour porpoise detection also varied significantly with the spring-neap tidal cycle, with a significantly increase in detection during neap tides (Cox *et al*., 2017).

147. The seasonal movements and temporal changes in distributional patterns observed are likely to reflect the changes in preferred prey availability and patterns (Skov and Thomsen, 2008; Simon *et al.*, 2010; Sveegaard *et al.*, 2011, 2012).

148. Site-specific surveys indicate that harbour porpoise are present in and around the MDZ year round. As outlined in **Table 12-11**, harbour porpoise were recorded within the site and / or buffer in every month during the Natural Power surveys between November 2016 and October 2018 (**Appendix 11.1**).

12.5.1.6. Life History

149. The calving period for harbour porpoise is primarily between May and July, when sea temperatures are increasing (Read 1990; Sørensen and Kinze 1994; Lockyer, 1995; Bandomir-Krischack 1996; Börjesson and Read 2003; Learmonth *et al*., 2014).

150. At present, not enough is known about harbour porpoise to determine whether some parts of their range are more important for breeding than others. Potential calving grounds have been identified in the German North Sea (Sonntag *et al*., 1999), but there is currently no evidence of specific habitat requirements for mating and calving in UK waters (JNCC, 2002, 2019).

151. Harbour porpoises typically occur in groups of 1-3 animals; larger aggregations have been reported, probably where many smaller groups are concentrated in the same area rather than coordinated schools (Reid *et al*., 2003).

152. During the Natural Power boat surveys of the MDZ and 2 km buffer, most harbour porpoise records were of single animals (73% of sightings) but groups of up to three animals were observed. There were 61 records of two individuals and 11 groups of three individuals recorded. Most of the porpoises recorded were given a behaviour of ‘slow swimming’; with eight records (14 animals) recorded as ‘foraging’, although such behaviour is likely to have been under-recorded (**Appendix 11.1**, **Volume III**).

153. During the SEACAMS surveys, harbour porpoise group size ranged between 1 and 5 animals with a mean estimated group size of 1.53 (CV=0.07; **Appendix 12.1**, **Volume III**).

12.5.1.7. Conservation Status

154. The current conservation status of the harbour porpoise, as assessed in the 3rd UK report on implementation of the Habitats Directive (submitted to the European Commission in 2013), is 'Favourable' (JNCC, 2013).

12.5.2. Bottlenose dolphin

12.5.2.1. Distribution and Occurrence

155. The bottlenose dolphin has a worldwide distribution across tropical and temperate seas of both hemispheres and can be found in coastal and continental shelf waters (Reid *et al*., 2003; DECC, 2016). In most regions, including the UKCS, inshore and offshore 'sub-populations' tend to be distinct (DECC, 2016; Oudejans *et al*., 2015; IAMMWG, 2015). In UK waters, inshore individuals are frequently reported off north-east and south-west Scotland, in the Irish Sea, and in the western English Channel (DECC, 2016; IAMMWG, 2015).

156. There are two main areas of UK territorial waters where there are semi-resident groups of bottlenose dolphin: Cardigan Bay in Wales and the Moray Firth on the north-east coast of Scotland. Both of these areas have been designated SAC for bottlenose dolphin. There are also smaller populations of bottlenose dolphin off south Dorset and around Cornwall (Williams *et al.,* 1996; Wither *et al.,* 2012; JNCC, 2019).

157. Bottlenose dolphin are recorded in the western Channel off the coast of Cornwall throughout most of the year (DECC, 2016). A small, possibly resident, population of bottlenose dolphin may also occur in the waters around the Inner Hebrides and sightings are also reported off the west coast of the Outer Hebrides, in the Sound of Barra and in the northern entrance to the Minch (Grellier and Wilson, 2003; Mandleberg, 2006; DECC, 2016; JNCC, 2019). Transient groups are not infrequent almost anywhere around the British coast except the southern North Sea and south-east England (JNCC, 2019).

158. In the Irish Sea, bottlenose dolphin have a predominantly coastal distribution, with higher concentrations off west Wales (particularly Cardigan Bay) and off the coast of Co. Wexford in southeast Ireland. They are also regularly sighted in summer off the Galloway coast of southwest Scotland and around the Isle of Man (Hammond *et al*., 2005, Baines and Evans, 2012; DECC, 2016). During the ObSERVE aerial surveys, only one sighting of five individuals in winter 2016 was made in stratum 5 (**Plate 12-6**), which covered western Irish Sea and east coast of Ireland (Rogan *et al*., 2018).

159. In Welsh waters, the inshore population is centred on Cardigan Bay, although bottlenose dolphin are also regularly observed in the coastal waters between Cardigan Bay and Anglesey (Pesante *et al*., 2008a,b), with concentrations in south Cardigan Bay, south of the Lleyn Peninsula and off Anglesey (Baines and Evans, 2012). There are also regular sightings in the coastal waters to the east of Anglesey around Bull Bay and towards the Llandudno coast (Evans *et al*., 2015). Bottlenose dolphin are most commonly seen in Cardigan Bay within 10 miles of the coast and particularly within two miles; sightings are greatest in the southern portion of the bay (Feingold and Evans, 2014b).

160. During the site-specific boat surveys for the Wylfa Newydd Development Area, two sightings totalling 14 individuals of bottlenose dolphin (a pod of four and 10 individuals respectively). The first sighting occurred in May 2016 to the east of the Wylfa Newydd Development Area, approximately 3 km off Cemaes Bay. The second sighting (consisting of adults and one calf) was recorded in January 2017 to the west of Cemlyn Bay, approximately 4 km offshore (HNP, 2018a). During the Wylfa Newydd Development Area VP surveys between 2011 and 2014, bottlenose dolphin were sighted in Cemlyn Bay and off Cerrig Brith (HNP, 2018a).

161. During the Natural Power surveys between November 2016 and October 2018 (**Appendix 11.1**, **Volume III**), one group of 12 bottlenose dolphin were recorded during the February 2018 survey.

162. Three sightings of bottlenose dolphin were recorded during the SEACAMS surveys (**Appendix 12.1**, **Volume III**).

12.5.2.2. Abundance and Density Estimates

12.5.2.2.1. Irish Sea Management Unit

163. A number of inshore groups of bottlenose dolphin have been identified in UK and Irish waters and there appears to be limited interchange between these groups Robinson *et al*., 2012; Cheney *et al*., 2013; ICES, 2014; IAMMWG, 2015).

164. IAMMWG (2015) currently recognise seven MUs for bottlenose dolphin in UK waters:

(1) Coastal West Scotland and the Hebrides (CWSH, to 12nm);

(2) Coastal East Scotland (CES, to 12nm);

(3) Greater North Sea (GNS);

(4) Offshore Channel and SW England (OCSW);

(5) Coastal West Channel (CWC, to 12nm);

(6) Irish Sea (IS); and

(7) Oceanic Waters (OW).

165. The MDZ is located in the Irish Sea MU (**Plate 12-8**), which has an estimated bottlenose dolphin abundance of 397 (CV = 0.23; 95% CI = 362-414; IAMMWG, 2015; **Table 12-15**). This reference population was agreed with NRW at the 2nd marine mammal TWG meeting on the 19th February 2019.

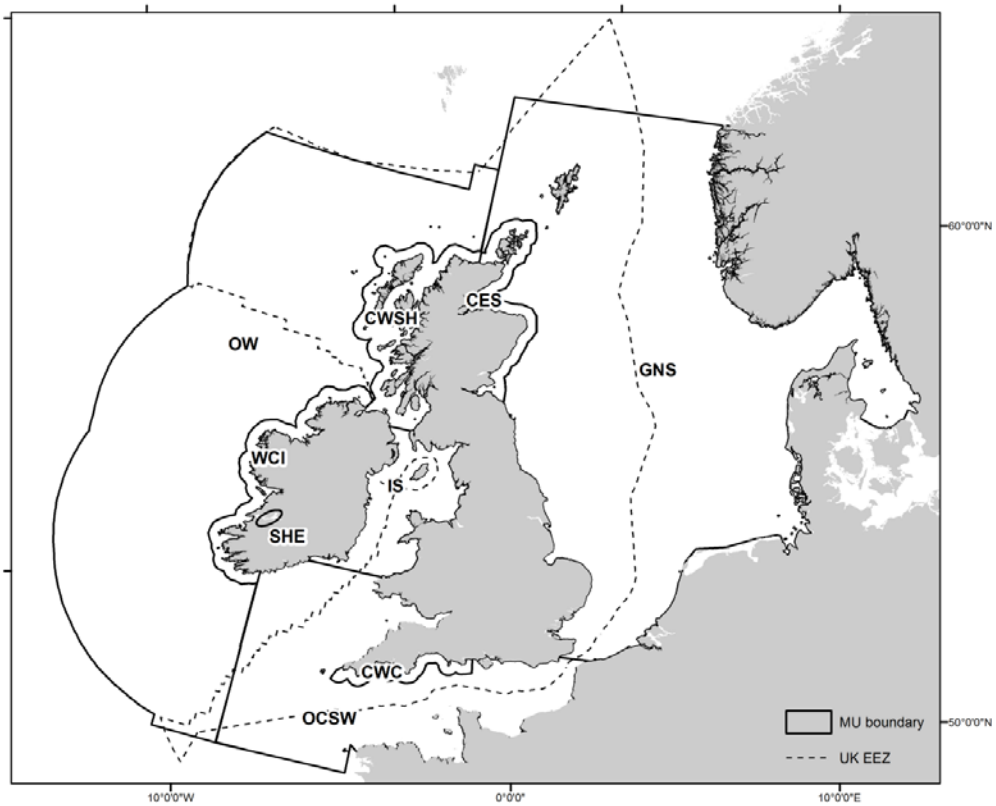

Plate 12-8 Bottlenose Dolphin MUs (source: IAMMWG, 2015)

12.5.2.2.2. SCANS data

166. For the entire SCANS-II survey area, bottlenose dolphin abundance in the summer of 2005 was estimated to be 16,485 (CV = 0.422; Hammond *et al*., 2013). The SCANS-II survey estimated the abundance of bottlenose dolphin in survey block O, which is located in the Irish Sea and includes the MDZ, to be 235 individuals (CV=0.75) and the density was estimated to be 0.0052 bottlenose dolphin per km^2 (CV=0.75) (Hammond *et al*., 2013).

167. For the entire SCANS-III survey area (not the same as SCANS-II area), bottlenose dolphin abundance in the summer of 2016 was estimated to be 27,697 with an overall estimated density of 0.015/ km^2 (CV = 0.233; 95% CI = 17,662 – 43,432; Hammond *et al*., 2017).

168. The SCANS-III survey estimated that the abundance of bottlenose dolphin in survey block E (**Plate 12-5**; surface area of 34,870 km^2), which is located in the Irish Sea and includes the MDZ, was 288 individuals and the density was estimated to be 0.008 bottlenose dolphin per km^2, with a mean group size of 1.50 (CV = 0.57; 95% CI = 0-664; Hammond *et al*., 2017). In the adjacent area, survey block F (**Plate 12-5**; surface area of 12,322 km^2), no bottlenose dolphin were recorded (Hammond *et al*., 2017).

12.5.2.2.3. Cardigan Bay

169. Cardigan Bay is the largest population in the UK with annual estimates for the wider area varying between 254 and 330 animals (CV = 0.25 – 0.28) for the years 2011 and 2013 inclusive (Feingold and Evans, 2013, 2014a, b).

170. Maximum density estimate based on area of Cardigan Bay Special Area of Conservation (SAC) (approx. 959 km^2) and maximum number of dolphins in the population (330 individuals), is 0.344 bottlenose dolphin per km^2.

171. The population is not closed as individuals may join up for periods of time from elsewhere (Reid *et al*., 2003) and sightings of individuals initially reported off the south-west coast of England, have been observed in Welsh waters (Wood, 1998; Hammond *et al*., 2008).

172. Photo identification studies completed by the Sea Watch Foundation (Veneruso and Evans, 2012a,b) have revealed that of 221 bottlenose dolphin recorded between 2007 and 2012 off the north coast of Anglesey, 141 (64%) had been previously recorded within the Bae Ceredigion/ Cardigan Bay SAC, as well as north of the Llyn Peninsula, and many had additionally been recorded within the Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC (Veneruso and Evans, 2012a,b). This indicates that the majority of the Cardigan Bay population of bottlenose dolphin move between the two sites.

173. Within the same study, bottlenose dolphin encountered from the north coast of Anglesey (n=28) were investigated to determine the seasonal movements of bottlenose dolphin. It was revealed that of the dolphins recorded in the winter surveys (December to February), 95% had previously been recorded within Cardigan Bay, supporting the theory that there is a seasonal movement of dolphins from Cardigan Bay to the north coast of Anglesey within the winter months (Veneruso and Evans, 2012a,b). During spring (March to May), 62% of the individuals recorded along the north coast of Anglesey had previously been recorded in Cardigan Bay, 38% were recorded in the summer (June to August) and 98% in the autumn (September to November). This pattern gives a clear indication of the movement of bottlenose dolphins from Cardigan Bay in summer to the north coast of Anglesey and the Llyn Peninsula in the autumn and winter (Veneruso and Evans, 2012a,b).

174. A review of the field research (2011-13) conducted by the Sea Watch Foundation for bottlenose dolphin in the Cardigan Bay and Pen Llŷn a’r Sarnau SACs (Feingold and Evans, 2014b), indicates that the entire coastal area from Aberaeron to Cardigan appears to be of particular significance. Bottlenose dolphin sightings have also been regularly reported in North Wales, particularly around the Isle of Anglesey but extending east into Liverpool Bay and north to at least the Isle of Man (Feingold and Evans, 2014b).

175. Photo-identification surveys off the coast of Anglesey, along with data provided from the Isle of Man and Liverpool Bay, indicate that individuals from Cardigan Bay extend their home ranges, particularly in winter, to the northern Irish Sea at least as far as the Isle of Man (Feingold and Evans, 2014b).

176. In addition to winter sightings of the species in the northern Irish Sea, bottlenose dolphin have also been recorded off the North Wales coast and across to Liverpool Bay in summer (Feingold and Evans, 2014b; Veneruso and Evans, 2011a,b).

12.5.2.2.4. Site-Specific Survey Data

177. There is currently insufficient data from the site-specific surveys to provide any estimates for abundance or density (**Appendix 11.1** and **12.1**, **Volume III**).

178. To take into account the range of bottlenose dolphin from Anglesey to Cardigan Bay, including the Cardigan Bay SAC and Lleyn Peninsula SAC (**Figure 12-1, Volume II**), the density estimate has been based on 330 dolphins in an area of 16,098 km^2 (**Table 12-14**). For the assessments, the density estimate of 0.02 bottlenose dolphin per km^2 has been used. This was agreed with NRW at the 2nd marine mammal TWG meeting on the 19th February 2019.

Table 12-14 Bottlenose dolphin density estimates

Area	Density	Source	Notes
Area from Anglesey to Cardigan Bay (**Figure 12-1, Volume II**)	**0.02/ km^2**	Feingold and Evans (2013)	Density estimate is based on area of 16,098 km^2 and maximum number of 330 individuals.
Cardigan Bay SAC and Lleyn Peninsula SAC	0.136/ km^2	Feingold and Evans (2013)	Density estimate is based on area of Cardigan Bay SAC & Lleyn Peninsula and the Sarnau SAC (approx. 2,419 km^2) and maximum number of 330 individuals.
Cardigan Bay SAC	0.344/ km^2	Feingold and Evans (2013)	Density estimate is based on area of Cardigan Bay SAC (approx. 959 km^2) and maximum number of 330 individuals.
Lleyn Peninsula SAC	0.226/ km^2	Feingold and Evans (2013)	Density estimate based on area of Lleyn Peninsula and the Sarnau SAC (approx. 1460 km^2) and maximum number of BND (330 individuals).
SCANS-III Block E (**Plate 12-5**)	0.008/ km^2 (CV = 0.57)	Hammond *et al*. (2017)	For context of the density estimate for the wider area.
Irish Sea (IS) MU (**Plate 12-8**)	0.009/ km^2 (Whole IS) 0.009/ km^2 (UK IS)	IAMMWG (2015)	For context of the density estimate for the wider area.
ObSERVE aerial surveys – stratum 5 Winter 2016/17 (**Plate 12-6**)	0.036/ km^2 (CV=0.94)	Rogan *et al*. (2018)	No bottlenose dolphin estimates available for stratum 5 for other seasons

Table 12-15 Bottlenose dolphin abundance estimates

Area	Abundance Estimate	Source
Irish Sea (IS) (**Plate 12-8**)	**397** (CV = 0.23; 95% CI = 362–414)	IAMMWG (2015)
SCANS-III Block E (**Plate 12-5**)	288 (95% CI = 0-664)	Hammond *et al*. (2017)
Cardigan Bay SAC	330 (CV = 0.24; 95% = CI 203-534)	Feingold and Evans (2013)
Lleyn Peninsula SAC	Up to 330 (CV = 0.24; 95% CI 203-534)	Feingold and Evans (2013)
ObSERVE aerial surveys – stratum 5 Winter 2016/17 (**Plate 12-6**)	401 (95% CI = 76 – 2015)	Rogan *et al*. (2018)
JCP estimate for Irish Seas Management Unit	1,863 (95% CI = 1,827 – 1,890)	JCP data (Paxton *et al*.,2016)

12.5.2.3. Habitat

179. Throughout its range, the bottlenose dolphin occurs in a diverse range of habitats, from shallow estuaries and bays, coastal waters, continental shelf edge and deep open offshore ocean waters. However, it is primarily an inshore species, with most sightings within 10 km of land, but they can also occur offshore, often in association with other cetaceans (JNCC, 2019).

180. In coastal waters, bottlenose dolphin are often associated with river estuaries, headlands or sandbanks, where there is uneven bottom relief and/or strong tidal currents (e.g. Lewis and Evans, 1993; Wilson *et al*., 1997; Liret *et al*., 1998; Liret, 2001; Ingram and Rogan 2002; Reid *et al*., 2003).

181. Within Cardigan Bay, bottlenose dolphins appear to use specific habitats consistently. Areas within 3.2 km of the shoreline, with strong currents, in proximity to rocky headlands and near small embayments and estuaries, are the habitats most frequented by the bottlenose dolphin (Lewis and Evans, 1993; Arnold and Mayer, 1995).

182. Within Cardigan Bay, bottlenose dolphin appear to use specific habitats. For example, areas within 3.2 km of the shoreline, with strong currents, in proximity to rocky headlands and near small embayments and estuaries, are the habitats most frequented by the bottlenose dolphin (Lewis and Evans, 1993; Arnold and Mayer, 1995). Habitat analysis shows preference for areas between 5m and 10m in depth, although areas of between 25m and 30m depth have seen an increase in sightings since 2005 with the majority of the sightings in this region occurring over the slope range of Cardigan Bay (Pesante *et al.,* 2008b).

183. The predominant bottlenose dolphin behaviour noted within the Cardigan Bay SAC was travelling or foraging, while in Pen Llyn the behaviours noted included consistently higher levels of socialising behaviours (Norrman *et al*., 2015). This suggests that the northern sector of Cardigan Bay may be a socialising and mating ground whereas the southern areas are key foraging and nursery areas (Norrman *et al*., 2015).

184. A photo-monitoring study researching connectivity of bottlenose dolphin in Wales (Pesante *et al*., 2008a), suggests that their preference for Cardigan Bay is a result of the shallow bathymetry and diverse benthic habitats, in addition to the fact that significant numbers of salmonids pass through the bay during migration.

12.5.2.4. Diet

185. Bottlenose dolphin are opportunistic feeders and take a wide variety of fish and invertebrate species. Benthic and pelagic fish (both solitary and schooling species), including haddock, saithe, pollock, cod, whiting, hake *Merluccius merluccius*, blue whiting *Micromesistius poutassou*, bass *Dicentrarchus labrax*, mullet Mugilidae, mackerel Scombridae, salmon *Salmo salar*, sea trout *Salmo trutta trutta*, flounder, sprat and sandeels, as well as octopus and other cephalopods have all been recorded in the diet of bottlenose dolphin (Santos *et al*., 2001; Santos *et al*., 2004; Reid *et al*., 2003).

186. In Irish waters, haddock, saithe and pollock are the dominant prey species, followed by whiting, blue whiting, Atlantic mackerel and horse mackerel; cephalopods are also important (Hernandez-Milian *et al*., 2015). The stomach contents analysis of three individuals in the Irish

Sea indicated a highly variable diet comprising horse mackerel, hake, mackerel, poor cod, pollock, whiting and saithe (Couperus, 1995; O'Brien and Berrow, 2006).

187. Diet analysis suggests that bottlenose dolphin are selective opportunists and although they may have preference for a type of prey, their diet seems to be determined largely by prey availability. Research in Australia has shown that when presented with a choice, they will preferentially feed on certain types of prey, particularly those with a high fat content (Corkeron *et al*., 1990).

188. Taking into account the fish species recorded in the area, as outlined in **Chapter 10, Fish and Shellfish Ecology**, the main prey species of bottlenose dolphin in and around the MDZ is likely to include a wide range of prey species such as salmon, sea trout, bass, mullet, whiting, mackerel, sandeels and flat fish.

12.5.2.5. Movements and Seasonal Occurrence

189. Greatest numbers are thought to occur in UK waters between July and October with a secondary peak in some localities in March-April (Reid *et al.,* 2003; Evans *et al.,* 2003) although animals are present all year round in some areas (Wilson *et al.,* 1997; Veneruso and Evans, 2012a, b; Cheney *et al.,* 2013). Analyses of photo-identification data from multiple studies have also shown that bottlenose dolphin can make long-distance movements (Robinson *et al.,* 2012).

190. In Cardigan Bay, the population ranges over an area wider than the SAC, which likely includes all of the west and north Wales coasts and a wide area of the Irish Sea (DECC, 2016). The distribution of bottlenose dolphin is variable with main concentrations in the summer being around Tremadog Bay and southern Cardigan Bay (Evans *et al.,* 2015; Feingold and Evans, 2014b). Sightings of bottlenose dolphin occurring around the coast of north Wales, primarily Anglesey, differed considerably to those in Cardigan Bay, with the most frequent sightings occurring during winter (Pesante *et al.,* 2008b), suggesting possible seasonal movements in the area (Norman *et al.,* 2015). Although there are a higher number of bottlenose dolphin off north Anglesey in the winter months, bottlenose dolphin are present off north Anglesey throughout the year (Veneruso and Evans, 2012a, b).

191. During photo-identification studies of bottlenose dolphin in Scotland, one individual was identified south of Aberdeen and then re-identified off Burghead 52 hours later, representing a distance of 218 km and a minimum swimming speed of 4.2 km/h (Wilson *et al.,* 2004). For consecutive sightings five or less days apart, the median rate of travel for dolphins identified primarily within the inner Moray was 0.071 km/h, whereas for dolphins observed using areas outwith the inner Moray Firth it was significantly greater at 0.22 km/h. Similarly, during sightings in the outer Moray Firth and along the coasts south of Fraserburgh the median rate of progress was 7.6 km/h, which was twice as fast as in the inner Moray Firth (3.9 km/h) (Wilson *et al.,* 2004).

12.5.2.6. Life History

192. Indications suggest that bottlenose dolphin in UK waters may have two calving peaks in the year (Evans, 1980) or an extended breeding season, meaning that calves can often be observed throughout the year. Calves stay with their mothers for at least four years (Smolker *et al*., 1992), but have been reported to stay together until the calf is eight years old (Grellier *et al*., 2003).

193. Cardigan Bay SAC is an important calving area for bottlenose dolphin. There are also two other important calving areas in north wales: the Pen Llyn Sarnau and the Isle of Anglesey (Feingold and Evans, 2013, 2014a). Peak calving times within the Cardigan Bay SAC are generally between July and September (when approximately 76% of all calves are born), although calving may occur at any time (Norrman *et al*., 2015).

194. There is currently not enough information to determine what, if any, the habitat requirements are for any breeding areas or calving areas for bottlenose dolphins in UK waters.

12.5.2.7. Conservation Status

195. The current conservation status, as assessed in the 3rd UK report on implementation of the Habitats Directive (submitted to the European Commission in 2012), of the bottlenose dolphin is 'favourable' (JNCC, 2013).

12.5.3. Risso's dolphin

12.5.3.1. Distribution and Occurrence

196. Risso's dolphin are seasonally recorded in the Celtic and Irish Seas (IAMMWG, 2015). There distribution is thought to be a relatively localised, running in a wide band running southwest to northwest Wales, encompassing west Pembrokeshire, the western end of the Lleyn Peninsula and Anglesey (Evans *et al.,* 2015). Risso's dolphin are also found on the southeast coast of Ireland and around the Isle of Man (Baines and Evans, 2012).

197. During the ObSERVE aerial surveys, sightings of Risso's dolphins were recorded in summer 2015 and 2016 in stratum 5 (**Plate 12-6**), which covered western Irish Sea and east coast of Ireland. These coastal sightings in the western Irish Sea likely represent a frequently sighted community that regularly appears near the Saltee Islands off Co. Wexford (Rogan *et al*., 2018).

198. Risso's dolphin are sighted regularly around the northern and western part of the Lleyn Peninsula, with a hot spot around Bardsey Island, and are rarely sighted in Cardigan Bay (Baines and Evans, 2012). Risso's dolphin are thought to present along the north coast of Anglesey all year round. Although abundance increases during the summer and autumn months (July to October) however sightings vary every year (Baines and Evans, 2012).

199. There were no sightings of Risso's dolphin along the north coast of Anglesey during land-based surveys undertaken for the Wylfa Newydd project during 2011 to 2014 (HNP, 2018) and only one sighting of a single individual was recorded during transit for the dedicated vessel transect surveys. The dedicated vessel transect surveys yielded three sightings of Risso's dolphin with an average pod size of two individuals (HNP, 2018a).

200. During the Natural Power surveys between November 2016 and October 2018, Risso's dolphin were encountered during three surveys (September 2017, May and October 2018; **Appendix 11.1**, **Volume III**). The two sightings of 8 individuals during the September 2017 survey was outwith the MDZ and buffer area. During the May 2018 survey there were two observations of 11 individuals and during the October 2018 survey there were three observations of 20 individuals. Most of these observations were in the buffer area rather than the MDZ (**Plate 12-9**).

201. Four sightings of Risso's dolphin were recorded during the SEACAMS surveys and these were all outside of the MDZ (**Appendix 12.1**, **Volume III**).

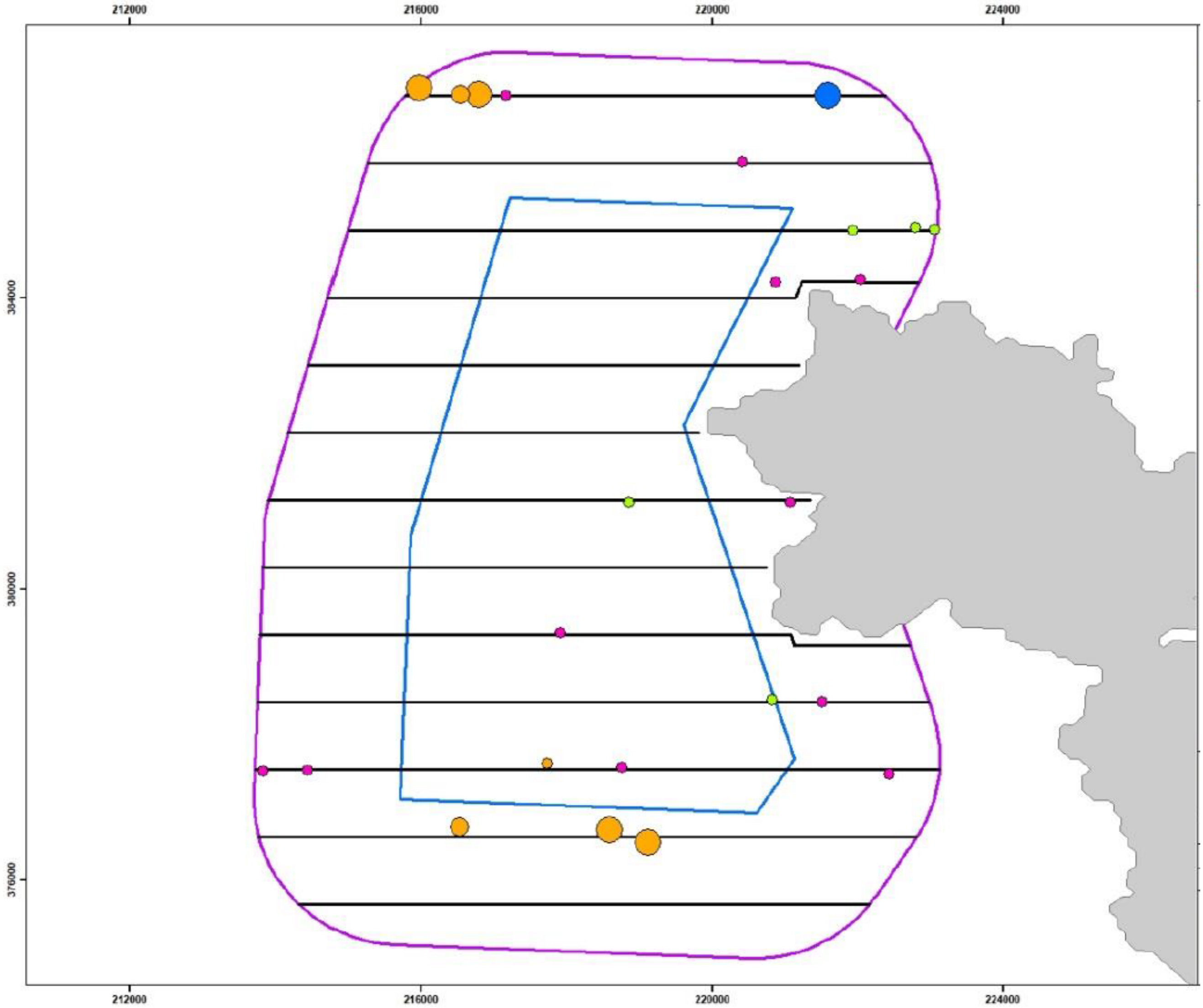

Plate 12-9 Distribution of marine mammal (excluding harbour porpoise) sightings (on-effort, off-effort and incidental) survey during Natural Power surveys (November 2016 to October 2018; Appendix 11.1)

12.5.3.2. Abundance and Density Estimates

202. The IAMMWG (2015), recommends a single MU, the Celtic and Greater North Seas (CGNS) MU comprising all UK waters and extending to the seaward boundary used by the European Commission for Habitats Directive reporting, with the eastern boundary determined by OSPAR's Regional Seas boundary (**Plate 12-10**).

203. The JCP abundance estimate for Risso's dolphin in the Celtic and Greater North Sea Management Unit is 8,794 (95% CI = 8,695 – 8,848) (Paxton *et al.,* 2016; **Table 12-16**). The JCP abundance estimates of Risso's dolphin in the Irish Sea Development Area were highest in spring with an abundance estimate of 70 individuals (CI = 0 – 280) and summer abundance estimate of 30 individuals (CI = 0 – 160) (Paxton *et al*., 2015).

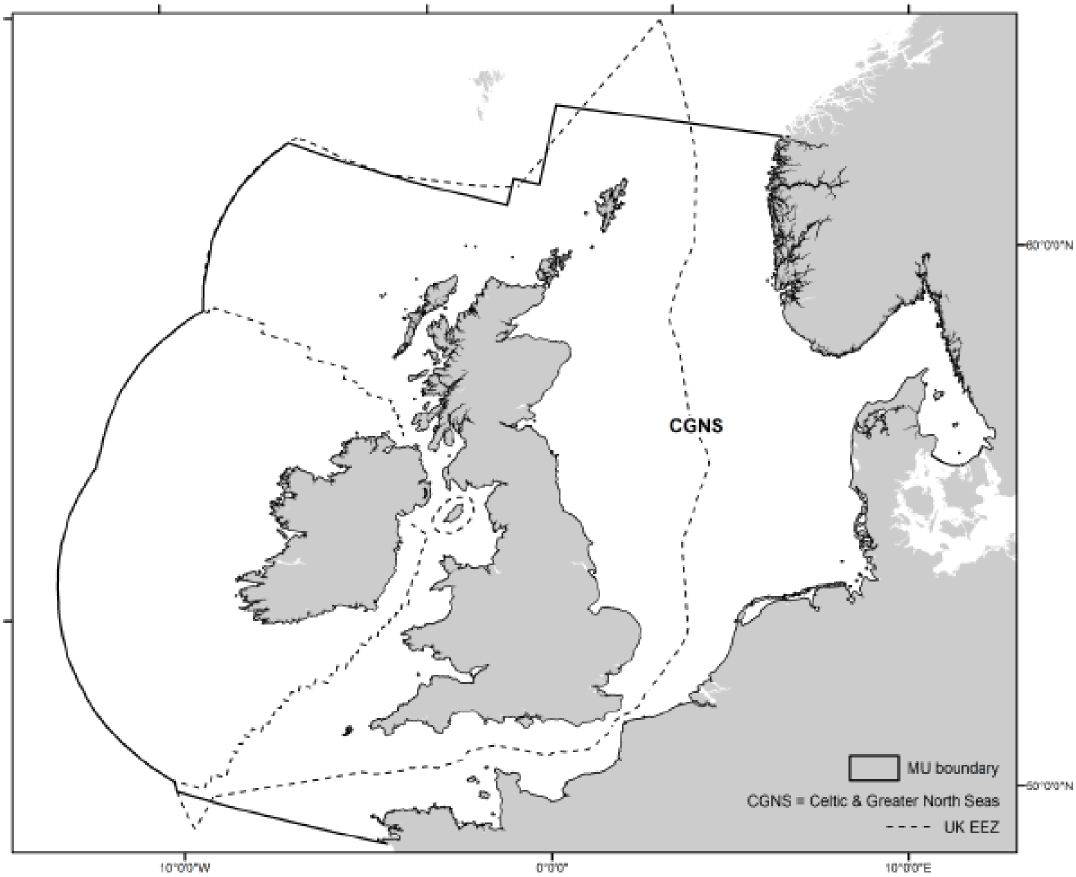

Plate 12-10 Celtic and Greater North Seas (CGNS) MU (source: IAMMWG, 2015)

204. The SCANS-III survey estimated that the abundance of Risso's dolphin in survey block E, which is located in the Irish Sea and includes the MDZ (**Plate 12-5**), was 1,090 individuals and the density was estimated to be 0.031 Risso's dolphin per km^2, with a mean group size of 7.50 (CV = 0.69; 95% CI = 0-2,843; Hammond *et al*., 2017; **Table 12-16**). In the adjacent area, survey block F, no Risso's dolphin were recorded (Hammond *et al*., 2017).

Table 12-16 Risso's dolphin abundance and density estimates

Area	Abundance Estimate	Density Estimate	Source
SCANS-III Block E (**Plate 12-5**)	1,090 (95% CI = 0-2,843)	**0.031/ km^2** (CV = 0.69)	Hammond *et al.* (2017)
JCP estimate for Celtic and Greater North Sea Management Unit (**Plate 12-10**)	**8,794** (95% CI = 8,695 – 8,848)	N/A	JCP data
ObSERVE aerial surveys – stratum 5 (Summer 2015) (**Plate 12-6**)	35.1 (95% CI =7-188)	0.0032/ km^2 (CV=0.96)	Rogan *et al.* (2018)

12.5.3.3. Diet

205. Risso's dolphin feed mostly on cephalopods including octopus, cuttlefish, and small squid (Santos *et al*. 1994). They also feed on pelagic and benthic fish species (Kruse *et al*. 1999; Bloch *et al*. 2012).

12.5.3.4. Conservation Status

206. The current conservation status, as assessed in the 3rd UK report on implementation of the Habitats Directive (submitted to the European Commission in 2012), of the Risso's dolphin is 'unknown' (JNCC, 2013).

12.5.4. Common dolphin

12.5.4.1. Distribution and Occurrence

207. The common dolphin is the most numerous offshore cetacean species in the north east Atlantic, most often sighted off the western coast of the UK, in the Celtic Sea, and western approaches to the Channel (Reid *et al*., 2003).

208. The MU for common dolphin encompasses the whole of the Celtic and Greater North Seas (**Plate 12-10**), with the majority of sightings having been reported south of 60˚N (Murphy *et al*. 2013; IAMMWG, 2015). The distribution of common dolphins in the Irish Sea is typically concentrated in the south, in an area offshore of Pembrokeshire called Celtic Deep, just within the 12nm territorial limit of Wales (Baines and Evans, 2012). In the northern Irish Sea, the densities of common dolphin are relatively low with another hotspot for common dolphin off the Isle of Man (Baines and Evans, 2012).

209. No common dolphin were recorded in stratum 5 of the Irish Sea (**Plate 12-6**) during the ObSERVE aerial surveys in summer and winter 2015 and 2016 (Rogan *et al*., 2018).

210. Sightings in Welsh waters are mainly in the summer with fewer individuals recorded in the winter, however it should be noted that survey effort in the winter months is low (Baines and Evans, 2012). However, the Phase-III Joint Cetacean Protocol reported the highest abundance estimate of 310 common dolphin (CI = 110 – 860) in autumn, which is significantly higher than summer estimate of 80 common dolphin (CI = 30 – 260) (Paxton *et al*., 2017).

211. One sighting was recorded for common dolphin by the Sea Watch Foundation (2019) which was for a group of 10 at Point Lynas, Anglesey on the 17th November 2018 (Sea Watch Foundation, 2019).

212. No common dolphin were sighted during the site-specific surveys for the Wylfa Newydd Development Area (HNP, 2018a).

213. No common dolphin were sighted during the MDZ site specific surveys conducted by Natural Power (**Appendix 11.1, Volume III**) and SEACAMS (**Appendix 12.1, Volume III**).

12.5.4.2. Abundance and Density Estimates

214. The abundance of common dolphin in the CGNS MU is 56,556 (CV = 0.28; 95% CI = 33,014-96,920; **Table 12-17**) and the UK component (abundance within the UK EEZ) is 13,607 (CV = 0.23; 95% CI = 8,720-21,234). These estimates were derived from SCANS-II (Hammond *et al*., 2013) and Cetacean Offshore Distribution and Abundance in the European Atlantic (CODA; Macleod *et al*., 2009) and are likely to be biased low due to perception bias that could not be corrected for in the aerial surveys (IAMMWG, 2015).

215. The SCANS-III survey did not record any common dolphin in survey block E (surface area of 34,870 km^2). SCANS-III survey block D, which is also located in the south-west (**Plate 12-5**) had an abundance of 18, 458 and the density was estimated to be 0.374/ km^2, with a mean group size of 10.06 (CV = 0.41, 95% CL = 4,394 – 33,077; Hammond *et al*., 2017).

216. A density estimate has been derived based on the density estimate of SCANS-III survey block D, which assumes the animals in block D could also be distributed in block E. A density of 0.22 common dolphin per km^2 was estimated based on 18,458 common dolphin in the total area (83,460 km^2) of survey blocks D and E (**Plate 12-5 Table 12-17**). This approach was agreed with NRW at the 2nd marine mammal TWG meeting on the 19th February 2019.

Table 12-17 Common dolphin abundance and density estimates

Area	Abundance Estimate	Density Estimate	Source
Celtic and Greater North Sea (CGNS) MU (**Plate 12-10**)	**56,556** (95% CI = 3,989-39,572) for CGNS MU 13,607 (95% CI=7,176-21,066) for UK portion of CGNS	N/A	IAMMWG (2015)
SCANS-III Block E (**Plate 12-5**)	0	0	Hammond *et al*. (2017)
SCANS-III Block D (**Plate 12-5**)	18, 458 (CV = 0.41, 95% CL = 4,394 – 33,077)	0.374/ km^2 (CV = 0.41, 95% CL = 4,394 – 33,077)	Hammond *et al*. (2017)
SCANS-III Block E and D (**Plate 12-5**)	18, 458	**0.22/ km^2**	Estimate based on 18,458 common dolphin in the total area (83,460 km^2) of survey blocks D and E

12.5.4.3. Diet

217. Common dolphins have a varied diet and are opportunistic feeders that often use cooperative feeding techniques to herd schools of fish (Sea Watch Foundation, 2012). Their diet depends on local prey availability and may include small schooling fish including hake, cod, sardine, mackerel, horse mackerel, scad, sprat, herring, sandeel, whiting, blue whiting, and squid (Sea Watch Foundation, 2012).

12.5.4.4. Conservation Status

218. The current conservation status of common dolphin, as assessed in the 3rd UK report on implementation of the Habitats Directive (submitted to the European Commission in 2012), is 'favourable' (JNCC, 2013).

12.5.5. Minke whale

12.5.5.1. Distribution and Occurrence

219. Minke whale are widely distributed along the Atlantic seaboard of Britain and Ireland (Reid *et al*., 2003). Within UK waters, minke whale are most commonly sighted in the western central North Sea and the west of Scotland around the Hebrides (DECC, 2016).

220. Minke whale are predominantly a seasonal visitor to UK waters, with sightings increasing from May to October, with sightings rare outside of this period. However, there are some individuals that are known to be resident in UK waters year-round (Evans, 2008). The annual movement patterns and migrations of minke whale are not well understood, but it is thought that they make a migration between tropical breeding grounds in the winter to colder feeding grounds in the summer (HWDT, 2019).

12.5.5.2. Abundance and Density Estimates

12.5.5.2.1. Celtic and Greater North Seas Management Unit

221. Genetic evidence suggests that the minke whales of the North Atlantic are likely to be a single genetic population (Anderwald *et al*., 2012). Therefore, IAMMWG (2015) considers a single MU is appropriate for minke whales in European waters.

222. The abundance of minke whales in the CGNS MU (**Plate 12-10**) is 23,528 animals (CV = 0.27; 95% CI = 13,989-39,572; IAMMWG 2015; **Table 12-18**). The estimate was derived from SCANS-II (Hammond *et al*., 2013) and CODA (Macleod *et al*., 2009) and is likely to be underestimated. The IAMMWG (2015) note the abundance of minke whales is highly seasonal, with abundance peaking during migration south into waters around the UK for summer.

12.5.5.2.2. JCP Data

223. The JCP estimated densities of minke whale across UK waters in summer are 0.02-0.04 individuals per km^2 (97.5% CI = 0-0.02 – 0.1-0.2 per km^2; Paxton *et al*., 2016).

224. The JCP abundance estimates for the Irish Sea Development area are highest in summer, with an estimated abundance of 190 individuals (97.5% CI = 80 – 620) and for winter months the estimated abundance is 60 individuals (97.5% CI = 0-100; Paxton *et al*., 2016).

12.5.5.2.3. SCANS and ObSERVE Data

225. SCANS-I in July 1994 estimated 8,445 minke whale (95% CI = 5,000-13,500) (Hammond *et al*., 2002). The SCANS-II survey gave an overall estimate of 18,958 minke whale (CV = 0.347); and 13,734 minke whale (CV = 0.41; 95%CI = 9,800 – 36,700) within an area comparable to the 1994 survey (Hammond *et a*l., 2013). Although these estimates were not significantly different, there were noticeable changes in distribution between the two surveys which is most likely to be linked to changes in prey availability.

226. For the entire SCANS-III survey area (not the same area as SCANS-II), minke whale in the summer of 2016 was estimated to be 14,759 with an overall estimated density of 0.008/ km^2 (CV = 0.327; 95% CI = 7,908-27,544; Hammond *et al*., 2017).

227. For the SCANS-III survey block E (**Plate 12-5**), the abundance of minke whale in the summer of 2016 was estimated as 603 individuals (CV = 0.62, 95% CI 134 – 1,573) with an estimated density of 0.017 individuals per km^2 (Hammond *et al*., 2017; **Table 12-18**).

228. ObSERVE aerial surveys estimated minke whale density in stratum 5 to be 0.045/ km^2 in Summer 2015 and 0.016/ km^2 in summer 2016 (Rogan *et al*., 2018).

Table 12-18 Minke whale abundance and density estimates

Area	Abundance Estimate	Density Estimate	Source
Celtic and Greater North Seas (CGNS) MU (**Plate 12-10**)	**23,528** (95% CI = 3,989-39,572) for CGNS MU 12,295 (95% CI=7,176-21,066) for UK portion of CGNS	N/A	IAMMWG (2015)
SCANS-III Block E (**Plate 12-5**)	603 (95% CI = 134-1,753)	**0.017/ km²** (CV = 0.62)	Hammond *et al*. (2017)
ObSERVE aerial surveys – stratum 5 Summer 2015 (**Plate 12-6**)	494.7 (95% CI = 221.5 – 1105)	0.045/ km² (CV=0.69)	Rogan *et al*. (2018)
ObSERVE aerial surveys – stratum 5 – Summer 2016 (**Plate 12-6**)	180.1 (95% CI = 58.6 – 552.9)	0.016/ km² (CV=1.06)	Rogan *et al*. (2018)

12.5.5.3. Diet

229. Minke whales feed on a variety of fish species, including herring, cod and haddock. Minke whale feed by engulfing large volumes of prey and water, which they then 'sieve' out of through their baleen plates and swallow their prey whole.

230. A study into the diet of minke whale in the north-eastern Atlantic sampled a total of 210 minke whale forestomach contents from 2000 to 2004, with a total of 37 minke whale samples analysed within the northern North Sea. Within this area, minke whale were found to prey upon a number of different species at the population level, however, 84% of individuals were found to prey upon only one species. Sandeels (56% of total prey by biomass) and mackerel (30% of total prey by biomass) were found to be the most dominant prey species for minke whale in the northern North Sea (Windsland *et al*., 2007).

12.5.5.4. Conservation Status

231. The current conservation status of minke whale, as assessed in the 3rd UK report on implementation of the Habitats Directive (submitted to the European Commission in 2012), is 'favourable' (JNCC, 2013).

12.5.6. Grey seal

12.5.6.1. Distribution and Occurrence

232. Grey seals only occur in the North Atlantic, Barents and Baltic Sea with their main concentrations on the east coast of Canada and United States of America and in north-west Europe (SCOS, 2017).

233. Approximately 38% of the world's grey seals breed in the UK and 88% of these animals breed at colonies in Scotland with the main concentrations in the Outer Hebrides and in Orkney. There are also breeding colonies in Shetland, on the north and east coasts of mainland Britain and in south-west England and Wales (SCOS, 2017). Although the number of grey seal pups born in the UK has been growing steadily since records began in 1960, the population growth is now

steadying in all areas except for the central and southern North Sea where population growth remains high (SCOS, 2017).

234. Long-term sightings rates data as collated in the Atlas of the Marine Mammals of Wales found that the main concentrations of grey seals sightings were off the north coast of Wales, as well as the southern coast of the Isle of Man (Baines and Evans, 2012).

235. Marine Scotland commissioned Sea Mammal Research Unit (SMRU) to produce maps of grey seal distribution in UK waters (Russell *et al*., 2017). These maps were produced by combining information about the movement patterns of electronically tagged seals with survey counts of seals at haul-out sites. The resulting maps show estimates of mean seal usage (seals per 5 km x 5 km grid cell). The maps indicate relatively higher usage in some areas of the Celtic and Irish Sea along coastal locations of Ireland and Wales, for example, Llŷn Peninsula and West Hoyle Bank in Wales and the waters surrounding Lambay Island, as well as the south-east tip (Saltee Islands) of Ireland. Although, mean grey seal usage is relatively low (1<5 animals) in the area in and around the MDZ (Russell *et al*., 2017).

236. Grey seal are regularly recorded in and around the Irish Sea, including north Anglesey (e.g. Westcott, 2002; Westcott and Stringell, 2003, 2004; Clarke *et al*., 2018). Grey seals are present year round on both the Irish and Welsh coasts and are known to move between the two, for example between the southeast coast of Ireland and the southwest coast of Wales (Kiely *et al*., 2000).

237. During the Natural Power surveys of the MDZ and 2 km buffer (**Appendix 11.1, Volume III**), grey seal were recorded throughout the survey period between November 2016 and October 2018. Records of unidentified seals were also made, but as no harbour seals were recorded, it is considered likely that these records were also of grey seals. Ten sightings of grey seal were recorded during the SEACAMS surveys (**Appendix 12.1, Volume III**).

12.5.6.2. Abundance and Density Estimates

238. Grey seal populations are assessed from the counts of pups born each year. Surveys are undertaken during the breeding season where females will congregate on land to give birth (SCOS, 2017). The most recent counts available are from the 2014 autumn breeding season surveys, that were released in 2016. The 2014 surveys of the principal grey seal breeding sites in Scotland, Wales, Northern Ireland and south-west England, resulted in an estimate of 60,500 pups (95% CI = 53,900 - 66,900; SCOS, 2017). The pup counts can be used to determine actual population size through a mathematical model and have been projected forward to 2016. This model provides an estimated UK population for 2016 of 141,000 (95% CI = 117,500 - 168,500; SCOS, 2017).

239. In addition to counts of grey seal pups during the breeding season, grey seal are also counted during harbour seal surveys. The most recent counts of grey seal in the August 2016 surveys estimated that the total count of grey seals in the UK was 40,662 (SCOS, 2017).

240. In Ireland, the grey seal population was estimated to between 7,284 and 9,365 individuals, during the 2009-2012 monitoring program at seven main breeding sites (O'Cadhla *et al*., 2013).

12.5.6.2.1. South and West England and Wales Management Unit

241. Grey seal population size is normally derived from the numbers of pups born during their autumn breeding season. Grey seal distribution during their breeding season is, however, very different to their distribution at other times of the year. For this reason, the numbers of grey seal pups born in the autumn is provided as well as the summer counts of grey seals for each MU (IAMMWG, 2013).

242. In the South and West England and Wales MU, the grey seal pup production (autumn) was 1,900 with an estimated summer population size of 6,000, based on summer survey counts 1994-2003 and 2007 (SCOS, 2017; IAMMWG, 2013; **Table 12-19**). However, IAMMWG (2013) note that the South and West England and Welsh count is less certain due to infrequent assessment over this large area.

12.5.6.2.2. Wales

243. The colonies around the coast of Wales are rarely monitored. The most recent estimate for pup production in 2014 at Welsh colonies was 1,650 (SCOS, 2017). It is estimated that 96 pups were born in North Wales, 465 in North Pembrokeshire and 379 on Skomer and nearby mainland (Stringell *et al*., 2014; Strong *et al*., 2006).

244. Haul-out sites in Anglesey and the Llŷn Peninsula surveyed in 2014 had a count of 96 pups. Based on this count, there are an estimated 242-307 grey seal pups in the whole of north Wales (Stringell *et al*., 2014).

245. Recent surveys of grey seal pup production in North Wales was conducted in Autumn 2017 between Aberystwyth and the Dee Estuary (Clarke *et al*., 2018). The results show that 279 individual pups were born across 79 active nursery sites throughout the season. This suggests an approximate increase in pup production of 180% and a 145% increase in the number of nursery sites in comparison to the last full census of grey seal pups in North Wales in 2004 (Clarke *et al*., 2018).

246. Based on August counts (2011-2015) of grey seals at haul-out sites in Wales there are an estimated 422 grey seal and an estimated 480 grey seal in south-west England (SCOS, 2017). However, there are no dedicated seal surveys in these areas and only sparse information is available, therefore, estimates are compiled from counts from various different sources (SCOS, 2017). In addition, it should be noted that grey seal summer counts are known to be more variable than harbour seal summer counts and therefore caution is advised when interpreting these numbers (SCOS, 2017).

12.5.6.2.3. Seal Density Maps

247. As outlined above, SMRU has produced maps of grey seal distribution in UK waters (Russell *et al*., 2017). The grey seal density estimate of 0.155 per km^2 for the MDZ has been calculated from the seal density maps (**Figure 12-2, Volume II**; **Table 12-19**), based on the highest density estimate for the grid squares within 2 km of the area. There is currently insufficient data from the site-specific surveys to provide robust density estimates, therefore the latest seal at sea density maps (Russell *et al*., 2017) have been used to estimate the density of grey seal for the

MDZ. This was agreed with NRW at the 2nd marine mammal TWG meeting on the 19th February 2019.

Table 12-19 Grey seal abundance and density estimates

Area	Abundance Estimate	Density Estimate	Source
South and West England and Wales MU	**6,000**	N/A	IAMMWG (2013)
Morlais site	N/A	**0.155/ km^2**	Russell *et al*. (2017)
OSPAR Region	40,223 (9,997 – 7,4105)	0.10/ km^2 (0.02 – 0.18)	Russell *et al*. (2017)

12.5.6.3. Movements and Foraging Ranges

248. Grey seals forage in the open sea and they may range widely to forage and frequently travel over 100 km between haul-out sites (SCOS, 2017). Foraging trips can last anywhere between one and 30 days. Tracking of individual grey seals has shown that most foraging probably occurs within 100 km of a haul-out site, although they can feed up to several hundred kilometres offshore (SCOS, 2017).

249. Telemetry data show much individual variability in the movement patterns of grey seals (Matthiopoulos *et al*., 2004; McConnell *et al*., 1999), with some animals ranging widely and spending time in a variety of locations; while others remain in one limited area for most of the time they were tagged.

250. Grey seals from telemetry studies off western Scotland and off northern France indicate that the tagged grey seals from these areas did not enter the Irish Sea (Matthiopoulos *et al*., 2004). Tagging data of grey seals from haul-out sites in Liverpool Bay, Wales and southeast Ireland, indicates that most movement from these sites was contained within the Irish Sea (Hammond *et al*., 2005).

251. SCOS (2014) described telemetry studies that have been undertaken by tagging grey seals at five SACs across the UK (Pembrokeshire Marine, Lleyn Peninsula and the Sarnau, Monach Islands, Isle of May, and Berwickshire and North Northumberland Coast). The results indicate that grey seal travel between Sir Benfro Forol/Pembrokeshire Marine SAC, Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC and the Saltee Islands SAC (Ireland).

252. Data from tagging studies in the Irish Sea were examined in order to describe the extent of ‘forging trips’ of grey seals in the Irish Sea (SCOS, 2014). The telemetry data included in this study were from adult grey seals tagged at Ramsey (n=7), Bardsey (n=4), and Hilbre island (n=7) in 2004 and from pups tagged at Anglesey in 2009 and 2010 (n= 3 and 5), Bardsey in 2009 (n=2) and Ramsey in 2010 (n=7).

253. Over the lifetime of the tags, pups made an average of 58 trips per seal (over the average tag duration of 151 days) with a median trip duration of 0.92 days (95% CI = 0.12-7.89) between haul-out locations and covered an average distance of 19.47 km. The greatest distance travelled by one pup was 435.8 km. Grey seal adults made less trips with an average of 41 trips per seal (over the average tag duration of 131 days) and covered less distance (average maximum of 16.94 km), with trips between haul-out locations lasting on average 0.75 days (as a median, 95% CI = 0.12-5.61). The greatest distance travelled by one adult was 172.6 km.

The tag data showed that seals often move between haul out locations, in particular between the Lleyn Peninsula, Cardigan Bay and haul out locations around the Isle of Anglesey.

12.5.6.4. Haul-Out Sites

254. Grey seals spend longer hauled out during their annual moult between December and April, generally three and five months after the breeding season and during the breeding season between August and December (SCOS, 2017).

255. Around Wales, the breeding and pupping season for grey seal is between August and December with a peak in October-November, but this is extending. Pups are typically weaned 17 to 23 days after birth, when they moult their white natal coat and then remain on the breeding colony for up to two or three weeks before going to sea (SCOS, 2017).

256. The main breeding and haul-out sites for grey seal in Wales are located at the Skerries (11 km northeast of the MDZ and cable route), East Mouse (28 km northeast of the MDZ and cable route), Puffin Island (52 km east of the MDZ and cable route), Bardsey Island (55 km south of the MDZ and cable route), Tudwals and Carreg y Trai (84 km southeast of the MDZ and cable route) and Skomer Island (176 km south of the MDZ and cable route). The location of these sites is shown in **Plate 12-11**.

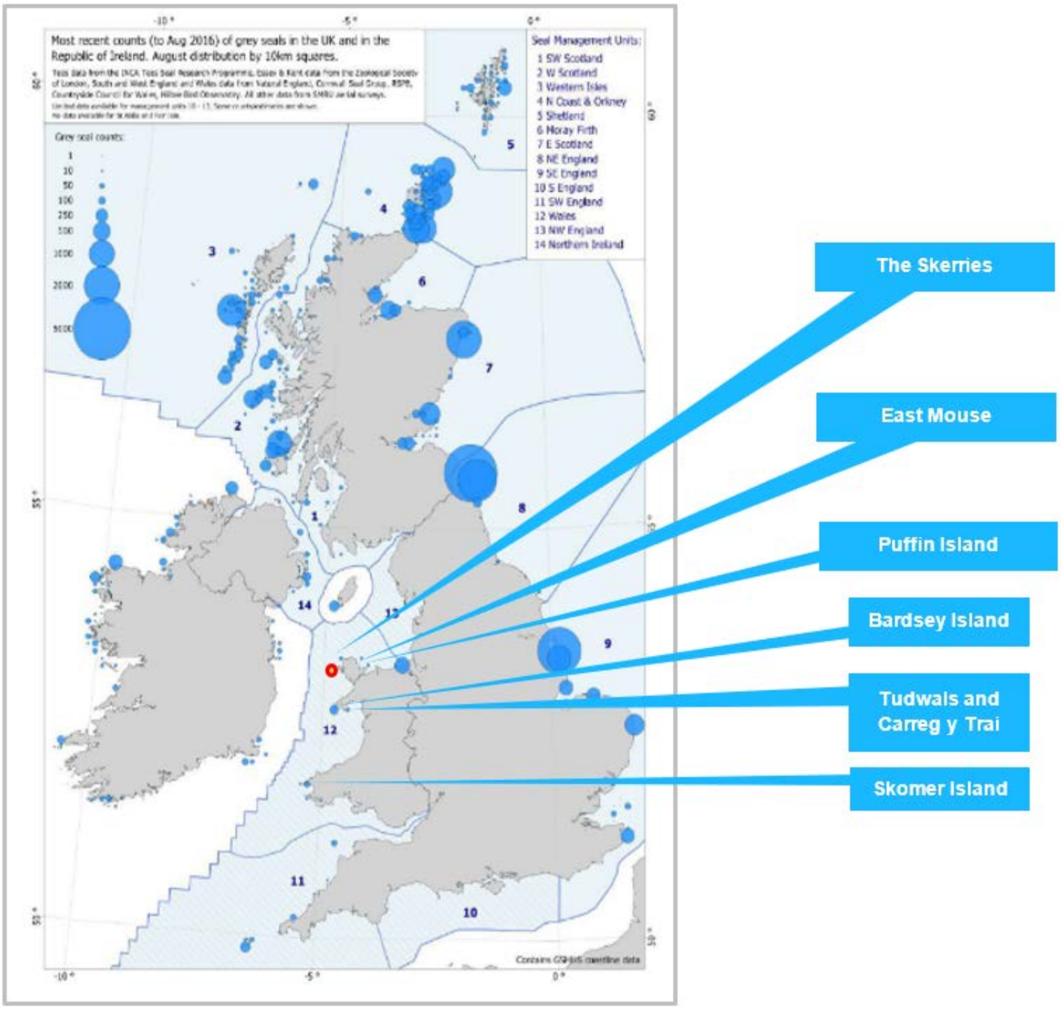

Plate 12-11 Grey seal haul out sites in Wales with MDZ indicated by red dot (source: SCOS, 2017)

257. In north Wales grey seal are known to use habitats such as intertidal rocky outcrops, beaches and sea caves that are tidally exposed. Breeding colonies in south-west England and in Wales are typically at the foot of steep cliffs or in caves and are therefore difficult to monitor (SCOS, 2017). During a grey seal haul-out site survey in Anglesey and the Llŷn Peninsula in 2014 (Stringell *et al*., 2014), an estimated 48% and 75% of pups born in Anglesey and the Llŷn Peninsula, respectively, were born in cave habitats (Stringell *et al*., 2014).

258. Recent surveys of grey seal pup production and distribution in North Wales conducted in Autumn 2017 between Aberystwyth and the Dee Estuary, identified 79 active nursery sites throughout the season (Clarke *et al*., 2018). The sites closest to the MDZ and cable area are indicted in **Figure 12-3** (**Volume II**) with the distances to these sites presented in **Table 12-20**.

Table 12-20 Distance to grey seal pupping sites near the MDZ and cable area (based on Clarke *et al.*, 2018)

Site Name	Distance to Cable Corridor (km)
Porth Namarch (West)	0.961
Porth Narach (East)	1.27
Yr Ogof Olaf	0.696
Porth y Nant	0.573
Ogof y Nant	0.554
Ogof Arw	0.338
Arw Cleft	0.069
Parliament House	0.22
Ogof Morlo	0.247
Ogof Migway (Yns Arw)	0.244
Ogof Ddeuddrws (Dream of White Horses)	0.300
Ofog Gogarth	0.549
Gof-du Big	2.306
Trearddur North	3.843

12.5.6.5. Diet

259. Grey seal are generalist feeders and will prey upon a variety of species. The most common food sources for grey seal are sandeels, gadoid species (such as cod, haddock, whiting and ling *Molva molva*) as well as flatfish species (such as plaice *Pleuronectes platessa*, sole *Soleidae sp.,* flounder and dab *Limanda limanda*), however this does vary from season and by location (Hammond and Grellier, 2006).

260. Food requirements for grey seal will depend on a number of factors, such as its size and fat content of the prey, but a general estimate is that a typical grey seal requires 4 to 7kg of prey a day, depending on the prey species (SCOS, 2017).

12.5.6.6. Conservation Status

239. The current conservation status of grey seal, as assessed in the 3rd UK report on implementation of the Habitats Directive (submitted to the European Commission in 2012), is ‘favourable’ (JNCC, 2013).

12.5.7. Harbour seal

12.5.7.1. Distribution and Abundance

261. Harbour seals have a circumpolar distribution in the Northern Hemisphere and are divided into five sub-species. The population in European waters represents one sub-species *Phoca vitulina vitulina* (SCOS, 2017).

262. Harbour seals are counted on land during their August moulting period, which gives a minimum population estimate. Combining the most recent counts available (2008-2016) gives a total count of 31,300 harbour seals in the UK (25,150 of which are in Scotland), and scaling this to reflect the number of seals missed by not being hauled-out, gives a total UK population estimate of 43,500 (95% CI = 35,600-58,000) in 2016 (SCOS, 2017).

263. The most recent estimate of the harbour seal population in the Wales MU is less than 50 individuals (SCOS, 2017; **Table 12-21**). The most recent harbour seal count (2011-2016) for the Wales MU was five (SCOS, 2017). Point of Ayr is the only haul-out location for harbour seal in this MU is located approximately 98 km east of the MDZ and cable area. **Plate 12-12** shows the location of the major harbour seal haul-out sites around the UK and the most recent seal counts for each site.

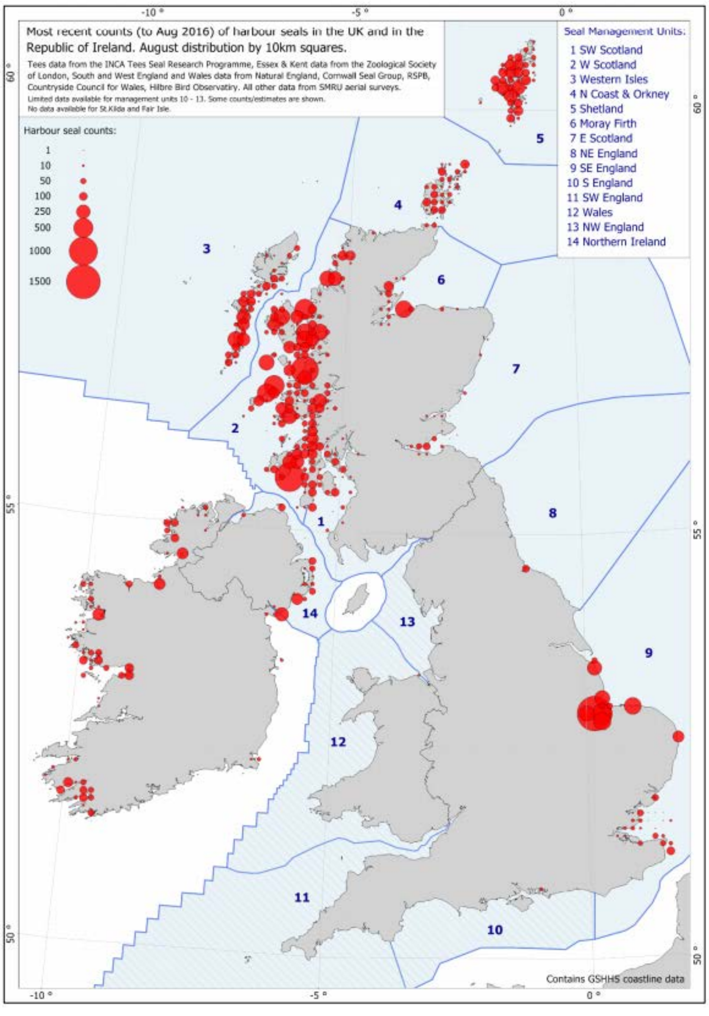

Plate 12-12 Location of the major harbour seal haul-out sites around the UK (source: SCOS, 2017)

264. It is noted in SCOS (2017) that very small numbers (<50) harbour seals are reported in the Wales MU are not included in this figure (SCOS, 2017). There are no systematic surveys for harbour seal in Wales.

265. The at-sea seal usage maps produced by SMRU show that the harbour seal usage is low in and around the MDZ, with a harbour seal density of 0.0005/ km^2 (**Figure 12-4, Volume II**; **Table 12-21**; Russel *et al*., 2017).

Table 12-21 Harbour seal abundance and density estimates

Area	Abundance Estimate	Density Estimate	Source
Wales	**50**	N/A	SCOS (2017)
Morlais site	N/A	**0.0005/ km^2**	Russell *et al*. (2017)
OSPAR Region	31,549 (13,217 – 50,218)	0.08/ km^2 (0.03 – 0.12)	Russell *et al*. (2017)

12.5.7.2. Movements and Foraging Ranges

266. SMRU, in collaboration with others, has deployed around 344 telemetry tags on harbour seals around the UK between 2001 and 2012 (Russell and McConnell, 2014). Spatial distributions indicate harbour seals persist in discrete regional populations, display heterogeneous usage and generally stay within 50 km of the coast (Russell and McConnell, 2014).

267. Harbour seals normally feed within 40 km and 50 km around their haul out sites (SCOS, 2017). Tracking studies have shown that harbour seal typically travel between 50 km and 100 km offshore and can travel 200 km between haul-out sites (Lowry *et al*., 2001; Sharples *et al*., 2012). Harbour seal exhibit relatively short foraging trips from their haul out sites. The range of these trips does vary depending on the surrounding marine habitat (e.g. 25 km on the west of Scotland; between 30 km and 45 km in the Moray Firth (Tollit *et al*., 1998; Thompson and Miller, 1990) and data from The Wash (from 2003- 2005)) suggest that harbour seal in this area travel further, and repeatedly forage between 75 km and 120 km offshore (with one seal travelling 220 km; Sharples *et al*., 2008).

268. Telemetry studies indicate that the tracks of tagged harbour seals have a more coastal distribution than grey seals and do not travel as far from haul-outs (Russell and McConnell, 2014).

269. The SMRU seal usage maps indicate there are small amounts of harbour seal usage around the north-east Irish coast, but no evidence of usage in the rest of the Irish Sea or along the Welsh coastline (Russell *et al*., 2017).

12.5.7.3. Haul-Out Sites

270. Harbour seal come ashore in sheltered waters, often on sandbanks and in estuaries, but also in rocky areas. Harbour seal haul out on land regularly in a pattern that is often related to the tidal cycle (SCOS, 2017).

271. Harbour seal give birth to their pups in June and July and pups can swim almost immediately after birth (SCOS, 2017). Harbour seals moult in August and spend a higher proportion of their time on land during the moult than at other times (SCOS, 2017).

12.5.7.4. Diet

272. Harbour seal take a wide variety of prey including sandeels, gadoids, herring and sprat, flatfish and cephalopods. Diet varies seasonally and regionally, prey diversity and diet quality also showed some regional and seasonal variation (SCOS, 2017).

273. It is estimated harbour seals eat 3-5 kg per adult seal per day depending on the prey species (SCOS, 2017).

12.5.7.5. Conservation Status

274. The current conservation status of harbour seal, as assessed in the 3rd UK report on implementation of the Habitats Directive (submitted to the European Commission in 2012), is 'Bad' (JNCC, 2013).

275. Harbour seals have been declining in recent years, with a loss of 21% of the UK population between 2000 and 2010 (JNCC, 2013). It was stated within JNCC (2013). that the reasons for the decline could potentially be down to shooting (under licence), bycatch, disturbance, dynamic positioning vessels (ducted propellers) or it could be bio-toxin related, competition with grey seals and predations by orca and grey seal (JNCC, 2013). More recent information describes only two of these factors as potential causes; interactions with grey seals and toxins from harmful algae (SCOS, 2017).

276. The decline was found predominantly in a few locations: Orkney with a population loss of 78% between 1978 and 2013; the east coast with a loss of 70% from 1997 to 2015; Firth of Tay loss of 92% from 2000 to 2015; and Shetland with a loss of 30% from 2000-2009 (this has now increased by 10% from 2009-2015) (SCOS, 2017). The population is now increasing again and is close to the levels before the decline described above.

12.5.8. European Designated Sites

277. All cetaceans in UK waters are classed as European Protected Species (EPS) under Annex IV of the Habitats Directive (EU Directive 92/43/EEC).

278. Bottlenose dolphin, harbour porpoise, grey seal and harbour seal are listed under Annex II of the Habitats Directive and are afforded protection through the designation of Natura 2000 (SAC) sites.

279. The HRA screening for the Project (**Document MOR/RHDHV/DOC/0067**) identified the following European Designated Sites for further assessment in the HRA:

- Gogledd Môn Forol/North Anglesey Marine SAC for harbour porpoise;
- Pen Llŷn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC for bottlenose dolphin and grey seal;
- Gorllewin Cymru Forol/West Wales Marine SAC for harbour porpoise;
- Bae Ceredigion/Cardigan Bay SAC for bottlenose dolphin and grey seal;
- Dynesfeydd Môr Hafren/Bristol Channel Approaches SAC for harbour porpoise;

- Sir Benfro Forol/Pembrokeshire Marine SAC for grey seal;
- North Channel SAC for harbour porpoise;
- The Maidens SAC for grey seal;
- Rockabill to Dalkey SAC for harbour porpoise;
- Lambay Island SAC for harbour seal; and
- Saltee Islands SAC for grey seal.

280. These sites were determined based on:

- The European Designated Sites within the relevant MU area for each species;
- The potential for connectivity between individual marine mammals from European Designated Sites and the potential effects from the project (i.e. demonstration of a clear source-pathway-receptor relationship); and
- The potential for a realistic pathway for a possible effect on European Designated Sites for marine mammals.

281. The European Designated Sites are assessed further in the information to support the HRA (**Document MOR/RHDHV/DOC/0067**).

282. For harbour porpoise any European Designated Sites located more the 400 km from the Project in the Celtic and Irish Seas MU, it was determined that the potential did not exist for a LSE to arise and are therefore screened out of further assessment. Harbour porpoise are highly mobile. However, they have relatively high daily energy demands and it has been estimated that they can only rely on stored energy (primarily blubber) for three to five days, depending on body condition (Kastelein *et al*., 1997). Based on a swimming speed of approximately 1.5m/s (Otani *et al*., 2000), it is estimated that harbour porpoise could cover a distance of approximately 400 km in three days. In light of the above, it is highly unlikely that harbour porpoise from European Designated Sites located 400 km or more from the Project are dependent on the MDZ area. Although harbour porpoise from European Designated Sites more than 400 km away could have foraging ranges that overlap the MDZ, any potential indirect effects on prey are highly unlikely to have a significant effect on harbour porpoise from that European Designated Site.

283. For bottlenose dolphin, connectivity was considered possible between the Project and the two European Designated Sites within the Irish Sea MU.

284. Based on the foraging ranges for grey seal and the assessment of the telemetry data in and around the Irish Sea, it was determined that there was potentially connectivity for any European Designated Site for grey seal up to 200 km from the Project. Consequently, all European Designated Sites for grey seal beyond 200 km of the Project in the OSPAR region were not assessed further.

285. Based on the foraging ranges for harbour seal, it was determined that there was potential connectivity for any European Designated Sites for harbour seal up to 100 km of the Project. Consequently, all European Designated Sites for harbour seal beyond 100 km of the Project in the OSPAR region were not assessed further.

12.5.9. Anticipated Trends in Baseline Conditions

286. The existing baseline conditions for marine mammals as described in **Section 12.5** are considered to be relatively stable. The baseline environment of the Celtic and Irish Seas areas has been influenced by fishing by various methods for hundreds of years, coastal and harbour developments and the construction and operation of offshore wind farms for over ten years (for example, North Hoyle, Rhyl Flats and Burbo Bank). The baseline will continue to evolve as a result of global trends which include the effects of climate change.

287. For harbour porpoise, the observed distribution of harbour porpoises during the SCANS-III survey in 2016 was similar to that observed in SCANS-II in 2005, but one notable difference was more sightings were made throughout the English Channel (block C) in 2016 than previously (Hammond *et al*., 2017). Similarly, the observed distribution of bottlenose dolphin and common dolphin in 2016 was also similar to that observed during the SCANS-II and CODA surveys in 2005/07 (Hammond *et a*l., 2017).

288. Feingold and Evans (2014b), indicated that the low abundance values within Cardigan Bay SAC in 2012 and 2013, the lowest since monitoring began in 2001, may represent a shift in usage by the dolphins in the region since in recent years, bottlenose dolphin sightings have been reported regularly for the first time during summer months in North Wales, particularly around the Isle of Anglesey but extending east into Liverpool Bay and north to at least the Isle of Man.

289. The number of grey seal pups throughout Britain has grown steadily since the 1960s; when records began and there is clear evidence that the population growth is levelling off in all areas, except the central and southern North Sea where growth rates remain high (SCOS, 2017). Surveys of grey seal pup production and distribution in North wales in 2017 indicates an increase in pup production of 180% and a 145% increase in the number of nursery sites in comparison to the 2004 surveys (Clarke *et al*., 2017).

290. The potential impacts of climate change on marine mammals can be direct, such as the effects species tracking a specific range of water temperatures in which they can physically survive, or indirect effects, which could include changes in prey availability affecting distribution, abundance and community structure (Learmonth *et al*., 2006).

291. There is potential evidence of the effects of climate change on the composition and structure of cetacean communities off north-west Scotland (MacLeod *et al*., 2005). Analysis of strandings from 1948 to 2003 found that no new cetacean species per decade were recorded in north-west Scotland between 1965 and 1981, however, this rose to two new species per decade from 1988 onwards. The new species recorded since 1988 are generally restricted to warmer waters, while those recorded prior to 1981 regularly occur in colder waters. In the period 1992 to 2003, the relative frequency of stranding of white-beaked dolphin, a colder water species, had declined while stranding of common dolphin, a warmer water species, had increased. Similarly, sightings surveys conducted in May–September 2002 and 2003 show that the relative occurrence and abundance of white-beaked dolphins declined and common dolphins increased in comparison to previous studies. These observations are consistent with changes in the local cetacean community being driven by increases in local water temperature (MacLeod *et al*., 2005).

292. In a wider context, such changes may lead to populations of cetaceans moving out of areas specifically designated for their protection as they respond to changes in local oceanic conditions.

12.5.10. Summary of Marine Mammal Reference Populations and Density Estimates

293. **Table 12-22** summarises the reference populations and density estimates that are used to inform the assessments for harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal. These were agreed with NRW at the 2nd marine mammal TWG meeting on the 19th February 2019.

Table 12-22 Reference populations and density estimates to inform the impact assessment for marine mammals

Species	Density Estimate (per km^2)	Reference Population
Harbour porpoise	0.783/ km^2	104,695 (Celtic and Irish Seas MU; IAMMWG, 2015)
Bottlenose dolphin	0.02/ km^2	397 (Irish Sea MU; IAMMWG, 2015)
Risso's dolphin	0.031/ km^2	8,794 (Celtic and Greater North Sea MU population; Paxton *et al.* 2016).
Common dolphin	0.22/ km^2	56,556 (Celtic and Greater North Seas MU population; IAMMWG, 2015).
Minke whale	0.017/ km^2	23,528 (Celtic and Greater North Seas MU population; IAMMWG, 2015).
Grey seal	0.155/ km^2	6,000 (South and West England and Wales MU; IAMMWG, 2013). 40,233 grey seal in the wider OSPAR region (based on Russell *et al.*, 2017)
Harbour seal	0.0005/ km^2	50 (Wales MU; SCOS, 2017). 31,549 harbour seal in the wider OSPAR region (based on Russell *et al.*, 2017).

12.5.11. Sensitivity of Marine Mammal Populations in Welsh Waters

294. Sparling *et al*. (2015) provides a level of sensitivity for each MU for marine mammals in Welsh waters (as defined by IAMMWG, 2015), based on an appraisal of a number of features. The main factors that contribute to the sensitivity of a marine mammal population to impacts are the current population size and distribution, current and recent trends in demographic parameters (fecundity, juvenile and adult survival) and life history variables such as age at maturity and longevity. The ability to adapt to change and the degree of existing threats are also important.

295. **Table 12-23** provides the predetermined sensitivity for each MU from Sparling *et al*. (2015). As there is only a single MU of relevance to Wales, these are presented as a 'species' in the table.

296. Sparling *et al*. (2015) note that although other marine mammal species are present in Welsh waters and may be species of concern for some developments, it is expected that that for most developments, the primary species of concern will be harbour porpoise, grey seals and/or bottlenose dolphins. This is because these are the most abundant species in Wales and are the only marine mammal Annex II species present in Wales. Other species can include Risso's dolphins around Bardsey Island (Llŷn Peninsula) and common dolphins in the southwest of Wales (e.g. Outer Bristol Channel and Pembrokeshire).

Table 12-23 Sensitivity classification of Welsh marine mammal populations from Sparling *et al*. (2015)

Species	Sensitivity	Rationale
Harbour porpoise	Low	Large population Favourable condition (unknown whether stable or increasing) Moderately fast maturing species Moderately long lived Wide ranging species
Bottlenose dolphin	High	Small population Favourable condition (stable population) Moderately slow maturing Moderately long lived Not a highly mobile population
Common dolphin	High in some areas, such as the outer Bristol channel	Moderately large population Favourable condition (stable population) Moderately slow maturing species Moderately long lived Wide ranging species
Grey seal	Low	Moderately large population Favourable condition (increasing population) Moderately fast maturing species Moderately long lived Wide ranging species

297. Based on the sensitivity classification of the marine mammal populations by Sparling *et al*. (2015) in **Table 12-23**, the sensitivity of marine mammal populations to potential impacts for the proposed Morlais Project have been considered, for context only, as:

- Low for harbour porpoise, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal; and
- High for bottlenose dolphin.

298. However, the sensitivity for the assessments has been based on the impact assessment matrix approach, as outlined in **Section 12.4.4.1**.

12.6. IMPACT ASSESSMENTS

12.6.1. Overview of Potential Impacts for Marine Mammals

299. The following section provides an overview of all impacts identified during scoping study and those which have been determined as the EIA has progressed. Each impact may not be relevant to all stages of the project, and thus impacts have been assessed within the stage of the project at which they will occur (construction, operation, repowering and decommissioning). Further, these impacts are comprised of both direct and indirect impacts.

300. Impacts are classified as follows:

- Direct impacts: these may arise from impacts associated with the construction, operation and maintenance, repowering or decommissioning of the project;
- Indirect impacts: these may be experienced by a receptor that is removed (e.g. in space or time) from the direct impact (e.g. noise impacts upon fish which are a prey resource for marine mammals).
- Inter-relationships between impacts; or cumulative impacts: these may occur as a result of the project in conjunction with other existing or planned projects within the study area for each receptor.

301. The potential impacts assessed for marine mammals are:

1. During Construction, Installation and Repowering:

- Underwater noise and disturbance:
  - Installation tidal devices and hubs (for example, drilling of foundations);
  - Construction activities (such as, cable installation and cable protection); and
  - Vessels;
- Potential barrier effects from underwater noise during construction;
- Disturbance at haul out sites (for example, from vessels moving to and from the site and at cable landfall);
- Increased collision risk with vessels;
- Potential changes in water quality (for example, increased suspended sediments, or any accidental release of contaminants); and
- Potential changes in prey availability (for example, underwater noise, disturbance, temporary loss of seabed habitat, increased suspended sediment concentrations and sediment re-deposition).

2. During Operation, Maintenance and Repowering:

- Underwater noise and disturbance:
  - Operational tidal devices;
  - Maintenance and repowering activities (such as, cable re-burial and additional cable protection; removal and replacement of devices / array);
  - Vessels; and
  - Acoustic Deterrent Devices (ADDs), if required;
- Collision risk with tidal devices;
- Increased collision risk with vessels;
- Potential entanglement with moorings for floating devices;
- Potential electromagnetic fields (EMF) effects;
- Potential barrier effects;

- Potential changes in water quality (for example, any accidental release of contaminants); and
- Potential changes in prey availability (for example, underwater noise, disturbance, loss of seabed habitat, introduction of hard substrate (e.g. foundations, cable and scour protection), changes to water quality and EMF.

3. Decommissioning:

- Underwater noise and disturbance;
- Increased collision risk with vessels;
- Potential changes in water quality; and
- Potential changes in prey availability.

4. Potential Cumulative Impacts and In-combination Effects:

- Underwater noise and disturbance;
- Collision risk; and
- Potential changes in prey availability.

12.6.2. Embedded Mitigation

302. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible.

303. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process (see **Chapter 4, Project Description** for further details). A range of different information sources has been considered as part of embedding mitigation into the design of the project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

304. Embedded mitigation relevant to Marine Ornithology is as follows;

- The PDE for tidal devices defined using parameters available from established tidal device technologies, which has been assumed will be developed sufficiently for commercial use at time of deployment. These have been incorporated in the modelling outlined in **Section 12.6.4.5.1**.

12.6.1. Worst-Case Scenarios

305. The realistic worst-case parameters for each category of potential impact (as outlined in **Table 12-25 Section 12.6.1.4**) has been determined. This takes into account the Project Design Envelope (PDE) and tidal devices that could be deployed, as outlined in **Chapter 4, Project Description**.

306. For this assessment, the realistic worst-case scenario involves consideration of both the timing of impacts, as well as the physical parameters that define the PDE. The worst-case scenario

for each potential impact is outlined in **Table 12-25**. Further details on the project design are presented in **Chapter 4, Project Description**.

307. The realistic worst-case scenarios identified here also apply to the Cumulative Impact Assessment (CIA). When the worst-case scenarios for the project in isolation do not result in the worst-case for cumulative impacts, this is addressed within the cumulative section of this chapter (see **Section 12.6.6**).

12.6.1.1. Construction

12.6.1.1.1. Tidal Device and Infrastructure Foundation Systems and Installation Methods

308. As outlined in **Chapter 4 Project Description**, there are two types of foundation systems proposed within the MDZ; seabed mounted and anchored / moored systems.

309. Seabed mounted foundations include:

- Gravity Based Structures (GBS):
  - The footprint (the element of the foundation in direct contact with the seabed) of gravity foundations, proposed at the MDZ would typically be very small (<10m^2), with gravity bases often using 'feet' that focus the weight of the foundation on a small area of seabed.
- Multi-piled Structures (including tripod and quadrapod):
  - A tripod or quadrapod structure typically using three or four pin-piles. A socket is drilled into the seabed and the pin-pile is inserted into the socket and grouted into place.
- Monopiles:
  - Monopiles may also be utilised within the MDZ, primarily for the electrical hub infrastructure.

310. Anchored / moored foundation systems include:

- Catenary moorings with four GBS as anchors.
- Tension mooring system with four GBS as anchors.

311. Installation methods for these foundation systems include:

- Drilling for multi-piles and monopile foundations:
  - Due to the hard substrate (bedrock) in the MDZ, drilling will be required to install piled foundations.
- Gravity based foundations and anchors.

312. In addition to the tidal devices, other infrastructure at the site will include:

- Electrical hubs (seabed mounted fully submerged hubs; floating surface emergent hubs; or seabed mounted surface emergent hubs);
- Navigational and mooring buoys;

- Acoustic Doppler Current Profilers (ADCPs);
- Seabed mounted environmental monitoring platforms; and
- Floating environmental monitoring platforms.

313. The hubs could have drilled piled foundations while the other infrastructure would have GBS or anchor foundations, rather than requiring drilled piled foundations.

314. For the main installation phase of tidal devices and associated electrical hub infrastructure, the typical time for complete installations is between three and 15 days per device, including foundation installation.

315. For the tidal device installation, it is estimated there could be up to a total of 4,306 days required. However, in practice it will most likely be done by up to three separate vessels working in parallel.

316. For the hub installation, it is estimated there could be up to a total of 1,800 days required, based on up to 15 days per hub for 120 hubs. However, hub installation would be conducted in parallel with the inter-array cable installation.

317. The other infrastructure (navigational and mooring buoys and ADCPs) would be installed during the tidal device and hub installation periods.

12.6.1.1.2. Offshore Cables

318. Up to nine export cables will be installed between the MDZ and the shore. The individual cable route lengths are predicted to range between 1.2 km and 6 km. For the export cable installation, it is anticipated that each of the nine export cables would take up to 20 days installation (total of 180 days), plus up to 108 days for export cable protection installation

319. Inter-array cables will be laid between the tidal devices and hubs. For the full 240MW capacity, there could be up to 740 individual array cables, with a maximum length of 2.5 km per cable, but the majority of cables being less than this (<1 km). The total length of array cables will up to 204.5 km. Total installation duration for all the inter-array cables would be up to 1,110 days, based on up to 1.5 days per cable. It is assumed that two arrays would be installed in parallel.

320. Due to the hard and rocky nature of the seabed, it is expected that the majority of the cables will be free laid with strategic protection (rock bags or concrete mattresses) at locations along the length. Where burial may be possible this will be done using jet trenching. However, this will have to be confirmed by pre-installation geotechnical site investigations informing detailed design.

12.6.1.1.3. Offshore Construction Schedule

321. Offshore works (for installation of tidal devices and associated cabling and infrastructure) would be phased over a period of up to ten years (see **Chapter 4 Project Description** for further details).

322. The offshore construction schedule has been determined based on the number of days vessels could be required to be on site for each stage of construction, this is summarised in **Table 12-24**.

Table 12-24 Installation durations

Construction Stage	Predicted number of vessels on site	Indicative number of days vessels on site during 10 year construction	Indicative number of days vessels on site per year	Indicative number of days vessels on site per year	% of time vessels on site per year
Cable tail installation	3 vessels (1 x cable tail installation vessel; 1 x cable tail installation support vessel; and 1 x dive support vessel)	20 days (assumes single operation of up to 15 days with 5 days extra for protection)	20 days	N/A (works in nearshore area)	5.48%
Export cable installation	2 vessels (1 x cable installation vessel; and 1 x support vessel)	180 days (assumes 9 blocks of 20 days over 10yr period)	20 days (worst-case assumes that one 20 day block of activity occurs per year, for 9yrs of the 10yr build-out period)	Each 20 day block of export cable installation per year	5.48%
Export cable protection installation	3 vessels (1 x cable tail installation vessel; 1 x cable tail installation support vessel; and 1 x dive support vessel)	108 days (assumes 9 x blocks of 12 days following each block of export cable installation)	12 days (worst-case assumes that one 12 day block of activity occurs per year, for 9 yrs of the 10yr build-out period)	Each 12 day block of export cable protection installation per year	3.29%
Inter-array cable Installation	2 vessels (1 x cable installation vessel; and 1 x support vessel)	775 days (assumes a 10 year period build out of all 8 arrays, and no more than 2 arrays built in parallel at any time)	77.5 days	Up to 10 days	21.23%
Hub installation	2 vessels (1 x hub installation vessel; and 1 x support vessel)	1,800 days (assumes 15 days per hub for 120 hubs)	180 days	22.5 days	49.32%
Tidal device installation	2 vessels (1 x construction vessel; plus 1 support vessel) Or 4 vessels (2 x construction vessel; plus 2 support vessel)	4,306 days	431 days	54 days	100% & 18% (assumes 1 x construction vessel plus 1 support vessel on sites every day; plus for 18% of year assumes 2 x construction vessel plus 2 support vessels on site)

12.6.1.2. Operation, Maintenance and Repowering

12.6.1.2.1. Tidal Devices

323. The tidal devices which may be installed under the Project Design Envelope have the following key elements, common across all device types:

- Tidal Energy Converter (TEC) or converters;
- Foundations, anchors or moorings on the seabed;
- Substructures supporting the TECs; and
- Cable connections.

324. Tidal devices currently being considered can be placed in three broad categories:

- Seabed mounted and submerged;
- Buoyant and mid-water column; and
- Surface floating.

325. The TECs could be:

- Horizontal axis (axial flow) rotors; or
- Vertical axis (cross flow) rotors.

326. A number of other device categories have been excluded from further consideration following a review of device types, technologies (see **Chapter 4 Project Description** for further details), these include:

- Surface piercing seabed mounted tower;
- Large seabed mounted cross-flow, horizontally orientated;
- Ducted cross-flow; and
- Other novel designs.

327. Further details on the parameters used in the collision risk assessment for the tidal devices are provided in **Section 12.6.4.5.1**.

12.6.1.2.2. Tidal Array Layout

328. As outlined in **Chapter 4, Project Description**, the final array layout will be identified post consent, following the berth selection and allocation process. The final detailed device locations will be developed based on further site investigation works conducted post-consent to determine detailed construction constraints.

329. Seabed mounted devices (Category 1) may have a spacing of 70 m to 150 m between centres of devices perpendicular to the flow and 180 m to 25 0m parallel to the flow. Such spacings may need to be modified to allow for seabed conditions, and this could alter spacings considerably, resulting in larger spacings.

330. The maximum case in terms of spacing would be floating tidal devices sharing moorings (Category 3). Such devices may require up to 150 m between structure centres perpendicular to the flow and 250 m parallel to the flow.

331. Each device could move by up to 80 m (±40 m) in the direction parallel to the flow and 60m (±3 0m) in the direction perpendicular to the flow. Therefore, the overall surface area covered by device movement (including device yawing) is up to 4,800 m^2 for a single floating device (Category 3).

332. This equates to a maximum area taken up by all arrays, including spaces between devices (i.e. not the seabed footprint) of up to 12.5 km^2 (up to 35% of the MDZ array area of 35 km^2) for the full 240MW capacity project.

333. Indicative layouts are presented in **Chapter 4 Project Description**.

12.6.1.2.3. Maintenance and Repowering Activities

334. As outlined in **Chapter 4 Project Description**, typical maintenance jobs may include: diagnostic tests, oil changes and lubrication, replacement of control cards and sensors, removal of biofouling, overhaul or replacement of systems (gearboxes, generators, switchgear etc.). Major operations such as retrieval and repair following structural failures would require similar vessels and procedures as installation works.

335. The project is a tidal technology demonstration project and it is anticipated that the tidal devices/arrays may be replaced several times within the project life time.

336. A repowering of a device/array is defined as the end of a berth/array demonstration cycle, at which time the TECs, device foundations, support structures, electrical hubs, tenant monitoring equipment, and inter-array cabling will be removed and replaced.

337. As a worst-case scenario, maintenance and repowering activities have been based on the assessment for construction. Because both maintenance and repowering (assumed at 50% of construction) are less than initial construction, this assessment is conservative.

12.6.1.3. Decommissioning

338. Assumed to be no greater than during construction phase.

12.6.1.4. Worst-Case Parameters

339. The worst-case scenario for each potential impact is outlined in **Table 12-25**.

Table 12-25 Worst-case parameters for marine mammal assessments

Project Phase	Impact	Parameter	Maximum worst-case	Notes
Construction	Underwater noise for foundation	Number of tidal devices requiring drilled foundations	Up to 620	Up to 620 small (less than 300kW) devices; or Up to 240 large 1MW+ devices

Project Phase	Impact	Parameter	Maximum worst-case	Notes
	installation – drilling			Up to 180 surface piercing devices (large or small) Maximum of 30MW of any one device in an array (maximum of 150 devices)
		Number of hubs requiring drilled foundations	Up to 120	60 hubs (each with 3 x 2.6m diameter piles); plus 60 hubs (each with 4 x of 2.6m diameter piles)
		Maximum number of piles for tidal devices	3,675	80 devices (each with 4 x 2.6m diameter piles); plus 120 devices (each with 4 x 1.2m diameter piles); plus 90 devices (each with 3 x 2.6m diameter piles)
		Maximum number of piles for hubs	420	
		Maximum pile diameter	2.6m	
		Total maximum duration of drilling for tidal device foundations	2,730 days	The duration to drill each pile could be up to 2 days for 1.2m diameter piles and up to 3 days for 2.6 diameter piles. 80 devices (each with 4 x 2.6m diameter piles) x 3 days = 960 days; plus 120 devices (each with 4 x 1.2m diameter piles) x 2 days = 960 days; plus 90 devices (each with 3 x 2.6m diameter piles) x 3 days = 810 days
		Total maximum duration of drilling for hub foundations	1,260 days	60 hubs (each with 3 x 2.6m diameter piles) x 3 days = 540 days; plus 60 hubs (each with 4 x of 2.6m diameter piles) x 3 days = 720 days
		Total maximum duration of drilling for tidal device and hubs foundation installation	Up to 3,990 days for 1,490 drilled piles	2 days for each of 120 x 1.2 m diameter drills and 3 days each for other diameter drills.
		Number of concurrent foundation installations (drilling events)	2	Up to two deployment areas could be developed at the same time.
	Underwater noise from	Cable installation method	Surface laid with strategic protection.	Underwater noise potentially greater during jet trenching.

Project Phase	Impact	Parameter	Maximum worst-case	Notes
	cable installation		Jet trenching where possible.	
		Cable protection	Rock bags or concrete mattresses.	Underwater noise during placement of cable protection
		Duration of cable installation	1,310 days	Export cables = 180 days Inter-array cables = 1,110 days Cable tails = 20 days
		Duration of cable protection	Up to 108 days	Export cable protection: 9 x blocks of 12 days, to begin up to 1 month after commencement of export cable laying
		Number of concurrent cable installations	2	Up to two deployment areas could be developed at the same time.
	Underwater noise and disturbance from vessels	Number of vessels	Up to 16 vessels	See **Table 12-24**. Maximum is likely to be 14 vessels at any one time, but based on up to 16 as worst-case scenario.
		Cable tail vessel days	Up to 20 days	Assume as one operation of 20 days duration.
		Export cable vessel days	Up to 180 days	Assumes 9 x blocks of 20 days, with each block continuous, but the 9 blocks spread across a possible 5 year period (may be longer, perhaps much, but not shorter) build out to 240MW.
		Cable protection vessel days	Up to 108 days	Assumes 9 x blocks of 12 days, to begin up to 1 month after commencement of export cable laying
		Inter-array cable vessel days	Up to 775 days	Assuming a minimum 10 year period build out, 8 arrays, and no more than 2 arrays built in parallel at any time. 194 vessel days per array. Therefore, 774.5 days over the 3650 days (10 years) assuming 2 arrays in parallel up to 1,549 days over 3,650 days assuming in sequence.
		Hub installation vessel days	Up to 1,800 days	1,800 days across a 3,650 day period. Hubs and arrays will be installed in parallel.
		Tidal device installation days	4,306 days	4,306 days across a 3,650 day period.
		Note: Number of vessel days is not the sum of all these values as many installation operations will take place in parallel.		
	Barrier effects from	Maximum potential area and duration of underwater during construction.		

Project Phase	Impact	Parameter	Maximum worst-case	Notes
	underwater noise			
	Disturbance at seal haul-out sites	Distance of construction activities, vessels and landfall from seal haul-out and pupping sites.		
	Increased collision risk with vessels	Number of vessels	Up to 16 vessels on site	Increased risk from increased number of vessels during construction compared to baseline.
		Number of vessel trips	Up to 16 per day	Assumed worst-case that each vessel would move to and from the site each day. Increased risk from increased number of vessels movements during construction compared to baseline.
		Area	Up to 10.75 km^2	Based on construction vessels in two indicative largest potential deployment areas (3 km^2 + 3 km^2); plus, vessels in export cable corridor area (4.75 km^2).
		Vessel route area	4.34 km^2	Vessel route from Holyhead Port to MDZ and cable corridor, based on 250m buffer either side of vessel.
	Changes in water quality	Increased suspended sediments	117,780m^3	Based on a 240MW capacity, the worst-case volume of cuttings for the entire site. A single device requiring four drilled piles will produce 160m^3 of cuttings
		Accidental release of contaminants	7,000 vessel days	Approximately 7,000 vessel days throughout the duration of the construction phase
			For the liquid inventory of devices deployed within the MDZ, the following worst-case values have been assumed: Oil (gearboxes, transformers etc.) 240,000 litres; Grease (bearing, seals etc.) 12,000 litres; and Hydraulic fluid 192,000 litres.	
	Changes in prey availability	Underwater noise	Parameters as outlined above.	
		Temporary habitat loss during construction	0.42 km^2	Post-lay burial of cable = 27,259m^2 Deployment of anchor blocks by barges during cable installation = 100,240m^2 Deployment of anchor blocks by barges during TEC device installation = 248,000m^2

Project Phase	Impact	Parameter	Maximum worst-case	Notes
				Deployment of anchor blocks by barges during hub installation = 48,000m^2 (see Chapter 10 for details)
		Changes in water quality	Parameters as outlined above.	
Operation, Maintenance and Repowering	Collision risk with tidal devices	See **Section 12.6.4.5.1.**		
	Underwater noise and disturbance from operational tidal devices	Worst-case scenarios based on underwater noise modelling for PTEC. 90 dB_{ht}(*Species*) maximum range = 610m for harbour porpoise, 95m for dolphin species; 400m for minke whale and 75m for seal species.		
	Underwater noise and disturbance from maintenance and repowering activities	Although likely to be less than parameters assessed for construction. Assessment has been based on construction parameters as a worst-case scenario.		
		Export cable inspection	Annual inspections of the export cable for the first 2 or 3 years, reducing to every 2 years thereafter.	Inspection / maintenance = 15 single day events per year. Assumes that 10 are late spring, summer, early autumn. Other 5 are across rest of year.
		Device inspection	Device inspection up to 15 times annually (for both planned and unplanned maintenance activities).	
		Cable repairs	Up to 10 major cable repairs (5 days each) may be required throughout the project life. It is assumed that up to 750m of cable will be subject to repair works per event (7,500m in total).	Cable repairs – 10 x 5 days or 50 days across life of project. Assume project operation life is 25 - 35 years, then one event every 2.5 to 3.5 years
	Underwater noise and disturbance from vessels	Number of vessels	Up to 16 vessels on site	As a worst-case scenario, assessment based on construction parameters, although likely to be less. Annual inspections of all cables will occur for the first three years after installation, reducing to every two years thereafter. Up to ten major cable repairs of five days each may be required

Project Phase	Impact	Parameter	Maximum worst-case	Notes
				throughout the project life of 35 years. Devices will be visited up to 15 times annually. Approximately four groups of vessels may be present in the MDZ and ECC at any one time during the lifespan of the project, of which two would be in the MDZ, and two in the ECC.
	Acoustic Deterrent Devices (ADDs)	Potential area of disturbance	1 km	Based on ADD review (see **Section 12.6.4.4**).
		Duration of activation	10-20 minutes	
		Number of ADDs	Up to 40 ADDs	Indicative as will depend on final mitigation plan and requirements.
	Increased collision risk with vessels	Area	Up to 10.75 km^2	As for construction, based on vessels in two indicative largest potential deployment areas (3 km^2 + 3 km^2); plus, vessels in export cable corridor area (4.75 km^2).
		Vessel route area	4.34 km^2	Vessel route from Holyhead Port to MDZ and cable corridor, based on 250m buffer either side of vessel.
	Entangle-ment with moorings for floating devices	Mooring will either be via tensioned systems, or catenary anchors. No loose mooring cables anticipated.		
	Electromag-netic fields (EMF) from offshore cables	Cable area	0.042 km^2	Foot print of cables and protection systems: Export cables = 11,745m^2: Inter-array cables = 30,040m^2; and Offshore cable tails = 120m^2.
	Barrier effects	Physical structures	12.5 km^2 (up to 36% of the MDZ array area)	Maximum area taken up by all arrays, including spaces between devices (i.e. not the seabed footprint) of up to 12.5 km^2 (up to 36% of the MDZ array area of 35 km^2) for the full 240 MW capacity project.
	Changes in water quality	Accidental release of contaminants	Same as for construction	There is also the possibility of pollution incidents due to ejection of contaminants or accidents involving tidal devices, and/or vessels. Any discharge will be limited and rapidly dispersed in tidal environment.

Project Phase	Impact	Parameter	Maximum worst-case	Notes
		Increased suspended sediments from 50% of all devices replaced via repowering works.	124,000 m^2	Footprint of temp seabed disturbance via anchor barges = 124,000m^2 (50% of 248,000 m^2 of temp seabed disturbance via TEC installation in construction phase)
		Increased suspended sediments during cable repairs	3,000 m^2	Up to 10 major cable repairs (5 days each) may be required throughout the project life. It is assumed that up to 750m of cable will be subject to repair works per event (7,500 m in total). Using same value of 400 m^2 temp seabed disturbance per 1 km of cable works (400 x 7.5) = 3,000 m^2
	Changes in prey availability	Underwater noise	Parameters as outlined above.	
		Temporary habitat loss	0.12 km^2	50% of all devices replaced via repowering works = 124,000 m^2 Cable repairs = 3,000 m^2 (see **Chapter 10** for details)
		Permanent habitat loss	2.18 km^2	Based on area for Gravity Base Structures (GBS) (74,790 m^2), swept area of catenary cables (2,055,000 m^2), export cable footprint (cables and protection systems; 11,745 m^2), array cable footprint (cables and protection systems; 30,040 m^2), additional cable protection material (4,860 m^2), cable tails (120 m^2), trench for 9 x landfall cables (7,400 m^2), footprint of navigation marker buoys (540 m^2), footprint of Acoustic Doppler Current Profiler (ADCP) moorings (280 m^2), footprint of seabed mounted environmental monitoring units (112 m^2) and footprint of mooring for floating environmental monitoring units (45 m^2). (see **Chapter 10** for details)
		EMF effects	Parameters as outlined above.	
		Changes in water quality	Parameters as outlined above.	
Decommissioning	Underwater noise	Assumed to be no greater than during construction phase		

Project Phase	Impact	Parameter	Maximum worst-case	Notes
	Increased collision risk with vessels	Assumed to be no greater than during construction phase		
	Changes in water quality	Assumed to be no greater than during construction phase		
	Changes in prey availability	Assumed to be no greater than during construction phase		

12.6.2. Mitigation

12.6.2.1. Embedded Mitigation

340. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process. A range of different information sources has been considered as part of embedding mitigation into the design of the project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

341. Embedded mitigation in the project design stage has involved not including several types of devices, restrictions on the position in the water column for some devices and maximum potential number of devices due to the initial collision risk assessments.

12.6.2.2. Water Quality

342. Menter Môn is committed to the use of best practice and pollution prevention guidelines at all times. A Marine Pollution Contingency Plan (MPCP) would be in place and agreed with NRW in line with the Integrated Pollution Prevention and Control (IPPC) Directive such that any potential risk is minimised.

12.6.2.3. Proposed Approach to Marine Mammal Mitigation and Monitoring

12.6.2.3.1. Proposed Mitigation for Underwater Noise During Construction

343. Marine Mammal Mitigation Protocols (MMMPs) will be prepared to reduce the risk of any permanent auditory injury (Permanent Threshold Shift (PTS)) to marine mammals as a result of underwater noise during construction. The MMMP(s) will be developed in the pre-construction period and based upon best available information, methodologies, industry best practice, latest scientific understanding, current guidance and detailed project design.

344. The MMMP(s) will be developed in consultation with NRW and the relevant SNCBs, detailing the proposed mitigation measures to reduce the risk of any physical or permanent auditory injury (PTS) to marine mammals from underwater noise. This will include details of any embedded mitigation, as well as details of the mitigation zone and any additional mitigation measures required in order to minimise potential impacts of any physical or permanent auditory injury

(PTS), for example, the use of Marine Mammal Observers (MMOs), Passive Acoustic Monitoring (PAM) and / or activation of acoustic deterrent devices (ADDs). The methods for achieving the mitigation zone would be agreed with NRW and the relevant SNCBs.

345. It is currently proposed, that a MMMP for drilling activity would be prepared prior to construction, for example with the option of having MMOs on site during drilling activities to ensure marine mammals do not enter a predetermined mitigation zone (for example, 500m), based on the maximum potential PTS impact range, e.g. 210m for minke whale (see **Table 12-30**).

346. It is also proposed that a MMMP for cable installation and cable protection activities would be prepared prior to construction, for example with the option of having MMOs on site to ensure marine mammals do not enter a predetermined mitigation zone, based on the potential PTS impact range of up to 100m (see **Table 12-40**).

12.6.2.3.2. Proposed Mitigation and Monitoring for Collision Risk with Operational Turbines

347. The mitigation and monitoring plan to reduce the collision risk of marine mammals with operational turbines will be developed in the pre-construction period so that it can be based upon best available information, methodologies, industry best practice, latest scientific understanding, current guidance and detailed project design.

348. It will be developed in consultation with NRW and the relevant SNCBs, detailing the proposed mitigation measures which could include, but may not be limited to, detecting marine mammals in and around the arrays (this could be done using remotely monitored PAM, underwater cameras, autonomous recorders, and / or high definition (HD) and thermal imaging camera systems). There would also be the use of active sonar to detect marine mammals in close proximity to the arrays / devices which could be used to trigger mitigation measures, such as the automatic activation of ADDs to deter marine mammals from a predetermined mitigation zone around the arrays / devices.

349. The approach would be based on deployment, monitoring and adaptive management, with regular reviews of the installation at appropriate deployment increments directly related to collision risk to marine mammals, specifically bottlenose dolphin, to ensure that no more than one bottlenose dolphin could be theoretically at risk of collision or other significant impact.

350. An outline Environmental Mitigation and Monitoring Plan (EMMP) has been submitted with the ES (**Document MOR/RHDHV/DOC/0072**). The EMMP will develop alongside the development of the project, and the “proposed approach to the EMMP is that it will provide a flexible framework, through which further knowledge and understanding of the risks presented from the project that can be achieved throughout the project lifespan.” In addition, the EMMP will meet the project specific licence conditions.

351. The EMMP will focus on the potential collision risk of marine mammals and seabirds, as well as outlining the Marine Mammal Mitigation Plan (MMMP) for reducing the risk of any auditory injury in marine mammals as a result of underwater noise, which will be submitted as a separate document six months prior to construction.

352. The EMMP will be developed in consultation with NRW with a schedule of agreed milestones to meet the requirements prior to construction.

12.6.3. Assessment of Potential Impacts During Construction

12.6.3.1. Underwater Noise During Installation of Tidal Devices and Hubs

353. As outlined in **Chapter 4, Project Description** and **Section 12.6.1.1.1**, due to the hard substrate (bedrock) in the MDZ, drilling will be required to install pin-pile and monopiles foundations for the tidal devices and hubs. Of the potential installation methods that could be used, this has been considered as the worst-case scenario for underwater noise during the installation of the foundations for the tidal devices and hubs, compared to GBS and weighted anchors.

354. Underwater noise can cause both physiological (e.g. lethal, physical injury and auditory injury) and behavioural (e.g. disturbance and masking of communication) impacts on marine mammals (e.g. Bailey *et al*., 2010; Madsen *et al*., 2006; Thomsen *et al*., 2006, Thompson *et al*., 2010).

355. High exposure levels from underwater noise sources can cause auditory injury or hearing impairment taking the form of a permanent loss of hearing sensitivity (Permanent Threshold Shift (PTS)) or a temporary loss in hearing sensitivity (Temporary Threshold Shift (TTS)). The potential for auditory injury is not just related to the level of the underwater sound and its frequency relative to the hearing bandwidth of the animal, but is also influenced by the duration of exposure. The level of impact on an individual is a function of the Sound Exposure Level (SEL) that an individual receives as a result of underwater noise.

356. Marine mammals may exhibit varying intensities of behavioural response at different noise levels. These include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment, and in severe cases, panic, flight stampede or stranding, sometimes resulting in injury or death. The response can vary due to exposure level, the hearing sensitivity of the individual, context, previous exposure history or habituation, motivation and ambient noise levels (e.g. Southall *et al*., 2007).

- The potential impact of underwater noise will depend on a number of factors which include, but are not limited to:
- The source levels of noise;
- Frequency relative to the hearing bandwidth of the animal (dependent upon species);
- Propagation range, which is dependent on:
- Sediment/sea floor composition;
- Water depth;
- Duration of exposure;
- Distance of the animal to the source; and
- Ambient noise levels.

357. A series of underwater noise monitoring stations were installed by SEACAMS (University of Bangor) to sample the background noise levels in and around the MDZ over periods of between

15 and 30 days in 2016, 2017 and 2018. Four of these datasets from different time periods and locations have been analysed by Subacoustech (**Appendix 12.4, Appendix III**) to provide a range of noise levels to define a baseline over a daily (high-low) and fortnightly (springs-neaps) tidal cycle. All measurements analysed were taken with a 48 kHz sample rate and with contiguous 10-minute samples, except the June 2017 sample period which used a finer 1-minute sample period throughout.

358. The results of the background noise monitoring in these locations in and around the MDZ show a remarkable degree of consistency in all locations and time periods, and noise levels varying with position of the tide. There were occasional, rare outliers expected to be associated with passing vessel traffic. All locations show a range of noise levels of 89 dB to 107 dB SPLRMS re 1 µPa (as either 1-minute or 10-minute samples).

359. An overview of the noise levels sampled at each location is given in **Table 12-26** (excluding outliers).

Table 12-26 Summary of background noise levels in and around the MDZ

Period	Overall average noise level	Tide cycle: Springs		Tide cycle: Neaps	
		Max SPL_{RMS}	Min SPL_{RMS}	Max SPL_{RMS}	Min SPL_{RMS}
April 2017	98.3 dB SPL_{RMS}	103.0 dB	91.9 dB	99.7 dB	90.7 dB
June 2017	96.9 dB SPL_{RMS}	104.1 dB	89.1 dB	97.5 dB	89.7 dB
July 2017	98.9 dB SPL_{RMS}	106.4 dB	92.7 dB	100.2 dB	95.2 dB
July 2018	98.0 dB SPL_{RMS}	106.6 dB	89.9 dB	99.8 dB	92.6 dB

360. At MeyGen during August 2011 measurements of background underwater noise were recorded in the Inner Sound (Kongsberg, 2012). The Inner Sound is a turbulent location, with tides reaching speeds of 8-9 knots. Measurements were made from a drifting vessel, so that the differential flow of water across the hydrophone was minimised. **Table 12-27** summaries the background sea noise measurements undertaken in the Inner Sound (August 2011) and data are presented in sound pressure levels (SPL), sound exposure levels (SEL) and M-weighted SEL formats.

Table 12-27 Summary of the background sea noise measurements undertaken in the Inner Sound (August 2011)

Metric	Inner Sound
RMS SPL / SEL	106 - 139 dB re 1 µPa
M-Weighted SEL for low frequency cetaceans (minke whale)	102 – 131 dB re 1 µPa
M-Weighted SEL for mid frequency cetaceans (dolphin species)	106 - 139 dB re 1 µPa
M–Weighted SEL for high frequency cetaceans (harbour porpoise)	106 -139 dB re 1 µPa
M–Weighted SEL for pinnipeds in water (grey and harbour seal)	137 dB re 1 µPa

12.6.3.1.1. Underwater Noise Assessment

361. Underwater noise modelling has not currently been conducted for the MDZ, as the types of devices and how they could be installed has still to finalised. If required, underwater noise modelling will be undertaken pre-construction once the project design has been finalised. However, as a worst-case scenario, it has been assumed that the foundations of the tidal devices and hubs could be installed by drilling piles. Therefore, the assessment has been based on underwater noise modelling that has been conducted for drilling into a hard substrate at the

nearby Wylfa Newydd Development Area, drilling at the Perpetuus Tidal Energy Centre (PTEC) off the coast of the Isle of Wight and drilling at MeyGen in the Inner Sound of the Pentland Firth.

12.6.3.1.1.1. Drilling at Wylfa Newydd Development Area

362. The proposed Wylfa Newydd Development Area is located on the Wylfa peninsula, extending into the Irish Sea between the bays of Cemlyn and Cemaes, on the northern tip of the Isle of Anglesey off the North Wales coast. The distance to the Wylfa Newydd Development Area from the MDZ is 16.6 km.

363. Underwater noise modelling for the Wylfa Newydd Development Area was undertaken for rotary drilling, percussive drilling and concurrent drilling (HNP, 2018) and was updated to take into account the National Oceanographic and Atmospheric Association (NOAA) (National Marine and Fisheries Service (NMFS), 2018) thresholds and criteria (**Table 12-28**).

364. The NMFS (2018) guidance groups marine mammals into functional hearing groups and applies filters to the noise level to approximate the hearing response of the receptor:

- High Frequency (HF) Cetaceans, such as harbour porpoise;
- Mid Frequency (MF) Cetaceans, includes dolphin species, such as bottlenose dolphin, Risso's dolphin and common dolphin;
- Low Frequency (LF) Cetaceans, such as minke whale; and
- Phocid Pinnipeds Underwater (PW), such as grey and harbour seal.

365. For non-impulsive (i.e. continuous) noise, which is representative of drilling activity, NMFS (2018) presents cumulative weighted sound exposure criteria (SEL_{cum}) for both permanent threshold shift (PTS), where unrecoverable hearing damage may occur, and temporary threshold shift (TTS), where a short-term, recoverable effect on hearing sensitivity may occur in individual receptors. **Table 12-28** summarise the NMFS (2018) criteria for onset of risk of PTS and TTS for each of the key marine mammal hearing groups for non-impulsive noise.

Table 12-28 NMFS (2018) non-impulsive noise exposure criteria for PTS and TTS

Non-Impulsive noise	**PTS criteria**	**TTS criteria**
Hearing group	**Weighted SEL_{cum} (dB re 1 μPa²s)**	**Weighted SEL_{cum} (dB re 1 μPa²s)**
HF Cetaceans: harbour porpoise	173	153
MF Cetaceans: dolphin species	198	178
LF Cetaceans: minke whale	199	179
PW Pinnipeds: grey and harbour seal	201	181

366. Sound may be expressed in many different ways depending on the particular type of noise and the parameters of the noise that allow it to be evaluated in terms of a biological effect.

367. The attenuation of sound in the water as it propagates from the noise source must be considered in an assessment of potential impacts. As the measurement or receiver point moves away from the source, the sound pressure measured will decrease due to spreading. To standardise all source levels, regardless of where they are measured, they are referred back to a conceptual point 1m away from the point of origin of the noise. Consequently, source levels (**Table 12-29**) are presented with units of 'dB re 1 μPa @ 1 m'.

368. The sound pressure level (SPL) is normally used to characterise noise and vibration of a continuous nature such as drilling, boring, or background sea levels. To calculate the SPL, the variation in sound pressure is measured over a specific time period to determine the root mean square (RMS) level of the time varying acoustic pressure. The SPL_{RMS} therefore can be considered to be a measure of the average unweighted level of the sound over the measurement period.

369. The peak sound pressure level (SPL_{peak}) is the maximum level of sound. SPL_{peak} is often used to characterise sound transients from impulsive sources where there is a clear positive peak, such as impact piling or following the detonation of explosives. A peak SPL is calculated using the maximum variation of the pressure from positive to zero within the wave. This represents the maximum change in positive pressure (differential pressure from positive to zero) as the transient pressure wave propagates.

370. The Sound Exposure Level (SEL) sums the acoustic energy over a measurement period, and effectively takes account of both the SPL of the sound source and the duration for which the sound is present in the acoustic environment.

371. The cumulative sound exposure level (SEL_{cum}) takes into account the potential sound exposure level during the duration of the activity. For the SEL_{cum} modelling a worst-case static animal model was assumed for the Wylfa site. This assumes that the animal remains at a fixed distance from the noise source throughout, which in this case is a 24-hour period. This is assumed to be a very worst-case scenario, as it is more likely that animals exposed to high noise levels will move away from the noise source.

372. The source levels used in the underwater noise modelling for drilling at the Wylfa Newydd Development Area are summarised in **Table 12-29**. These source levels were derived using a combination of measurement data and extrapolations based on the differences in methodology, equipment and location.

Table 12-29 Summary of predicted source levels used for modelling drilling at Wylfa site

Noise source	**Predicted unweighted source level** (dB re 1 µPa (RMS) @ 1m)	**Predicted NMFS (2018) weighted source level** (dB re 1 µPa^{2}s @ 1m) (SEL)			
		LF Cetacean	**MF Cetacean**	**HF Cetacean**	**Pinniped**
Rotary drilling (242 kW)	161.2	153.3	116.9	110.1	139.6
Rotary drilling (570 kW)	164.9	157.0	120.6	113.8	143.3
Percussive drilling	185.3	181.4	146.5	139.9	167.5

373. Rotary drilling consists of two diameters and the rotating head is forced into the ground. Typical noise outputs from rotary drilling are characterised by a fairly continuous low pitch rumble with numerous higher levels of noise for short periods of time, as a result of the drill bit hitting inconsistencies in the rock.

374. Percussive drilling is different from rotary drilling as it adds a rapid hammer action to the rotating head. The noise is characterised by very rapid transient peaks associated with the hammer action of the drilling rig being used. Compared to rotary drilling, percussive drilling is a louder

process overall. Percussive drilling could be used over rotary drilling where harder substrate exists as the hammer action of the drill head would enable penetration into the harder material.

375. Measurements used in the modelling of rotary drilling were taken from measurements at close range to operations in Strangford Lough, Northern Ireland and the percussive drilling measurements that have been used were taken at the EMEC site off the coast of Eday, Orkney. The drills proposed for Wylfa varied in size compared to these measurements and as such a scaling factor was applied to the measurements in order to give a good estimate of the likely source levels.

376. The underwater noise modelling for the Wylfa Newydd Development Area was undertaken using the RAMSGeo software package which is designed to model any noise source where it is reasonable to assume it is a point source. RAMSGeo is a fully range dependent parabolic equation (PE) model that performs underwater acoustic transmission loss calculations. RAMSGeo is a purely theoretical model based solely around the physical acoustic processes that occur underwater.

377. The speed of sound in water is connected to temperature, and a representative sound speed of 1,489m/s was used in the modelling, based on a uniform temperature profile.

378. The seabed along the transects was assumed to be made up of predominately rock and hard substrate covered by a layer of sandy gravel. Similar to the predominately rock and hard substrate at the MDZ.

379. A location in 10m above ordinance datum water depth was used for the modelling at the Wylfa Newydd Development Area. All modelling for the Wylfa Newydd Development Area was conducted assuming a worst-case mean high water springs (MHWS) tide of 6.6m above LAT from the nearby Cemaes Bay. Three transects were modelled to illustrate the propagation of noise from the Wylfa site, with two of these extending out into the Irish Sea and deeper water, with 40-50m water depth in 5 km range of the noise modelling location. The results used in this assessment are based on the maximum potential impact ranges.

12.6.3.1.1.2. Drilling at PTEC

380. Underwater noise modelling of tidal devices and other associated noise at the Perpetuus Tidal Energy Centre off the coast of the Isle of Wight, England (Subacoustech, 2014) was undertaken prior to the NOAA (NMFS, 2016, 2018) thresholds and criteria. The noise metrics used were unweighted metrics (Parvin *et al*., 2007), the dB_{ht}(*Species*) (Nedwell *et al*., 2007) and M-Weighted SELs (Southall *et al*., 2007). The Source Level for the noise from percussive drilling operations was estimated to be 179.8 dB re 1 µPa@1 m (RMS) for installing a 4m diameter pile.

12.6.3.1.1.3. Drilling at MeyGen

381. Underwater noise modelling for the tidal turbine development in Inner Sound, Pentland Firth (Konsberg, 2012) was also undertaken prior to the NOAA (NMFS, 2016, 2018) thresholds and criteria. Drilling noise measurements indicate that limits of 144 dB re 1 µPa at 1m to 178 dB re 1 µPa at 1m may be considered representative for the activities at the Inner Sound site.

12.6.3.1.2. Potential Impacts from Underwater Noise During Drilling

12.6.3.1.2.1. Permanent Auditory Injury (PTS)

382. The maximum predicted impact ranges for the risk of PTS using the non-impulsive NMFS (2018) criteria for the proposed drilling operations at the Wylfa Newydd Development Area, assuming a stationary animal remaining in the vicinity over a 24-hour period, are presented in **Table 12-30**.

Table 12-30 Summary of the maximum predicted PTS impact ranges (and areas) for marine mammal species for drilling operations at Wylfa, based on NMFS (2018) weighted SEL_{cum} criteria for non-impulsive sounds

Potential Impact	Rotary drilling [570 kW]	Percussive drilling	Two rotary drilling rigs	Two percussive drilling rigs
Range (and area*) for PTS in High Frequency Cetaceans (harbour porpoise) 173 dB re 1 µPa^{2}s Weighted SEL_{cum}	<1m (0.000003 km^2)	9m (0.00025 km^2)	<1m (0.000003 km^2)	10m (0.0003 km^2)
Range (and area*) for PTS in Mid Frequency Cetaceans (dolphin species) 198 dB re 1 µPa^{2}s Weighted SEL_{cum}	<1m (0.000003 km^2)	<1m (0.000314 km^2)	<1m (0.000003 km^2)	1m (0.000003 km^2)
Range (and area*) for PTS in Low Frequency Cetaceans (minke whale) 199 dB re 1 µPa^{2}s Weighted SEL_{cum}	4m (0.00005 km^2)	100m (0.03 km^2)	6m (0.0001 km^2)	210m (0.14 km^2)
Range (and area*) for PTS in Pinnipeds in water (grey and harbour seals) 201 dB re 1 µPa^{2}s Weighted SEL_{cum}	<1m (0.000003 km^2)	9m (0.00025 km^2)	<1m (0.000003 km^2)	10m (0.0003 km^2)

*based on area of a circle

383. The maximum number of harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal that could be at risk of PTS from cumulative exposure over a 24 hour period, based on the density estimates for the MDZ and maximum area of impact for two percussive drilling operations are presented in **Table 12-31**.

Table 12-31 Maximum number of individuals (and % of reference population) that could be at risk of permanent auditory injury (PTS) from cumulative exposure over a 24 hour period for two percussive drilling operations at MDZ

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
PTS in harbour porpoise	0.00024 individuals (based on density estimate of 0.783/ km^2) (0.00000023% of the 104,695 reference population).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in bottlenose dolphin	0.00000006 individuals (based on density estimate of 0.02/ km^2) (0.000000015% of the reference population of 397 bottlenose dolphin)	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in Risso's dolphin	0.00000009 individuals (based on density estimate of 0.031/ km^2) (0.000000001% of the reference population of 8,794 Risso's dolphin).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
PTS in common dolphin	0.00000066 individuals (based on density estimate of 0.22/ km^2) (0.000000001% of the reference population of 56,556 common dolphin).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in minke whale	0.0024 individuals (based on density estimate of 0.017/ km^2) (0.00001% of the reference population of 23,528 minke whale).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in grey seal	0.000049 individuals (based on density estimate of 0.155/ km^2) (0.0000008% of the reference population of 6,000 grey seal).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in harbour seal	0.00000015 individuals (based on density estimate of 0.0005/ km^2) (0.0000003% of the reference population of 50 harbour seal).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).

384. The magnitude of the potential risk of PTS is assessed as **negligible / very low** for all species, with less than 0.001% of all relevant reference populations anticipated to be exposed to the permanent effect without any mitigation (**Table 12-31**).

385. Taking into account the high sensitivity of all marine mammal species to any permanent auditory injury (i.e. receptor has very limited capacity to recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect (negligible/ very low for all species; **Table 12-31**), the impact significance (as defined in **Table 12-10**) for any permanent auditory injury in harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal from cumulative exposure for two percussive drilling operations over 24 hours has been assessed as **minor (not significant)** (**Table 12-33**).

386. For PTEC, the source levels for the noise from percussive drilling operations was estimated to be 179.1 dB re 1 μPa@1 m (RMS) for the installation of 3m diameter piles. These levels are below the 240 and 220 dB re 1 μPa (SPL_{peak}) criteria for lethal effect and physical injury (Subacoustech, 2014). Therefore, no injury is anticipated.

387. Modelling undertaken for drilling at PTEC, based on the dB_{ht}(*Species*) criteria also indicates that for drilling noise the highest predicted source level was for harbour porpoise, for percussive drilling to install a 4m diameter pile, was 118.8 dB_{ht}(*Phocoena phocoena*)@1m. This is below 130 dB_{ht}(*Species*) perceived level used to indicate traumatic hearing damage (Subacoustech, 2014).

388. The modelling for PTEC, based on the M-weighted SEL Southall *et al*. (2007) thresholds is summarised in **Table 12-32**. The largest impact ranges are for the pinniped due to the more conservative criterion and shows a maximum range of 29m for installing the 3m pile through percussive drilling and 34m for a 4m pile. This means if a pinniped was positioned closer than 29m or 34m, respectively, from the drilling operation for 24 hours it would receive an exposure to sound that could be injurious using the Southall *et al*. (2007) criteria for non-pulses. However, the chance of a receptor staying this close to a noise source for such a long period of time is extremely unlikely (Subacoustech, 2014).

Table 12-32 Summary of the ranges out to which the injury criteria for non-pulses (Southall *et al*, 2007) is reached for percussive drilling noise over a 24 hour period modelled for PTEC (Subacoustech, 2014)

Percussive drilling	Range (m)			
	High Freq. Cetaceans (harbour porpoise) Range to 215 dB re 1 μPa²s	**Mid Freq. Cetaceans (dolphin species) Range to 215 dB re 1 μPa²s**	**Low Freq. Cetaceans (minke whale) Range to 215 dB re 1 μPa²s**	**Pinnipeds (in water) (grey and harbour seal) Range to 203 dB re 1 μPa²s**
1m diameter pile	2m	3m	4m	18m
2m diameter pile	3m	4m	5m	25m
3m diameter pile	4m	5m	6m	29m
4m diameter pile	6m	7m	8m	34m

389. For MeyGen, the source levels for drilling were considerably below the levels at which lethal injury to species of marine mammal might occur (240 dB re. 1 μPa). It was therefore considered unlikely that any marine animals would be killed as a consequence of the underwater noise from drilling activities at the Inner Sound development area.

390. The noise modelling for MeyGen also indicates that the peak source levels associated with drilling were also below the levels at which hearing damage from the underwater noise might occur (230 dB re. 1μPa and 224 dB re. 1μPa for the onset of Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) for cetaceans and 218 dB re. 1μPa and 212 dB re. 1μPa for the onset of PTS and TTS for pinnipeds). Even taking into account the more conservative criteria proposed by Lucke *et al*. (2009) for harbour porpoises (193.7 dB re 1 μPa) and those put forward by the US National Marine Fisheries Service (NMFS) (1995), whereby auditory injury may occur to pinnipeds and cetaceans following prolonged exposure to underwater sound at levels at or above 190 dB re. 1 μPa and 180 dB re. 1 μPa respectively, the source levels were sufficiently low such that the NMFS impact criteria were not exceeded (Kongsberg, 2012).

12.6.3.1.2.1.1. Mitigation

391. A MMMP for drilling activity would be prepared prior to construction, for example with the option of having MMOs on site during drilling activities to ensure marine mammals do not enter a predetermined mitigation zone, based on the maximum potential PTS impact range, e.g. 210m for minke whale. Although, to take into account the deeper water at the MDZ compared to the Wylfa site and the potential for increased noise propagation, the proposed mitigation zone for drilling activity would be a precautionary 500m.

12.6.3.1.2.1.2. Residual Impact

392. After the proposed mitigation, the residual impact would be negligible as marine mammals would be outwith the mitigation zone and potential area for any permanent auditory injury.

Table 12-33 Assessment of impact significance for any permanent auditory injury (PTS) in marine mammals from underwater noise during drilling to install tidal device and hub foundations at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
PTS during drilling to install tidal device and hub foundations	Harbour porpoise	High	Negligible / very low	Minor (not significant)	MMMP	Negligible
	Bottlenose dolphin		Negligible / very low	Minor (not significant)		Negligible
	Risso's dolphin		Negligible / very low	Minor (not significant)		Negligible
	Common dolphin		Negligible / very low	Minor (not significant)		Negligible
	Minke whale		Negligible / very low	Minor (not significant)		Negligible
	Grey and harbour seal		Negligible / very low	Minor (not significant)		Negligible

12.6.3.1.2.2. Temporary Auditory Injury (TTS) and Disturbance

393. For all marine mammal species considered, a fleeing response is assumed to occur at the same noise levels as TTS and the potential impact is also described as 'likely disturbance'. The behavioural response of individuals to a noise stimulus will vary, and not all individuals will respond, or in the same way, however, for the purposes of this assessment, it is assumed that at the 'likely disturbance' range of TTS onset, 100% of the individuals exposed to the noise stimulus will respond and flee the area.

394. The maximum predicted impact ranges for TTS using the non-impulsive NMFS (2018) criteria for the proposed drilling operations at the Wylfa Newydd Development Area, assuming a stationary animal remaining in the vicinity over a 24-hour period, are presented in **Table 12-34**.

395. The maximum predicated impact range for minor behavioural response in harbour porpoise based on the unweighted Lucke *et al*. (2009) criteria of 145 dB re 1 μPa^{2}s (SEL_{ss}) for single strike and not cumulative exposure for two percussive drilling rigs was up to 530m a the Wylfa site. However, it should be noted that this criteria is for possible behavioural response and not all animals within this range would be predicted to be disturbed. Therefore, using the weighted TTS ranges for cumulative exposure based on the NOAA (NMFS, 2018) thresholds and criteria modelled for Wylfa also represents a good indication of the potential disturbance ranges.

Table 12-34 Summary of the maximum predicted TTS / fleeing response impact ranges (and areas) for marine mammal species for drilling operations at Wylfa, based on NMFS (2018) weighted SEL_{cum} criteria for non-impulsive sounds

Potential Impact	Rotary drilling [570 kW]	Percussive drilling	Two rotary drilling rigs	Two percussive drilling rigs
Range (and area*) for TTS in High Frequency Cetaceans (harbour porpoise) 153 dB re 1 μPa^{2}s Weighted SEL_{cum}	6m (0.0001 km^2)	250m (0.2 km^2)	7m (0.00015 km^2)	320m (0.32 km^2)

Potential Impact	Rotary drilling [570 kW]	Percussive drilling	Two rotary drilling rigs	Two percussive drilling rigs
Range (and area*) for TTS in Mid Frequency Cetaceans (dolphin species) 178 dB re 1 µPa²s Weighted SEL_{cum}	<1m (0.000003 km²)	10m (0.0003 km²)	<1m (0.000003 km²)	20m (0.0013 km²)
Range (and area*) for TTS in Low Frequency Cetaceans (minke whale) 179 dB re 1 µPa²s Weighted SEL_{cum}	60m (0.01 km²)	1.5 km (7.07 km²)	90m (0.025 km²)	2.1 km (13.85 km²)
Range (and area*) for TTS in Pinnipeds in water (grey and harbour seals) 181 dB re 1 µPa²s Weighted SEL_{cum}	7m (0.00015 km²)	240m (0.18 km²)	8m (0.0002 km²)	320m (0.32 km²)

*based on area of a circle

396. The maximum number of harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal that could be at risk of TTS from cumulative exposure over a 24 hour period, based on the density estimates for the MDZ and maximum area of impact for two percussive drilling operations are presented in **Table 12-35**.

Table 12-35 Maximum number of individuals (and % of reference population) that could be at risk of temporary auditory injury (TTS) and fleeing response / disturbance from cumulative exposure over a 24 hour period for two percussive drilling operations at MDZ

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
TTS / fleeing response in harbour porpoise	0.25 individuals (based on density estimate of 0.783/ km²) (0.00024% of the 104,695 reference population).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in bottlenose dolphin	0.000026 individuals (based on density estimate of 0.02/ km²) (0.0000065% of the reference population of 397 bottlenose dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in Risso's dolphin	0.00004 individuals (based on density estimate of 0.031/ km²) (0.0000005% of the reference population of 8,794 Risso's dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in common dolphin	0.0003 individuals (based on density estimate of 0.22/ km²) (0.0000005% of the reference population of 56,556 common dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in minke whale	0.24 individuals (based on density estimate of 0.017/ km²) (0.001% of the reference population of 23,528 minke whale).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in grey seal	0.05 individuals (based on density estimate of 0.155/ km²) (0.0008% of the reference population of 6,000 grey seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
TTS / fleeing response in harbour seal	0.00016 individuals (based on density estimate of 0.0005/ km^2) (0.0003% of the reference population of 50 harbour seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

397. The magnitude of the potential of TTS / fleeing response is assessed as **negligible / very low** for all species, with less than 1% of all relevant reference populations anticipated to be exposed to the temporary effect (**Table 12-35**).

398. Taking into account the medium sensitivity of all marine mammal species to any temporary auditory injury (i.e. receptor has limited capacity to recover from the anticipated impact; **Table 12-6**) and low sensitivity to any disturbance (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect (negligible/ very low for all species; **Table 12-35**), the impact significance (based in the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) for any temporary auditory injury or disturbance in harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal from cumulative exposure for two percussive drilling operations over 24 hours has been assessed as **minor (not significant)** for TTS and **negligible** for disturbance (**Table 12-36**).

399. The modelling for PTEC, based on the dB_{ht}(*Species*) criteria that:

- For 90 and above, strong avoidance reaction by virtually all individuals; and
- For 75 and above, some avoidance reaction by the majority of individuals, but habituation or context may limit effect (e.g. in the presence of another biological imperative (such as migration to breeding or feeding grounds or avoiding a predator) individuals may not exhibit any behavioural reaction to the noise source).

400. The maximum range for 90 dB_{ht} is 76m for harbour porpoise, 22m for bottlenose dolphin, 42m for minke whale and 12m for grey and harbour seal and that the maximum range for 75 dB_{ht} is 780m for harbour porpoise, 180m for bottlenose dolphin, 280m for minke whale and 78m for grey and harbour seal (Subacoustech, 2014).

401. For Meygen, in a relatively noisy environment such as the Inner Sound where background noise levels are fairly high (in the range 106 – 139 dB re 1 μP), drilling noise propagates over only short distances (0.5 km) before it falls below background noise levels (Konsberg, 2012).

12.6.3.1.2.2.1. Mitigation

402. The proposed mitigation to reduce the risk of any PTS, for example, 500m mitigation zone and MMOs during drilling activity, will also reduce the risk of animals in the predicted impact area for TTS.

12.6.3.1.2.2.2. Residual Impact

403. After the proposed mitigation, the residual impact would be negligible for harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, grey seal and harbour seal, as they would be outwith the mitigation zone (500m) and potential area for any temporary auditory injury. After

the proposed mitigation, the residual impact would be minor (not significant) for minke whale (**Table 12-36**).

Table 12-36 Assessment of impact significance for any temporary auditory injury (TTS) and disturbance in marine mammals from underwater noise during drilling to install tidal device and hub foundations within the MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
TTS during drilling to install tidal device and hub foundations	Harbour porpoise	Medium	Negligible / very low	Minor (not significant)	MMMP	Negligible
	Bottlenose dolphin		Negligible / very low	Minor (not significant)		Negligible
	Risso's dolphin		Negligible / very low	Minor (not significant)		Negligible
	Common dolphin		Negligible / very low	Minor (not significant)		Negligible
	Minke whale		Negligible / very low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal		Negligible / very low	Minor (not significant)		Negligible
Disturbance during drilling to install tidal device and hub foundations	Harbour porpoise	Low	Negligible / very low	Negligible	No mitigation required.	Negligible
	Bottlenose dolphin		Negligible / very low	Negligible		Negligible
	Risso's dolphin		Negligible / very low	Negligible		Negligible
	Common dolphin		Negligible / very low	Negligible		Negligible
	Minke whale		Negligible / very low	Negligible		Negligible
	Grey and harbour seal		Negligible / very low	Negligible		Negligible

12.6.3.1.2.3. Duration of Potential Disturbance during Drilling

404. As outlined in **Table 12-25**, the estimated total maximum duration of drilling for all tidal device and hubs foundation installation for 240MW array is up to 3,990 drilling days. Based on two deployment areas being developed at the same time, this could result in 1,995 days during the 10 year construction period (approximately 55%).

405. The 240MW array would not be installed all at once, but rather in phases with different deployment areas being developed at different times with different devices.

406. Drilling would not be continuous during the phases or construction period, but with gaps in drilling activity as vessels move to different positions within the sites, between different deployment areas being developed, plus any downtime for weather or any technical issues.

407. This assessment also does not take into account that not all foundations will require drilling (i.e. some will be GBS or anchored).

408. As a worst-case scenario it is assumed that marine mammals could be disturbed from areas for two percussive drilling rigs presented in **Table 12-34**, throughout the year for up to 5.5 years during the construction period. However, based on the maximum number of individuals that could potential be disturbed (**Table 12-35**), this is unlikely to result in significant disturbance (**Table 12-36**).

12.6.3.2. Underwater Noise During Other Construction Activities

409. In addition to the installation of the tidal device and hub foundations, other construction activities will include the cable installation and cable protection. Due to the hard substrate (bedrock) in the MDZ there will be very little, if any, seabed preparation.

410. As outlined in **Chapter 4, Project Description** and **Section 12.6.1.1.2**, due to the hard and rocky nature of the seabed, it is expected that the majority of the cables will be free laid with strategic protection (rock bags or concrete mattresses) at locations along the length. Where burial may be possible this will be done using jet trenching.

411. There are no clear indications that underwater noise caused by the installation of sub-sea cables poses a high risk of harming marine fauna (OSPAR, 2009). However, behavioural responses of marine mammals to dredging, an activity emitting comparatively higher underwater noise levels, are predicted to be similar to those during cable installation (OSPAR, 2009).

412. Based on reviews of published sources of underwater noise during dredging activity (e.g. Thomsen *et al*., 2006; CEDA, 2011; Theobald *et al*., 2011; WODA, 2013; Todd *et al*., 2014), sound levels that marine mammals may be exposed to during dredging activities are usually below auditory injury thresholds or PTS exposure criteria; however, TTS cannot be ruled out if marine mammals are exposed to noise for prolonged periods (Todd *et al*., 2014), although marine mammals remaining in close proximity to such activities for long periods of time is unlikely. Therefore, the potential risk of any auditory injury (permanent or temporary) in marine mammals as a result of dredging / cable installation activity is highly unlikely.

413. Underwater noise as a result of dredging activity/cable installation, has the potential to disturb marine mammals. Therefore, there is the potential for short, perhaps medium-term behavioural reactions and disturbance to marine mammals in the area during dredging / cable installation activity. Marine mammals may exhibit varying behavioural reactions intensities as a result of exposure to noise (Southall *et al*., 2007).

12.6.3.2.1. Underwater Noise Assessment

414. Underwater noise modelling has not been conducted for the MDZ, however, underwater noise modelling has been conducted for the nearby Wylfa Newydd Development Area, this included cutter-suction dredging on a hard substrate (HNP, 2018) and was updated to take into account the NOAA (NMFS, 2018) thresholds and criteria (**Table 12-28**).

415. The underwater noise modelling for cutter-suction dredging at Wylfa has been used as a precautionary worst-case scenario for the underwater noise that could be generated during the cable installation and placement of cable protection at the MDZ.

416. Cutter-suction dredging involves the use of a rotating cutter head to loosen rock in conjunction with a suction inlet that sucks up material onto the dredge vessel. Cutter-suction dredgers are often used in areas with harder substrata, such as rock. The dominant noise generated is characterised by short pulses that correspond with the cutter tool on the dredger, although noise from the vessel's engines can also be heard.

417. The source levels used in the underwater noise modelling of cutter-suction dredging for the Wylfa Newydd Development Area are summarised in **Table 12-37**. The source levels were derived using a combination of measurement data and extrapolations based on the differences in methodology, equipment and location. Further details of the underwater noise modelling conducted for the Wylfa Newydd Development Area is provided in **Section 12.6.3.1.1**.

Table 12-37 Summary of predicted source levels used for modelling cutter suction dredging at Wylfa

Noise source	**Predicted unweighted source level** (dB re 1 µPa (RMS) @ 1m)	**Predicted NMFS (2018) weighted source level** (dB re 1 µPa^{2}s @ 1m) (SEL)			
		LF Cetacean	**MF Cetacean**	**HF Cetacean**	**Pinniped**
Cutter-suction dredging	176.1	171.7	150.2	144.7	163.4

418. In addition to the underwater noise modelling for cutter-suction dredging in the Wylfa Newydd Development Area, reference is also made to underwater noise modelling for cable laying, rock placement and trenching in the Southern North Sea.

419. The underwater noise modelling in the Southern North Sea was undertaken for sites with water depths of 45-55m and sandy sediment. Although the sediments are different for the majority of the MDZ, this modelling provides an indication of potential underwater noise for areas where burial using jet trenching may be possible.

420. The underwater noise propagation modelling for the Southern North Sea sites was undertaken using a simple modelling approach for a number of offshore construction activities; using measured sound source data scaled to relevant parameters for the site. The unweighted source levels used were:

- Cable laying: estimated sound source of 171dB re 1µPs @1m (RMS)
  Based on eleven datasets from a pipe laying vessel measuring 300m in length; this is considered a worst-case noise source for cable laying operations.
- Rock placement: estimated sound source of 172dB re 1µPs @1m (RMS)
  Based on four datasets from rock placement vessel 'Rollingstone.'
- Trenching: estimated sound source of 172dB re 1µPs @1m (RMS)
  Based on three datasets of measurements from trenching vessels more than 100m in length.

12.6.3.2.2. Potential Impacts from Underwater Noise During Other Construction Activities

12.6.3.2.2.1. Permanent Auditory Injury (PTS)

421. The maximum predicted impact ranges for the risk of PTS using the non-impulsive NMFS (2018) criteria for the proposed cutter-suction dredging operations at the Wylfa Newydd Development Area, assuming a stationary animal remaining in the vicinity over a 24-hour period, are presented in **Table 12-38**.

Table 12-38 Summary of the maximum predicted PTS impact ranges (and areas) for marine mammal species for cutter-suction dredging operations at Wylfa, based on NMFS (2018) weighted SEL_{cum} criteria for non-impulsive sounds

Potential Impact	Cutter-suction dredging
Range (and area*) for PTS in High Frequency Cetaceans (harbour porpoise) 173 dB re 1 µPa^2s Weighted SEL_{cum}	10m (0.0003 km^2)
Range (and area*) for PTS in Mid Frequency Cetaceans (dolphin species) 198 dB re 1 µPa^2s Weighted SEL_{cum}	1m (0.000003 km^2)
Range (and area*) for PTS in Low Frequency Cetaceans (minke whale) 199 dB re 1 µPa^2s Weighted SEL_{cum}	10m (0.0003 km^2)
Range (and area*) for PTS in Pinnipeds in water (grey and harbour seals) 201 dB re 1 µPa^2s Weighted SEL_{cum}	9m (0.00025 km^2)

*based on area of a circle

422. The maximum number of harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal that could be at risk of PTS from cumulative exposure over a 24 hour period, based on the density estimates for the MDZ and maximum area of impact for cutter-suction dredging operations / cable installation and protection at MDZ are presented in **Table 12-39**.

423. The magnitude of the potential risk of PTS is assessed as **negligible / very low** for all species, with less than 0.001% of all relevant reference populations anticipated to be exposed to the permanent effect without any mitigation (**Table 12-39**).

Table 12-39 Maximum number of individuals (and % of reference population) that could be at risk of permanent auditory injury (PTS) from cumulative exposure over a 24 hour period for cutter-suction dredging operations / cable installation and protection at MDZ, based on Wylfa modelling

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
PTS in harbour porpoise	0.00024 individuals (based on density estimate of 0.783/ km^2) (0.00000023% of the 104,695 reference population).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in bottlenose dolphin	0.00000006 individuals (based on density estimate of 0.02/ km^2) (0.000000015% of the reference population of 397 bottlenose dolphin).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in Risso's dolphin	0.00000009 individuals (based on density estimate of 0.031/ km^2) (0.000000001% of the reference population of 8,794 Risso's dolphin)	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in common dolphin	0.00000066 individuals (based on density estimate of 0.22/ km^2) (0.000000001% of the reference population of 56,556 common dolphin).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in minke whale	0.000005 individuals (based on density estimate of 0.017/ km^2) (0.00000002% of the reference population of 23,528 minke whale).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in grey seal	0.00004 individuals (based on density estimate of 0.155/ km^2) (0.0000007% of the reference population of 6,000 grey seal).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in harbour seal	0.0000001 individuals (based on density estimate of 0.0005/ km^2) (0.0000002% of the reference population of 50 harbour seal).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).

424. The maximum predicted impact ranges for the risk of PTS using the impulsive NMFS (2018) criteria for cable laying, rock placement and trenching in the Southern North Sea sites is presented in **Table 12-40**. In this assessment, a fleeing animal model has been used for SEL_{cum}. This more realistically assumes that the animal exposed to high noise levels will swim away from the noise source. For this a constant fleeing speed of 3.25m/s has been assumed for the low frequency (LF) cetaceans group (Blix and Folkow, 1995), based on data for minke whale, and for other receptors a constant rate of 1.5m/s has been assumed, which is a cruising speed for a harbour porpoise (Otani *et al.*, 2000). These are considered 'worst-case' as marine mammals are expected to be able to swim much faster under stress conditions. For example, Kastelein *et al*. (2018) recorded harbour porpoise swimming speeds of 1.97m/s during playbacks of pile driving sounds.

425. The modelling ranges smaller than 100m (cumulative) were not presented for the Southern North Sea sites and could therefore be a lot less than 100m. However, as a worst-case scenario, impact ranges of up to 100m have been assumed.

Table 12-40 Summary of the maximum predicted PTS impact ranges (and areas) for marine mammal species for cable laying, rock placement and trenching at Southern North Sea sites, based on NMFS (2018) weighted SEL_{cum} criteria for impulsive sounds

Potential Impact	Cable laying	Rock placement	Trenching
Range (and area*) for PTS in High Frequency Cetaceans (harbour porpoise) 155 dB re 1 µPa^{2}s Weighted SEL_{cum}	<100m (0.03 km^2)	<100m (0.03 km^2)	<100m (0.03 km^2)
Range (and area*) for PTS in Mid Frequency Cetaceans (dolphin species) 185 dB re 1 µPa^{2}s Weighted SEL_{cum}	<100m (0.03 km^2)	<100m (0.03 km^2)	<100m (0.03 km^2)
Range (and area*) for PTS in Low Frequency Cetaceans (minke whale) 183 dB re 1 µPa^{2}s Weighted SEL_{cum}	<100m (0.03 km^2)	<100m (0.03 km^2)	<100m (0.03 km^2)
Range (and area*) for PTS in Pinnipeds in water (grey and harbour seals) 185 dB re 1 µPa^{2}s Weighted SEL_{cum}	<100m (0.03 km^2)	<100m (0.03 km^2)	<100m (0.03 km^2)

*based on area of a circle

426. The maximum number of harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal that could be at risk of PTS from cumulative exposure, based on the density estimates for the MDZ and maximum area of impact for cable laying, rock placement and trenching are presented in **Table 12-41**.

427. The magnitude of the potential risk of PTS is again assessed as **negligible / very low** for all species, with less than 0.001% of all relevant reference populations anticipated to be exposed to the permanent effect without any mitigation (**Table 12-41**).

Table 12-41 Maximum number of individuals (and % of reference population) that could be at risk of permanent auditory injury (PTS) from cumulative exposure for cable laying, rock placement and trenching at MDZ, based on Southern North Sea modelling

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
PTS in harbour porpoise	0.024 individuals (based on density estimate of 0.783/ km^2) (0.000023% of the 104,695 reference population).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in bottlenose dolphin	0.0006 individuals (based on density estimate of 0.02/ km^2) (0.00015% of the reference population of 397 bottlenose dolphin).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in Risso's dolphin	0.0009 individuals (based on density estimate of 0.031/ km^2) (0.00001% of the reference population of 8,794 Risso's dolphin).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in common dolphin	0.0066 individuals (based on density estimate of 0.22/ km^2)	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
	(0.00001% of the reference population of 56,556 common dolphin).	reference population anticipated to be exposed to effect).
PTS in minke whale	0.0005 individuals (based on density estimate of 0.017/ km^2) (0.000002% of the reference population of 23,528 minke whale).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in grey seal	0.005 individuals (based on density estimate of 0.155/ km^2) (0.00008% of the reference population of 6,000 grey seal).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in harbour seal	0.000015 individuals (based on density estimate of 0.0005/ km^2) (0.00003% of the reference population of 50 harbour seal).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).

428. Taking into account the high sensitivity of all marine mammal species to any permanent auditory injury (i.e. receptor has very limited capacity to recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect (negligible/ very low for all species; **Table 12-39** and **Table 12-41**), the impact significance (as defined in **Table 12-10**) for any permanent auditory injury in harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal from cumulative exposure for cable installation and protection has been assessed as **minor (not significant)** (**Table 12-42**).

12.6.3.2.2.1.1. Mitigation

429. A MMMP for cable installation and cable protection activities would be prepared prior to construction, for example with the option of having MMOs on site to ensure marine mammals do not enter a predetermined mitigation zone, based on the potential PTS impact range, e.g. 100m. Although, the proposed mitigation zone could be a precautionary 500m.

12.6.3.2.2.1.2. Residual Impact

430. After the proposed mitigation, the residual impact would be negligible as marine mammals would be outwith the mitigation zone and potential area for any permanent auditory injury.

Table 12-42 Assessment of impact significance for any permanent auditory injury (PTS) in marine mammals from underwater noise during cable installation and protection at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
PTS during cable installation and cable protection	Harbour porpoise	High	Negligible / very low	Minor (not significant)	MMMP	Negligible
	Bottlenose dolphin		Negligible / very low	Minor (not significant)		Negligible
	Risso's dolphin		Negligible / very low	Minor (not significant)		Negligible
	Common dolphin		Negligible / very low	Minor (not significant)		Negligible
	Minke whale		Negligible / very low	Minor (not significant)		Negligible

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
	Grey and harbour seal		Negligible / very low	Minor (not significant)		Negligible

12.6.3.2.2.2. Temporary Auditory Injury (TTS) and Disturbance

431. The maximum predicted impact ranges for TTS / disturbance using the non-impulsive NMFS (2018) criteria for the cutter-suction dredging operations at the Wylfa Newydd Development Area, assuming a stationary animal remaining in the vicinity over a 24-hour period, are presented in **Table 12-43**.

432. The maximum predicated impact range for minor behavioural response in harbour porpoise based on the unweighted Lucke *et al*. (2009) criteria of 145 dB re 1 μPa^{2}s (SEL_{ss}) for single strike and not cumulative exposure for cutter-suction dredging was up to 580m a the Wylfa site. However, as previously noted that this criteria is for possible behavioural response and not all animals within this range would be predicted to be disturbed. Therefore, using the weighted TTS ranges for cumulative exposure based on the NOAA (NMFS, 2018) thresholds and criteria modelled for Wylfa also represents a good indication of the potential disturbance ranges.

Table 12-43 Summary of the maximum predicted TTS / fleeing response impact ranges (and areas) for marine mammal species for cutter-suction dredging operations at Wylfa, based on NMFS (2018) weighted SEL_{cum} criteria for non-impulsive sounds

Potential Impact	Cutter-suction dredging
Range (and area*) for TTS in High Frequency Cetaceans (harbour porpoise) 153 dB re 1 μPa^{2}s Weighted SEL_{cum}	260m (0.21 km^2)
Range (and area*) for TTS in Mid Frequency Cetaceans (dolphin species) 178 dB re 1 μPa^{2}s Weighted SEL_{cum}	10m (0.0003 km^2)
Range (and area*) for TTS in Low Frequency Cetaceans (minke whale) 179 dB re 1 μPa^{2}s Weighted SEL_{cum}	280m (0.25 km^2)
Range (and area*) for TTS in Pinnipeds in water (grey and harbour seals) 181 dB re 1 μPa^{2}s Weighted SEL_{cum}	70m (0.015 km^2)

*based on area of a circle

433. The maximum number of harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal that could be at risk of TTS from cumulative exposure over a 24 hour period, based on the density estimates for the MDZ and maximum area of impact for cutter-suction dredging operations / cable installation and protection are presented in **Table 12-44**.

434. The maximum predicted impact ranges for the risk of TTS / fleeing response using the non-impulsive NMFS (2018) criteria for cable laying, rock placement and trenching in the Southern North Sea sites was assessed as less than 100m (0.03 km^2) for all species, with the exception of rock placement for harbour porpoise which had a maximum predicted impact range of up to 990m (3.08 km^2).

435. The magnitude of the potential of TTS / fleeing response is assessed as **negligible / very low** for all species, with less than 1% of all relevant reference populations anticipated to be exposed to the temporary effect (**Table 12-44**).

Table 12-44 Maximum number of individuals (and % of reference population) that could be at risk of temporary auditory injury (TTS) and fleeing response / disturbance from cumulative exposure over a 24 hour period for cable installation and cable protection at MDZ, based on worst-case modelling for Wylfa and Southern North Sea sites

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
TTS / fleeing response in harbour porpoise[1]	2.4 individuals in 3.08 km^2 (based on density estimate of 0.783/ km^2) (0.002% of the 104,695 reference population).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in bottlenose dolphin[2]	0.00006 individuals in 0.03 km^2 (based on density estimate of 0.02/ km^2) (0.00015% of the reference population of 397 bottlenose dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in Risso's dolphin[2]	0.0009 individuals in 0.03 km^2 (based on density estimate of 0.031/ km^2) (0.00001% of the reference population of 8,794 Risso's dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in common dolphin[2]	0.007 individuals in 0.03 km^2 (based on density estimate of 0.22/ km^2) (0.000012% of the reference population of 56,556 common dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in minke whale[3]	0.004 individuals in 0.25 km^2 (based on density estimate of 0.017/ km^2) (0.00017% of the reference population of 23,528 minke whale).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in grey seal[2]	0.005 individuals in 0.03 km^2 (based on density estimate of 0.155/ km^2) (0.00008% of the reference population of 6,000 grey seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in harbour seal[2]	0.000015 individuals in 0.03 km^2 (based on density estimate of 0.0005/ km^2) (0.00003% of the reference population of 50 harbour seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

[1]based on 990m range modelled for rock placement at Southern North Sea Sites; [2]based on 100m range modelled for cable laying, rock placement and trenching at Southern North Sea; [3]based on cutter-suction dredging at Wylfa.

436. Taking into account the medium sensitivity of all marine mammal species to any temporary auditory injury (i.e. receptor has limited capacity to recover from the anticipated impact; **Table 12-6**) and low sensitivity to any disturbance (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect (negligible/ very low for all species), the impact significance (based in the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) for any temporary auditory injury or disturbance in harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal from cumulative exposure during cable installation and cable protection activities has been assessed as **minor (not significant)** for TTS and **negligible** for disturbance (**Table 12-45**).

12.6.3.2.2.2.1. Mitigation

437. The proposed mitigation to reduce the risk of any PTS, for example, 500m mitigation zone and MMOs, will also reduce the risk of animals in the predicted impact area for TTS.

12.6.3.2.2.2.2. Residual Impact

438. After the proposed mitigation, the residual impact would be negligible as marine mammals would be outwith the mitigation zone and potential area for any temporary auditory injury.

Table 12-45 Assessment of impact significance for any temporary auditory injury (TTS) and disturbance in marine mammals from underwater noise during cable installation and cable protection at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
TTS during cable installation and cable protection	Harbour porpoise	Medium	Negligible / very low	Minor (not significant)	MMMP	Minor (not significant)
	Bottlenose dolphin		Negligible / very low	Minor (not significant)		Negligible
	Risso's dolphin		Negligible / very low	Minor (not significant)		Negligible
	Common dolphin		Negligible / very low	Minor (not significant)		Negligible
	Minke whale		Negligible / very low	Minor (not significant)		Negligible
	Grey and harbour seal		Negligible / very low	Minor (not significant)		Negligible
Disturbance during cable installation and cable protection	Harbour porpoise	Low	Negligible / very low	Negligible	No mitigation required.	Negligible
	Bottlenose dolphin		Negligible / very low	Negligible		Negligible
	Risso's dolphin		Negligible / very low	Negligible		Negligible
	Common dolphin		Negligible / very low	Negligible		Negligible
	Minke whale		Negligible / very low	Negligible		Negligible
	Grey and harbour seal		Negligible / very low	Negligible		Negligible

12.6.3.2.2.3. Duration of Potential Disturbance during Other Construction Activities

439. As outlined in **Table 12-25**, the estimated total maximum duration of cable installation for 240MW array is up to 1,310 days, with an additional 108 days for cable protection with would begin up to one month after the start of the export cable laying. Based on two deployment areas being developed at the same time, this could result in 709 days during the 10 year construction period (approximately 19%).

440. The 240MW array would not be installed all at once, but rather in phases with different deployment areas being developed at different times with different devices.

441. Cable installation and cable protection activities would not be continuous during the phases or construction period, but with gaps as vessels move to different positions within the sites, between different deployment areas being developed, plus any downtime for weather or any technical issues.

442. As a worst-case scenario it is assumed that marine mammals could be disturbed from the areas presented in **Table 12-43**, for up to 1,418 days during the construction period. Or for two concurrent installation activities, twice the areas for half the duration (up 709 days). However, based on the maximum number of individuals that could potential be disturbed (**Table 12-44**), this is unlikely to result in significant disturbance (**Table 12-45**).

12.6.3.3. Underwater Noise and Disturbance from Construction Vessels

443. During the construction phase of the proposed scheme, there will be an increase in the number of vessels associated with construction activities. Vessel movements during construction will be within the MDZ and cable corridor area or travelling to and from the site. Installation support ports are likely to be Holyhead, Mostyn, Liverpool or Birkenhead; although ports further afield may be used.

444. As outlined in **Chapter 4, Project Description**, foundations would mainly be installed by a moored barge or Dynamic Positioning (DP) vessel. If a moored barge is used for installation, this will require one or two small support vessels to assist with positioning and anchor deployment. The TECs and supporting structures would then be installed separately using a DP vessel (likely to be the same as for the foundation installation) or a multi-cat vessel.

445. Cables will be installed using specialist cable installation vessel, barge or multi-cat, plus vessel or barge for installation of cable protection (rockbags / mattresses) and additional support vessel(s).

446. It is estimated that there could be up to 14 construction vessels in the MDZ and cable corridor at any one time, however, as a precautionary worst-case scenario the assessment has been based on 16 vessels, to allow for additional guard vessels.

447. Modelling by Heinänen and Skov (2015) indicates that the number of ships represents a relatively important factor determining the density of harbour porpoise in the CIS MU during summer, with markedly lower densities with increasing levels of traffic. A threshold level in terms of impact seems to be approximately 15,000 ships per year (approximately 50 vessels per day within a 5 km^2 area).

448. The number of construction vessels within the MDZ array area (35 km^2) and cable corridor area (4.75 km^2) would be well below this threshold with an estimated two vessels per 5 km^2. If all the vessels were within one development area (e.g. indicative smallest area of 1.85 km^2) and the cable corridor area (4.75 km^2) at any one time, there could be up to 11.5 vessels per 5 km^2.

449. **Chapter 15, Shipping and Navigation** provides a description of the existing marine traffic in and around the MDZ. Most vessel movements are inshore by small vessels such as recreational craft, workboats and small fishing vessels and the ferry route to the north of the MDZ.

450. Current traffic density of larger vessels carrying Automatic Identification System (AIS) is low within the MDZ during winter with less than four transits per month and up to 12 transits per month occurring in the northern most 200m of the MDZ as a result of the ferry route. In addition to ferries, five transits were made by four cruise ship vessels; within the two-week summer 2017 dataset. The cruise ships, while infrequent, are noted occupying a larger portion of the proposed MDZ.

451. Other vessel types which are active in and around the MDZ, include tugs and tows, survey vessels, RNLI vessels, construction and maintenance vessels and cable laying vessels. This vessel category is active across the entirety of the proposed MDZ. Holyhead is one of three main commercial fishing ports in Wales.

452. Holyhead Port is the third busiest port in Wales, providing a link to Ireland. There are approximately 8,500 vessel arrivals at Holyhead Harbour every year, equating to approximately 23 vessel movements (including commercial and recreational) per day.

453. Based on the precautionary worst-case scenario, including existing vessel movements in around the MDZ and cable corridor area, but taking into account that other vessels would be restricted from entering the immediate construction site (with a 500m safety zone around construction vessels and partially installed foundations), the number of vessels would be unlikely to exceed the Heinänen and Skov (2015) threshold level of 50 vessels per day in a 5 km^2 area. Therefore, there is unlikely to be the potential for significant disturbance to harbour porpoise as a result of the increased number of vessels during construction.

454. The construction vessels within the MDZ and cable corridor will be slow moving (or stationary) and most noise emitted is likely to be of a lower frequency, associated with large, slow moving vessels and the use of dynamic positioning systems.

455. Noise levels reported by Malme *et al*. (1989) and Richardson *et al*. (1995) for large surface vessels indicate that physiological damage to auditory sensitive marine mammals is unlikely. However, the levels could be sufficient to cause local disturbance to sensitive marine mammals in the immediate vicinity of the vessel, depending on ambient noise levels.

456. Underwater noise generated by vessels would not be sufficient to cause PTS and the potential for TTS is only likely if the animal remains in very close proximity to a vessel for a prolonged period of time, which is highly unlikely. Disturbance is therefore the only potential impact associated with the presence and underwater noise of vessels.

457. Thomsen *et al*. (2006) reviewed the effects of ship noise on harbour porpoise and seal species. As both species use lower frequency sound for communicating (with acute hearing capabilities at 2kHz) there is the potential for detection, avoidance and masking in both species. Thomsen *et al*. (2006) considered the detection thresholds for harbour porpoises (hearing threshold = 115dB rms re 1 µPa at 0.25 kHz; ambient noise = 91dB rms re 1 µPa at 2kHz) and concluded that ship noise around 0.25kHz could be detected at distances of 1 km; and ship noise around 2kHz could be detected at around 3 km. However, although the ship noise could be detected this does not mean that there would be an adverse reaction or disturbance.

12.6.3.3.1. Underwater Noise Assessment

458. Underwater noise modelling has not been conducted for the MDZ, however, underwater noise modelling has been conducted for vessels at the Wylfa Newydd Development Area (HNP, 2018) and was updated to take into account the NOAA (NMFS, 2018) thresholds and criteria (**Table 12-28**).

459. For the purposes of modelling, vessels were divided into two categories: medium sized and large sized. Medium sized vessels include support boats such as tugs and workboats, while the large sized vessels are equivalent of barges and the vessels used for foundations and cable installation.

460. The underwater noise propagation modelling was undertaken using a simple modelling approach for underwater noise associated with both medium and large sized vessels, using measured sound source data. The source levels used in the underwater noise modelling of large and medium vessels for the Wylfa Newydd Development Area are summarised in **Table 12-46**.

Table 12-46 Summary of predicted source levels used for modelling of vessels at Wylfa

Noise source	Predicted NMFS (2018) weighted source level (dB re 1 µPa^{2}s @ 1m) (SEL)			
	LF Cetacean	MF Cetacean	HF Cetacean	Pinniped
Large vessel movements	162.8	133.9	129.7	164.9
Medium vessel movements	155.0	126.1	121.9	157.1

461. It is important to highlight the transitory nature of underwater noise from passing vessels. Vessels used for foundations and cable installation would operate over an extended period in a defined area, so the cumulative noise exposure in a fixed position would be greater than the exposure from a vessel passing by.

462. For the modelling it was assumed that the vessels are travelling at an average speed of approximately 10 knots; the speed of the vessel would alter the sound level, with faster moving vessels generally creating more noise. The average vessel speed of 10 knots is based on the worst-case scenario, with vessels in and around the construction area typically moving at slower speeds.

463. Ambient underwater sound pressure levels were acquired between 2013 and 2014 to establish a baseline level of noise in the vicinity of Cemlyn Bay, Cemaes Bay and the Wylfa Newydd Development Area. This indicates that existing natural background noise levels for the area, with the mean underwater noise levels recorded between 111.4dB re 1µPa (SPL_{RMS}) and 120.9dB re 1µPa (SPL_{RMS}) (based on all transects measured). The noise levels generated from vessel movements would not be discernible above background noise after approximately 4.4 km for large vessels and 2.4 km for medium vessels (HNP, 2018).

12.6.3.3.2. Potential Impacts for Underwater Noise from Vessels

12.6.3.3.2.1. Permanent Auditory Injury (PTS)

464. The maximum predicted impact ranges for the risk of PTS using the non-impulsive NMFS (2018) criteria for large and medium vessels at the Wylfa Newydd Development Area, assuming a stationary animal remaining in the vicinity over a 24-hour period, are presented in **Table 12-47**.

Table 12-47 Summary of the maximum predicted PTS impact ranges (and areas) for marine mammal species for large and medium vessels at Wylfa, based on NMFS (2018) weighted SEL_{cum} criteria for non-impulsive sounds

Potential Impact	Large vessels	Medium vessels
Range (and area*) for PTS in High Frequency Cetaceans (harbour porpoise) 173 dB re 1 µPa^{2}s Weighted SEL_{cum}	4m (0.00005 km^2)	<1m (0.000003 km^2)
Range (and area*) for PTS in Mid Frequency Cetaceans (dolphin species) 198 dB re 1 µPa^{2}s Weighted SEL_{cum}	<1m (0.000003 km^2)	<1m (0.000003 km^2)
Range (and area*) for PTS in Low Frequency Cetaceans (minke whale) 199 dB re 1 µPa^{2}s Weighted SEL_{cum}	10m (0.0003 km^2)	3m (0.00003 km^2)
Range (and area*) for PTS in Pinnipeds in water (grey and harbour seals) 201 dB re 1 µPa^{2}s Weighted SEL_{cum}	<1m (0.000003 km^2)	<1m (0.000003 km^2)

*based on area of a circle

465. The maximum number of harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal that could be at risk of PTS from cumulative exposure over a 24 hour period, based on the density estimates for the MDZ and maximum area of impact for large vessels at MDZ are presented in **Table 12-48**.

466. The magnitude of the potential risk of PTS is assessed as **negligible / very low** for all species, with less than 0.001% of all relevant reference populations anticipated to be exposed to the permanent effect (**Table 12-48**).

Table 12-48 Maximum number of individuals (and % of reference population) that could be at risk of permanent auditory injury (PTS) from cumulative exposure over a 24 hour period for large vessels at MDZ

Potential Impact	Maximum number of individuals and (% of reference population)		Magnitude
	One large vessel	Up to 16 large vessels	
PTS in harbour porpoise	0.00004 individuals (based on density estimate of 0.783/ km^2) (0.0000004% of the 104,695 reference population).	0.0006 individuals (based on density estimate of 0.783/ km^2) (0.0000006% of the 104,695 reference population).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in bottlenose dolphin	0.00000006 individuals (based on density estimate of 0.02/ km^2) (0.000000015% of the reference population of 397 bottlenose dolphin).	0.000001 individuals (based on density estimate of 0.02/ km^2) (0.0000002% of the reference population of 397	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).

Potential Impact	Maximum number of individuals and (% of reference population)		Magnitude
	One large vessel	Up to 16 large vessels	
PTS in Risso's dolphin	0.00000009 individuals (based on density estimate of 0.031/ km^2) (0.000000001% of the reference population of 8,794 Risso's dolphin)	0.000002 individuals (based on density estimate of 0.031/ km^2) (0.00000002% of the reference population of 8,794 Risso's dolphin)	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in common dolphin	0.00000066 individuals (based on density estimate of 0.22/ km^2) (0.000000001% of the reference population of 56,556 common dolphin).	0.00001 individuals (based on density estimate of 0.22/ km^2) (0.00000002% of the reference population of 56,556 common dolphin).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in minke whale	0.000005 individuals (based on density estimate of 0.017/ km^2) (0.00000002% of the reference population of 23,528 minke whale).	0.00008 individuals (based on density estimate of 0.017/ km^2) (0.0000004% of the reference population of 23,528 minke whale).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in grey seal	0.0000005 individuals (based on density estimate of 0.155/ km^2) (0.000000008% of the reference population of 6,000 grey seal).	0.000007 individuals (based on density estimate of 0.155/ km^2) (0.0000001% of the reference population of 6,000 grey seal).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
PTS in harbour seal	0.0000000015 individuals (based on density estimate of 0.0005/ km^2) (0.000000003% of the reference population of 50 harbour seal).	0.00000002 individuals (based on density estimate of 0.0005/ km^2) (0.00000005% of the reference population of 50 harbour seal).	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).

467. Taking into account the high sensitivity of all marine mammal species to any permanent auditory injury (i.e. receptor has very limited capacity to recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect (negligible/ very low for all species), the impact significance (as defined in **Table 12-10**) for any permanent auditory injury in harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal from cumulative exposure for vessels has been assessed as **minor (not significant)** (**Table 12-49**).

12.6.3.3.2.1.1. Mitigation

468. Given the small impact ranges (10m or less around each vessel) and very small number of marine mammals that could potentially be at risk of any permanent auditory injury (PTS) and the assessment of minor (not significant) impact, no mitigation measures are required or proposed.

12.6.3.3.2.1.2. Residual Impact

469. The residual impact would remain minor (not significant).

Table 12-49 Assessment of impact significance for any permanent auditory injury (PTS) in marine mammals from underwater noise from vessels at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
PTS from large vessels	Harbour porpoise	High	Negligible / very low	Minor (not significant)	None required or proposed	Minor (not significant)
	Bottlenose dolphin		Negligible / very low	Minor (not significant)		Minor (not significant)
	Risso's dolphin		Negligible / very low	Minor (not significant)		Minor (not significant)
	Common dolphin		Negligible / very low	Minor (not significant)		Minor (not significant)
	Minke whale		Negligible / very low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal		Negligible / very low	Minor (not significant)		Minor (not significant)

12.6.3.3.2.2. Temporary Auditory Injury (TTS) and Disturbance

470. The maximum predicted impact ranges for TTS / disturbance using the non-impulsive NMFS (2018) criteria for large and medium vessels at the Wylfa Newydd Development Area, assuming a stationary animal remaining in the vicinity over a 24-hour period, are presented in **Table 12-50**.

Table 12-50 Summary of the maximum predicted TTS / fleeing response impact ranges (and areas) for marine mammal species for large and medium vessels at Wylfa, based on NMFS (2018) weighted SEL_{cum} criteria for non-impulsive sounds

Potential Impact	Large vessels	Medium vessels
Range (and area*) for TTS in High Frequency Cetaceans (harbour porpoise) 153 dB re 1 µPa^{2}s Weighted SEL_{cum}	140m (0.062 km^2)	30m (0.003 km^2)
Range (and area*) for TTS in Mid Frequency Cetaceans (dolphin species) 178 dB re 1 µPa^{2}s Weighted SEL_{cum}	3m (0.00003 km^2)	<1m (0.000003 km^2)
Range (and area*) for TTS in Low Frequency Cetaceans (minke whale) 179 dB re 1 µPa^{2}s Weighted SEL_{cum}	480m (0.72 km^2)	130m (0.053 km^2)
Range (and area*) for TTS in Pinnipeds in water (grey and harbour seals) 181 dB re 1 µPa^{2}s Weighted SEL_{cum}	40m (0.005 km^2)	9m (0.0003 km^2)

*based on area of a circle

471. The maximum number of harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal that could be at risk of TTS from cumulative exposure over a 24 hour period, based on the density estimates for the MDZ and maximum area of impact for large vessels are presented in **Table 12-51**.

472. The magnitude of the potential of TTS / fleeing response is assessed as **negligible / very low** for all species, with less than 1% of all relevant reference populations anticipated to be exposed to the temporary effect (**Table 12-51**).

Table 12-51 Maximum number of individuals (and % of reference population) that could be at risk of temporary auditory injury (TTS) and fleeing response / disturbance from cumulative exposure over a 24 hour period for large vessels at MDZ

Potential Impact	Maximum number of individuals and (% of reference population)		Magnitude
	One large vessel	Up to 16 large vessels	
TTS / fleeing response in harbour porpoise	0.05 individuals (based on density estimate of 0.783/ km^2) (0.00005% of the 104,695 reference population).	0.78 individuals (based on density estimate of 0.783/ km^2) (0.0007% of the 104,695 reference population).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in bottlenose dolphin	0.0000006 individuals (based on density estimate of 0.02/ km^2) (0.00000015% of the reference population of 397 bottlenose dolphin).	0.00001 individuals (based on density estimate of 0.02/ km^2) (0.000002% of the reference population of 397 bottlenose dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in Risso's dolphin	0.0000009 individuals (based on density estimate of 0.031/ km^2) (0.00000001% of the reference population of 8,794 Risso's dolphin).	0.00001 individuals (based on density estimate of 0.031/ km^2) (0.0000002% of the reference population of 8,794 Risso's dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in common dolphin	0.000007 individuals (based on density estimate of 0.22/ km^2) (0.00000001% of the reference population of 56,556 common dolphin).	0.0001 individuals (based on density estimate of 0.22/ km^2) (0.0000002% of the reference population of 56,556 common dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in minke whale	0.01 individuals (based on density estimate of 0.017/ km^2) (0.00004% of the reference population of 23,528 minke whale).	0.20 individuals (based on density estimate of 0.017/ km^2) (0.0008% of the reference population of 23,528 minke whale).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in grey seal	0.0008 individuals (based on density estimate of 0.155/ km^2) (0.00001% of the reference population of 6,000 grey seal).	0.01 individuals (based on density estimate of 0.155/ km^2) (0.0002% of the reference population of 6,000 grey seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in harbour seal	0.0000025 individuals (based on density estimate of 0.0005/ km^2) (0.000005% of the reference population of 50 harbour seal).	0.00004 individuals (based on density estimate of 0.0005/ km^2) (0.00008% of the reference population of 50 harbour seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

473. Taking into account the medium sensitivity of all marine mammal species to any temporary auditory injury (i.e. receptor has limited capacity to recover from the anticipated impact; **Table 12-6**) and low sensitivity to any disturbance (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect (negligible/ very low for all species), the impact significance (based in the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) for any temporary auditory injury or disturbance in harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal from cumulative exposure from vessels has been assessed as **minor (not significant)** for TTS and **negligible** for disturbance (**Table 12-53**).

12.6.3.3.2.2.1. Mitigation

474. No mitigation measures are required or proposed.

12.6.3.3.2.2.2. Residual Impact

475. The residual impact would remain minor (not significant) for TTS and negligible for disturbance.

Table 12-52 Assessment of impact significance for any temporary auditory injury (TTS) and disturbance in marine mammals from underwater noise from vessels at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
TTS from vessels	Harbour porpoise	Medium	Negligible / very low	Minor (not significant)	None required or proposed	Minor (not significant)
	Bottlenose dolphin		Negligible / very low	Minor (not significant)		Minor (not significant)
	Risso's dolphin		Negligible / very low	Minor (not significant)		Minor (not significant)
	Common dolphin		Negligible / very low	Minor (not significant)		Minor (not significant)
	Minke whale		Negligible / very low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal		Negligible / very low	Minor (not significant)		Minor (not significant)
Disturbance from vessels	Harbour porpoise	Low	Negligible / very low	Negligible	None required or proposed	Negligible
	Bottlenose dolphin		Negligible / very low	Negligible		Negligible
	Risso's dolphin		Negligible / very low	Negligible		Negligible
	Common dolphin		Negligible / very low	Negligible		Negligible
	Minke whale		Negligible / very low	Negligible		Negligible
	Grey and harbour seal		Negligible / very low	Negligible		Negligible

12.6.3.3.2.3. Duration of Potential Disturbance from Construction Vessels

476. As outlined in **Table 12-24** and **Table 12-25**, there could be up to 16 vessels within the MDZ throughout the construction period. However, the activities and number of vessels required will vary throughout the construction period and it is unlikely that construction activities and the number of vessels on site would be continuous during the construction period.

477. As a worst-case scenario it is assumed that marine mammals could be disturbed from areas presented in **Table 12-50** throughout the construction period. However, based on the maximum number of individuals that could potential be disturbed (**Table 12-51**), this is unlikely to result in significant disturbance (**Table 12-52**).

12.6.3.4. Potential Barrier Effects from Underwater Noise During Construction

478. Underwater noise during construction could have the potential to create a barrier effect, preventing movement or migration of marine mammals between important feeding and / or breeding areas, or potentially increasing swimming distances if marine mammals avoid the site and go around it.

479. The worst-case scenario in relation to barrier effects as a result of underwater noise is based on the maximum spatial and temporal (i.e. longest duration) scenarios. This assumes the maximum potential disturbance and possible barrier effects during construction, in that there could be at any one time:

- Up to two drilling activities;
- Up to two cable installation activities;
- Up to two cable protection activities; and
- Up to 16 vessels on site.

480. The maximum duration for this potential combination of activities could be up to 709 days based on the maximum duration for two concurrent cable installation and protection activities, which could be underway at the same time as drilling activities for the foundation installation.

481. This assessment is precautionary as the vessels have been assessed separately, but in reality, these would be within the potential areas of disturbance for drilling, cable installation and cable protection activities.

482. The maximum predicted impact area for any potential barrier effects has been assessed based on the maximum predicted ranges for TTS / disturbance using the non-impulsive NMFS (2018) criteria for drilling, cable installation, cable protection and vessels (**Table 12-53**).

Table 12-53 Summary of the maximum predicted barrier effects for marine mammal species during construction, based on NMFS (2018) weighted SEL_{cum} criteria for TTS / fleeing response

Potential Impact	Two percussive drilling rigs	Cable installation and protection	Up to 16 large vessels	Maximum total area (% of MDZ and ECC area)
Area* for TTS / fleeing response in	0.32 km^2	6.58 km^2	0.99 km^2	7.89 km^2 (20%)

Potential Impact	Two percussive drilling rigs	Cable installation and protection	Up to 16 large vessels	Maximum total area (% of MDZ and ECC area)
High Frequency Cetaceans (harbour porpoise)				
Area* for TTS / fleeing response in Mid Frequency Cetaceans (dolphin species)	0.0013 km^2	0.12 km^2	0.0005 km^2	0.12 km^2 (0.3%)
Area* for TTS / fleeing response in Low Frequency Cetaceans (minke whale)	13.85 km^2	1 km^2	11.5 km^2	26.35 km^2 (66.3%)
Area* for TTS / fleeing response in Pinnipeds in water (grey and harbour seals)	0.32 km^2	0.12 km^2	0.08 km^2	0.52 km^2 (1.3%)

*based on area of a circle

483. The maximum number of harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal that could be at risk of potential barrier effects during construction has been based on the maximum areas for TTS from cumulative exposure over a 24 hour period, based on the density estimates for the MDZ and maximum area of impact for drilling, cable installation, cable protection and vessels (**Table 12-54**).

484. The magnitude of the potential of TTS / fleeing response is assessed as **negligible / very low** for all species, with less than 1% of all relevant reference populations anticipated to be exposed to the temporary effect (**Table 12-54**).

Table 12-54 Maximum number of individuals (and % of reference population) that could be impacted by any potential barrier effects from underwater noise during construction at MDZ

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
TTS / fleeing response in harbour porpoise	6.2 individuals (based on density estimate of 0.783/ km^2) (0.006% of the 104,695 reference population).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in	0.002 individuals (based on density estimate of 0.02/ km^2)	Temporary effect with negligible / very low magnitude (less than 1% of the reference

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
bottlenose dolphin	(0.0006% of the reference population of 397 bottlenose dolphin).	population anticipated to be exposed to effect).
TTS / fleeing response in Risso's dolphin	0.004 individuals (based on density estimate of 0.031/ km^2) (0.00004% of the reference population of 8,794 Risso's dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in common dolphin	0.03 individuals (based on density estimate of 0.22/ km^2) (0.00005% of the reference population of 56,556 common dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in minke whale	0.45 individuals (based on density estimate of 0.017/ km^2) (0.0019% of the reference population of 23,528 minke whale).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in grey seal	0.08 individuals (based on density estimate of 0.155/ km^2) (0.001% of the reference population of 6,000 grey seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in harbour seal	0.0003 individuals (based on density estimate of 0.0005/ km^2) (0.0005% of the reference population of 50 harbour seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

485. There is unlikely to be any potential barrier effects that could significantly affect the movements of marine mammals in or through the MDZ and ECC area during construction. As outlined in **Table 12-53**, the maximum area for disturbance and any barrier effects as a result of underwater noise during construction in relatively small in relation to the MDZ array and ECC area and when put into the context of the marine mammal MUs.

486. The potential for displacement from underwater noise is unlikely to result in any significant increase in energy expenditure that could be required by harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, grey seal and harbour seal to temporary avoid the maximum potential areas of disturbance in **Table 12-53**. Although the potential area of disturbance for minke whale is greater than for the other species, however, taking into account the movements and areas covered by minke whale, along with the number of whales that could be present in the area, again this is unlikely to result in any significant impacts (**Table 12-55**).

487. It is highly unlikely two drilling activities, two cable installation activities, two cable protection activities and 16 vessels on site, would occur all at the same time or for any prolonged period of time. Any disturbance during construction would be limited to the area around the activity within the MDZ array area and / or ECC, rather than across the entire site and as such there is unlikely to be any barrier effects as animals would be able to move around these discrete areas. For example, two drilling foundations installation events would be within two different deployment areas and likewise the related cable installation, protection and vessels would be associated with the two different deployment areas.

488. Taking into account the low sensitivity to any disturbance (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact and the potential magnitude of

the effect (negligible/ very low for all species), the impact significance (based on the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) for any potential barrier effects as a result of underwater noise during construction for harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal has been assessed as **negligible** (**Table 12-55**).

12.6.3.4.1. Mitigation

489. No mitigation measures are required or proposed.

12.6.3.4.2. Residual Impact

490. The residual impact would remain negligible.

Table 12-55 Assessment of impact significance for any temporary disturbance and barrier effects as a result of underwater noise during construction at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Barrier effects from underwater noise	Harbour porpoise	Low	Negligible / very low	Negligible	None required or proposed	Negligible
	Bottlenose dolphin		Negligible / very low	Negligible		Negligible
	Risso's dolphin		Negligible / very low	Negligible		Negligible
	Common dolphin		Negligible / very low	Negligible		Negligible
	Minke whale		Negligible / very low	Negligible		Negligible
	Grey and harbour seal		Negligible / very low	Negligible		Negligible

12.6.3.5. Disturbance at Seal Haul-Out Sites

491. Hauled-out seals are sensitive to disturbance, particularly if they are in their breeding or moult periods. For grey seal, this is from August to December with a peak in October-November (see **Section 12.5.6.4**). There are no harbour seal haul-out sites in the vicinity of the MDZ (see **Plate 12-12**).

492. Studies on the distance of disturbance, on land or in the water, from hauled-out seals have found that the closer the disturbance, the more likely seals are to move into the water. For the grey seal, mothers responded by moving into the water more due to boat speed rather than as a result of the distance, although movement into the water was generally observed to occur at distances of between 20 and 70m, with no detectable disturbance at 150m (Wilson, 2014; Strong and Morris, 2010). However, grey seals have also been reported to move into the water when vessels are at a distance of approximately 200m to 300m (Wilson, 2014).

493. As outlined in **Table 12-20**, the closest grey seal pupping sites (based on Clarke *et al*., 2018) are located at Arw Cleft, 69m from the nearest point of the MDZ cable corridor area, however, no pups were recorded at this site during the 2017 survey. The rest of the grey seal sites are

beyond 200m from the nearest point of the MDZ cable area, with the closest located at Parliament House site 220m from the cable corridor area (**Figure 12-4, Volume II**).

494. There are no haul-out sites identified in the area for the proposed landfall at Abraham's Bosom on the west coast of Holy Island (**Figure 12-4, Volume II**).

495. Taking into account the distance of the proposed cable corridor area from the nearest grey seal pupping site (over 200m) and the proximity of current vessel movements to these sites (see **Chapter 15, Shipping and Navigation**), there is unlikely to be any increased disturbance at grey seal pupping sites as a result of vessels and any cable laying activity in the MDZ cable corridor area.

496. With the proximity of vessel movements, including current vessel routes to and from Holyhead Port, it is likely that seals hauled-out along these routes and in the area of the port would be habituated to the noise, movements and presence of vessels. Therefore, the sensitivity of grey seals at haul-out sites to disturbance from vessels during construction is likely to be negligible. As a very precautionary approach, it is proposed that sensitivity during the breeding season and annual moult could be slightly higher and has therefore been considered as low in this assessment for any activity in the cable corridor area at this time.

497. Vessel movements to the offshore project area would use direct routes and are unlikely to be close to the shore (i.e. within a few hundred metres) except when near the landfall site or port to avoid the risk of collision and grounding.

498. Taking into account the low sensitivity to any disturbance (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect (negligible / very low), the impact significance (based in the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) for any potential disturbance at grey seal haul-out sites has been assessed as **negligible** (**Table 12-56**).

12.6.3.5.1. Mitigation

499. No mitigation measures are required or proposed.

12.6.3.5.2. Residual Impact

500. The residual impact would remain negligible.

Table 12-56 Assessment of impact significance for any disturbance at grey seal haul-out sites during construction at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Disturbance haul-out sites	Grey seal	Low	Negligible / very low	Negligible	No mitigation is required or proposed	Negligible

12.6.3.6. Increased Collision Risk with Vessels

501. Marine mammals are able to detect and avoid vessels. However, vessel strikes are known to occur, possibly due to distraction whilst foraging and socially interacting, or due to the marine mammals' inquisitive nature (Wilson *et al*., 2007). Therefore, increased vessel movements, especially those out-with recognised vessel routes, can pose an increased risk of vessel collision to harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal.

502. Studies have shown that larger vessels are more likely to cause the most severe or lethal injuries, with vessels over 80m in length causing the most damage to marine mammals (Laist *et al*., 2001). Vessels travelling at high speeds are considered to be more likely to collide with marine mammals, and those travelling at speeds below 10 knots would rarely cause any serious injury (Laist *et al*., 2001).

503. Harbour porpoise are small and highly mobile and given their responses to vessel noise (e.g. Thomsen *et al*., 2006; Evans *et al*.,1993; Polacheck and Thorpe, 1990), are expected to largely avoid vessel collisions. The Heinänen and Skov (2015) report indicates a negative relationship between the number of ships and the distribution of harbour porpoise in the Celtic and Irish Seas, suggesting that the species could exhibit avoidance behaviour which reduces the risk of strikes.

504. Of the 274 reported harbour porpoise strandings in 2015 (latest UK Cetacean Stranding's Investigation Programme (CSIP) Report currently available), 53 were investigated at post mortem (27 were conducted in England, 13 in Scotland and 13 in Wales). A cause of death was established in 51 examined individuals (approximately 96% of examined cases). Of these, four (8%) had died from physical trauma of unknown cause, which could have been vessel strikes (CSIP, 2015). Approximately 4% of all harbour porpoise post mortem examinations from the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS area) are thought to have evidence of interaction with vessels (Evans *et al*., 2011). The UK CSIP report for 2015 reported a total of 18 minke whale stranding's; four of which were investigated at post mortem with none showing signs of vessel strike (CSIP, 2015). A total of 20 minke post mortems undertaken through the ASCOBANS area revealed that three (15%) show signs of physical trauma (Evans *et al*., 2011).

505. There is limited information on which to quantity the collision risk of marine mammals from the vessels likely to be used during construction. Although the risk of collision is likely to be low, as a precautionary worse-case scenario, the number of harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal that could be at increased collision risk with vessels during construction of the proposed scheme has been assessed based on precautionary 5% to 10% of the number of individuals that could be present in the area potentially being at increased collision risk.

506. As outlined in **Section 12.6.3.3**, Holyhead Port is the third busiest port in Wales, and there are approximately 8,500 vessel arrivals at Holyhead Harbour every year, equating to approximately 23 vessel movements (including commercial and recreational) per day. Therefore, marine mammals in and around the MDZ would be custom to the presence and movements of vessels and would therefore be expected to detect and avoid vessels. Taking into account the potential

disturbance as a result of underwater noise (as assessed in **Section 12.6.3.3**) and that the construction vessels within the MDZ and cable corridor will be slow moving or stationary, harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal are considered to have a low sensitivity to the risk of a vessel strike.

507. During the construction there will be an increase in vessel movements to and from the MDZ. However, where possible, vessels will follow established shipping routes to the relevant ports in order to minimise vessel traffic in the wider area.

508. As outlined in **Table 12-25**, the potential for increased collision risk with vessels during construction has been based on up to 16 vessels on site at any one time, with up to 16 vessel movements to and from the site per day. The maximum area of potential risk has been estimated based on construction vessels in indicative examples of the two potentially largest deployment areas (3 km^2 and 3 km^2); plus, vessels in ECC area (4.75 km^2). In addition, increased collision risk has also been estimated based on the potential vessel route area to and from Holyhead Harbour, based on a precautionary 250m buffer either side of the vessels.

Table 12-57 Estimated number of individuals (and % of reference population) that could be at increased collision risk with vessels during construction at MDZ

Species	Increased collision risk (5-10% of individuals in area at increased risk)			
	Two indicative deployment areas and cable corridor area (10.75 km^2).	**Vessel route to Holyhead Port (4.34 km^2)**	**Number of individuals (% of reference population) at potential increased risk in total area (15.09 km^2)**	**Magnitude**
Harbour porpoise	0.42-0.84 individuals (based on density estimate of 0.783/ km^2) (0.0004-0.008% of the 104,695 reference population).	0.17-0.34 individuals (based on density estimate of 0.783/ km^2) (0.0002-0.0003% of the 104,695 reference population).	0.59-1.18 individuals (0.0006-0.0011% of MU)	Potential permanent effect with negligible to low magnitude (0.01% or less of the reference population anticipated to be exposed to effect).
Bottlenose dolphin	0.011-0.022 individuals (based on density estimate of 0.02/ km^2) (0.003-0.0054% of the reference population of 397 bottlenose dolphin)	0.0043-0.009 individuals (based on density estimate of 0.02/ km^2) (0.0011-0.0022% of the reference population of 397 bottlenose dolphin)	0.015-0.031 individuals (0.0038-0.0076% of MU)	Potential permanent effect with low magnitude (between 0.001% and 0.01% of the reference population anticipated to be exposed to effect).
Risso's dolphin	0.017-0.033 individuals (based on density estimate of 0.031/ km^2) (0.0002-0.0004% of the reference population of 8,794 Risso's dolphin).	0.007-0.014 individuals (based on density estimate of 0.031/ km^2) (0.0001-0.0002% of the reference population of 8,794 Risso's dolphin).	0.024-0.047 individuals (0.0003-0.0005% of MU)	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).

Species	Increased collision risk (5-10% of individuals in area at increased risk)			
	Two indicative deployment areas and cable corridor area (10.75 km^2).	**Vessel route to Holyhead Port (4.34 km^2)**	**Number of individuals (% of reference population) at potential increased risk in total area (15.09 km^2)**	**Magnitude**
Common dolphin	0.12-0.24 individuals (based on density estimate of 0.22/ km^2) (0.0002-0.0004% of the reference population of 56,556 common dolphin).	0.05-0.096 individuals (based on density estimate of 0.22/ km^2) (0.0001-0.0002% of the reference population of 56,556 common dolphin).	0.17-0.336 individuals (0.0003-0.0006% of MU)	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
Minke whale	0.009-0.02 individuals (based on density estimate of 0.017/ km^2) (0.00004-0.0001% of the reference population of 23,528 minke whale).	0.004-0.007 individuals (based on density estimate of 0.017/ km^2) (0.00002-0.00003% of the reference population of 23,528 minke whale).	0.013-0.027 individuals (0.0001-0.0001% of MU)	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
Grey seal	0.083-0.17 individuals (based on density estimate of 0.155/ km^2) (0.0014-0.003% of the reference population of 6,000 grey seal).	0.034-0.067 individuals (based on density estimate of 0.155/ km^2) (0.0006-0.0011% of the reference population of 6,000 grey seal).	0.117-0.237 individuals (0.0019%-0.0039% of MU)	Potential permanent effect with negligible to low magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Harbour seal	0.0003-0.0005 individuals (based on density estimate of 0.0005/ km^2) (0.0005-0.0011% of the reference population of 50 harbour seal).	0.0001-0.0002 individuals (based on density estimate of 0.0005/ km^2) (0.0002-0.0004% of the reference population of 50 harbour seal).	0.0004-0.0007 individuals (0.0008-0.0015% of MU)	Potential permanent effect with negligible to low magnitude (0.01% or less of the reference population anticipated to be exposed to effect).

509. Taking into account the low sensitivity of all marine mammal species to increased collision risk with vessels and the potential magnitude of the effect (negligible or low for all species), the impact significance for any permanent impact on harbour porpoise, bottlenose dolphin, grey seal and harbour seal has been assessed as **minor (not significant)** and **negligible** for Risso's dolphin, common dolphin and minke whale (**Table 12-58**).

12.6.3.6.1. Mitigation

510. Where possible, all vessel movements will be kept to the minimum number that is required to reduce any potential collision risk. Additionally, vessel operators will use good practice to reduce any risk of collisions with marine mammals. No further mitigation is proposed.

12.6.3.6.2. Residual Impact

511. The residual impact would remain negligible or minor (not significant).

Table 12-58 Assessment of impact significance for increased collision risk with vessels during construction at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Increased collision risk with vessels	Harbour porpoise	Low	Negligible to low	Negligible to minor (not significant)	No mitigation is required or proposed	Negligible to minor (not significant)
	Bottlenose dolphin		Low	Minor (not significant)		Minor (not significant)
	Risso's dolphin		Negligible / very low	Negligible		Negligible
	Common dolphin		Negligible / very low	Negligible		Negligible
	Minke whale		Negligible / very low	Negligible		Negligible
	Grey and harbour seal		Negligible to low	Negligible to minor (not significant)		Negligible to minor (not significant)

12.6.3.7. Potential Changes in Water Quality

512. As outlined in **Chapter 8, Marine Water and Sediment Quality**, the potential impacts on marine water quality are:

- Changes in marine water quality as a result of sediment re-suspension caused by seabed disturbance;
- Change in marine water quality as a result of mobilisation of contaminants adsorbed onto potentially re-suspended seabed sediments; and
- Impacts on marine water quality and sediment quality as a result of potential accidental discharge and spillage of oils, fuels and materials.

513. During the construction phase there is the potential for disturbance and re-suspension of sediments, either directly from the sea bed, or from sub-seabed cuttings, and for these re-suspended sediments to be dispersed through the water column as a plume. This has the potential to increase the suspended sediment concentrations and potentially increase turbidity around the MDZ.

514. Based on a 240MW capacity, the worst-case volume of cuttings for the entire site would amount to 117,780m^3. This is the total for all foundations and foundations will be installed sequentially. A single device requiring four drilled piles will produce 160m^3 of cuttings.

515. The maximum envisaged effect associated with sediment plumes arising from the foundation installation activities will cause a small increase in suspended sediment concentration (typically less than 1mg/l a short distance from the release point) over only a small geographical area (a few hundred metres). The effects will be temporary, with a return to very low background concentrations occurring rapidly upon cessation of installation activities (i.e. the effect is temporary only). Other than at the immediate release point, such a change would be

immeasurable and has been assessed as negligible in **Chapter 8, Marine Water and Sediment Quality**, with no mitigation required.

516. The free-laying of cables and the placement of cable protection would not cause plumes along the offshore sections of the cable corridor because the sea bed is characterised by bedrock or, where sparse sediment cover does exist, by sediments with a particle size that cannot be suspended in the water column.

517. In the nearshore, the bedrock is overlain by sand which has the potential to be disturbed. The assessment in **Chapter 8, Marine Water and Sediment Quality**, indicates that there could be a minor adverse (not significant) impact via increased suspended sediments in the area around the sandwave field and close to shore. However, the likely increase in suspended sediment concentration in areas with sand cover nearer to shore (including at the landfall) will remain within the natural variation that are governed by storm waves and surge effects. Any increase in suspended sediments would reduce rapidly with distance from the point of disturbance to a few mg/l over a small geographical area (within a few hundred metres, along the axis of tidal currents). Furthermore, these effects will be one-off and temporary in duration, with a return to the very low background concentrations occurring rapidly upon cessation of installation.

518. Marine mammals often inhabit turbid environments and cetaceans utilise sonar to sense the environment around them and there is little evidence that turbidity affects cetaceans directly (Todd *et al*., 2014). Pinnipeds are not known to produce sonar for prey detection purposes; however, it is likely that other senses are used instead of, or in combination with, vision. Studies have shown that vision is not essential to seal survival, or ability to forage (Todd *et al*., 2014).

519. Increased turbidity is unlikely to have a substantial direct impact on marine mammals that often inhabit naturally turbid or dark environments. This is likely because other senses are utilised, and vision is not relied upon solely. Therefore, harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal have negligible sensitivity to increases in suspended sediments during construction.

520. The re-suspension of sediments during construction activities could also lead to the release of any contaminants that may be present within them. However, as outlined in **Chapter 8, Marine Water and Sediment Quality**, sediment contamination within the MDZ is low, due to the dynamic hydrological regime and generally low level of industrial activity in this region. The low proportion of fine sediments within the MDZ is another factor that indicates low sediment contamination levels. Therefore, the assessment determined a negligible impact on general water quality in the MDZ via release of contaminated sediments, as even though mobilisation of the relatively limited amount of sediments in the MDZ will occur via construction works, none of these sediments are known to have high levels of contaminants.

521. During construction there is the potential for changes in water quality as a result of accidental discharge and spillage of oils, fuels and materials. As outlined in **Chapter 8, Marine Water and Sediment Quality**, the liquid inventory for the Project indicates that there are large amounts of chemicals including oil, grease and hydraulic fluid that could be accidentally released/leaked from project components. Other sources of potential chemicals include drilling fluids from any drilled pin-piles. However, Menter Môn is committed to the use of best practice and pollution prevention guidelines at all times. An Marine Pollution Contingency Plan (MPCP) would be in

place and agreed with NRW in line with the Integrated Pollution Prevention and Control (IPPC) Directive such that any potential risk is minimised. Any permitted discharges would be small volumes, intermittent and dilute and disperse quickly.

522. If any such substances were accidentally released/leaked, quantities would likely be small due to relatively small amounts being present in individual devices. Due to the dynamic nature of the tidal and wave regime in and around the MDZ, lateral and vertical dispersion rates of any spilled substances would be expected to be high.

523. The assessment in **Chapter 8, Marine Water and Sediment Quality**, indicates the magnitude of this potential effect is considered to be low, as it is not anticipated to significantly affect local water quality and would also be temporary in nature (established controls would prevent further spillage/leakage once an event was detected).

524. Due to the limited chance of exposure of marine mammals to any contaminants released from the re-suspension of sediments or from the accidental discharge and spillage of oils, fuels and materials, the sensitivity of marine mammals has been classed as negligible.

525. Taking into account the negligible sensitivity of all marine mammal species to any changes in water quality and the potential magnitude of the effect (negligible or low), the impact significance for any temporary impact on harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale grey seal and harbour seal has been assessed as negligible (**Table 12-59**).

12.6.3.7.1. Mitigation

526. As outlined above and in **Chapter 8, Marine Water and Sediment Quality**, mitigation would include adherence to project-specific Environmental Management Plans (EMPs) and Marine Pollution Contingency Plans (MPCP). No further mitigation for marine mammals in proposed.

12.6.3.7.2. Residual Impact

527. The residual impact would remain negligible.

Table 12-59 Assessment of impact significance for any changes in water quality during construction at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Increased suspended sediments	Harbour porpoise	Negligible	Negligible	Negligible	EMP and MPCP	Negligible
	Bottlenose dolphin		Negligible	Negligible		Negligible
	Risso's dolphin		Negligible	Negligible		Negligible
	Common dolphin		Negligible	Negligible		Negligible
	Minke whale		Negligible	Negligible		Negligible
	Grey and harbour seal		Negligible	Negligible		Negligible

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Release of contaminants from re-suspension of sediments	Harbour porpoise	Negligible	Negligible	Negligible		Negligible
	Bottlenose dolphin		Negligible	Negligible		Negligible
	Risso's dolphin		Negligible	Negligible		Negligible
	Common dolphin		Negligible	Negligible		Negligible
	Minke whale		Negligible	Negligible		Negligible
	Grey and harbour seal		Negligible	Negligible		Negligible
Accidental discharge and spillage of oils, fuels and materials	Harbour porpoise	Negligible	Low	Negligible		Negligible
	Bottlenose dolphin		Low	Negligible		Negligible
	Risso's dolphin		Low	Negligible		Negligible
	Common dolphin		Low	Negligible		Negligible
	Minke whale		Low	Negligible		Negligible
	Grey and harbour seal		Low	Negligible		Negligible

12.6.3.8. Potential Changes in Prey Availability

528. Potential impacts on marine mammal prey species which could result in changes to prey availability include

- Underwater noise (that could lead to mortality, physical injury, auditory injury or behavioural responses);
- Physical disturbance and temporary loss of seabed habitat; and
- Increased suspended sediment concentrations and sediment re-deposition.

529. The diet of the harbour porpoise consists of a wide variety of prey species and varies geographically and seasonally, reflecting changes in available food resources. Harbour porpoise have relatively high daily energy demands and need to capture enough prey to meet its daily energy requirements. It has been estimated that, depending on the conditions, harbour porpoise can rely on stored energy (primarily blubber) for three to five days, depending on body condition (Kastelein *et al*., 1997). Harbour porpoise are therefore considered to have low to medium sensitivity to changes in prey resources.

530. Bottlenose and common dolphins are opportunistic feeders that have large foraging ranges (Santos *et al*., 2001; Reid *et al*., 2003; Sea Watch Foundation, 2012) and are therefore considered to have low sensitivity to changes in prey resources. Risso's dolphins have a more restricted diet than other dolphin species, feeding mostly on cephalopods (Santos *et al*., 1994) and are therefore are considered to have medium sensitivity to changes in prey resource.

531. Minke whale feed on a variety of prey species, but in some areas, they have been found to prey upon specific species at the population level. Therefore, minke whale are considered to have a medium sensitivity to changes in prey resource.

532. Grey and harbour seal feed on a variety of prey species. Both species are considered to be opportunistic feeders that are able to forage in other areas and have relatively large foraging ranges. Grey seal and harbour seal are therefore considered to have low sensitivity to changes in prey resources.

12.6.3.8.1. Prey Impacts from Underwater Noise during Construction

533. As outlined in the assessments for underwater noise on marine mammals, underwater noise modelling has not been conducted for the MDZ, however, underwater noise modelling has been conducted for the nearby Wylfa Newydd Development Area for drilling into a hard substrate, cutter-suction dredging as a proxy for cable installation and cable protection, and for large vessels (**Table 12-60**). The modelling was conducted based on the Popper *et al*. (2014) thresholds and criteria.

534. Fish responses to noise are in part related to the anatomy of their hearing mechanisms. The presence of a swim bladder enhances hearing sensitivity as the bladder acts as a pressure transducer, converting sound pressure to particle velocity. Those species where the swim bladder is near to or connected to the ear have increased hearing sensitivity. The hearing range of fish varies extensively amongst species, and it is not only related to anatomy, for example, cod and Atlantic salmon both have a swim bladder, but cod is sensitive to pressure at higher frequencies (Popper *et al*., 2014).

535. The categories for fish are based on the presence or absence of a swim bladder and the potential for the swim bladder to enhance hearing sensitivity:

- Fish with no swim bladder or other gas chamber, e.g. flatfish. These species generally only detect particle motion and are less sensitive to sound pressure.
- Fish with swim bladders in which hearing does not involve the swim bladder or other gas volume, e.g. Atlantic salmon. These species hear through particle motion.
- Fish in which hearing involves a swim bladder or other gas volume, e.g. herring and cod. These species detect sound pressure and particle velocity.

536. Fish with swim bladders involved in hearing are more sensitive to underwater noise and have the greatest potential impact ranges, therefore the results have been presented for these species as a worst-case scenario. The results are based on the stationary animal model (**Table 12-60**).

537. The number of marine mammals that could affected by any changes in prey availability has been assessed, based on the maximum potential area of impact (TTS) for prey species (based on two percussive drilling rigs, two cable installation activities, two cable protection activities (4 x cutter-suction dredging area) and up to 16 large vessels in **Table 12-61**.

538. It is important to note that the potential impact areas for marine mammals are greater than those predicted for their prey, therefore there would be no further impact as marine mammals would already be disturbed from the area of potential prey displacement.

Table 12-60 Summary of the maximum predicted impact ranges (and areas) for marine mammal prey species for drilling, cutter-suction dredging operations and large vessels at Wylfa, based on Popper *et al*. (2014) criteria for continuous sounds and predicted maximum total area of impact on prey species during construction

Potential Impact	Two percussive drilling rigs	Cutter-suction dredging / cable installation and protection	Large vessel	Maximum total area during construction*
Recoverable injury (fish with swim bladders involved in hearing) (48h) 170 dB re 1 µPa (SPL_{RMS})	13m (0.00053 km^2)	2m (0.000013 km^2)	<1m (0.000003 km^2)	0.00063 km^2
TTS (fish with swim bladders involved in hearing) (12h) 158 dB re 1 µPa (SPL_{RMS})	100m (0.031 km^2)	13m (0.00053 km^2)	4m (0.00005 km^2)	0.034 km^2

Areas based on area of a circle
*based on maximum area for two percussive drilling rigs, two cable installation activities, two cable protection activities and up to 16 large vessels.

539. The magnitude of the potential displacement due to changes in prey availability as a result of underwater noise during construction is assessed as **negligible / very low** for all species, with less than 1% of all relevant reference populations anticipated to be exposed to the temporary effect (**Table 12-61**).

Table 12-61 Maximum number of individuals (and % of reference population) that could be impacted by any changes of prey availability as a result of underwater noise during construction at MDZ

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
Displacement of harbour porpoise due to changes in prey availability	0.3 individuals (based on density estimate of 0.783/ km^2) (0.00003% of the 104,695 reference population).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Displacement of bottlenose dolphin due to changes in prey availability	0.0007 individuals (based on density estimate of 0.02/ km^2) (0.00017% of the reference population of 397 bottlenose dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Displacement of Risso's dolphin due to changes in prey availability	0.001 individuals (based on density estimate of 0.031/ km^2) (0.000012% of the reference population of 8,794 Risso's dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Displacement of common dolphin due to	0.0075 individuals (based on density estimate of 0.22/ km^2)	Temporary effect with negligible / very low magnitude (less than 1% of the reference

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
changes in prey availability	(0.000013% of the reference population of 56,556 common dolphin).	population anticipated to be exposed to effect).
Displacement of minke whale due to changes in prey availability	0.001 individuals (based on density estimate of 0.017/ km^2) (0.000002% of the reference population of 23,528 minke whale).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Displacement of grey seal due to changes in prey availability	0.001 individuals (based on density estimate of 0.155/ km^2) (0.0001% of the reference population of 6,000 grey seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Displacement of harbour seal due to changes in prey availability	0.00002 individuals (based on density estimate of 0.0005/ km^2) (0.00003% of the reference population of 50 harbour seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

540. The assessment in **Chapter 10 Fish and Shellfish Ecology**, has determined that the potential impacts of underwater noise on prey species would result a low magnitude of the effect, coupled with the medium sensitivity of the receptors, the impact significance was assessed as minor adverse on the receptors during construction. No mitigation measures were considered to be required.

12.6.3.8.2. Prey Impacts from Temporary Loss of Seabed Habitat during Construction

541. As outlined in **Chapter 10 Fish and Shellfish Ecology** and in **Table 12-25**, the worst-case scenario for temporary habitat loss during construction could be up to 0.42 km^2, based on area for post-lay burial of cables (27,259m^2), deployment of anchor blocks by barges during cable installation (100,240m^2), deployment of anchor blocks by barges during TEC device installation (248,000m^2) and deployment of anchor blocks by barges during hub installation(48,000m^2).

542. The magnitude of the potential displacement due to changes in prey availability as a result of temporary habitat loss during construction is assessed as **negligible / very low** for all species, with less than 1% of all relevant reference populations anticipated to be exposed to the temporary effect (**Table 12-63**).

Table 12-62 Maximum number of individuals (and % of reference population) that could be impacted by any changes of prey availability as a result of temporary habitat loss during construction at MDZ

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
Displacement of harbour porpoise due to changes in prey availability	0.33 individuals (based on density estimate of 0.783/ km^2) (0.0003% of the 104,695 reference population).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
Displacement of bottlenose dolphin due to changes in prey availability	0.0084 individuals (based on density estimate of 0.02/ km^2) (0.002% of the reference population of 397 bottlenose dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Displacement of Risso's dolphin due to changes in prey availability	0.013 individuals (based on density estimate of 0.031/ km^2) (0.00015% of the reference population of 8,794 Risso's dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Displacement of common dolphin due to changes in prey availability	0.09 individuals (based on density estimate of 0.22/ km^2) (0.0002% of the reference population of 56,556 common dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Displacement of minke whale due to changes in prey availability	0.007 individuals (based on density estimate of 0.017/ km^2) (0.00003% of the reference population of 23,528 minke whale).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Displacement of grey seal due to changes in prey availability	0.07 individuals (based on density estimate of 0.155/ km^2) (0.0011% of the reference population of 6,000 grey seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Displacement of harbour seal due to changes in prey availability	0.0002 individuals (based on density estimate of 0.0005/ km^2) (0.0004% of the reference population of 50 harbour seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

543. The assessment in **Chapter 10, Fish and Shellfish Ecology**, has determined that the potential impacts of temporary habitat disturbance on prey species would result a low magnitude of the effect, coupled with the medium sensitivity of the receptors, the impact significance was assessed as minor adverse on the receptors during construction. No mitigation measures were considered to be required.

12.6.3.8.3. Prey Impacts from Increased Suspended Sediment and Sediment Re-Deposition during Construction

544. As outlined in **Section 12.6.3.7**, any changes in water quality will be negligible.

545. The assessment in **Chapter 10, Fish and Shellfish Ecology**, has also determined that the potential impacts of increased suspended sediment concentrations and sediment deposition on prey species would result a low magnitude of the effect, coupled with the medium sensitivity of the receptors, the impact significance was assessed as minor adverse on the receptors during construction. No mitigation measures were considered to be required.

12.6.3.8.4. Mitigation

546. No mitigation measures are required or proposed.

12.6.3.8.5. Residual Impact

547. The residual impact would remain negligible or minor (not significant).

Table 12-63 Assessment of impact significance for any displacement as a result of any changes to prey availability during construction at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Displacement due to underwater noise impact on prey species	Harbour porpoise	Low to medium	Negligible / very low	Negligible to Minor (not significant)	None required or proposed	Negligible to Minor (not significant)
	Bottlenose dolphin	Low	Negligible / very low	Negligible		Negligible
	Risso's dolphin	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)
	Common dolphin	Low	Negligible / very low	Negligible		Negligible
	Minke whale	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal	Low	Negligible / very low	Negligible		Negligible
Displacement due to temporary habitat loss impact on prey species	Harbour porpoise	Low to medium	Negligible / very low	Negligible to Minor (not significant)	None required or proposed	Negligible to Minor (not significant)
	Bottlenose dolphin	Low	Negligible / very low	Negligible		Negligible
	Risso's dolphin	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)
	Common dolphin	Low	Negligible / very low	Negligible		Negligible
	Minke whale	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal	Low	Negligible / very low	Negligible		Negligible
Displacement due to increased suspended sediment concentrations and sediment re-deposition impact on prey species	Harbour porpoise	Low to medium	Negligible / very low	Negligible to Minor (not significant)	None required or proposed	Negligible to Minor (not significant)
	Bottlenose dolphin	Low	Negligible / very low	Negligible		Negligible
	Risso's dolphin	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)
	Common dolphin	Low	Negligible / very low	Negligible		Negligible
	Minke whale	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal	Low	Negligible / very low	Negligible		Negligible

12.6.4. Assessment of Potential Impacts During Operation, Maintenance and Repowering

12.6.4.1. Underwater Noise from Operational Tidal Devices

12.6.4.1.1. Review of Tidal Device Operational Noise

548. There is currently limited information on the underwater noise generated from operational tidal devices. However, some consented projects have taken turbine noise measurements from scaled down test devices and extrapolated these to provide a predicted source level. This has been reviewed and summarised below.

549. A study by Malinka *et al*. (2018) of the turbine at Strangford Lough found that metal flaps used to reduce the inflow of silt to the turbine produced regular low frequency (0.7 – 1.4 kHz) clanging noises with a source level of up to 185 - 198 dB re 1 μPa^2 which is approximately 96 dB above the auditory threshold for harbour porpoises at 1kHz (Kastelein *et al.,* 2002). Hydraulic pumps that rotate the turbine into the current were also a significant source of noise and caused false whistle detections at 13 kHz. However, the infrequent nature of this noise meant changes to average background noise levels were not deemed to be significant (Malinka *et al.,* 2018).

550. Measurements of noise emitted by a single tidal current turbine were taken in France using 19 drifting transects at varying distances (100 – 2,400m) from the device. Measured source level (SL) was between 118 to 152 dB re 1 μ Pa at 1m in third octave bands at frequencies between 40 and 8,192 Hz. This level was compared to a 19m boat travelling at 10 knots. The ‘acoustic footprint’ of the device was modelled and was found to extend to a radius of 1.5 km, however physiological injury to mammals, fish and invertebrates was considered to be improbable. Behavioural disturbance was estimated to occur within 1 km for harbour porpoises (Lossent *et al.,* 2018).

551. Schmitt *et al*. (2018) characterised the noise emitted by a subsea tidal kite and found broadband noise between 0.2 and 0.7 kHz. Sound levels varied in a repetitive cycle every seven seconds. Emitted noise levels decreased when rotations per minute were reduced from 500-700 rpm to 300-500 rpm from 105 dB re μPa to 95 re μPa. At higher kite speeds (4 to 5.5ms^{-1}) emitted noise levels were observed over a wider range of frequencies (0.05 to 0.9 kHz) (Schmitt *et al.,* 2018).

552. Robertson *et al.* (2018) conducted field trials in spring, summer and autumn 2017 where marine mammals were observed from land over a trial period of two weeks during each season. For half of each trial period, an underwater projector played recordings of tidal turbine sound at a broadband source level of 158 dB re μPa at 1m. Harbour seals did not show a significant behavioural response to the simulated turbine noise, however harbour seals would have needed to have been 10m away from the playback location to experience noise levels equivalent to previous studies that found a significant effect (Hastie *et al.,* 2017). During trial 1 (spring) calculated distances suggest harbour porpoise avoided the playback location by 300m, however in trial 2 (summer) this distance was reduced to 100m and during trial 3 (autumn) this distance disappeared and was reduced to zero. This change could suggest that the harbour porpoise became tolerant or habituated to the turbine noise (Robertson *et al.,* 2018).

553. Halvorsen *et al*. (2011) measured a turbine in the Bay of Fundy and found no change in ambient noise level greater than 200m away from the turbine and a source level of 162 dB re µm referred to 1m.

554. Vertical Axis turbines in Cobscook Bay, USA emit noise lower than the NOAA threshold for behavioural harassment by continuous noise (120 dB). Noise produced depended on if the turbine was freewheeling or generating, with a peak in source level of 110 dB at 105 Hz whilst freewheeling (Ocean Renewable Power Company, 2014).

555. The Brims Underwater Noise Assessment (Xodus, 2015) indicated that for 30 turbines, the extent of the potential disturbance for marine mammals for the operational tidal array was a radius of approximately 1 km from the centre of the array, and for 170 turbines, the extent of the potential disturbance could be 2 to 4 km. These noise ranges relate to device operation during full tidal flow, however during these periods the background noise will also be at its highest and this is not taken into consideration in the underwater noise modelling.

556. A study by Lossent *et al*. (2018) for a 16 m diameter, 0.5 MW, OpenHydro turbine, predicted a source noise level of 152 dB SPL_{RMS} and an acoustic spectrum with most energy in the 125 Hz ⅓ octave frequency band. Outside of this band, noise levels are a minimum of 10 dB lower. The low frequency for the OpenHydro turbine is below the peak hearing sensitivity of both pinniped and harbour porpoise, where at the greatest sensitivity range for these species the predicted octave-band source noise level from the device is at least 25 and 35 dB, respectively, below the low frequency peak. These noise levels are considerably below any which could potentially lead to PTS or TTS in the species. Moving away from the source location, this will fall quickly to the order of background noise levels and Lossent *et al*. (2018) estimated that this 'footprint' would be of the order of 1.0 to 1.5 km^2 around a turbine (**Appendix 12.4, Appendix III**).

557. For PTEC, a wide variety of tidal device designs and models were used to inform the Rochdale Envelope of the development site, these included:

- An axial flow device, mounted on a tripod base, secured with pin piles to the seabed. An example of this is the Deep Gen by Tidal Generation Ltd (TGL) Alstom, which has a rotor diameter of 18m.
- An axial flow device, mounted to the seabed using a monopile base; this has a higher rotational speed than the tripod base axial flow device with a tip speed of up to 41m/s. An example of this is the hyTyde by Voith Hydro, which has a rotor diameter of 16m.
- A bottom mounted pile with a surface piercing tower, for example, the SeaGen S by Marine Current Turbines, which is available with a rotor diameter of up to 24m.
- A ducted device, which is mounted to the seabed using a gravity base. Example of this includes the Tidal Turbine Generator by Clean Current Power Systems, which could have a rotor diameter of up to 10m and OpenHydro with a rotor diameter of up to 16m.
- Floating, surface piercing, multiple tidal energy convertors (TECs), such as the Scotrenewables Tidal Turbine or BlueTEC, which has two TECs, each with a rotor diameter of up to 24m for axial flow TECs or 10m diameter by 15m long vertical transverse axis TECs.

- Multiple buoyant, mid-water column, TECs attached to a single platform. An example of this is the PLAT-O by SME, which features two up to 12m diameter rotors.
- A bottom mounted, single platform with multiple TECs, for example the Deltastream by Tidal Energy Limited, which has 3 TECs mounted on a frame, each with rotor diameters of up to 20m.
- Transverse axis devices, for example the Turbine generator unit by Kepler, which uses a horizontal rotor which is up to 15m in diameter and 90m long.
- Multiple TECs on a single platform attached to a surface piercing structure attached to seabed, for example the Triton system by Tidal Stream Limited, which can be configured with up to 6 large rotors (up to 20m diameter) or 36 small TECs (around 4.5m in diameter).

558. Previous measurements of operational tidal devices undertaken by Subacoustech Environmental (Parvin *et al*., 2005; Parvin *et al*., 2008a) have shown that, using the information available, the level of noise introduced by the tidal devices was directly linked to the size of the tidal device, i.e. the larger the tidal device, the greater the sound it will produce while operational.

559. Therefore, in order to cover all of these designs in the underwater noise modelling for PTEC, three rotor diameters were chosen to give an idea of the sound from small, medium and large TECs; the three diameters were 10m, 15m and 20m. This covered all of the sizes of TEC considered for PTEC, as well as encompassing models where several smaller TECs are used on the same platform such as the device type with multiple small (approximately 4.5m) diameter rotors noted above; this range of TEC sizes also gives conservative estimates for any smaller size TECs.

560. Modelling of an operational tidal device with a rotor diameter of 24m was also been undertaken as a worst-case scenario in terms of rotor size and location for noise propagation at PTEC.

561. It should also be noted that this approximation was based on the data available at the time of the assessment (Subacoustech, 2014). The overall noise level does increase when a larger TEC is used but the frequency characteristics of the resulting noise will also differ due to mechanical differences in the TEC. For example, the tonal characteristics of noise from the gearbox of the tidal devices listed above, or the different types of rotors (open, ducted, transverse, etc.), may be different from the devices previously measured by Subacoustech Environmental (Subacoustech, 2014).

562. For the MeyGen project in the Pentland Firth, the predicted noise levels were up to 177 dB SPL_{RMS} for a 2.4MW turbine (extrapolated from a measured 0.3MW turbine in Strangford Lough, Northern Ireland). Most noise energy for this turbine was below 100Hz, although there were also significant peaks in the 1,500Hz and 5,000Hz bands (Kongsberg, 2012).

12.6.4.1.2. Potential Impacts for Underwater Noise from Operational Tidal Devices

563. The noise measurements and modelling for a range of different operational tidal devices, indicates that the noise levels would not be sufficient to result in any auditory injury. Therefore, the only potential impact is disturbance.

564. For PTEC, the source levels for the operational tidal device noise were estimated to be 155.8, 162.2, and 165.4 dB re 1 µPa@1 m (RMS) for the 10m, 15m, and 20m rotor diameters respectively, were below the 240 and 220 dB re 1 µPa (SPL_{peak}) criteria for lethal effect and physical injury (Subacoustech, 2014).

565. The modelling for MeyGen indicates that the source levels for operational noise from either the 1MW turbine or the 2.4MW turbine were below the levels at which lethal injury to species of marine mammal might occur (240 dB re. 1 µPa). It was therefore considered unlikely that any marine animals would be killed as a consequence of the underwater noise from any operational turbines in the Inner Sound development area (Konsberg, 2012).

566. The modelling for MeyGen also indicates that peak source levels associated with operational noise from either the 1MW or 2.4MW turbines were below the levels at which hearing damage from the underwater noise might occur (230 dB re. 1µPa and 224 dB re. 1µPa for the onset of PTS and TTS in cetaceans and 218 dB re. 1µPa and 212 dB re. 1µPa for the onset of PTS and TTS in pinnipeds). Even taking into account the more conservative criteria proposed by Lucke *et al*. (2009) for harbour porpoises (193.7 dB re 1 µPa) and NMFS (1995), whereby auditory injury may occur to pinnipeds and cetaceans following prolonged exposure to underwater sound at levels at or above 190 dB re. 1 µPa and 180 dB re. 1 µPa respectively, the source levels for operational noise for each turbine were sufficiently low such that the NMFS impact criteria were not exceeded (Konsberg, 2012).

Potential Disturbance from Underwater Noise of Operational Turbines

567. Although the noise levels are below injury levels, they may still be high enough to lead to avoidance behaviour. For example, Hastie *et al*. (2018) studied the reaction of harbour seals to simulated turbine noise in Kyle Rhea on the west coast of Scotland. The study found a reduction in seal abundance of between 11% and 41% at the source location. At up to 500m the reduction was just under 10%. The source used by Hastie *et al*. (2018) was based on a 1.2MW turbine design measured at SeaGen at Strangford Lough (**Appendix 12.4, Appendix III**).

568. The underwater noise modelling for PTEC predicted that the largest impact ranges were for harbour porpoise with a maximum range for 90 dB_{ht}(*Species*) level where a strong behavioural avoidance reaction is likely of 450m and a maximum range for 75 dB_{ht}(*Species*) of 7 km where some avoidance reaction could occur; both of these impact ranges are estimated for the largest 20m rotor diameter. The estimated impact ranges for the 24m diameter rotor were expected to extend the furthest for harbour porpoise, with a maximum 90 dB_{ht} impact range out to 610m and a 75 dB_{ht} impact range out to 9.1 km (Subacoustech, 2014; **Table 12-64**).

569. For PTEC, using the levels where the onset of TTS was found to occur in a harbour porpoise by Kastelein *et al*. (2012), a receptor would have to be present at a range of 800m around an operational 20m rotor diameter for an hour (Subacoustech, 2014).

Table 12-64 Summary of the modelled ranges for 90 and 75 dB_{ht}(*Species*) levels from an operational tidal device with a rotor diameter of 24m at PTEC

Potential Impact	90 dB_{ht}(*Species*) maximum range (m)	75 dB_{ht}(*Species*) maximum range (m)
Disturbance of harbour porpoise	610m	9,100m
Disturbance of bottlenose dolphin (dolphin species)	95m	2,200m
Disturbance of minke whale	400m	4,700m
Disturbance of grey and harbour seal	75m	2,000m

570. The underwater noise modelling for MeyGen indicates that odontocetes such as the harbour porpoise and dolphin species (bottlenose dolphin, Risso's dolphin and common dolphin) may not show signs of strong behavioural reactions from each 1MW turbine, while mysticetes such as minke whales, may respond out to 14m. Mild reactions in odontocetes and mysticetes may be seen at distances up to 140m and 364m, respectively, from the 1MW turbines. When exposed to 2.4MW turbine, odontocetes may exhibit strong behavioural reactions up to 14m from the turbines and mild behavioural reactions up to 350m and for mysticetes (minke whale) there could be mild behavioural reactions out to 1,736m (**Table 12-65**; Konsberg, 2012).

Table 12-65 Summary of the modelled ranges for 90 and 75 dB_{ht}(*Species*) levels from 2.4MW operational tidal devices at MeyGen

Potential Impact	90 dB_{ht}(*Species*) maximum range (m) (strong avoidance)	75 dB_{ht}(*Species*) maximum range (m) (mild avoidance)
Disturbance of harbour porpoise	14m	336m
Disturbance of bottlenose dolphin (dolphin species)	14m	336m
Disturbance of minke whale	42m	1,736m
Disturbance of grey and harbour seal	13m	28m

571. Based on the worst-case scenario for the PTEC noise modelling (**Table 12-64**), the number of marine mammals that could be disturbed from the underwater of operational turbines at MDZ has been estimated for one device based on the possible mild avoidance range for 75 dB_{ht}(*Species*) and 90 dB_{ht}(*Species*) (**Table 12-66**).

572. For full deployment the assessment has been based on the more realistic possible strong avoidance (90 dB_{ht}(*Species*) range from the worst-case scenario of the modelling for PTEC. The assessment for the full deployment has been based on arrays rather than individual tidal devices, as individual marine mammals would be more likely to be disturbed by the closest turbine they approach rather than all individual turbines within the array. As an indicative precautionary worst-case, the assessment has been based on up to 10 arrays, however the maximum number of arrays at the MDZ is likely to be eight. The areas are based on an area of a circle and assessment also assumes no overlap in disturbance areas between arrays / groups of turbines (**Table 12-66**).

Table 12-66 Maximum number of individuals (and % of reference population) that could be disturbed as a result of underwater from operational tidal devices at MDZ

Potential Impact	Maximum number of individuals and (% of reference population)			Magnitude
	One device (possible mild avoidance (75dB$_{ht}$))	One device (possible strong avoidance (90dB$_{ht}$))	Full deployment* (possible strong avoidance (90dB$_{ht}$))	
Disturbance of harbour porpoise	204 individuals in 260.2 km^2 (based on density estimate of 0.783/ km^2) (0.195% of the 104,695 reference population).	0.92 individuals in 1.17 km^2 (based on density estimate of 0.783/ km^2) (0.0009% of the 104,695 reference population).	9.2 individuals in 11.7 km^2 (0.009% of MU)	Long term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Disturbance of bottlenose dolphin	0.3 individuals in 15.21 km^2 (based on density estimate of 0.02/ km^2) (0.08% of the reference population of 397 bottlenose dolphin).	0.0006 individuals in 0.028 km^2 (based on density estimate of 0.02/ km^2) (0.00015% of the reference population of 397 bottlenose dolphin).	0.006 individuals in 0.28 km^2 (0.0015% for MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Disturbance of Risso's dolphin	0.47 individuals in 15.21 km^2 (based on density estimate of 0.031/ km^2) (0.005% of the reference population of 8,794 Risso's dolphin).	0.0009 individuals in 0.028 km^2 (based on density estimate of 0.031/ km^2) (0.00001% of the reference population of 8,794 Risso's dolphin).	0.009 individuals in 0.28 km^2 (0.0001% for MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Disturbance of common dolphin	3.35 individuals in 15.21 km^2 (based on density estimate of 0.22/ km^2) (0.006% of the reference population of 56,556 common dolphin).	0.006 individuals in 0.028 km^2 (based on density estimate of 0.22/ km^2) (0.00001% of the reference population of 56,556 common dolphin).	0.06 individuals in 0.28 km^2 (0.0001% of MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Disturbance of minke whale	1.18 individuals in 69.4 km^2 (based on density estimate of 0.017/ km^2) (0.005% of the reference population of 23,528 minke whale).	0.0085 individuals (0.5 km^2; based on density estimate of 0.017/ km^2) (0.00004% of the reference population of 23,528 minke whale).	0.0085 individuals in 5 km^2 (0.0004% of MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Disturbance of grey seal	1.95 individuals in 12.75 km^2 (based on density estimate of 0.155/ km^2) (0.003% of the reference population of 6,000 grey seal).	0.012 individuals in 0.018 km^2 (based on density estimate of 0.155/ km^2) (0.0002% of the reference population of 6,000 grey seal).	0.03 individuals in 0.18 km^2 (0.0005% of MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Disturbance of harbour seal	0.006 individuals in 12.75 km^2 (based on density estimate of 0.0005/ km^2)	0.000009 individuals in 0.018 km^2 (based on density estimate of 0.0005/ km^2)	0.00009 individuals in 0.18 km^2 (0.00018% of MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of

Potential Impact	Maximum number of individuals and (% of reference population)			Magnitude
	One device (possible mild avoidance (75dBht))	One device (possible strong avoidance (90dBht))	Full deployment* (possible strong avoidance (90dBht))	
	(0.013% of the reference population of 50 harbour seal).	(0.000018% of the reference population of 50 harbour seal).		the reference population anticipated to be exposed to effect).

573. Taking into account the low sensitivity to any disturbance (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect of very low / negligible for all marine mammal species, the impact significance (based in the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) for any possible long-term disturbance in harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal has been assessed as **negligible** (**Table 12-67**).

Table 12-67 Assessment of impact significance for long-term disturbance of marine mammals from underwater noise of operational tidal devices at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Disturbance from operational tidal devices	Harbour porpoise	Low	Very low / negligible	Negligible	No mitigation required or proposed.	Negligible
	Bottlenose dolphin		Very low / negligible	Negligible		Negligible
	Risso's dolphin		Very low / negligible	Negligible		Negligible
	Common dolphin		Very low / negligible	Negligible		Negligible
	Minke whale		Very low / negligible	Negligible		Negligible
	Grey and harbour seal		Very low / negligible	Negligible		Negligible

12.6.4.1.2.1.1. Mitigation

574. No mitigation measures are required or proposed.

12.6.4.1.2.1.2. Residual Impact

575. The residual impact would remain minor (not significant) for disturbance from operational turbines.

12.6.4.2. Underwater Noise and Disturbance from Maintenance and Repowering Activities

576. Although impacts will be less than during construction, as a worst-case scenario assessment has been based on assessment for construction in **Sections 12.6.3.1.2**, **12.6.3.2.2** and **12.6.3.4**.

577. As a precautionary worst-case scenario, the assessment is based on the assessment of potential barrier effects as a result of underwater noise during construction, which assumed

there could be up to two drilling activities; two cable installation activities; two cable protection activities; and up to 16 vessels on site (**Table 12-68**).

Table 12-68 Maximum number of individuals (and % of reference population) that could be disturbed by underwater noise during maintenance and repowering activities at MDZ

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
Disturbance of harbour porpoise	1.7 individuals (based on density estimate of 0.783/ km^2) (0.0016% of the 104,695 reference population).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of bottlenose dolphin	0.00006 individuals (based on density estimate of 0.02/ km^2) (0.000015% of the reference population of 397 bottlenose dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of Risso's dolphin	0.00009 individuals (based on density estimate of 0.031/ km^2) (0.000001% of the reference population of 8,794 Risso's dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of common dolphin	0.0007 individuals (based on density estimate of 0.22/ km^2) (0.0000012% of the reference population of 56,556 common dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of minke whale	0.45 individuals (based on density estimate of 0.017/ km^2) (0.0019% of the reference population of 23,528 minke whale).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of grey seal	0.07 individuals (based on density estimate of 0.155/ km^2) (0.0012% of the reference population of 6,000 grey seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of harbour seal	0.00023 individuals (based on density estimate of 0.0005/ km^2) (0.00046% of the reference population of 50 harbour seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

578. It is highly unlikely two drilling activities, two cable installation activities, two cable protection activities and 16 vessels on site, would occur all at the same time or for any prolonged period of time. Any disturbance would be limited to the area around the activity within the MDZ array area and / or ECC.

579. Taking into account the low sensitivity to any disturbance (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect (negligible/ very low for all species), the impact significance (based on the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) for any disturbance as a result of underwater noise during maintenance and repowering activities for harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal has been assessed as **negligible** (**Table 12-69**).

12.6.4.2.1. Mitigation

580. No mitigation measures are required or proposed.

12.6.4.2.2. Residual Impact

581. The residual impact would remain negligible.

Table 12-69 Assessment of impact significance for any temporary disturbance as a result of underwater noise during maintenance and repowering activities at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Disturbance during maintenance and repowering activities	Harbour porpoise	Low	Negligible / very low	Negligible	None required or proposed	Negligible
	Bottlenose dolphin		Negligible / very low	Negligible		Negligible
	Risso's dolphin		Negligible / very low	Negligible		Negligible
	Common dolphin		Negligible / very low	Negligible		Negligible
	Minke whale		Negligible / very low	Negligible		Negligible
	Grey and harbour seal		Negligible / very low	Negligible		Negligible

12.6.4.3. Underwater Noise and Disturbance from Vessels

582. Although impacts from vessels during operation, maintenance and repowering will be less than during construction, as a worst-case scenario assessment has been based on assessment for construction in **Section 12.6.3.3**. However, it should be noted that vessels have also been included in the assessment for underwater noise and disturbance from maintenance and repowering activities in Section 12.6.4.2. Therefore, this is not an additional impact.

583. The maximum number of harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal that could be at risk of TTS from cumulative exposure over a 24 hour period, based on the density estimates for the MDZ and maximum area of impact for large vessels are presented in **Table 12-75**.

584. The magnitude of the potential of TTS / fleeing response is assessed as **negligible / very low** for all species, with less than 1% of all relevant reference populations anticipated to be exposed to the temporary effect (**Table 12-75**).

Table 12-70 Maximum number of individuals (and % of reference population) that could be at risk of temporary auditory injury (TTS) and fleeing response / disturbance from cumulative exposure over a 24 hour period for large vessels at MDZ

Potential Impact	Maximum number of individuals and (% of reference population)		Magnitude
	One large vessel	Up to 16 large vessels	
TTS / fleeing response in harbour porpoise	0.05 individuals (based on density estimate of 0.783/ km^2) (0.00005% of the 104,695 reference population).	0.78 individuals (based on density estimate of 0.783/ km^2) (0.0007% of the 104,695 reference population).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

Potential Impact	Maximum number of individuals and (% of reference population)		Magnitude
	One large vessel	Up to 16 large vessels	
TTS / fleeing response in bottlenose dolphin	0.0000006 individuals (based on density estimate of 0.02/ km^2) (0.00000015% of the reference population of 397 bottlenose dolphin).	0.00001 individuals (based on density estimate of 0.02/ km^2) (0.000002% of the reference population of 397 bottlenose dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in Risso's dolphin	0.0000009 individuals (based on density estimate of 0.031/ km^2) (0.00000001% of the reference population of 8,794 Risso's dolphin).	0.00001 individuals (based on density estimate of 0.031/ km^2) (0.0000002% of the reference population of 8,794 Risso's dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in common dolphin	0.000007 individuals (based on density estimate of 0.22/ km^2) (0.00000001% of the reference population of 56,556 common dolphin).	0.0001 individuals (based on density estimate of 0.22/ km^2) (0.0000002% of the reference population of 56,556 common dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in minke whale	0.01 individuals (based on density estimate of 0.017/ km^2) (0.00004% of the reference population of 23,528 minke whale).	0.20 individuals (based on density estimate of 0.017/ km^2) (0.0008% of the reference population of 23,528 minke whale).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in grey seal	0.0008 individuals (based on density estimate of 0.155/ km^2) (0.00001% of the reference population of 6,000 grey seal).	0.01 individuals (based on density estimate of 0.155/ km^2) (0.0002% of the reference population of 6,000 grey seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
TTS / fleeing response in harbour seal	0.0000025 individuals (based on density estimate of 0.0005/ km^2) (0.000005% of the reference population of 50 harbour seal).	0.00004 individuals (based on density estimate of 0.0005/ km^2) (0.00008% of the reference population of 50 harbour seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

585. Taking into account the medium sensitivity of all marine mammal species to any temporary auditory injury (i.e. receptor has limited capacity to recover from the anticipated impact; **Table 12-6**) and low sensitivity to any disturbance (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect (negligible/ very low for all species), the impact significance (based in the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) has been assessed as **minor (not significant)** for TTS and **negligible** for disturbance for all species.

12.6.4.3.1.1.1. Mitigation

586. No mitigation measures are required or proposed.

12.6.4.3.1.1.2. Residual Impact

587. The residual impact would remain minor (not significant) for TTS and negligible for disturbance.

Table 12-71 Assessment of impact significance for any temporary auditory injury (TTS) and disturbance in marine mammals from underwater noise from vessels at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
TTS from vessels	Harbour porpoise	Medium	Negligible / very low	Minor (not significant)	None required or proposed	Minor (not significant)
	Bottlenose dolphin		Negligible / very low	Minor (not significant)		Minor (not significant)
	Risso's dolphin		Negligible / very low	Minor (not significant)		Minor (not significant)
	Common dolphin		Negligible / very low	Minor (not significant)		Minor (not significant)
	Minke whale		Negligible / very low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal		Negligible / very low	Minor (not significant)		Minor (not significant)
Disturbance from vessels	Harbour porpoise	Low	Negligible / very low	Negligible	None required or proposed	Negligible
	Bottlenose dolphin		Negligible / very low	Negligible		Negligible
	Risso's dolphin		Negligible / very low	Negligible		Negligible
	Common dolphin		Negligible / very low	Negligible		Negligible
	Minke whale		Negligible / very low	Negligible		Negligible
	Grey and harbour seal		Negligible / very low	Negligible		Negligible

12.6.4.4. Acoustic Deterrent Devices (ADDs)

588. Acoustic deterrent devices (ADDs) may be used as part of the mitigation plan to deter. The principle behind the use of ADDs is that they produce an aversive signal that causes a marine mammal to move away and out of the area of potential collision risk. ADDs have been used widely in an attempt to deter mammals from aquaculture facilities and fishing gear. ADDs have also been adopted as a method of deterring marine mammals to a 'safe distance' from the potential impact area surrounding a piling event to reduce the risk of permanent auditory injury (Gordon *et al*., 2007). ADDs are presently employed as a voluntary supplement to the 'standard' components of a Marine Mammal Management Plan (MMMP) in the UK and have been used recently for piling at UK offshore windfarm (OWF) sites including, for example, Beatrice, Dudgeon and Galloper. Several other UK wind farm projects are known to be including them in their current plans. In contrast, several European countries stipulate the use of ADDs as a standard component of their MMMPs for OWFs.

589. A potential disadvantage of ADDs is that their use introduces additional noise into the marine environment. ADDs rely on behavioural disturbance to work, although the risk of marine mammals receiving a dose of sound sufficient to cause auditory injury from ADDs is very low. The Joint Nature Conservation Committee (JNCC) guide to selection of ADDs (McGarry *et al*., 2018) modelled the potential for auditory injury from ADDs, assuming a swim speed of 2.5m/s

and 30 minutes of ADD activation. The results showed that the NOAA (NMFS, 2018) PTS threshold for all mammals was not exceeded beyond 100m for any of the devices modelled, with the exception of the SaveWave Orcasaver where PTS could potentially occur up to 130m from the device. It was therefore concluded that the risk of injury due to ADD deployment is low for all devices (McGarry *et al*., 2018).

590. There is a risk that using ADDs may add to the degree of disturbance and displacement, however their use in reducing the risk of collision with operational turbines, which theoretically has the potential to result in permanent or fatal injuries, is deemed beneficial compared to the relatively small area of their range over which disturbance and displacement could occur. For example, the Sea Mammal Research Unit (SMRU) assessed the potential for impact on marine mammals from the use of ADDs and concluded that although a disturbing noise source prior to piling could result in an approximately 6% increase in the duration of disturbing sound levels, the benefit of reducing the likelihood of injury was more important than the disturbance for a limited duration (Sparling *et al*., 2015).

591. The mitigation plan to reduce the collision risk with operational turbines will be developed in the pre-construction period, so that it is based upon best available information, methodologies, industry best practice, latest scientific understanding, current guidance and detailed project design. An outline mitigation and monitoring plan outlining the potential options and approach to be considered and developed in the pre-construction period has be included with the submission (**Document MOR/RHDHV/DOC/0072**). However, as the use ADDs could be considered as part of the mitigation, the potential disturbance effect of ADDs have been assessed.

592. In the JNCC guide to selection of ADDs in industry, which describes the commercially available ADDs and their applications (McGarry *et al*., 2018), the Offshore Renewables Joint Industry Project (ORJIP) review on the effectiveness of ADD for mitigation purposes (Herschel *et al*., 2013; 2014) and a review of the effectiveness of ADDs on minke whale (McGarry *et al*., 2017), the Lofitech device has been shown to be the most consistent and effective device for deterring seals, harbour porpoise and minke whale. The Lofitech device has successfully been used in a number of projects for a range of industries, including for aquaculture projects and the offshore wind industry. Therefore, this device has been used, as an example, in this assessment (**Table 12-73**). The Lofitech device has been designed to have a source noise level of 189 dB, with numerous field measurements confirming the device to have recorded source levels of 179 to 194 dB (Coram *et al*., 2014).

593. Studies have shown the Lofitech device to be effective for harbour porpoise with an immediate response on activation of the device (Brandt *et al*., 2012, 2013; McGarry *et al*., 2018). In tests of the effectiveness of the Lofitech device on harbour porpoise at a site in the German North Sea, the Lofitech device was active for four continuous hours and a total of ten trials were conducted (Brandt *et al*., 2013). During these trials, a significant decline in harbour porpoise detection was observed even at the furthest CPOD at 7.5 km from the source (Brandt *et al*., 2013). Harbour porpoise were not habituated to the device over trials of 4-6 months (Brandt *et al*., 2012). During construction at Dan Tysk offshore windfarm, the Lofitech device was found to deter porpoise between 12 km and up to 18 km (although not statistically significant for the latter). There was also no evidence of reduced effectiveness over the construction period (Dähne *et al*., 2017). The device noise source levels are below the sound level that could result

in PTS onset in harbour porpoise (202 dB re 1µPa SPL_{peak}) and TTS onset (196 dB re 1µPa SPL_{peak}) based on the NOAA criteria (NMFS, 2018).

594. There is no information available on the effectiveness of the Lofitech device on dolphin species. However, studies on the effectiveness of ADDs in captive dolphins has shown startle responses in bottlenose dolphins at ADD source levels of 135 dB re 1µPa RMS (Janik and Götz, 2015). It could therefore be assumed that the deterrence range of bottlenose dolphins from an ADD emitting a sound source level of 190 dB re 1 µPa with a high frequency could be more than 4 km (McGarry *et al*., 2017). However, it should be noted that this is untested.

595. There is very little information on the effect of ADDs on other dolphin species, such as Risso's dolphin and common dolphin. However, as they are classed as mid frequency cetaceans with a typical hearing range of 150 Hz to 160 Hz (NMFS, 2018), they would be expected to have a similar response as bottlenose dolphins. Acoustic devices are used to reduce by-catch of dolphin species. In trials of some of these devices there have been significantly lower detection rates of dolphin vocalisations. Leeny *et al*. (2007) also found during these trials, that continuous and responsive devices caused dolphins to leave the area rapidly.

596. The Lofitech device has been proven to effect minke whale behaviour up to 1 km from the source (McGarry *et al*., 2017). Within 15 minutes of ADD activation, minke whale were shown to travel to a minimum distance of 1.7 km from the ADD location, with a maximum deterrence range of 4.5 km detected. Mean swim speeds of minke whale away from the active device was found to be 15 km/h (± 4.7 km/h) (McGarry *et al*., 2017). This would be the equivalent of 4.2m/s. The device noise source levels are below the sound level that could result in PTS onset in minke whale (219 dB re 1µPa SPL_{peak}) and TTS onset (213 dB re 1µPa SPL_{peak}) based on the NMFS criteria (NMFS, 2018).

597. A number of different trials have shown that the Lofitech device is effective at deterring harbour and grey seals to a distance of 1 km from the device location (Brandt *et al*., 2012; 2013; Harris *et al*., 2014; Gordon *et al*., 2015). There was no habituation of harbour seals in field trials that occurred over several weeks (Gordon *et al*., 2015). However, some trials have indicated a potential deterrent range of 60m to 473m (Götz and Janik 2010; Gordon *et al*., 2015; McGarry *et al*., 2018). The noise source level from the Lofitech device (of a maximum 194 dB re 1 µPa) is also lower than the injury thresholds for seals in water, with PTS onset at 218 dB re 1µPa SPL_{peak} and TTS onset at 212 dB re 1µPa SPL_{peak} (NMFS, 2018).

598. In addition, as a precautionary approach, the assessment has also been based on a potential average disturbance range of approximately 1 km (3.14 km^2) for a range of ADD devices for all species, based on the JNCC guide for the selection and deployment of acoustic deterrent devices (McGarry *et al*., 2018) (**Table 12-72**).

Table 12-72 Summary of ADD deterrence distances from JNCC guide for the selection and deployment of acoustic deterrent devices (McGarry *et al*., 2018)

Species	ADD type	Range of deterrence distances[1]
Harbour porpoise	Lofitech Seal Scarer	300-1,200m
	Ace Aquatech: MMD (High Frequency)	50 – 6,000m

Species	ADD type	Range of deterrence distances[1]
	Ace Aquatech: Universal Scrammer	Likely avoidance between 200m and 1.2 km. Potential exclusion up to 6 km
	Terecos Ltd: DSMS-4	301m – 1.2 km
	Seamarco: Fauna Guard – FG Porpoise	Observed efficacy of at least 1,000m
	Airmar dB plus II	200m – 3,500 km
	Aquamark 848	Up to 1,500m
	DDD, DID from STM Products	1.2 to 3 km
Dolphin species	Ace Aquatech: MMMD (Mid Frequency)	50 – 1,000m
	Aquamark 848	Up to 1,500m
	DDD and DID (STM Products) [	1.2 to 3 km
Minke whale	Lofitech	1,000m
	Aquamark 848	Up to 1,500m
Seals	Lofitech Seal Scarer	60 to 473m. Behavioural response when seals within 1 km of sound source.
	Ace Aquatech MMMD (LOW)	50 – 1,000m
	Ace Aquatech: MMMD (High Frequency)	50 – 2,000m
	Ace Aquatech: Universal Scrammer	Between 200m and 1.4 km

[1]These ranges are likely to be influenced by factors such as local propagation characteristics, as well as animal's motivation, previous exposures to device and background noise levels.

599. As outlined in **Appendix 12.4** (**Volume III**), all of the devices are significantly above the background noise in the area and so this should not interfere with the audibility for the target species when in the vicinity of the devices. Although the source noise level, presented as an overall, broadband level, may be lower than the figure presented for a TEC, it must be taken into account that the acoustic frequency produced by each device is critical. For an ADD, to be effective in being audible to a marine mammal, it will operate at a much higher frequency, typically >5,000 Hz, than the dominant frequencies that will be produced by a TEC, and will thus remain clearly audible.

600. Commonly used ADDs, for example as supplied by Lofitech (Seal Scarer) and Ace Aquatech (e.g. the Marine Mammal Mitigation Device (MF) for pinnipeds and cetaceans) have a stated source level of 204 dB and 195 dB respectively, operating at frequency ranges of 10-20 kHz and 8-24 kHz. These are likely to be over 80 dB louder than the TECs at around 10m from the turbine (**Appendix 12.4, Volume III**).

601. As outlined in **Appendix 12.4** (**Volume III**), it is important to note, that audibility of the ADDs should not be considered the same as disturbance or displacement. The differences in the frequencies of typical ambient coastal noise, TEC machinery and an ADD means that there will be negligible interference with ADD audibility within the near vicinity of a TEC, where physical harm from a potential collision could occur. An ADD would therefore still be effective mitigation in the MDZ.

602. The requirements for ADD use has still to be determined during the development of the mitigation plan. Therefore, for this assessment a precautionary indicative example has been assumed in that there could be four ADDs at each of the arrays with a worst-case scenario of up to ten arrays, although a maximum of eight arrays are proposed for the MDZ (**Table 12-73**).

603. However, it is proposed that the ADDs would only be activated when marine mammals are in close proximity to the arrays and therefore not all 40 ADDs would ever be activated at the same time.

Table 12-73 Number of individuals (and % of reference population) that could be disturbed during ADD activation based on Lofitech device and average 1 km (3.24 km²) disturbance range

Potential Impact	One Lofitech device (maximum potential range)	Number of individuals and (% of reference population)			Magnitude
		One ADD (3.14 km²)	Full deployment for up to 10 ADDs (31.4 km²)	Full deployment for up to 40 ADDs (125.6 km²)	
Disturbance of harbour porpoise	Up to 7.5 km (177 km²) 139 individuals (0.13% of MU)	2.46 individuals (based on density estimate of 0.783/ km²) (0.002% of the 104,695 reference population).	24.6 individuals (based on density estimate of 0.783/ km²) (0.02% of the 104,695 reference population).	98 individuals (based on density estimate of 0.783/ km²) (0.09% of the 104,695 reference population).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of bottlenose dolphin	Up to 4 km (50.3 km²) 1 individual (0.25% of MU)	0.06 individuals (based on density estimate of 0.02/ km²) (0.015% of the reference population of 397 bottlenose dolphin).	0.6 individuals (based on density estimate of 0.02/ km²) (0.15% of the reference population of 397 bottlenose dolphin).	2.5 individuals (based on density estimate of 0.02/ km²) (0.63% of the reference population of 397 bottlenose dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of Risso's dolphin	Up to 4 km (50.3 km²) 1.6 individual (0.02% of MU)	0.1 individuals (based on density estimate of 0.031/ km²) (0.001% of the reference population of 8,794 Risso's dolphin).	1 individual (based on density estimate of 0.031/ km²) (0.01% of the reference population of 8,794 Risso's dolphin).	4 individuals (based on density estimate of 0.031/ km²) (0.04% of the reference population of 8,794 Risso's dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of common dolphin	Up to 4 km (50.3 km²) 11 individual (0.02% of MU)	0.69 individuals (based on density estimate of 0.22/ km²) (0.001% of the reference population of 56,556 common dolphin).	7 individuals (based on density estimate of 0.22/ km²) (0.01% of the reference population of 56,556 common dolphin).	28 individuals (based on density estimate of 0.22/ km²) (0.05% of the reference population of 56,556 common dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of minke whale	Up to 4.5 km (64 km²) 1 individual (0.004 of MU)	0.05 individuals (based on density estimate of 0.017/ km²)	0.05 individuals (based on density estimate of 0.017/ km²)	2 individuals (based on density estimate of 0.017/ km²)	Temporary effect with negligible / very low magnitude

Potential Impact	One Lofitech device (maximum potential range)	Number of individuals and (% of reference population) One ADD (3.14 km^2)	Full deployment for up to 10 ADDs (31.4 km^2)	Full deployment for up to 40 ADDs (125.6 km^2)	Magnitude
		(0.0002% of the reference population of 23,528 minke whale).	(0.0002% of the reference population of 23,528 minke whale).	(0.01% of the reference population of 23,528 minke whale).	(less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of grey seal	Up to 1 km (3.14 km^2) 0.49 individuals (0.008% of MU)	0.49 individuals (based on density estimate of 0.155/ km^2) (0.008% of the reference population of 6,000 grey seal).	5 individuals (based on density estimate of 0.155/ km^2) (0.08% of the reference population of 6,000 grey seal).	19.5 individuals (based on density estimate of 0.155/ km^2) (0.32% of the reference population of 6,000 grey seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of harbour seal	Up to 1 km (3.14 km^2) 0.002 individuals (0.004% of MU)	0.002 individuals (based on density estimate of 0.0005/ km^2) (0.004% of the reference population of 50 harbour seal).	0.02 individuals (based on density estimate of 0.0005/ km^2) (0.04% of the reference population of 50 harbour seal).	0.06 individuals (based on density estimate of 0.0005/ km^2) (0.13% of the reference population of 50 harbour seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

604. The duration of the ADD activation has also still to be determined, therefore as a precautionary approach the assessment has been based on possible 10 and 20 minute activation and the distance marine mammals could be disturbed based on them swimming away for the ADD during this activation time (**Table 12-74**). For minke whale the average swimming speed of 3.25m/s has been used (Blix and Folkow, 1995) and for all other species an average marine mammal swimming speed of 1.5m/s (Otani *et al*., 2000) has been assumed.

Table 12-74 Number of individuals (and % of reference population) that could be disturbed during ADD activation for 10 and 20 minutes

Potential Impact	Number of individuals and (% of reference population)		Magnitude
	10 minute ADD activation	20 minute ADD activation	
Disturbance of harbour porpoise (1.5m/s swim speed)	2 individuals (2.54 km^2; based on density estimate of 0.783/ km^2) (0.002% of the 104,695 reference population).	8 individuals (10.18 km^2; based on density estimate of 0.783/ km^2) (0.008% of the 104,695 reference population).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of bottlenose dolphin	0.05 individuals (2.54 km^2; based on density estimate of 0.02/ km^2) (0.01% of the reference	0.2 individuals (10.18 km^2; based on density estimate of 0.02/ km^2) (0.05% of the reference	Temporary effect with negligible / very low magnitude (less than 1% of the reference population

Potential Impact	Number of individuals and (% of reference population)		Magnitude
	10 minute ADD activation	20 minute ADD activation	
(1.5m/s swim speed)	population of 397 bottlenose dolphin).	population of 397 bottlenose dolphin).	anticipated to be exposed to effect).
Disturbance of Risso's dolphin (1.5m/s swim speed)	0.08 individuals (2.54 km^2; based on density estimate of 0.031/ km^2) (0.001% of the reference population of 8,794 Risso's dolphin).	0.32 individuals (10.18 km^2; based on density estimate of 0.031/ km^2) (0.004% of the reference population of 8,794 Risso's dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of common dolphin (1.5m/s swim speed)	0.56 individuals (2.54 km^2; based on density estimate of 0.22/ km^2) (0.001% of the reference population of 56,556 common dolphin).	2.24 individuals (10.18 km^2; based on density estimate of 0.22/ km^2) (0.003% of the reference population of 56,556 common dolphin).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of minke whale (3.25m/s swim speed)	0.2 individuals (11.95 km^2; based on density estimate of 0.017/ km^2) (0.001% of the reference population of 23,528 minke whale).	0.81 individuals (47.78 km^2; based on density estimate of 0.017/ km^2) (0.001% of the reference population of 23,528 minke whale).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of grey seal (1.5m/s swim speed)	0.39 individuals (2.54 km^2; based on density estimate of 0.155/ km^2) (0.01% of the reference population of 6,000 grey seal).	1.6 individuals (10.18 km^2; based on density estimate of 0.155/ km^2) (0.03% of the reference population of 6,000 grey seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).
Disturbance of harbour seal (1.5m/s swim speed)	0.001 individuals (2.54 km^2; based on density estimate of 0.0005/ km^2) (0.003% of the reference population of 50 harbour seal).	0.005 individuals (10.18 km^2; based on density estimate of 0.0005/ km^2) (0.01% of the reference population of 50 harbour seal).	Temporary effect with negligible / very low magnitude (less than 1% of the reference population anticipated to be exposed to effect).

605. Taking into account the low sensitivity to any disturbance (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect (negligible / very low for all species), the impact significance (based in the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) for disturbance as a result of ADDs has been assessed as **negligible** (**Table 12-75**).

Table 12-75 Assessment of impact significance for possible disturbance of marine mammals from underwater noise during ADD activation at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Disturbance during ADD activation	Harbour porpoise	Low	Negligible / very low	Negligible	No mitigation required.	Negligible
	Bottlenose dolphin		Negligible / very low	Negligible		Negligible
	Risso's dolphin		Negligible / very low	Negligible		Negligible
	Common dolphin		Negligible / very low	Negligible		Negligible

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
	Minke whale		Negligible / very low	Negligible		Negligible
	Grey and harbour seal		Negligible / very low	Negligible		Negligible

12.6.4.4.1. Mitigation

606. No further mitigation measures are required or proposed.

12.6.4.4.2. Residual Impact

607. The residual impact would remain negligible.

12.6.4.5. Collision Risk with Tidal Devices

608. There is considerable uncertainty regarding the collision risk of marine mammals with all tidal turbine types. The moving rotors of tidal energy devices pose a potential collision risk for marine mammals. However, there is currently limited understanding and empirical data relating interactions between marine mammals with tidal devices and there have been no recorded incidents at any operational tidal arrays, including the following projects in the UK:

- Several years of operation of the SeaGen tidal turbine (Strangford Lough) 1.4MW tidal device;
- Ongoing monitoring of multiple deployments of single tidal devices in the Falls of Warness (EMEC, Orkney) test site since 2007; and
- Ongoing monitoring of Phase 1a (6MW) of the MeyGen (Caithness) array, the full phase 1 (86MW) of which is now consented.

609. SeaGen as it was deployed in 2008 and there were no marine mammal collision incidents reported during its operational monitoring. Although the SeaGen device has now been removed, data from its monitoring programmes are still being analysed. The European Marine Energy Centre (EMEC) at Orkney has tested many different devices and no incidents involving collisions with marine mammals have been recorded (SLR, 2015).

610. There is an absence of data to determine the ability of animals to avoid coming into contact with devices, either through close-range evasion, where animals take last minute evasive action, or through avoidance, which may operate at a wider scale with animals avoiding the area the devices are located in (Sparling and Smith, 2019). Data from telemetry studies around the SeaGen device in Strangford Lough, Northern Ireland, suggest that harbour seal may be exhibiting a degree of avoidance, with peaks in transit approximately 250m either side of the device (Sparling *et al*., 2016).

611. There is also uncertainty associated with the potential for a collision to result in fatality, and the potential physical effect of collision impacts on marine mammals. Thompson *et al.* (2016) and Onoufriou *et al*. (2019), carried out empirical tests with grey seal carcasses and concluded that collisions at blade speeds of 5.2 ms^{-1} or less did not result in any significant muscle or skeletal

damage and would be unlikely to result in serious injury or mortality. Incorporating this into the collision risk model (CRM) resulted in a reduction of predicted collision risk across a range of simulations of between 20% and 75%, depending on the proportion of predicted collisions which are below this speed. Above this speed, the probability of death or serious injury will increase with rotor speed, as will the likelihood of a collision. Therefore, rotor speeds and the relationship between rotor speed and current speed are clearly important factors. However, rotor speeds vary widely by device type and size. The size of moving parts, and therefore the area swept by them, is also an important determinant of the risk of collision. Larger blades sweep a larger area, putting a higher proportion of animals at risk of collision. However, larger blades are also likely to be slower than smaller blades and therefore collision probability will be lower for a given passage rate and animal speed. The variety in collision probability as a result of variation in different turbine parameters is therefore difficult to predict (Sparling and Smith, 2019).

612. The position of the devices in the water column will also have a significant effect on the predicted collision risk (Sparling and Smith, 2019). Therefore, the depth distribution of the marine mammals using a particular site is an important consideration and will often vary by species and potentially between sites. Many marine mammals are benthic foragers and divide their time primarily between the surface to breathe, and the seabed to feed, with relatively less time spent mid-water. For example, a study of grey seal juveniles tagged at Anglesey, Bardsey Island and Ramsey Sound found that tagged animals spent the majority of their time either at the surface or at the bottom of a dive with little time spent in the mid water depths (Thompson, 2012). Whereas other species may spend considerable time in other parts of the water column. For example, studies indicate that bottlenose dolphins may spent little time in waters deeper than 10m, based on a depth distribution for bottlenose dolphins obtained from a vertical array of hydrophones (Hastie *et al*., 2006) and dolphin dive data from satellite-linked, time–depth recorders (Corkeron and Martin, 2004; Klatsky *et al*., 2007; Sparling and Smith, 2019). Studies also indicate the harbour porpoises spent about half their time within the top 2m of the water column (Teilmann *et al*., 2007, 2013). Therefore, for species that spend a considerable amount of their time near the surface, such as bottlenose dolphins and harbour porpoises, TECs close to the surface would represent the worst-case scenario for collision risk. Whereas, where animals are foraging on the seabed, midwater devices with adequate clearance above and below could represent a lower risk than devices situated close to the seabed or the water surface (Sparling and Smith, 2019).

613. The total number of TECs is also be a major factor in determining collision risk. As outlined by Sparling and Smith (2019), currently there is no way of realistically modelling the collision risk posed by multiple devices, other than simply multiplying the risk for a single device by the total number of devices. However, this is likely to be unrealistic as it is difficult to predict how animals might respond to an array of devices. For example, the probability of avoidance is likely to be modified as a result of a close range encounters with preceding devices. There is the possibility that animals might learn from encountering and avoiding the first device and then subsequently avoid additional devices at a greater distance. However, there could also be the possibility that avoiding one device might bring an animal into the path of a subsequent device with an increased probability of collision, although this will depend on device spacing. Although collision risk may not scale linearly with the number of TECs in an array, given current uncertainty regarding marine mammal behaviour, and a lack of empirical data, most assessments make the assumption that there will be a linear increase in risk with the total number of devices installed.

614. There are a number of different features of tidal devices and arrays which can have an effect on the magnitude of potential collision risk for marine mammals (Sparling and Smith, 2019), including:

- The number and size of Tidal Energy Converters (TEC) moving parts (e.g. for horizontal axial flow designs; number of rotors and rotor dimensions and shape);
- The total number of devices with moving parts;
- The speed of movement of moving parts; and
- The position of TECs in the water column (in relation to the depth distribution of marine mammals).

615. These factors have been taken into account when determining the realistic worst-case parameters for the collision risk assessment, as outlined in **Section 12.6.4.5.1**.

12.6.4.5.1. Parameters used Collision Risk Assessment

12.6.4.5.1.1. CRM and ERM models

616. For the marine mammal collision risk assessment two methods, Encounter Rate Modelling (ERM) and Collision Risk Modelling (CRM), using the Scottish Natural Heritage guidance for assessing collision risk between underwater turbines and marine wildlife (SNH, 2016) and accompanying spreadsheets. This approach was agreed with NRW at the 2nd Marine Mammal TWG in February 2019.

617. The ERM, based on the work by the Scottish Association for Marine Science (SAMS) (Wilson *et al*., 2007), is designed to predict potential encounters with predator and prey. The model considers the volume swept by each rotor blade (predator) and the number of individuals (prey) present within that volume and estimates how many encounters on this basis and scales up to relevant time period. Key device parameters include number of rotors, number of blades, blade depth, blade length, rotation speed.

618. The CRM was originally developed as the “Band Model” to assess collision risk to flying birds with wind turbines. The model considers the number of animals likely to pass through each rotor, and the probability of collision for each such passage and estimates how many collisions on this basis and scales up to relevant time period. Key device parameters include number of rotors, number of blades, blade width, blade length, rotation speed.

619. The difference in the models and the parameters used result in different results for different devices and scenarios. Therefore, the collision risk assessments were conducted using both the ERM and CRM for all marine mammal species.

620. It should be noted, as acknowledged by SNH (2016), that the ERM and CRM methods will provide at best, an order of magnitude estimate of collision risk.

12.6.4.5.1.2. Tidal Devices and Array Scenarios

621. The tidal sector is an emerging industry with a wide range of technology types that are still being developed and optimised. As a result, Morlais may attract a wide spectrum of tidal devices over

the life of the project. The range and flexibility sought within the consent application has been limited by careful consideration of development scenarios designed to rationalise the likely approach to development and to set workable limits on potential impacts. As a result, a series of key design principles have been identified and used to shape the impact assessments undertaken. This approach allows a range or “envelope” of design parameters, and the likely worst case of each parameter, to be defined. This approach is tested in planning law and referred to as the ‘Rochdale Envelope’ approach, often called a Project Design Envelope (PDE).

622. It is important to note that because a wide range of designs at varying scales are currently available (and may be available in the future), the technologies referred to are provided as examples for reference only and are to be considered representative of the range of device types that could be utilised at Morlais. A review of these potential tidal technologies has allowed the identification of realistic worst-case parameters for each device type (as outlined in **Table 12-76**).

623. The worst-case parameters used to define the PDE in terms of the device parameters and the relevant worst-case scenarios for the Project have been used in the impact assessments.

624. The device types outlined represent the device type parameters which fall within the PDE. There are a number of novel device types available. The device types included in this assessment are deemed to represent the most suitable parameters for deployment at Morlais.

Table 12-76 Tidal device parameters used in marine mammal collision risk (ERM and CRM) assessments

Tidal device category		**1**	**2a**	**2b**	**3**	**4**	**5a**	**5b**	**6a**	**6b**	**7a**
Position in water column		**Surface**	**Surface**	**Mid-water**	**Surface**	**Surface**	**Seabed**	**Seabed**	**Seabed**	**Seabed**	**Surface**
Description		**Twin-rotor floating**	**Multiple-rotor buoyant platform**	**Multi-rotor buoyant mid water**	**Multiple-rotor buoyant platform**	**Spar buoy**	**Seabed mounted single rotor**	**Seabed mounted single rotor**	**Seabed mounted single rotor**	**Three-rotor seabed mounted platform**	**Cross-flow multi-rotor floating**
Parameter	**Unit**										
Rotor tip min depth*	m	3.2	5	10	5	6	23	14	26	30	1
No. of rotors	n	2	5	5	20	1	1	1	1	3	2
Rotor radius	m	10	5	5	2.5	13.5	7.5	13	5	5	2.5
No. of blades	n	2	2	2	3	2	6	3	2	3	3
Blade "depth" (front to back, side view)	m	0.84	0.25	0.25	0.09	0.4	0.3	0.4	0.25	0.25	0.064
Blade "width" (side to side, front view)	m	2	1.1	1.1	0.2	0.2	0.2	0.2	0.8	0.8	N/A
Rotation speed	rpm	8.71	18	18	26.7	10.1	7.5	7.5	22	22	13.6
Mean tangential blade speed	m/s	4.56	4.71	4.71	3.5	7.14	2.95	5.11	5.76	5.76	1.78
% time not in operation	%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%

Tidal device category		1	2a	2b	3	4	5a	5b	6a	6b	7a
Position in water column		**Surface**	**Surface**	**Mid-water**	**Surface**	**Surface**	**Seabed**	**Seabed**	**Seabed**	**Seabed**	**Surface**
Description		**Twin-rotor floating**	**Multiple-rotor buoyant platform**	**Multi-rotor buoyant mid water**	**Multiple-rotor buoyant platform**	**Spar buoy**	**Seabed mounted single rotor**	**Seabed mounted single rotor**	**Seabed mounted single rotor**	**Three-rotor seabed mounted platform**	**Cross-flow multi-rotor floating**
Parameter	**Unit**										
Mean current speed	m/s	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
Mean blade speed relative to water	n	4.81	4.95	4.95	3.81	7.30	3.31	5.33	5.96	5.96	2.34
Blade pitch at blade tip	degrees	2.4	5	5	0	5	5	5	5	0	N/A
Blade profile	n	Generic	Generic	Generic	Generic	Generic	Generic	Generic	Generic	Generic	N/A
Median water depth	m	42.5	40	40	30	45	43	43	40	40	40

*in median water depth
N/A = not applicable / required for ERM

12.6.4.5.1.3. Marine Mammal Parameters

625. The density estimates and reference populations used in the assessments are presented in **Table 12-22**. These were agreed with NRW at the 2nd marine mammal TWG meeting on the 19th February 2019.

626. **Table 12-77** outlines the marine mammal dimensions, based on the SNH guidance (SNH, 2016), used for the collision risk assessment. The SNH guidance (SNH, 2016) does not provide data for dolphin species, therefore for bottlenose dolphin, Risso's dolphin and common dolphin these have been determined based on Cetacean Stranding's Investigation Programme (CSIP) strandings records from Wales and data collected by Marine Environmental Monitoring (1994-2017). Further details are provided in **Appendix 12.2** (**Volume III**).

Table 12-77 Marine mammal dimensions used in the Morlais collision risk assessments

Species	Length (m)	Effective radius/body width (m)	Source
Harbour porpoise	1.48m	0.32m	SNH (2016); Thompson (2015)
Bottlenose dolphin	2.57m	0.64m	Calculated from Welsh strandings data (1994-2017)
Risso's dolphin	2.36m	0.59m	Calculated from Welsh strandings data (1994-2017)
Common dolphin	1.77m	0.44m	Calculated from Welsh strandings data (1994-2017)
Minke whale	8.8m	2.2m	SNH (2016); Horwood (1990)
Grey seal	1.86m	0.42m	SNH (2016); Thompson (2015)
Harbour seal	1.41m	0.34m	SNH (2016)

627. **Table 12-78** outlines the marine mammal swim speeds and dive profiles, based on the SNH guidance (SNH, 2016) used for the Morlais collision risk assessments. The SNH guidance (SNH, 2016) does not provide data for dolphin species, therefore for bottlenose dolphin these have been determined based on other sources, where available. Currently there is no or limited suitable data for Risso's and common dolphin, so where required values for bottlenose dolphin have been used. Further details are provided in **Appendix 12.2** (**Volume III**).

Table 12-78 Marine mammal swim speeds and dive profile used in the Morlais collision risk assessments

Species	Mean swim speed (m/s)	Mean dive time (s)	Mean surface time (s)	Depth distribution type / dive profile	Source
Harbour porpoise	1.4m/s	26.2s	3.9s	Harbour porpoise	SNH (2016); Westgate *et al*. (1995); Otani *et al*. (2000)
Bottlenose dolphin	1.8m/s	25.8s	3.7s	Uniform	Skrovan *et al*. (1999); Mate *et al*. (1995)
Risso's dolphin	1.7m/s	25.8s	3.7s	Uniform	N/A based on BND parameters
Common dolphin	1.7m/s	25.8s	3.7s	Uniform	N/A based on BND parameters

Species	Mean swim speed (m/s)	Mean dive time (s)	Mean surface time (s)	Depth distribution type / dive profile	Source
Minke whale	2.1m/s	87s	3.5s	Uniform	SNH (2016); Williams (2009); Stern (1992)
Grey seal	1.8m/s	297s	165s	Grey seal	SNH (2016); Thompson (2015); Beck *et al*. (2000)
Harbour seal	1.8m/s	180s	39.5s	Harbour seal	SNH (2016); Thompson (2015); Thompson *et al.* (2014); Chudzinska (2009)

12.6.4.5.1.4. Avoidance Rates

628. As outlined in **Section 12.6.4.1**, underwater noise from operational turbines will be detected by marine mammals and has the potential to cause disturbance. However, given the potential for masking of the devices operational noise due to high background noise levels, 100% avoidance behaviour cannot be assumed to occur in response to tidal device noise.

629. EMEC (2014) assumed avoidance rates of 98% for harbour porpoise, 95-98% for minke whale, 98% for harbour and grey seal in the collision risk modelling at the Falls of Warness tidal site. Band (2015) recommends presenting collision risk results using a range of avoidance rates 0%, 50%, 95%, 98% and 99%.

630. Avoidance rates of 0%, 50%, 90%, 95%, 98% and 99% have been presented for all species in **Appendix 12.2** (**Volume III**). However, the assessment of the potential impacts and effects have been based on the avoidance rates in **Table 12-79**.

Table 12-79 Marine mammal avoidance rates used in the Morlais collision risk assessments

Species	Avoidance rate
Harbour porpoise	98%
Bottlenose dolphin	98%
Risso’s dolphin	98%
Common dolphin	98%
Minke whale	98%
Grey seal	98%
Harbour seal	98%

12.6.4.5.2. Collision Risk Assessments

631. The indicative scenarios conducted for the maximum number of each type of device combined where the predicted collision risk is less than one bottlenose dolphin, have been conducted for each species, with no mitigation. **Table 12-80** and **Table 12-81** provides indicative scenarios for the maximum number of each type of device combined for collision risk of less than one bottlenose dolphin, using the ERM and CRM (number of individuals per year and percentage of reference population), respectively, based on 98% avoidance.

632. The assessments are based on the indicative scenarios for the combination of different types of devices where the collision risk is predicted to be less than one bottlenose dolphin (based on the scenarios with the current maximum MW). Each stage of deployment would only progress based on updated assessments and that the regular reviewing of the monitoring and mitigation indicated that there was no increased collision risk.

633. The approach will be to deploy to a level where the risk is less than one bottlenose dolphin. This deployment will then be monitored with mitigation, such as the use of ADDs if animals come too close to the tidal devices and arrays. The next phase of deployment would only proceed when a review of the monitoring and requirements for mitigation (e.g. how often ADDs were activated), indicates that there is no increased collisions risk. This would be done through the adaptive management and mitigation plan (EMMP) and in consultation with NRW. Therefore, the assessments, including the in-combination assessment, is based on the scenarios for less than one bottlenose dolphin, as this would be the worst-case scenario.

634. **Section 12.6.4.5.3** outlines the proposed monitoring and mitigation for the phased deployments.

635. It is important to note that the output of the devices (MW) used in the assessments are indicative and have been based on the current minimum rating, as a worst-case scenario and prior to deployment it is expected that the rating (MW) for the devices deployed would be higher, although the other parameters are unlikely to change. Further assessments will be conducted prior to deployment as part of the adaptive management and mitigation plan (EMMP; **Document MOR/RHDHV/DOC/0072**).

636. In addition to the indicative scenarios conducted for the maximum number of each type of device combined where the predicted collision risk is less than one bottlenose dolphin in **Table 12-82**, **Table 12-83** outlines the maximum number of each type of device for one device type only, where the predicted collision risk is less than one bottlenose dolphin. Further details on the assessment of these scenarios for the different species are presented in **Appendix 12.2** (**Volume III**).

637. Indicative assessments for 30MW and 40MW of each type of device and an indicative 240MW scenario are also presented in **Appendix 12.2** (**Volume III**), however, these would only be developed once the monitoring and mitigation indicates that the collision risk would be less than one bottlenose dolphin.

Table 12-80 ERM assessment with 98% avoidance for maximum number (and MW) of each type of device combined for collision risk of less than one bottlenose dolphin (number of individuals / year and % of reference population)

Tidal device category	1	2a	2b	3	4	5a	5b	6a	6b	7a	Total
Number (MW)	**4 (8MW)**	**1 (1.5MW)**	**1 (1.25MW)**	**0**	**1 (1MW)**	**2 (2MW)**	**1 (1.5MW)**	**1 (0.3MW)**	**1 (1.2MW)**	**0**	**12 (16.75MW)**
Bottlenose dolphin	0.39	0.10	0.10	0	0.07	0.11	0.08	0.02	0.11		0.99 (0.25%)
Harbour porpoise	13.7	2.8	2.3	0	1.6	0.8	1.0	0.1	0.37		22.76 (0.02%)
Risso's dolphin	0.56	0.14	0.14	0	0.11	0.16	0.12	0.03	0.16		1.42 (0.02%)
Common dolphin	3.34	0.78	0.78	0	0.6	0.89	0.66	0.19	0.85		8.08 (0.01%)
Minke whale	0.95	0.34	0.34	0	0.2	0.35	0.22	0.08	0.36		2.84 (0.01%)
Grey seal	2.17	0.47	0.47	0	0.34	0.4	0.32	0.08	0.35		4.6 (0.08%)
Harbour seal	0.006	0.001	0.001	0	0.001	0.002	0.001	0.0004	0.001		0.01 (0.03%)
Magnitude for each species	Potential permanent effect with medium magnitude for combination of devices (0.01-1% of the reference population anticipated to be exposed to effect).										

Table 12-81 CRM assessment with 98% avoidance for maximum number (and MW) of each type of device combined for collision risk of less than one bottlenose dolphin (number of individuals / year and % of reference population)

Tidal device category	1	2a	2b	3	4	5a	5b	6a	6b	7a*	Total
Number (MW)	**3 (6MW)**	**1 (1.5MW)**	**1 (1.25MW)**	**0**	**1 (1MW)**	**1 (1MW)**	**1 (1.5MW)**	**2 (0.6MW)**	**3 (3.6MW)**	**0**	**13 (16.45MW)**
Bottlenose dolphin	0.37	0.09	0.09	0	0.11	0.04	0.10	0.04	0.16		0.99 (0.25%)
Harbour porpoise	11.28	2.37	1.96	0	2.12	0.25	1.22	0.15	0.35		19.69 (0.02%)
Risso's dolphin	0.54	0.13	0.13	0	0.15	0.05	0.15	0.05	0.23		1.41 (0.02%)

Tidal device category	1	2a	2b	3	4	5a	5b	6a	6b	7a*	Total
Number (MW)	**3 (6MW)**	**1 (1.5MW)**	**1 (1.25MW)**	**0**	**1 (1MW)**	**1 (1MW)**	**1 (1.5MW)**	**2 (0.6MW)**	**3 (3.6MW)**	**0**	**13 (16.45MW)**
Common dolphin	2.89	0.67	0.67	0	0.82	0.27	0.8	0.27	1.2		7.6 (0.01%)
Minke whale	0.67	0.18	0.18	0	0.18	0.07	0.18	0.07	0.32		1.8 (0.008%)
Grey seal	1.89	0.39	0.39	0	0.47	0.12	0.39	0.11	0.5		4.3 (0.07%)
Harbour seal	0.005	0.001	0.001	0	0.002	0.0005	0.001	0.001	0.001		0.01 (0.03%)
Magnitude for each species	Potential permanent effect with medium magnitude for combination of devices (0.01-1% of the reference population anticipated to be exposed to effect).										

*CRM not applicable for vertical blade of cross-flow multi-rotor floating type device, therefore ERM results included

Table 12-82 ERM assessment with 98% avoidance for maximum number (and MW) for each type of device for collision risk of less than one bottlenose dolphin (number of individuals / year and % of reference population)

Tidal device category	1	2a	2b	3	4	5a	5b	6a	6b	7a
Number (MW)	10 (20MW)	9 (13.5MW)	9 (11.25MW)	4 (4MW)	13 (13MW)	17 (17MW)	12 (18MW)	40 (12MW)	9 (10.8MW)	69 (6.9MW)
Bottlenose dolphin	0.97	0.91	0.91	0.93	0.95	0.96	0.97	0.97	0.99	0.99

Table 12-83 CRM assessment with 98% avoidance for maximum number (and MW) for each type of device for collision risk of less than one bottlenose dolphin (number of individuals / year and % of reference population)

Tidal device category	1	2a	2b	3	4	5a	5b	6a	6b
Number (MW)	7 (14MW)	11 (16.5MW)	11 (13.75MW)	10 (10MW)	9 (9MW)	27 (27MW)	9 (13.5MW)	55 (16.5MW)	18 (21.6MW)
Bottlenose dolphin	0.87	0.97	0.97	0.99	0.95	0.96	0.92	0.97	0.95

Table 12-84 Number of individuals (and % of reference population) that could be at risk of collision with operational tidal devices at Morlais (based on scenarios for less than one bottlenose dolphin)

Species	Magnitude (ERM and CRM)
Harbour porpoise	20-23 individuals (0.02% of MU). Potential permanent effect with medium magnitude (0.01-1% of the reference population anticipated to be exposed to effect).
Bottlenose dolphin	0.99 individuals (0.25% of MU). Potential permanent effect with medium magnitude (0.01-1% of the reference population anticipated to be exposed to effect).
Risso's dolphin	1.4 individuals (0.02% of MU). Potential permanent effect with medium magnitude (0.01-1% of the reference population anticipated to be exposed to effect).
Common dolphin	8 individuals (0.01% of MU) Potential permanent effect with medium magnitude (0.01-1% of the reference population anticipated to be exposed to effect).
Minke whale	2-3 individuals (0.01%) Potential permanent effect with medium magnitude (0.01-1% of the reference population anticipated to be exposed to effect).
Grey seal	4-5 individuals (0.08% of MU) Potential permanent effect with medium magnitude (0.01-1% of the reference population anticipated to be exposed to effect).
Harbour seal	0.01 individuals (0.03% of MU) Potential permanent effect with medium magnitude (0.01-1% of the reference population anticipated to be exposed to effect).

638. As for increased collision risk with vessels, the sensitivity has been assessed as low for all marine mammal species. This has been determined based on no incidents reported for marine mammals with any operational tidal devices, the ability of marine mammal to detect the physical structures of the devices before they encounter the blades and the underwater noise generated by the operational devices, even with high ambient noise levels. The sensitivity classification of the Welsh marine mammal populations from Sparling *et al*. (2015), as outlined in **Section 12.5.11** and **Table 12-23** has also been included for context.

639. Taking into account the sensitivity and the potential magnitude of the effect for the different scenarios, the impact significance for any permanent impacts on harbour porpoise, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal has been assessed as **minor (not significant)** (**Table 12-85**).

640. The number of animals that can be 'removed' from a population varies but is largely dependent on the growth rate of the population; populations with low growth rates can

sustain the removal of a smaller proportion of the population. The JNCC *et al*. (2010) draft EPS guidance provides some indication on how many animals may be removed from a population without causing detrimental effects to the population at FCS.

641. JNCC *et al*. (2010) draft EPS guidance considered 4% as the maximum potential growth rate in harbour porpoise, and the 'default' rate for cetaceans. Therefore, beyond natural mortality, up to 4% of the population could theoretically be permanently removed before population growth would be halted.

642. The collision risk assessments have been based on the worst-case scenarios, does not take into account the proposed phased deployment, monitoring and mitigation measures and assumes that all encounter or collisions would be fatal.

643. Taking this into account, along with the JNCC *et al*. (2010) draft EPS guidance, it is therefore unlikely that the potential collision risk would result in any significant population effects for bottlenose dolphin, harbour porpoise, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal.

644. A threshold of 1.7% of the relevant harbour porpoise population above which a population decline is inevitable has been agreed with Parties to the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS), with an intermediate precautionary objective of reducing the impact to less than 1% of the population (Defra, 2003; ASCOBANS, 2015). This threshold relates to impacts from fisheries by-catch on harbour porpoise where the impact on the harbour porpoise is permanent, i.e. up to 1.7% of the population may be caught as by-catch before a population decline is inevitable.

645. The percentage of the reference population that could be at risk of collision with operational tidal devices at Morlais, based on scenarios for less than one bottlenose dolphin scenarios, is considerably less than 1.7% for bottlenose dolphin, harbour porpoise, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal, with a maximum of 0.25% or less of the reference population for bottlenose dolphin (**Table 12-84**).

646. As outlined in **Section 12.6.4.5.5**, the potential population level effects of collision risk with operational tidal turbines on marine mammals have been assessed in **Appendix 12.2** (**Volume III**). The result of the PVA indicate that population trajectories of the baseline and collision risk scenarios of 1, 2 and 3 animals are very similar, with only a potential for a decline when more than three adults per year are removed from the population of 397 bottlenose dolphins in the Irish Sea MU.

Table 12-85 Assessment of impact significance for collision risk with operational turbines at MDZ

Potential Impact	Receptor	Sensitivity (sensitivity of Welsh population)	Magnitude	Significance	Mitigation	Residual Impact
Collision risk for less than one bottlenose dolphin scenarios	Harbour porpoise	Low (Low)	Medium	Minor	Phased deployment, monitoring and mitigation (EMMP)	Minor (not significant)
	Bottlenose dolphin	Low (High)	Medium	Minor		Minor (not significant)
	Risso's dolphin	Low (Low)	Medium	Minor		Minor (not significant)
	Common dolphin	Low (Low)	Medium	Minor		Minor (not significant)
	Minke whale	Low (Low)	Medium	Minor		Minor (not significant)
	Grey seal	Low (Low)	Medium	Minor		Minor (not significant)
	Harbour seal	Low (Low)	Medium	Minor		Minor (not significant)

12.6.4.5.3. Mitigation

647. As outlined in **Section 12.6.2**, the deployment, monitoring and adaptive management plan will be developed in the pre-construction period and based upon best available information, methodologies, industry best practice, latest scientific understanding, current guidance and detailed project design.

648. This plan will consider the most suitable and effective monitoring and mitigation measures to, detect marine mammals in and around the arrays (for example, using remotely monitored PAM, underwater cameras, autonomous recorders, and / or high definition (HD) and thermal imaging camera systems). There would also be the use of active sonar to detect marine mammals in close proximity to the arrays / devices to trigger mitigation measures, such as the automatic activation of ADDs to deter marine mammals from a predetermined mitigation zone around the arrays / devices.

649. The approach would be based on deployment, monitoring and adaptive management, with regular reviews of the installation at appropriate increments directly related to collision risk to marine mammals, specially bottlenose dolphin, to ensure that in that no more than one bottlenose dolphin could be at risk.

12.6.4.5.4. Residual Impacts

650. With the effective and appropriate mitigation proposed any risk of collisions will be greatly reduced. As a precautionary approach the residual impacts have been assessed as minor (not significant) for most species and a very precautionary minor to moderate for bottlenose dolphin and the 30MW and 240MW scenarios. Although is expected to be lower, taking into account that bottlenose dolphins have not been

recorded in the MDZ and are more likely to move along the coast than through the MDZ array area.

12.6.4.5.5. Assessment of Potential Population Level Effects

651. The potential population level effects of collision risk with operational tidal turbines on marine mammals have been assessed in **Appendix 12.3**.

652. The potential population effects have been assessed in a separate appendix as this will continue to be updated and developed as part of the mitigation and monitoring plan (**Document MOR/RHDHV/DOC/0072**).

12.6.4.6. Increased Collision Risk with Vessels

653. Although impacts will be less than during construction, as a worst-case scenario assessment has been based on assessment for construction in **Section 12.6.3.6**.

654. The potential for increased collision risk with vessels has been based on up to 16 vessels on site at any one time, with up to 16 vessel movements to and from the site per day. The maximum area of potential risk has been estimated based on construction vessels in indicative examples of the two largest potential deployment areas (3 km^2 and 3 km^2); plus, vessels in ECC area (4.75 km^2). In addition, increased collision risk has also been estimated based on the potential vessel route area to and from Holyhead Harbour, based on a precautionary 250m buffer either side of the vessels (**Table 12-86**).

Table 12-86 Estimated number of individuals (and % of reference population) that could be at increased collision risk with vessels at MDZ

Species	Increased collision risk (5-10% of individuals in area at increased risk)			
	Two indicative deployment areas and cable corridor (10.75 km^2) area.	**Vessel route to Holyhead Port (4.34 km^2)**	**Number of individuals (% of reference population) at potential increased risk in total area (15.09 km^2)**	**Magnitude**
Harbour porpoise	0.42-0.84 individuals (based on density estimate of 0.783/ km^2) (0.0004-0.008% of the 104,695 reference population).	0.17-0.34 individuals (based on density estimate of 0.783/ km^2) (0.0002-0.0003% of the 104,695 reference population).	0.59-1.18 individuals (0.0006-0.0011% of MU)	Potential permanent effect with negligible to low magnitude (0.01% or less of the reference population anticipated to be exposed to effect).
Bottlenose dolphin	0.011-0.022 individuals (based on density estimate of 0.02/ km^2)	0.0043-0.009 individuals (based on density estimate of 0.02/ km^2) (0.0011-0.0022% of the reference	0.015-0.031 individuals (0.0038-0.0076% of MU)	Potential permanent effect with low magnitude (between 0.001% and 0.01% of the

Species	Increased collision risk (5-10% of individuals in area at increased risk)			
	Two indicative deployment areas and cable corridor (10.75 km²) area.	**Vessel route to Holyhead Port (4.34 km²)**	**Number of individuals (% of reference population) at potential increased risk in total area (15.09 km²)**	**Magnitude**
	(0.003-0.0054% of the reference population of 397 bottlenose dolphin)	population of 397 bottlenose dolphin)		reference population anticipated to be exposed to effect).
Risso's dolphin	0.017-0.033 individuals (based on density estimate of 0.031/ km²) (0.0002-0.0004% of the reference population of 8,794 Risso's dolphin).	0.007-0.014 individuals (based on density estimate of 0.031/ km²) (0.0001-0.0002% of the reference population of 8,794 Risso's dolphin).	0.024-0.047 individuals (0.0003-0.0005% of MU)	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
Common dolphin	0.12-0.24 individuals (based on density estimate of 0.22/ km²) (0.0002-0.0004% of the reference population of 56,556 common dolphin).	0.05-0.096 individuals (based on density estimate of 0.22/ km²) (0.0001-0.0002% of the reference population of 56,556 common dolphin).	0.17-0.336 individuals (0.0003-0.0006% of MU)	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
Minke whale	0.009-0.02 individuals (based on density estimate of 0.017/ km²) (0.00004-0.0001% of the reference population of 23,528 minke whale).	0.004-0.007 individuals (based on density estimate of 0.017/ km²) (0.00002-0.00003% of the reference population of 23,528 minke whale).	0.013-0.027 individuals (0.0001-0.0001% of MU)	Potential permanent effect with negligible / very low magnitude (less than 0.001% of the reference population anticipated to be exposed to effect).
Grey seal	0.083-0.17 individuals (based on density estimate of 0.155/ km²) (0.0014-0.003% of the reference population of 6,000 grey seal).	0.034-0.067 individuals (based on density estimate of 0.155/ km²) (0.0006-0.0011% of the reference population of 6,000 grey seal).	0.117-0.237 individuals (0.0019%-0.0039% of MU)	Potential permanent effect with negligible to low magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Harbour seal	0.0003-0.0005 individuals (based on density estimate of 0.0005/ km²) (0.0005-0.0011% of the reference	0.0001-0.0002 individuals (based on density estimate of 0.0005/ km²) (0.0002-0.0004% of the reference	0.0004-0.0007 individuals (0.0008-0.0015% of MU)	Potential permanent effect with negligible to low magnitude (0.01% or less of the reference population

Species	Increased collision risk (5-10% of individuals in area at increased risk)			
	Two indicative deployment areas and cable corridor (10.75 km^2) area.	**Vessel route to Holyhead Port (4.34 km^2)**	**Number of individuals (% of reference population) at potential increased risk in total area (15.09 km^2)**	**Magnitude**
	population of 50 harbour seal).	population of 50 harbour seal).		anticipated to be exposed to effect).

655. Taking into account the low sensitivity of all marine mammal species to increased collision risk with vessels and the potential magnitude of the effect (negligible or low for all species), the impact significance for any permanent impact on harbour porpoise, bottlenose dolphin, grey seal and harbour seal has been assessed as **minor (not significant)** and **negligible** for Risso's dolphin, common dolphin and minke whale (**Table 12-87**).

12.6.4.6.1. Mitigation

656. Where possible, all vessel movements will be kept to the minimum number that is required to reduce any potential collision risk. Additionally, vessel operators will use good practice to reduce any risk of collisions with marine mammals. No further mitigation is proposed.

12.6.4.6.2. Residual Impact

657. The residual impact would remain negligible or minor (not significant).

Table 12-87 Assessment of impact significance for increased collision risk with vessels at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Increased collision risk with vessels	Harbour porpoise	Low	Negligible to low	Negligible to minor (not significant)	No mitigation is required or proposed	Negligible to minor (not significant)
	Bottlenose dolphin		Low	Minor (not significant)		Minor (not significant)
	Risso's dolphin		Negligible / very low	Negligible		Negligible
	Common dolphin		Negligible / very low	Negligible		Negligible
	Minke whale		Negligible / very low	Negligible		Negligible
	Grey and harbour seal		Negligible to low	Negligible to minor (not significant)		Negligible to minor (not significant)

12.6.4.7. Potential Overall Collision Risk for Operational Turbines and Vessels

658. As a precautionary approach the number of marine mammals (and percentage of the reference populations) has been assessed for the potential collision risk with operational turbines (**Section 12.6.4.5.2**) and possible increased collision risk with vessels (**Section 12.6.4.6**).

659. The assessment has been based on the worst-case scenario that there could be up to 16 vessels on site at the same time as the scenario for less than one bottlenose dolphin (**Table 12-88**). However, it is highly unlikely that 16 vessels would be on site during operation, also when vessels are on site during operation this is likely to be for maintenance and repowering activities, which would result in a number of devices to be non-operational during these activities.

Table 12-88 Estimated number of individuals (and % of reference population) that could be at increased collision risk with vessels and operational tidal devices at MDZ (based on scenarios for less than one bottlenose dolphin)

Species	Number of individuals (% of reference population)			Magnitude
	Increased collision risk with vessels (5-10% of individuals in total area; 15.09 km^2)	**Collision risk for one bottlenose dolphin scenario (ERM and CRM)**	**Total (maximum based on worst-case scenario)**	
Harbour porpoise	0.59-1.18 individuals (0.0006-0.0011% of MU)	20-23 individuals (0.02% of MU).	Up to 25 individuals (0.024%)	Potential permanent effect with **medium** magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).
Bottlenose dolphin	0.015-0.031 individuals (0.0038-0.0076% of MU)	0.99 individuals (0.25% of MU)	Up to 1 individual (0.25% of MU)	Potential permanent effect with **medium** magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).
Risso's dolphin	0.024-0.047 individuals (0.0003-0.0005% of MU)	1.4 individuals (0.02% of MU)	Up to 1.5 individuals (0.02% of MU)	Potential permanent effect with **medium** magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).

Species	Number of individuals (% of reference population)			Magnitude
	Increased collision risk with vessels (5-10% of individuals in total area; 15.09 km^2)	Collision risk for one bottlenose dolphin scenario (ERM and CRM)	Total (maximum based on worst-case scenario)	
Common dolphin	0.17-0.336 individuals (0.0003-0.0006% of MU)	8 individuals (0.01% of MU)	Up to 9 individuals (0.02% of MU)	Potential permanent effect with **medium** magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).
Minke whale	0.013-0.027 individuals (0.0001-0.0001% of MU)	2-3 individuals (0.01%)	Up to 3 individuals (0.01% of MU)	Potential permanent effect with **medium** magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).
Grey seal	0.117-0.237 individuals (0.0019%-0.0039% of MU)	4-5 individuals (0.08% of MU)	Up to 5 individuals (0.08% of MU)	Potential permanent effect with **medium** magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).
Harbour seal	0.0004-0.0007 individuals (0.0008-0.0015% of MU)	0.01 individuals (0.03% of MU)	Less than 1 individual (0.03% of MU)	Potential permanent effect with **medium** magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).

660. Taking into account the sensitivity and the potential magnitude of the effect the impact significance for any permanent impacts on harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal has been assessed as **minor (not significant)**, without mitigation (**Table 12-89**).

661. As outlined in **Section 12.6.4.5.5**, the potential population level effects of collision risk with operational tidal turbines on marine mammals have been assessed in **Appendix 12.2** (**Volume III**). The result of the PVA indicate that population trajectories of the baseline and collision risk scenarios of 1, 2 and 3 animals are very similar, with only a

potential for a decline when more than three adults per year are removed from the population of 397 bottlenose dolphins in the Irish Sea MU.

12.6.4.7.1. Mitigation

662. As outlined in **Section 12.6.2** and **12.6.4.5.3**.

12.6.4.7.2. Residual Impacts

663. With the effective and appropriate mitigation proposed any risk of collisions will be greatly reduced. As a precautionary approach the residual impacts have been assessed as minor (not significant) for all species.

Table 12-89 Assessment of impact significance for potential overall collision risk with vessels and operational turbines at MDZ (based on scenarios for less than one bottlenose dolphin)

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Maximum overall collision risk with vessels and operational turbines	Harbour porpoise	Low	Medium	Minor	Phased deployment, monitoring and mitigation	Minor (not significant)
	Bottlenose dolphin		Medium	Minor		Minor (not significant
	Risso's dolphin		Medium	Minor		Minor (not significant)
	Common dolphin		Medium	Minor		Minor (not significant)
	Minke whale		Medium	Minor		Minor (not significant)
	Grey seal		Medium	Minor		Minor (not significant)
	Harbour seal		Medium	Minor		Minor (not significant)

12.6.4.8. Potential Entanglement with Moorings

664. To date, there have been no recorded instances of marine mammal entanglement from mooring systems of renewable devices (Sparling *et al*., 2013; Isaacman and Daborn, 2011), or for anchored floating production, storage and offloading (FPSO) vessels in the oil and gas industry (Benjamins *et al*., 2014) with similar mooring lines.

665. The level of risk to become entangled varies with species (Benjamins *et al*., 2014), these factors include:

- Body size;
- Flexibility of movement;
- The ability to detect mooring lines and ropes; and
- The feeding ecology of the species.

666. Toothed whales have a lower risk than baleen whales, primarily due to their small size and manoeuvrability. Seal species have a similar risk level to small toothed cetaceans, with an increase in manoeuvrability.

667. Benjamins *et al*. (2014) provides a qualitative assessment of relative entanglement risk across different marine megafauna groups, taking into account both biological risk factors such as animal size, sensory capabilities and foraging methods, and physical risk factors such as mooring flexibility, pre-tension and footprint. **Table 12-90** summarises the results of this assessment.

Table 12-90 Relative risk assessment for marine mammals and mooring scenarios relevant to the Morlais site (based on biological and physical risk parameters; Benjamins *et al.*, 2014)

Species	Catenary & chain	Taut & accessory buoy
Harbour porpoise	Low	Low
Bottlenose dolphin	Low	Low
Risso's dolphin	Low	Low
Common dolphin	Low	Low
Minke whale	High	High
Grey seal	Low	Low
Harbour seal	Low	Low

668. Taking into account that there have been no recorded instances of marine mammal entanglement from mooring systems of renewable devices or similar mooring lines, the sensitivity of marine mammals to potential entanglement at the MDZ is assessed to be low.

669. In addition, the tidal devices and moorings would be regular checked (approximately 15 times annually for both planned and unplanned maintenance activities), this would ensure that there was no material such as discarded nets, ropes or other debris which could increase the risk of entanglement for marine mammals or interfere with the optimal operation of the tidal devices.

670. As a precautionary approach, the potential magnitude of effect has been based on the on the relative risk assessment for marine mammals by Benjamins *et al*. (2014) for the mooring scenarios which most represent those likely to be used at MDZ (i.e. catenary & chain and taut & accessory buoy) (**Table 12-90**).

671. The impact significance for the possible entanglement with mooring lines disturbance has been assessed as minor for harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, grey and harbour seal and minor to moderate for minke whale (**Table 12-91**).

12.6.4.8.1. Mitigation

672. The mitigation and monitoring measures to reduce the risk of collision with operational turbines would also reduce the risk of entablement with mooring lines.

12.6.4.8.2. Residual Impact

673. As a precautionary approach the residual impacts have been assessed as minor (not significant) for all species.

Table 12-91 Assessment of impact significance for possible entanglement of marine mammals with mooring lines at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Entanglement with mooring lines	Harbour porpoise	Low	Low	Minor	Phased deployment, monitoring and mitigation	Minor (not significant)
	Bottlenose dolphin		Low	Minor		Minor (not significant)
	Risso's dolphin		Low	Minor		Minor (not significant)
	Common dolphin		Low	Minor		Minor (not significant)
	Minke whale		Low to High	Minor to Moderate		Minor (not significant)
	Grey and harbour seal		Low	Minor		Minor (not significant)

12.6.4.9. Potential Electromagnetic Field (EMF) Effects

674. Potential pathways for effects from electromagnetic fields (EMF) would be from the presence of cables within the MDZ and ECC.

675. Normandeau *et al*. (2011) modelled expected magnetic fields using design characteristics taken from a range of undersea cable projects. For eight of the ten AC cables modelled it was found that the intensity of the magnetic field (B) was approximately a direct function of voltage (ranging from 33kV to 345kV) although separation between the cables and burial depth also influenced field strengths. Similarly, the modelling carried out for nine DC cables also found that the B field was a function of voltage (ranging from 75 to 500kV) and cable configuration. For both AC and DC cables, the predicted B fields were strongest directly over the cables and decreased rapidly with vertical and horizontal distance from the cables (**Table 12-92**).

Table 12-92 Averaged magnetic field strength values from AC and DC cables buried 1m (Normandeau *et al.*, 2011)

Distance (m) below seabed	Magnetic Fields Strength (μT)					
	Horizontal distance (m) from cable					
	0m AC	0m DC	4m AC	4m DC	10m AC	10m DC
0	7.85	78.27	1.47	5.97	0.22	1.02
5	0.35	2.73	0.29	1.92	0.14	0.75
10	0.13	0.83	0.12	0.74	0.08	0.46

676. Although it is assumed that marine mammals are capable of detecting small differences in magnetic field strength, this is unproven and is based on circumstantial information. There is also, at present, no evidence to suggest that existing subsea cables have influenced cetacean or seal movements. For example, harbour porpoise move in and out of the Baltic Sea with several crossings over operating subsea HVDC cables in the Skagerrak and western Baltic Sea without any apparent effect on their migration pattern. There is no evidence that pinnipeds respond to electromagnetic fields (Gill *et al*., 2005).

677. In addition, data from operational windfarms show no evidence of exclusion of marine mammals, such as harbour porpoise or seals (for example, Diederichs *et al*., 2008; Lindeboom *et al*., 2011; Marine Scotland, 2012; McConnell *et al*., 2012; Russell *et al*., 2014; Scheidat *et al*., 2011; Teilmann *et al*., 2006; Tougaard *et al*., 2005, 2009a, 2009b).

678. Therefore, harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey and harbour seal have been assessed as having negligible sensitivity to any potential EMF effects.

679. The number of harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal that could be affected by any potential EMF effects have been assessed based on the cable area (0.042 km^2; **Table 12-25**) in the MDZ and ECC (**Table 12-93**).

Table 12-93 Number of individuals (and % of reference population) that could be affected by any potential EMF effects

Species	Maximum number of individuals and (% of reference population)	Magnitude
Harbour porpoise	0.03 individuals (based on density estimate of 0.783/ km^2) (0.00003% of the 104,695 reference population).	Long-term effect with negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Bottlenose dolphin	0.001 individuals (based on density estimate of 0.02/ km^2) (0.0002% of the reference population of 397 bottlenose dolphin).	Long-term effect with negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Risso's dolphin	0.001 individuals (based on density estimate of 0.031/ km^2) (0.00001% of the reference population of 8,794 Risso's dolphin).	Long-term effect with negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Common dolphin	0.01 individuals (based on density estimate of 0.22/ km^2) (0.00002% of the reference population of 56,556 common dolphin).	Long-term effect with negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Minke whale	0.001 individuals (based on density estimate of 0.017/ km^2) (0.000003% of the reference population of 23,528 minke whale).	Long-term effect with negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Grey seal	0.01 individuals (based on density estimate of 0.155/ km^2)	Long-term effect with negligible magnitude (less than 0.01% of the

Species	Maximum number of individuals and (% of reference population)	Magnitude
	(0.0001% of the reference population of 6,000 grey seal).	reference population anticipated to be exposed to effect).
Harbour seal	0.00002 individuals (based on density estimate of 0.0005/ km^2) (0.00004% of the reference population of 50 harbour seal).	Long-term effect with negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).

680. The magnitude of the potential for any EMF effects is assessed as **negligible** for all species, with less than 0.01% of all relevant reference populations anticipated to be exposed to the long-term effect (**Table 12-35**).

681. Taking into account the negligible sensitivity of all marine mammal species and the potential negligible magnitude of the effect, the impact significance (based in the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) for any long-term effects over the duration of the Project has been assessed as **negligible** (**Table 12-94**).

12.6.4.9.1. Mitigation

682. No mitigation measures are required or proposed.

12.6.4.9.2. Residual Impact

683. The residual impact would remain negligible.

Table 12-94 Assessment of impact significance for possible EMF on marine mammals

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
EMF effects	Harbour porpoise	Negligible	Negligible	Negligible	No mitigation required.	Negligible
	Bottlenose dolphin		Negligible	Negligible		Negligible
	Risso's dolphin		Negligible	Negligible		Negligible
	Common dolphin		Negligible	Negligible		Negligible
	Minke whale		Negligible	Negligible		Negligible
	Grey and harbour seal		Negligible	Negligible		Negligible

12.6.4.10. Potential Barrier Effects

684. The physical presence of the tidal array could have the potential to create a physical barrier, preventing movement or migration of marine mammals between important

feeding and / or breeding areas, or potentially increasing swimming distances if marine mammals avoid the site and go around it.

685. As outlined in **Chapter 4, Project Description**, the final array layout will be identified post consent, following the berth selection and allocation process. The final detailed device locations will be developed based on further site investigation works conducted post-consent to determine detailed construction constraints. However, the assessment has been based on indicative spacings and potential area of the tidal arrays.

686. Seabed mounted devices may have a spacing of 70m to 150m between centres of devices perpendicular to the flow and 180m to 250m parallel to the flow. Such spacings may need to be modified to allow for seabed conditions, and this could alter spacings considerably, resulting in larger spacings.

687. Floating tidal devices sharing moorings may require up to 150m between structure centres perpendicular to the flow and 250m parallel to the flow.

688. Each device could move by up to 80m (±40m) in the direction parallel to the flow and 60m (±30m) in the direction perpendicular to the flow. Therefore, the overall surface area covered by device movement (including device yawing) is up to 4,800m^2 for a single floating device.

689. This equates to a maximum area taken up by all arrays, including spaces between devices (i.e. not the seabed footprint) of up to 12.5 km^2 for the full 240MW capacity project (**Table 12-25**).

690. As illustrated by the three indicative layouts (each totalling 240MW), each with a different combination of device arrays (sub-categories) in different locations, as outlined in **Chapter 4, Project Description**, there would be space between the different deployment areas and the rows of tidal arrays in each deployment areas.

691. The number of harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal that could be at risk of potential barrier effects has been based on the maximum area of 12.5 km^2 (**Table 12-95**).

692. As for underwater noise, the sensitivity of marine mammals to any disturbance or displacement has been assessed as low.

693. The magnitude of the potential impact is assessed as low or negligible with less than 0.01% or 1% of all relevant reference populations anticipated to be exposed to the long-term effect (**Table 12-95**).

Table 12-95 Number of individuals (and % of reference population) that could be impacted by any potential barrier effects from the physical presence of the tidal arrays

Species	Maximum number of individuals and (% of reference population)	Magnitude
Harbour porpoise	Up to 10 individuals (based on density estimate of 0.783/ km^2) (0.01% of the 104,695 reference population).	Long-term effect with low magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).
Bottlenose dolphin	0.25 individuals (based on density estimate of 0.02/ km^2) (0.063% of the reference population of 397 bottlenose dolphin).	Long-term effect with low magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).
Risso's dolphin	0.4 individuals (based on density estimate of 0.031/ km^2) (0.005% of the reference population of 8,794 Risso's dolphin).	Long-term effect with negligible / very low magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Common dolphin	Up to 3 individuals (based on density estimate of 0.22/ km^2) (0.005% of the reference population of 56,556 common dolphin).	Long-term effect with negligible / very low magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Minke whale	0.2 individuals (based on density estimate of 0.017/ km^2) (0.0009% of the reference population of 23,528 minke whale).	Long-term effect with negligible / very low magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Grey seal	Up to 2 individuals (based on density estimate of 0.155/ km^2) (0.03% of the reference population of 6,000 grey seal).	Long-term effect with low magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).
Harbour seal	0.006 individuals (based on density estimate of 0.0005/ km^2) (0.012% of the reference population of 50 harbour seal).	Long-term effect with low magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).

694. There is unlikely to be any potential barrier effects that could significantly affect the movements of marine mammals in or through the MDZ and ECC area. The maximum area for disturbance and any displacement from any barrier effects is relatively small in relation to the marine mammal MUs.

695. The potential for displacement is also unlikely to result in any significant increase in energy expenditure that could be required by harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal to avoid the area.

696. Taking into account the low sensitivity to any disturbance or displacement (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact; **Table 12-6**) and the potential magnitude of effect, the impact significance (based on the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) for any potential barrier effects for harbour porpoise, bottlenose dolphin, grey seal and harbour seal has been assessed as minor and for Risso's dolphin, common dolphin and minke whale as negligible (**Table 12-96**).

12.6.4.10.1. Mitigation

697. The proposed phased development and monitoring measures to reduce the risk of collision with operational turbines would also allow the potential for any displacement effects, e.g. changes in use of the site or movements in and around the site, to be assessed, and if required, be taken into account for the installation of subsequent arrays.

12.6.4.10.2. Residual Impact

698. As a precautionary approach the residual impact would remain negligible or minor (not significant).

Table 12-96 Assessment of impact significance for any disturbance and displacement for any barrier effects at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Barrier effects	Harbour porpoise	Low	Low	Minor	None required or proposed	Minor (not significant)
	Bottlenose dolphin		Low	Minor		Minor (not significant)
	Risso's dolphin		Negligible / very low	Negligible		Negligible
	Common dolphin		Negligible / very low	Negligible		Negligible
	Minke whale		Negligible / very low	Negligible		Negligible
	Grey and harbour seal		Low	Minor		Minor (not significant)

12.6.4.11. Potential Changes in Water Quality

699. During the operational phase of the project there is a potential risk to water quality via accidental spillage or release of materials such as grease and oils during maintenance work, from vessels or during any major cable repair works and/or repowering activities.

700. As outlined for construction, Menter Môn is committed to the use of best practice and pollution prevention guidelines at all times. An MPCP would be in place and agreed with NRW in line with the IPPC Directive such that any potential risk is minimised. Any permitted discharges would be small volumes, intermittent and dilute and disperse quickly.

701. As for the construction phase, if any such substances were accidentally released/leaked, quantities would likely be small due to relatively small amounts being present in individual devices. Due to the dynamic nature of the tidal and wave regime in and around the MDZ, lateral and vertical dispersion rates of any spilled substances would be expected to be high. For the assessment in **Chapter 8, Marine Water and**

Sediment Quality, the magnitude of this potential effect was considered to be low, as it is not anticipated to significantly affect local water quality and would also be temporary in nature (established controls would prevent further spillage/leakage once an event was detected. Therefore, any changes to water quality was assessed as a minor adverse impact.

702. During the operational phase of the project repowering of devices will occur. As a worst-case scenario, it has been assumed that up to 50 % of all devices will be replaced (repowered) over the lifetime of the project. In addition, it has been assumed that there would be up to 10 cable repair events, totalling up to 7,500m of cable disturbance.

703. These activities will create similar effects as previously assessed for the construction phase. The potential removal and re-installation of seabed mounted devices and/or seabed anchor systems for floating devices coupled with potential cable de-burial and re-burial in sedimentary areas will all result in creation of localised sediment plumes and subsequent deposition. The magnitude of this effect will be less than for the main construction phase due to a lower amount of seabed disturbance via these operational phase activities. Therefore, for assessment in **Chapter 8, Marine Water and Sediment Quality**, the magnitude was assessed as negligible, resulting in a negligible impact.

704. As outlined in **Chapter 8, Marine Water and Sediment Quality**, placing any structure on the seabed has the potential to result in scour around the structure, leading in turn to mobilisation of any available sediment in the area around the structure via plumes.

705. In areas of the MDZ where the sea bed is comprised of bare bedrock or where this is covered with boulders, cobbles or gravels there is unlikely to be any scouring effects, therefore there will be no change in suspended sediment concentrations. Where devices are placed in areas of the MDZ characterised by sands (e.g. southwest section and in the vicinity of the sand ridge in the north) there is potential for locally accelerated flows around foundations to increase suspended sediment concentrations, but since flows in these areas are very high in the baseline conditions, this will unlikely to result in any significant change from the current conditions. Therefore, given the nature of the sea bed morphology, comprised mostly of exposed bedrock, the potential for adverse effects of this nature is extremely limited.

706. For the majority of the site, where sediment cover is absent/limited, **Chapter 8, Marine Water and Sediment Quality** assessed the magnitude of this effect to be negligible, with a negligible impact.

707. In areas where there is some sediment cover and, thus where scour may occur, the magnitude of effect was assessed to be low, resulting in a minor adverse impact.

708. As for construction, taking into account the negligible sensitivity of all marine mammal species to any changes in water quality and the potential magnitude of the effect (negligible or low), the impact significance for any temporary impact on harbour

porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale grey seal and harbour seal has been assessed as negligible (**Table 12-97**).

12.6.4.11.1. Mitigation

709. As outlined for construction and in **Chapter 8, Marine Water and Sediment Quality**, mitigation would include adherence to project-specific Environmental Management Plans (EMPs) and Marine Pollution Contingency Plans (MPCP). No further mitigation for marine mammals in proposed.

12.6.4.11.2. Residual Impact

710. The residual impact would remain negligible.

Table 12-97 Assessment of impact significance for any changes in water quality during operation

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Change in water quality due to sediment plumes generated by repowering and/or cable repair works	Harbour porpoise	Negligible	Negligible	Negligible	EMP and MPCP	Negligible
	Bottlenose dolphin		Negligible	Negligible		Negligible
	Risso's dolphin		Negligible	Negligible		Negligible
	Common dolphin		Negligible	Negligible		Negligible
	Minke whale		Negligible	Negligible		Negligible
	Grey and harbour seal		Negligible	Negligible		Negligible
Change in water quality due to sediment plumes produced via scour around seabed mounted project infrastructure	Harbour porpoise	Negligible	Negligible to Low	Negligible		Negligible
	Bottlenose dolphin		Negligible to Low	Negligible		Negligible
	Risso's dolphin		Negligible to Low	Negligible		Negligible
	Common dolphin		Negligible to Low	Negligible		Negligible
	Minke whale		Negligible to Low	Negligible		Negligible
	Grey and harbour seal		Negligible to Low	Negligible		Negligible
Change in water quality due to accidental	Harbour porpoise	Negligible	Low	Negligible		Negligible
	Bottlenose dolphin		Low	Negligible		Negligible

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
spillages/leaks from operational devices	Risso's dolphin		Low	Negligible		Negligible
	Common dolphin		Low	Negligible		Negligible
	Minke whale		Low	Negligible		Negligible
	Grey and harbour seal		Low	Negligible		Negligible

12.6.4.12. Potential Changes in Prey Availability

711. In **Chapter 10, Fish and Shellfish Ecology**, the potential impacts assessed for the operational and maintenance phase were

- Underwater Noise;
- Long-term habitat loss via placement of project infrastructure (project footprint);
- Barrier Effects;
- Collision Risk;
- Electromagnetic Fields; and
- Repowering.

12.6.4.12.1. Prey Impacts from Underwater Noise of Operational Turbines

712. The underwater noise assessment in **Chapter 10, Fish and Shellfish Ecology** was based on the modelling conducted for operational noise for the PTEC project, for 24m rotor (worst case scenario for the PTEC project). The largest range at which a behavioural reaction was predicted (i.e. levels of 75 dB_{ht} are reached) was 36m, for cod species. The largest range at which a startle response was predicted (i.e. levels of 90 dB_{ht} are reached) was 3m, also for cod.

713. These ranges are less than those predicted for marine mammal species (**Table 12-64**), therefore there will be no further impact on marine mammals as a result of any changes in prey availability due to underwater noise from operational turbines, as marine mammals will be displaced from the area that any changes in prey distribution could occur.

12.6.4.12.2. Prey Impacts from Permanent Habitat Loss

714. As outlined in **Chapter 10 Fish and Shellfish Ecology** and in **Table 12-25**, the worst-case scenario for permanent habitat loss would be up to 2.18 km^2, based on area for Gravity Base Structures (GBS) (74,790m^2), swept area of catenary cables (2,055,000m^2), export cable footprint (cables and protection systems; 11,745m^2), array

cable footprint (cables and protection systems; 30,040m^2), additional cable protection material (4,860m^2), cable tails (120m^2), trench for 9 x landfall cables (7,400m^2), footprint of navigation marker buoys (540m^2), footprint of Acoustic Doppler Current Profiler (ADCP) moorings (280m^2), footprint of seabed mounted environmental monitoring units (112m^2) and footprint of mooring for floating environmental monitoring units (45m^2).

715. The magnitude of the potential displacement due to changes in prey availability as a result of permanent habitat loss is assessed as **negligible / very low** for all species, with less than 1% of all relevant reference populations anticipated to be exposed to the effect (**Table 12-98**).

Table 12-98 Number of individuals (and % of reference population) that could be impacted by any changes of prey availability as a result of permanent habitat loss at MDZ

Potential Impact	Maximum number of individuals and (% of reference population)	Magnitude
Displacement of harbour porpoise due to changes in prey availability	1.71 individuals (based on density estimate of 0.783/ km^2) (0.0016% of the 104,695 reference population).	Long-term effect with negligible / very low magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Displacement of bottlenose dolphin due to changes in prey availability	0.04 individuals (based on density estimate of 0.02/ km^2) (0.011% of the reference population of 397 bottlenose dolphin).	Long-term effect low magnitude (between 0.01% and 1% of the reference population anticipated to be exposed to effect).
Displacement of Risso's dolphin due to changes in prey availability	0.07 individuals (based on density estimate of 0.031/ km^2) (0.0008% of the reference population of 8,794 Risso's dolphin).	Long-term effect with negligible / very low magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Displacement of common dolphin due to changes in prey availability	0.48 individuals (based on density estimate of 0.22/ km^2) (0.00085% of the reference population of 56,556 common dolphin).	Long-term effect with negligible / very low magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Displacement of minke whale due to changes in prey availability	0.04 individuals (based on density estimate of 0.017/ km^2) (0.0016% of the reference population of 23,528 minke whale).	Long-term effect with negligible / very low magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Displacement of grey seal due to changes in prey availability	0.34 individuals (based on density estimate of 0.155/ km^2) (0.006% of the reference population of 6,000 grey seal).	Long-term effect with negligible / very low magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Displacement of harbour seal due to changes in prey availability	0.001 individuals (based on density estimate of 0.0005/ km^2) (0.002% of the reference population of 50 harbour seal).	Long-term effect with negligible / very low magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).

716. The assessment in **Chapter 10, Fish and Shellfish Ecology**, determined that the potential impacts of permanent habitat loss on prey species would result in a low magnitude of the effect, coupled with the medium sensitivity of the receptors, the

impact significance was assessed as minor adverse. No mitigation measures were considered to be required.

12.6.4.12.3. Prey Impacts from Barrier Effects

717. Barrier effects to the movements of fish and shellfish through the water column can arise during the Project due to the presence of tidal devices and associated infrastructure, including mooring chains and catenaries. The worst-case scenario (arising during full site deployment) assessed in **Chapter 10, Fish and Shellfish Ecology** was for the swept area of TEC's of 84,500m^2 based on seabed-mounted multiple rotor platform device types with rotors up to 27m in diameter. However, the assessment found it unlikely to present a complete barrier to fish due to the separation distance (70m distance in the shortest dimension).

718. The assessment in **Chapter 10, Fish and Shellfish Ecology**, determined that the potential impacts of any barrier effects on prey species would result in a medium magnitude of the effect and coupled with the low sensitivity of the receptor there is a minor adverse impact. No mitigation measures were considered to be required.

719. For marine mammals, the potential magnitude for any changes in prey availability is considered to be low, taking into marine sensitivity to changes in prey availability, the impact significance has been assessed as minor (not significant) for all species (**Table 12-99**).

12.6.4.12.4. Prey Impacts from Collision Risk

720. Collision risks can arise from fish coming into contact with the operational tidal devices. The area within which collision risk could occur is equivalent to the maximum swept area (84,500m^2).

721. As outlined in **Chapter 10, Fish and Shellfish Ecology**, it can be assumed that if fatal collisions do occur, it is likely to only be to a small proportion of individuals and not result in a population level effect. The loss of individuals, in the context of the total loss of individuals for a population, are considered to be within the natural levels of mortality due to other factors, therefore the magnitude of the effect at a population was considered to be very low/negligible.

722. Therefore, the combination of a low sensitivity and a very low/negligible magnitude results in a negligible impact significance. However, due to the uncertainty over this assessment, the impact significance was augmented to minor adverse as a precautionary measure.

723. For marine mammals, the potential magnitude for any changes in prey availability is considered to be low, taking into marine sensitivity to changes in prey availability, the impact significance has been assessed as minor (not significant) for all marine mammal species (**Table 12-99**).

12.6.4.12.5. Prey Impacts from Electromagnetic Fields

724. The potential impact of EMF on prey would be the same as those assessed for marine mammals in **Section 12.6.4.9**.

725. The assessment in **Chapter 10, Fish and Shellfish Ecology**, has determined that the potential impacts of any EMF effects on prey species would result in a low magnitude of the effect and coupled with the low sensitivity of the receptor there is a minor adverse impact. No mitigation measures were considered to be required, other than the proposed cable protection.

726. For marine mammals, the potential magnitude for any changes in prey availability is considered to be low, taking into marine sensitivity to changes in prey availability, the impact significance has been assessed as minor (not significant) for all marine mammal species (**Table 12-99**).

12.6.4.12.6. Prey Impacts from Repowering

727. The potential impacts would be the same or less than those assessed for construction in **Sections 12.6.3.8.1**, **12.6.3.8.2** and **12.6.3.8.3**.

728. For marine mammals, the potential magnitude for any changes in prey availability is considered to be negligible / very low, taking into marine sensitivity to changes in prey availability, the impact significance has been assessed as negligible to minor (not significant) for marine mammal species (**Table 12-99**).

12.6.4.12.7. Mitigation

729. No mitigation measures are required or proposed.

12.6.4.12.8. Residual Impact

730. The residual impact would remain negligible or minor (not significant), as detailed in Table 12.99, below.

Table 12-99 Assessment of impact significance for any displacement as a result of any changes to prey availability during operation at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Displacement due to underwater noise impact on prey species	Harbour porpoise	Low to medium	Negligible / very low	Negligible to Minor (not significant)	None required or proposed	Negligible to Minor (not significant)
	Bottlenose dolphin	Low	Negligible / very low	Negligible		Negligible
	Risso's dolphin	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
	Common dolphin	Low	Negligible / very low	Negligible		Negligible
	Minke whale	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal	Low	Negligible / very low	Negligible		Negligible
Displacement due to permanent habitat loss impact on prey species	Harbour porpoise	Low to medium	Negligible / very low	Negligible to Minor (not significant)	None required or proposed	Negligible to Minor (not significant)
	Bottlenose dolphin	Low	Low	Minor (not significant)		Negligible
	Risso's dolphin	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)
	Common dolphin	Low	Negligible / very low	Negligible		Negligible
	Minke whale	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal	Low	Negligible / very low	Negligible		Negligible
Displacement due to changes in prey availability from barrier effects	Harbour porpoise	Low to medium	Low	Minor (not significant)	None required or proposed	Minor (not significant)
	Bottlenose dolphin	Low	Low	Minor (not significant)		Minor (not significant)
	Risso's dolphin	Medium	Low	Minor (not significant)		Minor (not significant)
	Common dolphin	Low	Low	Minor (not significant)		Minor (not significant)
	Minke whale	Medium	Low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal	Low	Low	Minor (not significant)		Minor (not significant)
Displacement due to changes in prey availability from collision risk	Harbour porpoise	Low to medium	Low	Minor (not significant)	None required or proposed	Minor (not significant)
	Bottlenose dolphin	Low	Low	Minor (not significant)		Minor (not significant)
	Risso's dolphin	Medium	Low	Minor (not significant)		Minor (not significant)
	Common dolphin	Low	Low	Minor (not significant)		Minor (not significant)
	Minke whale	Medium	Low	Minor (not significant)		Minor (not significant)

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
	Grey and harbour seal	Low	Low	Minor (not significant)		Minor (not significant)
Displacement due to changes in prey availability from EMF	Harbour porpoise	Low to medium	Low	Minor (not significant)	None required or proposed	Minor (not significant)
	Bottlenose dolphin	Low	Low	Minor (not significant)		Minor (not significant)
	Risso's dolphin	Medium	Low	Minor (not significant)		Minor (not significant)
	Common dolphin	Low	Low	Minor (not significant)		Minor (not significant)
	Minke whale	Medium	Low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal	Low	Low	Minor (not significant)		Minor (not significant)
Displacement due changers in prey availability from repowering	Harbour porpoise	Low to medium	Negligible / very low	Negligible to Minor (not significant)	None required or proposed	Negligible to Minor (not significant)
	Bottlenose dolphin	Low	Negligible / very low	Negligible		Negligible
	Risso's dolphin	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)
	Common dolphin	Low	Negligible / very low	Negligible		Negligible
	Minke whale	Medium	Negligible / very low	Minor (not significant)		Minor (not significant)
	Grey and harbour seal	Low	Negligible / very low	Negligible		Negligible

12.6.4.13. Overall Potential Disturbance During Operation

731. The overall maximum area of possible disturbance during ADD activation in-combination with the underwater noise from the operational turbines would be the same area as assessed for ADDs, for example, up to 31.4 km^2 if ten ADDs were activated at the same time (**Table 12-73**), as the area of disturbance would be greater than the area of potential disturbance for underwater noise from operational turbines for the full deployment of up to 11.7 km^2 for harbour porpoise, 0.28 km^2 for dolphin species, 5 km^2 for minke whale and 0.18 km^2 for seals (**Table 12-66**).

732. As a precautionary approach the maximum area of potential disturbance has been assessed for underwater water noise from operational turbines for the full deployment (240MW; **Table 12-66**) at the same time as underwater water noise from any maintenance, repowering and vessels, based on the worst-case scenarios and

maximum potential impact ranges for two drilling activities, two cable laying activities, two cable protection activities and up to 16 vessels (**Table 12-53**). However, during maintenance and repowering activities it is likely that a number of devices or array(s) would be none operational.

733. The magnitude of the long-term effect for the overall potential disturbance is assessed as low for harbour porpoise and very low / negligible for all other species (**Table 12-100**).

Table 12-100 Maximum number of individuals (and % of reference population) that could be disturbed as a result of underwater from maintenance, repowering, vessels and operational tidal devices at MDZ

Potential Impact	**Maximum number of individuals and (% of reference population)**			**Magnitude**
	Maintenance, repowering and vessels	**Full deployment* (possible strong avoidance ($90dB_{ht}$))**	**Total (maximum based on worst-case scenario)**	
Disturbance of harbour porpoise	6.2 individuals in 7.89 km^2 (based on density estimate of 0.783/ km^2) (0.006% of the 104,695 reference population).	9.2 individuals in 11.7 km^2 (0.009% of MU)	15.4 individuals in 19.59 km^2 (0.015% of MU)	Long term effect with low magnitude (with between 0.01% and 1% of the reference population anticipated to be exposed to effect).
Disturbance of bottlenose dolphin	0.002 individuals in 0.12 km^2 (based on density estimate of 0.02/ km^2) (0.0006% of the reference population of 397 bottlenose dolphin).	0.006 individuals in 0.28 km^2 (0.0015% for MU)	0.008 individuals in 0.4 km^2 (0.002% of MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Disturbance of Risso's dolphin	0.004 individuals in 0.12 km^2 (based on density estimate of 0.031/ km^2) (0.00004% of the reference population of 8,794 Risso's dolphin).	0.009 individuals in 0.28 km^2 (0.0001% for MU)	0.013 individuals in 0.4 km^2 (0.00015% of MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).

Potential Impact	Maximum number of individuals and (% of reference population)			Magnitude
	Maintenance, repowering and vessels	**Full deployment* (possible strong avoidance ($90dB_{ht}$))**	**Total (maximum based on worst-case scenario)**	
Disturbance of common dolphin	0.03 individuals in 0.12 km^2 (based on density estimate of 0.22/ km^2) (0.00005% of the reference population of 56,556 common dolphin).	0.06 individuals in 0.28 km^2 (0.0001% for MU)	0.09 individuals in 0.4 km^2 (0.00016% of MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Disturbance of minke whale	0.45 individuals in 26.35 km^2 (based on density estimate of 0.017/ km^2) (0.0019% of the reference population of 23,528 minke whale).	0.0085 individuals in 5 km^2 (0.0004% for MU)	0.9 individuals in 31.35 km^2 (0.004% of MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Disturbance of grey seal	0.08 individuals in 0.52 km^2 (based on density estimate of 0.155/ km^2) (0.001% of the reference population of 6,000 grey seal).	0.03 individuals in 0.18 km^2 (0.0005% for MU)	0.11 individuals in 0.7 km^2 (0.0018% of MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).
Disturbance of harbour seal	0.0003 individuals in 0.52 km^2 (based on density estimate of 0.0005/ km^2) (0.0005% of the reference population of 50 harbour seal).	0.00009 individuals in 0.18 km^2 (0.00018% for MU)	0.00039 individuals in 0.7 km^2 (0.0008% of MU)	Long-term effect with very low / negligible magnitude (less than 0.01% of the reference population anticipated to be exposed to effect).

734. Taking into account the low sensitivity to any disturbance (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact; **Table 12-6**) and the potential magnitude of the effect, the impact significance (based in the impact significance matrix (**Table 12-9**) and as defined in **Table 12-10**) for any possible long-term disturbance in harbour porpoise has been assessed as **minor (not significant)** and **negligible** for bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal (**Table 12-101**).

Table 12-101 Assessment of impact significance for long-term disturbance of marine mammals from underwater noise from maintenance, repowering, vessels and operational tidal devices at MDZ

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Disturbance from maintenance, repowering, vessels and operational tidal devices	Harbour porpoise	Low	Low	Minor	No mitigation required or proposed.	Minor (not significant)
	Bottlenose dolphin		Very low / negligible	Negligible		Negligible
	Risso's dolphin		Very low / negligible	Negligible		Negligible
	Common dolphin		Very low / negligible	Negligible		Negligible
	Minke whale		Very low / negligible	Negligible		Negligible
	Grey and harbour seal		Very low / negligible	Negligible		Negligible

12.6.4.13.1. Mitigation

735. No mitigation measures are required or proposed.

12.6.4.13.2. Residual Impact

736. The residual impact would remain minor (not significant) for harbour porpoise and negligible for all other species for the potential overall disturbance from maintenance, repowering, vessels and operational turbines.

12.6.5. Assessment of Potential Impacts During Decommissioning

12.6.5.1. Underwater Noise and Disturbance

737. Decommissioning would most likely involve the removal of the accessible installed components comprising: all of the tidal device components; part of the foundations (those above seabed level); and the sections of the array cables close to the offshore structures, as well as sections of the export cables. The process for removal of foundations is generally the reverse of the installation process. There would be no drilling, but foundations may be cut to an appropriate level.

738. It is not possible to provide details of the methods that will be used during decommissioning at this time. However, is it expected that the activity levels will be comparable to construction (with the exception of drilling noise which would not occur).

739. For this assessment it is assumed that the potential impacts from underwater noise during decommissioning would be comparable or less than those assessed for drilling (**Section 12.6.3.1**), other construction activities (**Section 12.6.3.2**), vessels (**Section 12.6.3.3**) and potential barrier effects (**Section 12.6.3.4**).

12.6.5.2. Disturbance at Seal Haul-Out Sites

740. For this assessment, it is assumed that the potential impacts from any disturbance at seal haul-out sites during decommissioning would be comparable or less than those assessed for construction (**Section 12.6.3.5**).

12.6.5.3. Possible Increased Collision Risk with Vessels

741. For this assessment, it is assumed that the potential impacts from possible increased collision risk with vessels during decommissioning would be comparable or less than those assessed for construction (**Section 12.6.3.6**).

12.6.5.4. Potential Changes in Water Quality

742. For this assessment, it is assumed that the potential impacts from any changes in water quality during decommissioning would be comparable or less than those assessed for construction (**Section 12.6.3.7**).

12.6.5.5. Potential Changes in Prey Availability

743. For this assessment, it is assumed that the potential impacts from potential changes in prey availability during decommissioning would be comparable or less than those assessed for construction (**Section 12.6.3.8**).

12.6.5.6. Mitigation

744. It is proposed the MMMPs would be prepared for decommissioning activities that could have potential underwater noise impacts, such as the removal of tidal devices and cables. These MMMPs would be similar to those proposed in **Sections 12.6.3.1.2.1.1** and **12.6.3.2.2.1.1**.

745. To reduce any potential impacts from changes in water quality, mitigation would include adherence to project-specific EMPs and MPCPs.

12.6.5.7. Residual Impacts

746. The residual impact would be the same as for construction, negligible or minor adverse.

12.6.6. Assessment of Potential Cumulative Impacts

12.6.6.1. Screening for Cumulative Impacts

747. The potential effects from the Project that were screened in for assessment for the project alone were further screened for the potential for cumulative effects with other projects. This process is detailed in **Table 12-102**.

Table 12-102 Cumulative Impact Assessment screening for marine mammals

Impact	Potential for Cumulative Impact	Confidence of Prediction	Justification
Underwater noise and disturbance	Yes	High	There is the potential for cumulative impacts from underwater noise, such as construction activities and vessels from other projects which could have a cumulative impact on marine mammals. A number of projects have been identified that have the potential for cumulative impacts and therefore a more detailed assessment will be carried out for construction, operation and decommissioning impacts of other projects. There is no potential for cumulative impacts for auditory injury as MMMPs for each project will reduce the risk of PTS and therefore any potential cumulative impacts.
Potential barrier effects	No	High	It has been identified that there is no potential for cumulative barrier impacts with other projects, based on the location and distances of the projects.
Disturbance at seal haul-out sites	No	High	No projects have been identified that have the potential for cumulative impacts on the seal haul-out site near the MDZ and ECC.
Increased collision risk with vessels	Yes	High	There is the potential for an increased risk of collision with vessels from a number of different projects, and therefore a more detailed assessment will be carried out for construction, operation and decommissioning impacts of other projects.
Potential changes in water quality	No	High	There is no potential for any changes to water quality to impact on marine mammal species in and around the MDZ and ECC, therefore there is no potential for cumulative impacts with other projects.
Potential changes in prey availability from habitat loss	Yes	High	There is the potential for changes to prey availability to impact on marine mammal species from a number of other projects, therefore a more detailed assessment will be carried out for construction, operation and decommissioning impacts of other projects.
Collision risk with tidal devices	Yes	High	It has been identified that there is the potential for collision risk from tidal devices from at least one other project, and therefore a more detailed assessment will be carried out for the operational impacts of other projects.
Potential entanglement with moorings for floating devices	Yes	High	It has been identified that there is the potential for entanglement from the mooring of floating devices from at least one other project, and therefore a more detailed

Impact	Potential for Cumulative Impact	Confidence of Prediction	Justification
			assessment will be carried out for the operational impacts of other projects.
Potential EMF impacts	No	High	It has been identified that there is no potential for EMF impacts to marine mammal species.

748. A number of cumulative impacts have been identified to have the potential to impact on marine mammal species as identified within **Table 12-102**, and are assessed further in the following sections.

12.6.6.2. Projects Considered for Cumulative Impacts

749. The classes of projects that were considered for the cumulative assessment of marine mammals include offshore wind farms, other marine renewable energy projects, marine aggregate extraction, any oil and gas exploration and extraction, port and harbour projects, subsea cables and pipelines. Only those projects that have had their application submitted or approved, are currently being constructed or are in their operational phases have been considered. Some additional projects have been included if there is enough information available prior to their submission. For projects that are operational, only those potential impacts from operational, maintenance and decommissioning activities are considered.

750. The identification of projects included in the cumulative assessment has been based on approved plans, constructed projects, approved but as yet unconstructed projects, projects for which an application has been made, are currently under consideration and may be consented. In addition, other '"foreseeable" projects are included: those for which an application has not been made but have been the subject of consultation by the developer, or those are listed in plans that have clear delivery mechanisms. For such projects, the absence of robust or relevant data could preclude a quantitative cumulative assessment being carried out.

751. Any projects which have been ongoing since the collection of baseline data (e.g. Holyhead Harbour Maintenance Dredging) are considered part of the baseline.

752. The projects identified have only been assessed for those species that are within the identified Management Unit that is included in the assessments. An indication has been made as to which marine mammal species each Project with the potential for cumulative impact has been included for.

753. A summary of projects considered for CIA and their potential for cumulative impacts is presented in **Table 12-103**.

Table 12-103 Summary of projects considered in CIA and potential for cumulative impacts

Project	Status	Species MU area	Distance from Nearest Part of Project (km)	Potential for Cumulative Impacts							
				Underwater noise and disturbance	Collision risk from vessels	Collision risk from tidal devices	Changes in water quality	Changes to prey availability	Potential for entanglement with moored devices	Potential for EMF impacts	Potential for barrier effects
Holyhead Deep Phase I	In April 2017, a Marine Licence was granted for the first 0.5 MW installation.	All	2	Yes	Yes	Yes	No	No	No	No	No
Holyhead Deep Tidal Array	In 2017, scoping report submitted for an 80MW extension to the Holyhead Deep tidal array.	All	2	Yes	Yes	Yes	No	Yes	No	No	No
Holyhead Port Expansion	ES currently being prepared	All	2	Yes	Yes	N/A	No	Yes	No	No	No
Holyhead Waterfront Regeneration	Awarded Outline Planning Permission in 2014, with Reserved Matters.	All	2	Yes	Yes	N/A	No	No	No	No	No
Wylfa Nuclear Power Plant	Project Suspended	All	17	Yes	Yes	N/A	No	Yes	No	No	No
Wylfa Decommissioning	Ongoing (most work on land)	All	17	Yes	Yes	N/A	No	Yes	No	No	No
Amlwch LNG	The existing consent was renewed in 2013, but future plans are unclear and timescales undefined.	All	20.5	Yes	Yes	N/A	No	No	No	No	No

Project	Status	Species MU area	Distance from Nearest Part of Project (km)	Potential for Cumulative Impacts							
				Underwater noise and disturbance	Collision risk from vessels	Collision risk from tidal devices	Changes in water quality	Changes to prey availability	Potential for entanglement with moored devices	Potential for EMF impacts	Potential for barrier effects
North Hoyle Offshore Wind Farm	Operation and Maintenance Activities only.	All	81	Yes	No	N/A	No	No	N/A	No	No
Rhyl Flats Offshore Windfarm	Operation and Maintenance Activities only.	All	59	Yes	Yes	N/A	No	No	N/A	No	No
Gwynt y Môr Offshore Wind Farm	Operations and Maintenance activities only.	All	65	Yes	Yes	N/A	No	No	N/A	No	No
Barrow Offshore Wind Farm	Operations and Maintenance activities only.	All	116	Yes	Yes	N/A	No	No	N/A	No	No
West of Duddon Sands Offshore Wind Farm	Operations and Maintenance activities only.	All	114	Yes	Yes	N/A	No	No	N/A	No	No
Ormonde Offshore Wind Farm	Operations and Maintenance activities only.	All	117	Yes	Yes	N/A	No	No	N/A	No	No
Walney Extension Offshore Wind Farm	Operations and Maintenance activities only.	All	114	Yes	No	N/A	No	No	N/A	No	No
Burbo Bank Extension Offshore Wind Farm	Operations and Maintenance activities only.	All	95	Yes	Yes	N/A	No	No	N/A	No	No

Project	Status	Species MU area	Distance from Nearest Part of Project (km)	Potential for Cumulative Impacts							
				Underwater noise and disturbance	Collision risk from vessels	Collision risk from tidal devices	Changes in water quality	Changes to prey availability	Potential for entanglement with moored devices	Potential for EMF impacts	Potential for barrier effects
Codling Wind Park	Consented.	All	75	Yes	Yes	N/A	No	No	N/A	No	No
Codling Wind Park Extension.	Application submitted.	All	75	Yes	Yes	N/A	No	No	N/A	No	No
Alexandra Basin Redevelopment.	Current status unknown, but the project has been consented.	All	96	Yes	No	N/A	No	No	N/A	No	No
Isle of Man Ferry Terminal.	MLA/2018/00536. Marine Licence App submitted Dec 2018.	All	92	Yes	Yes	N/A	No	No	N/A	No	No
Milford Haven, Maintenance Dredge Pembrokeshire	Application submitted.	All	175	Yes	Yes	N/A	No	Yes	N/A	No	No
Afon Dysynni outfall gravel removal and relocation	Marine Licences issued and valid until 17/10/2021.	All	81	Yes	Yes	N/A	No	Yes	N/A	No	No
Belfast Harbour D3 terminal cruise ship facility	Application submitted, awaiting a decision.	All	163	Yes	Yes	N/A	No	No	N/A	No	No
Disposal of dredge material from the D3 approach channel	Application submitted, awaiting a decision.	All	163	Yes	Yes	N/A	No	No	N/A	No	No

Project	Status	Species MU area	Distance from Nearest Part of Project (km)	Potential for Cumulative Impacts							
				Underwater noise and disturbance	Collision risk from vessels	Collision risk from tidal devices	Changes in water quality	Changes to prey availability	Potential for entanglement with moored devices	Potential for EMF impacts	Potential for barrier effects
Marine Energy Wales marine testing area	Scoping – Issued Nov 2018	All	175	Yes	Yes	Yes	No	No	No	No	No
Argyll Tidal Demonstration	Marine licence secured in 2015, status of works unknown	Grey and harbour seal OSPAR MU only	225	Yes	Yes	Yes	No	No	N/A	No	No
Sound of Islay Demonstration Site	Consented – construction programme not known	Grey and harbour seal OSPAR MU only	268	Yes	Yes	Yes	No	No	N/A	No	No
West of Islay Tidal Energy Park	Consented – construction programme not known	Grey and harbour seal OSPAR MU only	265	Yes	Yes	Yes	No	No	N/A	No	No
Enlli Tidal Energy Scheme, Bardsey Island	Pre-application. An Agreement for Lease was awarded pre-May 2018. The project would include up to 20 100 kW turbines	All	50	Yes	Yes	Yes	No	Yes	Unknown	Yes	Yes

12.6.6.3. Cumulative Impact Assessment

754. The quantitative cumulative impact assessment for marine mammals has been conducted for underwater noise and disturbance (**Table 12-104**), collision risk with tidal devices and vessels (**Table 12-105**) and changes in prey availability as a result of habitat loss (**Table 12-106**).

755. Changes in prey availability as a result of any potential disturbance from underwater noise would be less that areas of potential impact assessed for marine mammals and would therefore have no further potential cumulative impacts.

756. As no instances of entanglement with the mooring systems of renewable energy have been recorded, and the constant tension of the mooring line for the Holyhead Deep Phase I, the impact was concluded to be negligible for harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin and grey seal, and low for minke whale. Taking into account the assessment of potential entanglement at MDZ (**Section 12.6.4.8**), there is no predicted cumulative effects.

757. To take into account the movement of grey and harbour seal and locations of the projects in the cumulative impact assessment (i.e. not all located in the South and West England and the Wales MU) the assessments of disturbance from underwater noise and collision risk with tidal devices and vessels have been put into the context of the 40,233 grey seal and 31,549 harbour seal in the wider OSPAR region (based on Russell *et a*l., 2017).

Table 12-104 Cumulative impact assessment for potential disturbance of harbour porpoise (HP), bottlenose dolphin (BND), Risso's dolphin (RD), common dolphin (CD), minke whale (MW), grey seal (GS) and harbour seal (HS) from underwater noise (N/A = not available)

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
Morlais	Underwater noise and disturbance from installation of tidal devices and hubs (two drilling rigs), two cable laying activities, two cable protection activities and up to 16 vessels, plus operational turbine noise for full deployment (240MW).	See **Section 12.6.4.13**	15.4	0.008	0.0013	0.09	0.9	0.11	0.0004
Holyhead Deep Phase I[3]	Underwater noise and potential disturbance from vessels during operation and maintenance	Based on assessment in ES for estimated number of animals experiencing behavioural change as a result of the LARS support vessel noise during operation.	17	0	-	1	1	15	-
	Underwater noise and potential disturbance from operational turbine	For operational noise impacts, the ES concluded that the disturbance range would be less 1m as a result of noise from the turbines.	0	0	0	0	0	0	0
Holyhead Deep Tidal Array – 80MW	Underwater noise and disturbance during installation	Assumed to be the same as assessment in ES for single device that disturbance area could extend out to 375m for pile drilling and out to a maximum of 10,000m for the vibro-hammering.	105.2	1.6	10	6	7.5	49	0.16

[3] https://www.minesto.com/sites/default/files/documents/l100194-s14-eias-001-a01_es_compressed.pdf

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
		For the installation of one DGU piling activities are likely to be limited to approximately 5 days, the ES concluded that there is likely to be very limited interaction between the piling noise and mammals; any changes would likely be undetectable against natural variation and would have no residual impact at the population level. However, as a worst-case scenario the number of marine mammals in the 10 km range (314 km^2 area) has been estimated, based on the density estimates in the ES for HP, BND, CD & MW and the MDZ density estimates for RD, GS and HS, this area would include construction vessels.							
Holyhead Deep Tidal Array – 80MW	Underwater noise and potential disturbance from construction vessels	Assumed to be the same as assessment in ES for single device that disturbance ranges for marine mammals from vessel noise could be 14 km for installation / construction vessel (using DP) and up to 4 km for support vessels. No numbers of individuals provided in the ES. However, the ES concluded that whilst a small number of individual animals may exhibit some form of change	0	0	0	0	0	0	0

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
		in behaviour for the period in which they encounter sound from the installation or support vessels, this number is likely to be small and the main noise sources present for such a short time that any changes would likely be undetectable against natural variation.							
Holyhead Port Expansion	Underwater noise and disturbance	ES not available at time of writing, therefore, no information available to inform cumulative assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Holyhead Waterfront Regeneration	Underwater noise and disturbance	No information available to inform cumulative assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wylfa Nuclear Power Plant	Underwater noise and disturbance during construction	When the predicted effects of the construction works (e.g. two percussive drilling rigs, the disposal of dredged material and disturbance from vessels) are considered together, on a very precautionary basis, is 1.26 km^2 for harbour porpoise. For RD, CD and MW density estimates for the MDZ used.	3	1	0.04	0.3	0.02	4.5	0.05
Wylfa Decommissioning	Underwater noise and disturbance	No key significant adverse impacts were identified by the ecological assessment	0	0	0	0	0	0	0
Amlwch LNG	Underwater noise and disturbance	No information available to inform cumulative assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
North Hoyle Offshore Wind Farm[4]	Underwater noise and disturbance during operation and maintenance activities	Due to the low incidence of individuals in the area, and the pre-existing noisy environment, impacts from underwater noise are not considered to be significant.	0	0	0	0	0	0	0
Rhyl Flats Offshore Windfarm	Underwater noise and disturbance during operation and maintenance activities	No information available to inform cumulative assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Gwynt y Môr Offshore Wind Farm[5]	Underwater noise and disturbance during operation and maintenance activities	During the operation and maintenance of the Gwynt y Môr Offshore Wind Farm, there is the potential for disturbance as a result of underwater noise from maintenance activities such as cable re-burial and vessels. However, it is likely to be limited to the wind farm site, short-term and temporary, and therefore there would be a negligible impact only.	0	0	0	0	0	0	0
Barrow Offshore Wind Farm Operation &	Underwater noise and disturbance during operation and maintenance activities	Disturbance and masking effects could occur over the short-term but would be temporary effects only. Given the baseline level of vessel activity in the area, marine mammals will, to	0	0	0	0	0	0	0

[4] https://www.innogy.com/web/cms/mediablob/en/3170702/data/3170690/1/rwe-innogy/rwe-innogy-uk/sites/wind-offshore/in-operation/north-hoyle/environmental-statement/chapter5.pdf
[5] https://tethys.pnnl.gov/sites/default/files/publications/Gwynt-y-Mor-Offshore-Wind-Farm-Technical-Report.pdf

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
Maintenance Activities[6]		some degree, be sensitised to noise from vessels. Therefore, the effects are predicted to be short-term and reversible, with marine mammal activity returning to baseline levels after the vessel has passed / activity ceases. It is considered that there would no additional impacts to marine mammals over and above normal shipping activities.							
West of Duddon Sands Offshore Wind Farm Operation & Maintenance Activities[7, 8]	Underwater noise and disturbance during operation and maintenance activities	As above, it is considered that there would no additional impacts to marine mammals over and above normal shipping activities.	0	0	0	0	0	0	0
Ormonde Offshore Wind Farm[9]	Underwater noise and disturbance during	As above, it is considered that there would no additional impacts to marine	0	0	0	0	0	0	0

6 https://marinelicensing.marinemanagement.org.uk/mmofox5/download/parcel/6gbevdvpjrtve9km9ch4j9ldtss4nd3hapikrj14ukv072rkpk7c1ea2bprufqttfcvbog6qmil4obfptgae6k2c7h4rc8972b5f/cb08835002ff0877454187bec6de5ad5/EOR0680_Barrow+O%2526M+Marine+Licence_Assessment_Rev02_FINAL.pdf?

7 https://marinelicensing.marinemanagement.org.uk/mmofox5/download/parcel/6jpplqea6tc3ulc2c9vb8fm5hqsnjdfc553ajog293hg31acbv426tip6g6gkcanjc2nsjrn9mimli32hb71o5tdu6481e0cgeeq/553dd5a2fac017a8ea96bd524488df58/EOR0680_West+of+Duddon+Sands+O%2526M+Marine+Licence_Assessment_Rev02_FINAL.pdf?

8 https://marinelicensing.marinemanagement.org.uk/mmofox5/download/parcel/i0ft2qro0mii4uff5o4j377070dp4n6c9bmqu14gd2bqfnfodbv5oibvjarpscvnn3n94632mbsu97jkhnsjenuirkgqkv66k9m4/0fc03a8dc4bf2a5f7a97cb89855f8a53/EOR0709_WDS+OFTO+O%2526M+Marine+Licence_Assessment_Rev02.pdf?

9 https://marinelicensing.marinemanagement.org.uk/mmofox5/download/parcel/ejvk69u43qab71irh09f3373dah9h9cd4bhiqa44ts4k2v9bh3jp2ure0m31ng39i57jbdd8172dpmmk4k9egn262qtaroedqfc4/6b6d14cb74d569561df1a3e0b74a882c/EOR0682_Ormonde+O%2526M+Marine+Licence_Assessment_Rev02_FINAL.pdf?

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
	operation and maintenance activities	mammals over and above normal shipping activities.							
Walney Extension Offshore Wind Farm[10]	Underwater noise and disturbance during operation and maintenance activities	As noise associated with the WTGs through operation are temporary, of a low level and area localised in nature, the impact was assessed to be negligible. Due to the low level of noise associated with maintenance vessels, and the low level of activity required compared to existing baseline levels, it is considered that there would no additional impacts to marine mammals.	0	0	0	0	0	0	0
Burbo Bank Extension Offshore Wind Farm[11]	Underwater noise and disturbance during operation and maintenance activities	Impacts associated with turbine operating noise are considered to be direct and continuous. It is predicted that marine mammals will quickly habituate to the presence of turbines in the water, and that there will be sufficient distance between turbines to allow movement between foundations. The impact is therefore considered to be of neutral significance.	0	0	0	0	0	0	0

[10] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010027/EN010027-000266-10.1.12%20ES%20Ch%2012%20Marine%20Mammals.pdf
[11] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010026/EN010026-000365-5.1.2.14%20Marine%20Mammals.pdf

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
Codling Wind Park	Underwater noise and disturbance	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Codling Wind Park Extension.	Underwater noise and disturbance	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Alexandra Basin Redevelopment Project[12]	Underwater noise and disturbance	The proposed piling and dredging in Dublin Port; dredging works within Dublin bay; and dumping of dredged material the west of the Burford Bank has been assessed to be unlikely to have an effect on marine mammals. It is likely that individual marine mammals entering the works area will be affected by acoustic disturbance resulting from noise and boat activity associated with demolition works, piling, dredging, and dumping. With mitigation measures, it was concluded that there will be no significant impacts of the proposed development on marine mammals.	0	0	0	0	0	0	0
Isle of Man Ferry Terminal[13]	Underwater noise and disturbance	Underwater noise from the construction of the ferry terminal (from piling) could	0	0	0	0	0	0	0

[12] http://dublinportabr.ie/wp-content/uploads/2014/03/ABR-Project-March-2014-EIS-Volume-1.pdf

[13] https://marinelicensing.marinemanagement.org.uk/mmofox5/download/parcel/fl5r1i6hjphn6nupqhk05qb2l5s7dn77nl89bcpusov36jrpqouns7uq9el2o111je4v__kmu1ep7kvpc553h8qv8kmiein9gtjh4i/7f19880e35eb2a9216475d2b17aae95e/Isle+of+Man+Ferry+Terminal+ES+-+Vol+1+-+Main+Text+Part+2+%2528Jan+2019%2529.pdf?

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
		cause behavioural effects in seals, harbour porpoise and dolphin species. It is expected that these noise levels would attenuate quickly from source. Given that only three piles are to be installed, the rapid attenuation of the noise, and therefore the impact is considered to be temporary, local and of minor significance. The only additional vessel movements through the operational phase would be the occasional maintenance dredging vessel. No additional vessel movements are expected at the new ferry terminal above current levels. Based on these considerations, the impact is expected to be temporary, local and of negligible significance.							
Milford Haven, Maintenance Dredge Pembrokeshire	Underwater noise and disturbance	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Afon Dysynni outfall gravel removal and relocation	Underwater noise and disturbance	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
Belfast Harbour D3 terminal cruise ship facility[14]	Underwater noise and disturbance	Only grey and harbour seal were considered within this assessment and this project is within a different MU. Therefore, no potential for cumulative impacts.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Disposal of dredge material from the D3 approach channel	Underwater noise and disturbance	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Marine Energy Wales marine testing area	Underwater noise and disturbance	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Argyll Tidal Demonstration[15]	Underwater noise and disturbance	Disturbance during construction would be caused by vessels and drilling (if required) of foundations. Any drilling activities may cause avoidance behaviour if individuals are within a few metres of the drilling activity. Marine mammal numbers in the area are low and the site is predominantly used for transit. The overall impact of disturbance due to construction activity was assessed as being negligible to minor.	0	0	0	0	0	0	0

[14] Available for download from: http://epicpublic.planningni.gov.uk/publicaccess/applicationDetails.do?activeTab=summary&keyVal=O3IS1ISV30000
[15] http://www.nautricity.com/docs/014_036__argylltidal_environmentalappraisal_dec13_lores3_1392661149.pdf

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
		Operational tidal devices can emit low levels of noise. However, considering that marine mammals have the capacity to avoid, adapt to, accommodate and recover from the impact of noise, and the indications of low levels of effect from the monitoring at Strangford Lough tidal turbine, the impact was assessed as negligible.							
Sound of Islay Demonstration Site[16]	Underwater noise and disturbance	Due to the number of vessels already using the area, and the limited duration over which increased levels of construction vessel activity will occur, as well as the existing levels of background noise, the impact is expected to be relatively low. A negligible magnitude is predicted for construction noise, with no measurable response or change anticipated. During operation, the Islands of Islay and Jura will have a shielding effect on noise levels and is not likely to travel out of the Sound.	0	0	0	0	0	0	0

[16] http://marine.gov.scot/datafiles/lot/So_Islay_Tidal/2014_Application/Environmental%20Report/Volume%201_%202010%20Sound%20of%20Islay%20Environmental%20Statement.pdf

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
		Data from other tidal projects has not shown any significant effect on the activity of marine mammals in the area. With regard to maintenance activities, it is expected that marine mammals in the area will be accustomed to vessel noise. Noise effects from maintenance vessels (if any) are expected to be both short term, limited in scale and transitory. Based on levels of existing noise and the limited scale of potential noise impacts, operational noise is predicted to be limited.							
West of Islay Tidal Energy Park[17]	Underwater noise and disturbance	Not in HP MU, but in GS and HS OSPAR region (CD, RD & MW not assessed). Disturbance from underwater noise was assessed as negligible to minor.	-	-	-	-	-	0	0
Enlli Tidal Energy Scheme, Bardsey Island	Underwater noise and disturbance	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Overall Cumulative Impact Assessment (maximum number of individuals potentially disturbed)			Up to 282	Up to 3	Up to 10	Up to 8	Up to 10	Up to 69	Up to 0.2

[17] https://www2.gov.scot/Topics/marine/Licensing/marine/scoping/DPMarineEnergy

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
			HP	BND	RD	CD	MW	GS	HS
Percentage of reference population			0.3%	0.75%	0.1%	0.01%	0.04%	0.2%	0.0006%
Magnitude for any temporary effect			Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

Table 12-105 Cumulative impact assessment for collision risk with tidal devices and vessels for harbour porpoise (HP), bottlenose dolphin (BND), Risso's dolphin (RD), common dolphin (CD), minke whale (MW), grey seal (GS) and harbour seal (HS) (N/A = not available)

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals at increased risk)						
			HP	BND	RD	CD	MW	GS	HS
Morlais	Collision risk with tidal devices	Collision risk based on one bottlenose dolphin scenarios (ERM and CRM) – see **Section 12.6.4.4.1**.	23	0.99	1.4	8	3	5	0.01
	Collision risk with vessels	Increased collision risk with vessels (5-10% of individuals in total area; 15.09 km^2) - see **Section 12.6.3.6**.Table 12-88	1.2	0.03	0.05	0.34	0.03	0.24	0.0007
Holyhead Deep Phase I	Collision risk with tidal devices	In the ES for a single device, physical interaction with the DGU was considered low on the basis that the number of passages of animals through the Project area required to bring about population level effects is beyond that which the baseline data suggests is feasible. No values for the collision risk of individuals for each species was provided, just passage rates through swept area for the device.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Collision risk from vessels	The O&M activities associated with the Project will not involve significant numbers of vessels and therefore it is not considered that there would be any additional impacts to marine mammals over and above normal shipping activities and extremely unlikely that vessel collision will occur.	0	0	0	0	0	0	0
Holyhead Deep Tidal Array – 80MW	Collision risk with tidal devices	Scoping report only, therefore no assessments currently available.	N/A 0	N/A 0	N/A 0	N/A 0	N/A 0	N/A 0	N/A 0

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals at increased risk)						
			HP	BND	RD	CD	MW	GS	HS
		However, if assume same approach as used for Morlais that 1st phase would be used to monitor any collision risk and that development of next phases would be based on adequate mitigation and therefore no increased collision risk.							
	Collision risk with vessels	Scoping report only, therefore no assessments currently available. However, estimate has been based on AfL area of 9.1 km^2, 0.335/ km^2 density estimate for HP, 0.0052/ km^2 for BND, 0.008/ km^2 for CD and 0.0024/ km^2 for MW from the ES and 0.031/ km^2 for RD, 0.155/ km^2 for grey seal and 0.0005/ km^2 based on MDZ and increased collision risk of 5-10% of individuals in total area.	N/A 0.15-0.3	N/A 0.0025-0.05	N/A 0.014-0.03	N/A 0.004-0.008	N/A 0.001-0.002	N/A 0.65-1.3	N/A 0.0025-0.005
Holyhead Port Expansion	Collision risk with vessels	ES not available at time of writing, therefore, no information available to inform cumulative assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Holyhead Waterfront Regeneration	Collision risk with vessels	No information available to inform cumulative assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wylfa Nuclear Power Plant	Collision risk with vessels	Very precautionary assessment based on the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer and 1 km wide vessel route between the two sites.	5.5	0.75	0	0	0	0.3	0.0015
Wylfa Decommissioning	Collision risk with vessels	No key significant adverse impacts were identified by the ecological assessment, most of work would be done on land.	0	0	0	0	0	0	0
Amlwch LNG	Collision risk with vessels	No information available to inform cumulative assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rhyl Flats Offshore Windfarm	Collision risk with vessels	No information available to inform cumulative assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Gwynt y Môr Offshore Wind Farm	Collision risk with vessels	Due to the existing high levels of vessel traffic in the area, and the natural avoidance behaviours of marine mammals, the impact of increased collision risk is low. Therefore, it is not considered that there would be any additional impacts to marine mammals over	0	0	0	0	0	0	0

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals at increased risk)						
			HP	BND	RD	CD	MW	GS	HS
		and above normal shipping activities and extremely unlikely that any vessel collision will occur.							
Barrow Offshore Wind Farm Operation & Maintenance Activities	Collision risk with vessels	Collision risk could occur over short-term events, however the risk will be reduced immediately after a vessel has passed by the marine mammal receptor. Marine mammals will, to some extent, be sensitised to vessel movements due to the existing levels in the area. Therefore, it is not considered that there would be any additional impacts to marine mammals over and above normal shipping activities and extremely unlikely that any vessel collision will occur.	0	0	0	0	0	0	0
West of Duddon Sands Offshore Wind Farm Operation & Maintenance Activities	Collision risk with vessels	As above, therefore, it is not considered that there would be any additional impacts to marine mammals over and above normal shipping activities and extremely unlikely that any vessel collision will occur.	0	0	0	0	0	0	0
Ormonde Offshore Wind Farm	Collision risk with vessels	As above, therefore, it is not considered that there would be any additional impacts to marine mammals over and above normal shipping activities and extremely unlikely that any vessel collision will occur.	0	0	0	0	0	0	0
Walney Extension Offshore Wind Farm	Collision risk with vessels	As above, therefore, it is not considered that there would be any additional impacts to marine mammals over and above normal shipping activities and extremely unlikely that any vessel collision will occur.	0	0	0	0	0	0	0
Burbo Bank Extension Offshore Wind Farm	Collision risk with vessels	It is considered unlikely that vessel use during the operational phase of the wind farm for maintenance activities will significantly increase the number of vessels already utilising the Liverpool Bay area. Impacts associated with maintenance vessels are considered to be direct and intermittent. The impact of increased vessel traffic during operation of the offshore wind farm on marine mammals is considered to be probable, of	0	0	0	0	0	0	0

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals at increased risk)						
			HP	BND	RD	CD	MW	GS	HS
		short duration (i.e. only when vessel is present). Therefore, it is not considered that there would be any additional impacts to marine mammals over and above normal shipping activities and extremely unlikely that any vessel collision will occur.							
Codling Wind Park	Collision risk with vessels	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Codling Bank Extension	Collision risk with vessels	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Isle of Man Ferry Terminal	Collision risk with vessels	The vessels involved in the construction phase would be small and once on site are expected to remain relatively stationary. The risk of a collision with marine mammals is considered to be extremely small. As the only increase in vessels at the site is expected to be from occasional maintenance dredging, the potential for increased collision risk through the operation of the Ferry terminal is not expected to be any greater than current shipping activities and it is extremely unlikely that any vessel collision will occur.	0	0	0	0	0	0	0
Milford Haven, Maintenance Dredge Pembrokeshire	Collision risk with vessels	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Afon Dysynni outfall gravel removal and relocation	Collision risk with vessels	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Belfast Harbour D3 terminal cruise ship facility	Collision risk with vessels	The probability of a collision occurring is considered to be low as, while collision incidents have been recorded in the UK and Ireland, they are generally considered to be a rare occurrence. In addition, construction activities are only short term and temporary. The conclusion is that there would be a negligible impact on marine mammal species.	0	0	0	0	0	0	0
Marine Energy Wales marine testing area	Collision risk with tidal devices	Scoping. No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals at increased risk)						
			HP	BND	RD	CD	MW	GS	HS
	Collision risk with vessels		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Argyll Tidal Demonstration	Collision risk with tidal devices	Based on a modelling of other tidal arrays which assessed the impact of collision risk to be negligible for cetaceans, the impact of collision on marine mammal populations can also be assessed as negligible for this project. No values for the collision risk of individuals for each species was provided.	-	-	N/A	N/A	N/A	N/A	N/A
	Collision risk with vessels	Construction vessels are likely to be moving slowly, indicating a lower collision risk than from other vessels already in the area. The risk of collision is considered to be low as numbers of individuals in the area are low, and construction activities would be expected to require only a short period of activity. No values for the collision risk of individuals for each species was provided.	-	-	N/A	N/A	N/A	N/A	N/A
Sound of Islay Demonstration Site	Collision risk with tidal devices	The noise generated by the devices during operation could be detected up to a distance of between 20 and 400m and is expected to alert mammals to the presence of the devices when they are operating at full power and enable avoidance measures to be taken. This, along with the environmental awareness and manoeuvrability of marine mammals, the relatively slow movement of the rotors on each device, are all a factor in the impact assessment. No values for the collision risk of individuals for each species was provided.	-	-	N/A	N/A	N/A	N/A	N/A
	Collision risk with vessels	Based on existing levels of vessel activity in the area, the limited scale and timeframe for installation, as well as the lack of any evidence of collision risk from other tidal turbine installation works, impact is therefore predicted to be minor.	-	-	N/A	N/A	N/A	N/A	N/A

Project	Potential Cumulative Impact	Notes	Assessment of Cumulative Impact (maximum number of individuals at increased risk)						
			HP	BND	RD	CD	MW	GS	HS
		No values for the collision risk of individuals for each species was provided.							
West of Islay Tidal Energy Park	Collision risk with tidal devices	Assessment of possible collision risk used a 3-dimensional model for estimating encounter rates between marine mammals and tidal turbines. Estimated number of collisions for 30 rotors per year, based on 97% avoidance.	-	-	N/A	N/A	N/A	17	14.14
	Collision risk with vessels	Collision risk with vessels was assessed as negligible	-	-	0	0	0	0	0
Enlli Tidal Energy Scheme, Bardsey Island	Collision risk with tidal devices	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Collision risk with vessels	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Overall Cumulative Impact Assessment (maximum number of individuals at possible risk)			Up to 30	Up to 2	Up to 2	Up to 9	Up to 3	Up to 24	Up to 15
Percentage of reference population			0.03%	0.5%	0.02%	0.02%	0.01%	0.06%	0.05%
Magnitude for any permanent effect			Medium	Medium	Medium	Medium	Medium	Medium	Medium

Table 12-106 Cumulative impact assessment for potential displacement of harbour porpoise (HP), bottlenose dolphin (BND), Risso's dolphin (RD), common dolphin (CD), minke whale (MW), grey seal (GS) and harbour seal (HS) as a result of changes in prey availability from habitat loss (N/A = not available)

Project	Notes	Assessment of Cumulative Impact (maximum number of individuals potentially displaced)						
		HP	BND	RD	CD	MW	GS	HS
Morlais	The worst-case scenario for permanent habitat loss would be up to 2.18 km^2 (see **Section 12.6.4.12.2**).	1.7	0.04	0.07	0.48	0.04	0.34	0.001
Holyhead Deep Tidal Array – 80MW	Scoping report only, therefore no assessments currently available. However, the Holyhead Deep tidal development area is 9.1 km^2, therefore this area has been used as a worst-case scenario with the density estimates for the MDZ.	7	0.2	0.3	2	0.2	1.4	0.005

Project	**Notes**	**Assessment of Cumulative Impact (maximum number of individuals potentially displaced)**						
		HP	BND	RD	CD	MW	GS	HS
Holyhead Port Expansion	ES not available at time of writing, therefore, no information available to inform cumulative assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Holyhead Waterfront Regeneration	No information available to inform cumulative assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wylfa Nuclear Power Plant	Based on a precautionary approach, the marine area of the Wylfa Newydd Development Area (approximately 0.35 km^2) and Disposal Site including a 100m buffer (approximately 0.65 km^2), could experience a potential change or loss of habitat (1 km^2). For RD, CD and MW density estimates for the MDZ used.	2.09	0.34	0.03	0.2	0.02	0.16	0.0008
Milford Haven, Maintenance Dredge Pembrokeshire	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Afon Dysynni outfall gravel removal and relocation	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Enlli Tidal Energy Scheme, Bardsey Island	No information available to inform assessment.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Overall Cumulative Impact Assessment (maximum number of individuals potentially displaced)		Up to 11	Up to 0.6	Up to 0.4	Up to 3	Up to 0.3	Up to 2	Up to 0.007
Percentage of reference population (*grey and harbour seal South and West England and the Wales MU)		0.01%	0.15%	0.005%	0.005%	0.001%	0.03%*	0.01%*
Magnitude for any long-term effect		Negligible	Low	Negligible	Negligible	Negligible	Low	Negligible

12.6.6.3.1. Impact Significance for Cumulative Impacts

758. Taking into account the low sensitivity to any disturbance (i.e. has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact) and the potential magnitude of the effect, the impact significance for disturbance from cumulative underwater noise has been assessed as **negligible** for harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour (**Table 12-107**).

759. The impact significance for any cumulative collision risk with tidal devices and vessels has been assessed as **minor (not significant)** for harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal, without any mitigation, taking into account the receptor sensitivity and magnitude of effect (**Table 12-107**).

760. As outlined in **Section 12.6.4.5.5**, the potential population level effects of collision risk with operational tidal turbines on marine mammals have been assessed in **Appendix 12.2** (**Volume III**). The result of the PVA indicate that population trajectories of the baseline and collision risk scenarios of 1, 2 and 3 animals are very similar, with only a potential for a decline when more than three adults per year are removed from the population of 397 bottlenose dolphins in the Irish Sea MU.

761. The impact significance for any cumulative displacement due to changes in prey availability as a result of habitat loss has been assessed as **negligible to minor (not significant)** for harbour porpoise, **negligible** for common dolphin and harbour seal and **minor (not significant)** for bottlenose dolphin and grey seal, taking into account the receptor sensitivity and magnitude of effect (**Table 12-107**).

Table 12-107 Assessment of impact significance for potential cumulative impacts

Potential Cumulative Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Underwater noise and disturbance	Harbour porpoise	Low	Negligible	Negligible	No further mitigation proposed	Negligible
	Bottlenose dolphin		Negligible	Negligible		Negligible
	Risso's dolphin		Negligible	Negligible		Negligible
	Common dolphin		Negligible	Negligible		Negligible
	Minke whale		Negligible	Negligible		Negligible
	Grey seal		Negligible	Negligible		Negligible
	Harbour seal		Negligible	Negligible		Negligible
Collision risk with tidal devices and vessels	Harbour porpoise	Low	Medium	Minor	Phased deployment, monitoring and mitigation	Minor (not significant)
	Bottlenose dolphin		Medium	Minor		Minor (not significant)
	Risso's dolphin		Medium	Minor		Minor (not significant)
	Common dolphin		Medium	Minor		Minor (not significant)
	Minke whale		Medium	Minor		Minor (not significant)
	Grey seal		Medium	Minor		Minor (not significant)
	Harbour seal		Medium	Minor		Minor (not significant)

Potential Cumulative Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Displacement due to changes in prey availability as a result of habitat loss	Harbour porpoise	Low to medium	Negligible	Negligible to Minor	No mitigation required or proposed	Negligible to Minor (not significant)
	Bottlenose dolphin	Low	Low	Minor		Minor (not significant)
	Risso's dolphin	Medium	Negligible	Minor		Minor (not significant)
	Common dolphin	Low	Negligible	Negligible		Negligible
	Minke whale	Medium	Negligible	Minor		Minor (not significant)
	Grey seal	Low	Low	Minor		Minor (not significant)
	Harbour seal	Low	Negligible	Negligible		Negligible

12.6.6.3.2. Mitigation

762. No further mitigation measures are proposed, other than those already outlined for the Morlais project, including MMMPs and the phased deployment, monitoring and mitigation.

12.6.6.3.3. Residual Impact

763. The residual impact for disturbance from cumulative underwater noise would remain **negligible** for harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal.

764. The residual impact for any cumulative displacement due to changes in prey availability as a result of habitat loss would remain **negligible to minor (not significant)** for harbour porpoise, **negligible** for common dolphin and harbour seal and **minor (not significant)** for bottlenose dolphin and grey seal.

765. With the propose phased deployment, monitoring and mitigation at Morlais, the residual impact would be **minor (not significant)** for harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin, minke whale, grey seal and harbour seal.

12.7. SUMMARY

766. **Table 12-108** summarises the impact assessments undertaken for marine mammals. Throughout the construction, operation and maintenance, repowering, and decommissioning phases, taking into account the proposed mitigation, the impact on marine mammals is considered to be of negligible or minor adverse significance. The only exception is the potential collision risk of bottlenose dolphin with operational turbines, which has been precautionarily assessed as potentially minor to moderate adverse. This reflects the small number of individuals in the area, however, the potential risk is likely to be lower as bottlenose dolphins have not been recorded in the MDZ and are more likely to move along the coast than through the MDZ array area.

Table 12-108: Summary of potential impacts on marine mammals

<table>
<tr><th>Phase</th><th>Potential Impact</th><th>Receptor</th><th>Value / sensitivity combined</th><th>Magnitude</th><th>Significance</th><th>Mitigation</th><th>Residual Impact</th></tr>
<tr><td rowspan="6">Construction</td><td>Underwater noise</td><td>All species</td><td>Medium</td><td>Negligible / very low</td><td>Minor adverse</td><td>MMMPs</td><td>Minor adverse (not significant)</td></tr>
<tr><td>Barrier effects from underwater noise</td><td>All species</td><td>Low</td><td>Negligible / very low</td><td>Negligible</td><td>None proposed, other than MMMPs</td><td>Negligible</td></tr>
<tr><td>Disturbance haul-out sites</td><td>Grey seal</td><td>Low</td><td>Negligible / very low</td><td>Negligible</td><td>None required or proposed</td><td>Negligible</td></tr>
<tr><td>Increased collision risk with vessels</td><td>All species</td><td>Low</td><td>Negligible to low</td><td>Negligible to Minor adverse</td><td>Not required or proposed</td><td>Negligible to Minor adverse (not significant)</td></tr>
<tr><td>Changes in water quality</td><td>All species</td><td>Negligible</td><td>Low</td><td>Negligible</td><td>EMP and MPCP</td><td>Negligible</td></tr>
<tr><td>Changes in prey availability</td><td>All species</td><td>Low to Medium</td><td>Negligible / very low</td><td>Negligible to Minor adverse</td><td>None required or proposed</td><td>Negligible to Minor adverse (not significant)</td></tr>
<tr><td rowspan="11">Operation, Maintenance and Repowering</td><td>Underwater noise</td><td>All species</td><td>Low</td><td>Low to Medium</td><td>Minor adverse</td><td>None required or proposed</td><td>Minor adverse (not significant)</td></tr>
<tr><td rowspan="2">Collision risk with operational turbines</td><td>Bottlenose dolphin</td><td>High</td><td>Medium to High</td><td>Major adverse</td><td rowspan="2">Phased deployment, monitoring and mitigation</td><td>Minor to Moderate adverse</td></tr>
<tr><td>All other species</td><td>Low</td><td>Low to Medium</td><td>Minor adverse</td><td>Minor adverse (not significant)</td></tr>
<tr><td>Increased collision risk with vessels</td><td>All species</td><td>Low</td><td>Negligible to low</td><td>Negligible to Minor adverse</td><td>None required or proposed</td><td>Negligible to Minor adverse (not significant)</td></tr>
<tr><td rowspan="2">Entanglement with mooring lines</td><td>Minke whale</td><td>Low</td><td>Low to High</td><td>Minor to Moderate adverse</td><td rowspan="2">Phased deployment, monitoring and mitigation</td><td>Minor adverse (not significant)</td></tr>
<tr><td>All other species</td><td>Low</td><td>Low to Moderate</td><td>Minor adverse</td><td>Minor adverse (not significant)</td></tr>
<tr><td>EMF effects</td><td>All species</td><td>Negligible</td><td>Negligible</td><td>Negligible</td><td>None required or proposed</td><td>Negligible</td></tr>
<tr><td>Barrier effects</td><td>All species</td><td>Low</td><td>Low</td><td>Minor adverse</td><td>None required or proposed</td><td>Minor adverse (not significant)</td></tr>
<tr><td>Changes in water quality</td><td>All species</td><td>Negligible</td><td>Negligible to Low</td><td>Negligible</td><td>EMP and MPCP</td><td>Negligible</td></tr>
<tr><td>Changes in prey availability</td><td>All species</td><td>Low to Medium</td><td>Low</td><td>Minor adverse</td><td>None required or proposed</td><td>Minor adverse (not significant)</td></tr>
<tr><td>Decommissioning</td><td colspan="7">Same or less than construction phase</td></tr>
<tr><td>Cumulative Impacts</td><td>Underwater noise and disturbance</td><td>All species</td><td>Low</td><td>Negligible</td><td>Negligible</td><td>No further mitigation proposed</td><td>Negligible</td></tr>
</table>

Phase	Potential Impact	Receptor	Value / sensitivity combined	Magnitude	Significance	Mitigation	Residual Impact
	Collision risk with tidal devices and vessels	All species	Low	Medium	Minor	Phased deployment, monitoring and mitigation	Minor adverse (not significant)
	Displacement due to changes in prey availability / habitat loss	All species	Low to Medium	Negligible to Low	Negligible to Minor adverse	None required or proposed	Negligible to Minor adverse (not significant)

12.8. REFERENCES

Anderwald, P., Evans, P.G., Dyer, R., Dale, A., Wright, P.J. and Hoelzel, A.R. (2012). Spatial scale and environmental determinants in minke whale habitat use and foraging. Marine Ecology Progress Series, 450, pp.259-274.

Arnold, H. and Mayer, S.J. (1995). The ecology of bottlenose dolphins in Cardigan Bay, Wales, UK. Abstracts of the Eleventh Biennial Conference on the Biology of Marine Mammals. Orlando, Florida.

ASCOBANS (2015). Recommendations of ASCOBANS on the Requirements of Legislation to Address Monitoring and Mitigation of Small Cetacean Bycatch. October 2015.

Bailey, H., Senior, B., Simmons, D., Rusin, J., Picken, G. and Thompson, P.M. (2010). Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals. *Marine pollution bulletin*, *60*(6), pp.888-897.

Baines, M.E. and Evans, P.G.H. (2012). Atlas of the Marine Mammals of Wales. CCW Monitoring Report No. 68. 2nd edition. 139pp.

Band, W.T. (2015). Assessing collision risk between tidal turbines and marine wildlife (draft). *Scottish Natural Heritage Guidance Note Series (http://www. snh. gov. uk/docs/A1741443. pdf), 93.*

Bandomir-Krischack, B. M. (1996). Preliminary results on reproduction of harbor porpoises in German coastal waters. *European Research on Cetaceans 9*:212-214.

Beck, C., Don Bowen, W. and Iverson, S.J. (2000). Seasonal changes in buoyancy and diving behaviour of adult grey seals. Journal of Experimental Biology 203, 2323-2330.

Benjamins, S., Ledwell, W., Huntington, J. and Davidson, A.R. (2012). Assessing changes in numbers and distribution of large whale entanglements in Newfoundland and Labrador, Canada 1. *Marine Mammal Science, 28*(3), pp.579-601.

Benjamins, S., Harnois, V., Smith, H.C.M., Johanning, L., Greenhill, L., Carter, C. and Wilson, B. (2014). Understanding the potential for marine megafauna entanglement risk from renewable marine energy developments. Scottish Natural Heritage Commissioned Report No. 791.

Berrow, S.D. and Rogan, E. (1995). Stomach contents of harbour porpoises and dolphins in Irish waters. *European Research on Cetaceans. 9*, pp.179-181.

Bjørge, A. and Tolley, K.A. (2002). Harbour Porpoise. Encyclopedia of Marine Mammals. Perrin, W. F., Würsig, B. and Thewissen, J. G. M. (eds.), San Diego, Academic Press: 549-551.

Blix, A.S. and Folkow, L.P. (1995). Daily energy expenditure in free living minke whales. Acta *Physiologica Scandinavica, 153*(1), pp.61-66.

Bloch, D., Desportes, G., Harvey, P., Lockyer, C. and Mikkelsen, B. (2012). Life History of Risso's Dolphin (Grampus griseus)(G. Cuvier, 1812) in the Faroe Islands. *Aquatic Mammals, 38*(3).

Börjesson, P. and Read, A.J. (2003). Variation in timing of conception between populations of the harbor porpoise. Journal of Mammalogy, 84(3), pp.948-955.

Börjesson, P., Berggren, P. and Ganning, B. (2003). Diet of harbour porpoises in the Kattegat and Skagerrak seas: accounting for individual variation and sample size. Marine Mammal Science, 19(1), pp.38-058.

Brandt, M.J. (2012). Effectiveness of a sealscarer in deterring harbour porpoises (Phocoena phocoena) and its application as a mitigation measure during offshore pile driving.

Brandt, M.J., Höschle, C., Diederichs, A., Betke, K., Matuschek, R. and Nehls, G. (2013). Seal scarers as a tool to deter harbour porpoises from offshore construction sites. *Marine Ecology Progress Series, 475*, pp.291-302.

British Standards Institution (BSI) (2015) Environmental Impact Assessment for offshore renewable energy projects – Guide., PD 6900:2015

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L, and Thomas, L. (2004). Advanced Distance Sampling: Estimating Abundance of Biological Populations. Oxford University Press, Oxford, UK. 416pp.

Camphuysen, C.J., Fox, T., Leopold, M.F. and Petersen, I.K. (2004). Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the UK. Report to COWRIE.

CEDA (Central Dredging Association) (2011). Underwater sound in relation to dredging. Position Paper - 7 November 2011. Available URL: http://www.dredging.org/documents/ceda/downloads/2011-11_ceda_positionpaper_underwatersound.pdf

Chartered Institute of Ecology and Environmental Management (CIEEM) (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal

Cheney, B., Thompson, P.M., Ingram, S.N., Hammond, P.S., Stevick, P.T., Durban, J.W., Culloch, R.M., Elwen, S.H., Mandleberg, L., Janik, V.M., Quick, N.J., Islas-Villanueva, V., Robinson, K.P., Costa, M., Eisfel, S.M., Walters, A., Phillips, C., Weir, C.R., Evans, P.G.H., Anderwald, P., Reid, R.J., Reid, J.B. and Wilson, B. (2013). Integrating multiple data sources to assess the distribution and abundance of bottlenose dolphins (Tursiops truncatus) in Scottish waters. *Mammal Review. 43*(1), pp.71- 88.

Chudzinska, M. (2009). Diving behaviour of harbour seals (*Phoca vitulina*) from the Kattegat. Masters Thesis, University of Aarhus and Danish National Environmental Research Institute.

Clarke, L.J., Banga, R., Robinson, G.J., Lindenbaum, C.P., Morris, C.W. and Stringell, T.B. (2018). Grey Seal (*Halichoerus grypus*) Pup Production and Distribution in North Wales, 2017. NRW Evidence Report No. xxx. 55pp. Natural Resources Wales, Bangor.

Coram, A., Gordon, J., Thompson, D. and Northridge, S (2014). Evaluating and assessing the relative effectiveness of non-lethal measures, including Acoustic Deterrent Devices, on marine mammals. Scottish Government.

Corkeron, P.J. and Martin, A.R. (2004). Ranging and diving behaviour of two 'offshore' bottlenose dolphins, Tursiops sp., off eastern Australia. Journal of the *Marine Biological Association of the United Kingdom, 84*(2), pp.465-468.

Corkeron, P.J., Bryden, M.M. and Hedstrom, K.E. (1990). Feeding by bottlenose dolphins in association with trawling operations in Moreton Bay, Australia. In *The bottlenose dolphin* (pp. 329-336). Academic Press.

Couperus, A.S. (1995). Interactions between Dutch midwater-trawl and Atlantic white-sided dolphins (*Lagenorhynchus acutus*) southwest of Ireland. J. *Northwest Atl. Fish. Sci.*, 22, pp.209-218.

Cox, S.L., Witt, M.J., Embling, C.B., Godley, B.J., Hosegood, P.J., Miller, P.I., Votier, S.C. and Ingram, S.N. (2017). Temporal patterns in habitat use by small cetaceans at an oceanographically dynamic marine renewable energy test site in the Celtic Sea. Deep Sea Research Part II: *Topical Studies in Oceanography, 141*, pp.178-190.

Cronin, M., Kavanagh, A. and Rogan, E. (2008). The foraging ecology of the harbour seal (*Phoca vitulina*) in southwest Ireland.

CSIP (2015). UK Cetacean Strandings Investigation Programme Report. Annual Report for the period 1st January – 31st December 2015 (Contract number MB0111). http://ukstrandings.org/csip-reports/

Dähne, M., Tougaard, J., Carstensen, J., Rose, A. and Nabe-Nielsen, J. (2017). Bubble curtains attenuate noise from offshore wind farm construction and reduce temporary habitat loss for harbour porpoises. *Marine Ecology Progress Series*, 580, pp.221-237.

Department of Energy and Climate Change (DECC) (2016). UK Offshore Energy Strategic Environmental Assessment. OWESEA3 March 2016: Appendix 1a.7 – Marine and Other Mammals.

Department for Environment, Food and Rural Affairs (Defra) (2003). UK small cetacean bycatch response strategy. Department for Environment, Food and Rural Affairs. March 2003.

Diederichs, A., Hennig, V. and Nehls, G. (2008). Investigations of the bird collision risk and the responses of harbour porpoises in the offshore wind farms Horns Rev, North Sea, and Nysted, Baltic Sea. *Denmark Part II: Harbour porpoises Universität Hamburg and BioConsult SH, 99.*

EC (2007). Guidance document on the strict protection of animal species of community interest under the Habitats Directive 92/43/EEC.

EMEC (2014). EMEC Fall of Warness Test Site: Environmental Appraisal. European Marine Energy Centre, Orkney.

Evans, P.G.H. (1980). Cetaceans in British waters. Mammal Review, 10(1), pp.1-52.

Evans, P.G. (2008), February. Selection criteria for marine protected areas for cetaceans. In Proceedings of the ECS/ASCOBANS/ACCOBAMS workshop. ECS (European Cetacean Society). Special Publication Series (No. 48, p. 13).

Evans, P. G. H., Carson, Q., Fisher, P., Jordan, W., Limer, R and Rees, I. (1993). A study of the reactions of harbour porpoises to various boats in the coastal waters of Shetland. In European research on cetaceans, pp 60. Eds Evans. European Cetacean Society, Cambridge

Evans, P. G., Baines, M.E., and Anderwald. P. (2011). Risk Assessment of Potential Conflicts between Shipping and Cetaceans in the ASCOBANS Region. 18th ASCOBANS Advisory Committee Meeting AC18/Doc.6-04 (S) rev.1 UN Campus, Bonn, Germany, 4-6 May 2011 Dist. 2 May 2011.

Evans, P.G.H., Anderwald, P. and Baines, M.E. (2003). UK Cetacean Status Review. Report to English Nature and the Countryside Council for Wales.

Evans, P.G.H., Pierce, G.J., Veneruso, G., Weir, C.R., Gibas, D., Anderwald, P. and Begoña Santos, M. (2015). Analysis of long-term effort-related land-based observations to identify whether coastal areas of harbour porpoise and bottlenose dolphin have persistent high occurrence and abundance. JNCC report No. 543, JNCC, Peterborough.

Feingold, D. and Evans, P.G.H. (2013). A Summary of Photo-Identification of Bottlenose Dolphins in Cardigan Bay, Wales conducted by the Sea Watch Foundation in 2012. CCW Photo ID Report.

Feingold, D. and Evans, P.G.H. (2014a). Connectivity of Bottlenose Dolphin in Welsh Waters: North Wales Photo-Monitoring Report. Sea Watch Foundation. 16 pp.

Feingold, D. and Evans, P.G.H. (2014b). Bottlenose Dolphin and Harbour Porpoise Monitoring in the Cardigan Bay and Pen Llŷn a'r Sarnau Special Area of Conservation 2011 – 2013. NRW Evidence Report Series, Report No: 4, 120 pp. Natural Resources Wales, Bangor Sea Watch Foundation. Report Number. 95. 124 pp.

Fontaine, M.C., Baird, S.J.E., Piry, S., Ray, N., Ferreira, M., Jauniaux, T., Llavona, A., Ozturk, B., Ozturk, A.A., Ridoux, V., Rogan, E., Sequeira, M., Siebert, U., Vikingsson, G.A., Bouquegneau, J.M. and Michaux, J.R. (2007). Rise of oceanographic barriers in continuous populations of a cetacean: the genetic structure of harbour porpoises in Old World waters. BMC BIOLOGY, 5.

Fontaine, M.C., Roland, K., Calves, I., Austerlitz, F., Palstra, F.P., Tolley, K.A., Ryan, S., Ferreira, M., Jauniaux, T., Llavona, A. and Öztürk, B. (2014). Postglacial climate changes and rise of three ecotypes of harbour porpoises, *Phocoena phocoena*, in western Palearctic waters. Molecular ecology, 23(13), pp.3306-3321.

Gaskin, D.E. (1992). Status of the harbour porpoise, *Phocoena phocoena*, in Canada. Canadian field-naturalist. Ottawa ON, 106(1), pp.36-54.

Gill, A.B., Gloyne-Phillips, I., Neal, K.J. and Kimber, J.A. (2005). Cowrie 1.5 Electromagnetic Fields Review: The potential effects of electromagnetic fields generated by sub-sea power cables associated with offshore wind farm developments on electrically and magnetically sensitive marine organisms–a review. *Collaborative Offshore Windfarm Research, London, UK.*

Gordon, J., Thompson, D., Gillespie, S., Lonergan, M,. Calderan, S., Jaffey, B. and Todd, V. (2007). Assessment of the potential for acoustic deterrents to mitigate the impact on marine mammals of underwater noise arising from the construction of offshore windfarms. Sea Mammal Research Unit, for Cowrie Ltd, St Andrews. 71.

Gordon, J., Thompson, D., Leaper, R., Gillespie, D., Pierpoint, C., Calderan, S., Macaulay, J., Gordon, T. and Simpson, N. (2011). Phase 2 – Studies of marine mammals in Welsh high tidal energy waters v5. Report Number JER3688R110408JG. 130 pp + Appendices.

Gordon, J., Blight, C., Bryant, E. and Thompson, D. (2015). Tests of Acoustic Signals for Aversive Sound Mitigation with Common Seals. Sea Mammal Research Unit report to Scottish Government.

Götz, T. and Janik, V. (2010). Aversiveness of sounds in phocid seals: psycho-physiological factors, learning processes and motivation. The Journal of Experimental Biology 213, 1536-1548.

Grellier, K., Hammond, P.S., Wilson, B., Sanders-Reed, C.A. and Thompson, P.M. (2003) Use of photo-identification data to quantify mother-calf association patterns in bottlenose dolphins. Canadian Journal of Zoology 81: 1421-1427.

Grellier, K. and Wilson, B. (2003). Bottlenose dolphins using the Sound of Barra, Scotland. *Aquatic Mammals. 29*(3), pp.378-382.

Halvorsen, M.B., Carlson, T.J. and Copping, A. (2011). Effects of tidal turbine noise on fish. *PNNL Report-20787 for US Dept of Energy, WA, DC: by Pacific Northwest National Laboratory, Sequim*, WA, pp.1-41.

Hammond, P.S. and Grellier, K. (2006). Grey seal diet composition and prey consumption in the North Sea. *Final report to Department for Environment Food and Rural Affairs on project MF0319.*

Hammond, P.S., Northridge, S.P., Thompson, D., Gordon J.C.D., Hall, A.I., Aarts, G. and Matthiopoulos, J. (2005). Background information on marine mammals for Strategic Environmental Assessment 6. Sea Mammal Research Unit.

Hammond, P.S., Northridge, S.P., Thompson, D., Gordon, J.C.D., Hall, A.J., Murphy, S.N. and Embling, C.B. (2008). Background information on marine mammals for Strategic Environmental Assessment 8. Report to DECC. Sea Mammal Research Unit, St. Andrews, Scotland, UK, 52 pp.

Hammond P.S., Macleod K., Berggren P., Borchers D.L., Burt L., Cañadas A., Desportes G., Donovan G.P., Gilles A., Gillespie D., Gordon J., Hiby L., Kuklik I., Leaper R., Lehnert K, Leopold M., Lovell P., Øien N., Paxton C.G.M., Ridoux V., Rogano E., Samarraa F., Scheidatg M., Sequeirap M., Siebertg U., Skovq H., Swifta R., Tasker M.L., Teilmann J., Canneyt O.V. and Vázquez J.A. (2013). *Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. Biological Conservation. 164*, pp.107-122.

Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Boerjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M., Scheidat, M. and Teilmann, J. (2017). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. *Wageningen Marine Research.*

Hastie, G.D., Wilson, B. and Thompson, P.M. (2006) Diving deep in foraging hotspot: acoustic insights into bottlenose dolphin dive depths and feeding behaviour. Marine Biology 148: 1181-1188.

Hastie, G.D., Russell, D.J.F., Benjamins, S., Moss, S., Wilson, B. and Thompson, D. (2016). Dynamic habitat corridors for marine predators; intensive use of a coastal channel by harbour seals is modulated by tidal currents Behavioural Ecology and Sociobiology, 70, 2161-2174.

Hastie, G.D., Russell, D.J.F., Lepper, P., Elliott, J., Wilson, B., Benjamins, S., Thompson, D. and González-Suárez, M. (2017) Harbour seals avoid tidal turbine noise: Implications for collision risk. Journal of Applied Ecology, 55, 684-693.

Hastie, G.D., Russell, D.J., Lepper, P., Elliott, J., Wilson, B., Benjamins, S. and Thompson, D. (2018). Harbour seals avoid tidal turbine noise: Implications for collision risk. *Journal of applied ecology, 55*(2), pp.684-693.

Herschel, A., Stephenson, S., Sparling, C., Sams, C. and Monnington, J. (2013). Use of Deterrent Devices and Improvements to Standard Mitigation during Piling. ORJIP Project 4, Phase 1. Xodus Group Ltd. Document L-300100-S00-REPT-002.

Herschel, A., Stephenson, S., Sparling, C., Sams, C. and Monnington, J. (2014). ORJIP Project 4, Phase 1 Use of Deterrent Devices and Improvements to Standard Mitigation During Piling. Research Summary, 300100(2013), p.S00.

Hebridean Whale and Dolphin Trust (HWDT) (2019). Minke whale species profile. [Online]. [Accessed 28/03/18]. Available from: https://hwdt.org/minke-whale

Heinänen, S. and Skov, H. (2015). The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area, JNCC Report No.544 JNCC, Peterborough.

Hernández-Milian, G., Begoña Santos, M., Reid, D. and Rogan, E. (2015) Insights into the diet of Atlantic white-sided dolphins (*Lagenorhynchus acutus*) in the Northeast Atlantic. Marine Mammal Science, 32(2), pp.735-742.

Horizon Nuclear Power (HNP), (2018a). Wylfa Newydd Project. 6.4.88 ES Volume D – WNDA Development App D13-6 – Marine Mammal Baseline Review. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010007/EN010007-001534-6.4.88%20App%20D13-6-Marine%20Mammal%20Baseline%20Review%20(Rev%201.0).pdf

HNP, (2018b). Wylfa Newydd Project. 5.2 Shadow Habitats Regulations Assessment Report (Part 1 of 2). Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010007/EN010007-001360-5.2%20Shadow%20Habitats%20Regulations%20Assessment%20Report%20(Part%201%20of%202)%20(Rev%201.0).pdf

Horwood, J. (1990). Biology and exploitation of the minke whale. CRC Press, Florida 1990.

ICES. (2014).ICES WGMME Report 2014. Report of the Working Group on Marine Mammal Ecology

Ingram, S.N. and Rogan, E. (2002). Identifying critical areas and habitat preferences of bottlenose dolphins Tursiops truncatus. *Marine Ecology Progress Series.* 244, pp.247-255.

Inter-Agency Marine Mammal Working Group (IAMMWG). (2013). Management units for marine mammals in UK waters (June 2013).

Inter-Agency Marine Mammal Working Group (IAMMWG). (2015). Management Units for cetaceans in UK waters (January 2015). JNCC Report No. 547, JNCC Peterborough

Isaacman, L. and Daborn, G. (2011). Pathways of effects for offshore renewable energy in Canada. *Fundy Energy Research Network Document, 1.*

Janik, V. and Götz, T. (2015). Acoustic deterrence using startle sounds: long-term effectiveness and effects on odontocetes. Report for Marine Scotland.

JNCC (2002) Natura 2000 in UK Offshore Waters: Advice to support the implementation of the EC Habitats and Birds Directives in UK Offshore Waters. JNCC Report 325.

JNCC (2010a). Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise. August 2010.

JNCC (2010b). JNCC guidelines for minimising the risk of injury to marine mammals from using explosives. August 2010.

JNCC (2013). Individual Species Reports –3rd UK Habitats Directive Reporting 2013. Available at: http://jncc.defra.gov.uk/page-6391

JNCC (2016) 2016 consultation on possible Special Areas of Conservation for harbour porpoise. Post- Consultation Report. JNCC Report 597.

JNCC (2017a). JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys. April 2017.

JNCC (2019). JNCC website http://jncc.defra.gov.uk

JNCC and Natural England (2016). Harbour Porpoise (Phocoena phocoena) possible Special Area of Conservation: Southern North Sea Draft Conservation Objectives and Advice on Activities. Advice under Regulation 18 of The Offshore Marine Conservation (Natural Habitats, etc.) Regulations 2007 (as amended), and Regulation 35(3) of The Conservation of Habitats.

JNCC and NRW (2015). SAC Selection Assessment: North Anglesey Marine / Gogledd Môn Forol. January, 2016. Joint Nature Conservation Committee, UK.

JNCC and NRW (2017). SAC Selection Assessment: North Anglesey Marine/ Gogledd Môn Forol. January, 2017. Joint Nature Conservation Committee, UK. [Online]. [Accessed: 04/04/19]. Available from:http://jncc.defra.gov.uk/page-7244

JNCC, NE and CCW (2010). Draft EPS Guidance - The protection of marine European Protected Species from injury and disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area. Joint Nature Conservation Committee, Natural England and Countryside Council for Wales. October 2010.

Johnston, D.W., Westgate, A.J. and Read, A.J. (2005). Effects of finescale oceanographic features on the distribution and movements of harbour porpoises Phocoena phocoena in the Bay of Fundy. Marine Ecology Progress series. 295, pp.279-293.

Kastelein, R.A., Hardemann, J. and Boer, H. (1997). Food consumption and body weight of harbour porpoises (*Phocoena phocoena*). In *The biology of the harbour porpoise, Read, A.J., Wiepkema, P.R., Nachtigall P.E.* 1997pp. 217–234. ed. Woerden, The Netherlands: De Spil Publishers.

Kastelein, R.A., Bunskoek, P., Hagedoorn, M., Au, W.L.W. & de Haan, D. (2002a). Audiogram of a harbor porpoise (*Phocoena phocoena*) measured with narrow-band frequency-modulated signals. JASA, 112(1), 334-344.

Kastelein, R.A., Helder-Hoek, L., Covi, J. and Gransier, R. (2016). Pile driving playback sounds and temporary threshold shift in harbour porpoises (*Phocoena phocoena*): Effect of exposure duration. J. Acoust. Soc. Am. 139 (5): 2842-2851.

Kastelein, R.A., Van de Voorde, S. and Jennings, N. (2018). Swimming Speed of a Harbor Porpoise (*Phocoena phocoena*) During Playbacks of Offshore Pile Driving Sounds. *Aquatic Mammals, 44*(1), pp.92-99.

Keiper, C.A., Ainley, D.G., Allen, S.G. and Harvey, J.T. (2005). Marine mammal occurrence and ocean climate off central California, 1986 to 1994 and 1997 to 1999. Marine Ecology Progress Series, 289, pp.285-306

Kiely, O., Lidgard, D., McKibben, M., Connolly, N. and Baines, M. (2000). Grey seal: Status and monitoring in the Irish and Celtic Seas. Maritime INTERREG Series. Coastal Resources Centre, National University of Ireland, Cork. Wildlife Trust, Haverfordwest, Wales. Report No. 3. 77 pp.

Klatsky, L.J., Wells, R.S. and Sweeney, J.C. (2007). Offshore bottlenose dolphins (*Tursiops truncatus*): Movement and dive behavior near the Bermuda Pedestal. *Journal of Mammalogy, 88*(1), pp.59-66.

Kongsberg (2012). MayGen Tidal Energy Project Phase 1 Environmental Statement.

Kruse, S. Caldwell, D. K. and Caldwell, M. C. (1999). Risso’s dolphin *Grampus griseus* (G. Cuvier, 1812). In Handbook of Marine Mammals. Vol. 6. The second book of dolphins and porpoises (eds S H Ridgway and R Harrison), pp. 183-212. Academic Press, London.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. (2001). Collisions between ships and whales. *Marine Mammal Science, 17*(1), pp.35-75.

Learmonth, J.A., Macleod, C.D., Santos, M.B., Pierce, G.J., Crick, H.Q.P and Robinson, R.A. (2006). Potential effects of climate change on marine mammals. Oceanography and Marine Biology: An Annual Review 44, 429-462.

Learmonth, J.A., Murphy, S., Luque, P.L., Reid, R.J., Patterson, I.A.P., Brownlow, A., Ross, H.M., Barley, J.P., Begoña Santos, M. and Pierce, G.J. (2014). Life history of harbor porpoises (*Phocoena phocoena*) in Scottish (UK) waters. *Marine Mammal Science, 30*(4), pp.1427-1455.

Leeney, R.H., Berrow, S., McGrath, D., O'Brien, J., Cosgrove, R. and Godley, B.J. (2007). Effects of pingers on the behaviour of bottlenose dolphins. Journal of the Marine Biological Association of the United Kingdom, 87(1), pp.129-133.

Lewis, E.J. and Evans, P.G.H. (1993). Comparative ecology of bottlenose dolphins (*Tursiops truncatus*) in Cardigan Bay and the Moray Firth, pp.57-62. In: European Research on Cetaceans - 7. Proc. 7th Ann. Conf. ECS, Inverness, ed P.G.H. Evans. European Cetacean Society, Cambridge, England. 306pp.

Lindeboom, H.J., Kouwenhoven, H.J., Bergman, M.J.N., Bouma, S., Brasseur, S.M.J.M., Daan, R., Fijn, R.C., De Haan, D., Dirksen, S., Van Hal, R. and Lambers, R.H.R. (2011). Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. *Environmental Research Letters, 6*(3), p.035101.

Liret, C. (2001). Domaine vital, utilisation de l’espace et des ressources :les grands dauphins, Tursiops truncatus, de l’île de Sein. *Thèse de doctorat de l’Université de Bretagne Occidentale*, Brest. 155 p.

Liret, C., Creton, P., Evans, P. G. H., Heimlich-Boran, J. R. and Ridoux, V. (1998). English and French coastal Tursiops from Cornwall to the Bay of Biscay, 1996. Photo-identification Catalogue. *Project sponsored by Ministere de l'Environnement, France and Sea Watch Foundation,* UK.

Lockyer C. (1995). Investigations of aspects of the life history of the Harbour Porpoise, *Phocoena phocoena*, in British waters. In: BJØRGE A. & DONOVAN G.P. (eds) *Biology of the Phocoenids*: 189-197. Special Issue 16, International Whaling Commission, Cambridge.

Lossent, J., Lejart, M., Folegot, T., Clorennec, D., Di Iorio, L. and Gervaise, C. (2018). Underwater operational noise level emitted by a tidal current turbine and its potential impact on marine fauna. Marine Pollution Bulletin, 131, pp.323-334.

Lowry, L.F., Frost, K.J., Hoep, J.M. and Delong, R.A. (2001). Movements of satellite tagged subadult and adult harbour seals in Prince William Sound, Alaska. *Marine Mammal Science*. 17(4), pp.835-861.

Lucke, K., Siebert, U., Lepper, P.A. and Blanchet, M.A. (2009). Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli. *The Journal of the Acoustical Society of America, 125*(6), pp.4060-4070.

Mackey, M., Didac, P.G. and O'Cadhla, O. (2004)., SA678 Data Report for Offshore Cetacean Populations. Coastal & Marine Resources Centre, Environmental Research Institute, University College Cork.

MacLeod, C.D., Bannon, S.M., Pierce, G.J., Schweder, C., Learmonth, J.A., Herman, J.S. and Reid, R.J. (2005) Climate change and the cetacean community of North-West Scotland. Biological Conservation 124, 477-483.

Macleod, K., Simmonds, M.P. and Murray, E., (2003). Summer distribution and relative abundance of cetacean populations off north-west Scotland. *Journal of the Marine Biological Association of the United Kingdom, 83(*5), pp.1187-1192.

Macleod,K., Burt, M.L., Cañadas, A., Rogan, E., Santos, B., Uriarte, A., Van Canneyt, O., Vázquez, J. A. and Hammond, P. S. (2009). Design-based estimates of cetacean abundance in offshore European Atlantic waters. *Appendix I in the Final Report of the Cetacean Offshore Distribution and Abundance in the European Atlantic*. 16pp.

Malinka, C., Gillespie, D., Macaulay, J., Joy, R. and Sparling, C. (2018). First in situ passive acoustic monitoring for marine mammals during operation of a tidal turbine in Ramsey Sound, Wales. Marine Ecology Progress Series, [online] 590, pp.247-266. Available at: http://www.marinebioacoustics.com/files/2018/Malinka_etal_2018.pdf

Malme, C.I., Miles, P.R., Miller, G.S., Richardson, W.J. and Roseneau, D.G. (1989). Analysis and ranking of the acoustic disturbance potential of petroleum-industry activities and other sources of noise in the environment of marine mammals in Alaska. Final report (No. PB-90-188673/XAB; REPT--6945). Bolt, Beranek and Newman, Inc., Cambridge, MA (USA).

Mandleberg, L. (2006). Bottlenose dolphins of the Hebrides, a summary report from five years of research (2001-2005). *Report to Biodiversity Action Grants Scheme. Hebridean Whale and Dolphin Trust*, Tobermory, 19 pp.

Marine Scotland (MS) (2012). MS Offshore Renewables Research: Work Package A3: Request for advice about the displacement of marine mammals around operational offshore windfarms. Available at: http://www.gov.scot/Resource/0040/00404921.pdf

Marubini, F., Gimona, A., Evans, P., Wright, P., and Pierce, G. (2009). Habitat preferences and interannual variability in occurrence of the harbour porpoise *Phocoena phocoena* off northwest Scotland. *Marine Ecology Progress Series*. 381, pp.297–310.

Madsen, P.T., Wahlberg, M., Tougaard, J., Lucke, K. and Tyack, P.L. (2006). Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs. Mar. Ecol. Prog. Ser. 309, 279–295.

Mate, B.R., Rossbach, K.A., Nieukirk, S.L., Wells, R.S., Blair Irvine, A., Scott, M.D. and Read, A.J. (1995). Satellite-monitored movements and dive behavior of a bottlenose dolphin (*Tursiops truncatus*) in Tampa Bay, Florida. Marine Mammal Science, 11(4), pp.452-463.

Matthiopoulos J, McConnell B.J, Duck C and Fedak M.A. (2004). Using satellite telemetry and aerial counts to estimate space use by grey seals around the British Isles. *Journal of Applied Ecology. 41*(3), pp.476-491.

McConnell, B.J., Fedak, M.A., Lovell, P. and Hammond, P.S. (1999). Movements and foraging of grey seals in the North Sea. *Journal of Applied Ecology. 36*, pp.573-590.

McConnell, B., Lonergan, M. and Dietz, R. (2012). Interactions between seals and offshore wind farms. The Crown Estate. ISBN: 978-1-906410-34-5.

McGarry, T., Boisseau, O., Stephenson, S. and Compton, R. (2017). Understanding the Effectiveness of Acoustic Deterrent Devices on Minke Whale (*Balaenoptera acutorostrata*), a low frequency cetacean. ORJIP Project 4, Phase 2. RPS Report EOR0692. Prepared on behalf of The Carbon Trust. November 2017.

McGarry, T., de Silva, R., Canning, S., Mendes, S., Prior, A., Stephenson, S. and Wilson, J. (2018). JNCC Report No: 615 Guide for the Selection and Deployment of Acoustic Deterrent Devices. JNCC, Peterborough.

Minesto. (2016). Deep Green Holyhead Deep Project Phase 1 (0.5. MW) Environmental Statement. L-100194-S00-EIAS-001. 580 pp.

Murphy, S., Pinn, E.H. and Jepson, P.D. (2013). The short-beaked common dolphin (*Delphinus delphis*) in the North-East Atlantic: distribution, ecology, management and conservation status. *Oceanography and Marine Biology: An Annual Review, 51*, pp.193-280.

Nedwell, J.R, Parvin, S.J., Edwards, B., Wor kman, R., Brooker, A.G and Kynoch J.E. (2007). Measurement and interpretation of underwater noise during construction and operation of offshore windfarms in UK waters. Report for COWRIE by Subacoustech.

NMFS (National Marine Fisheries Service) (2016). Technical guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 p.

NMFS (2018). 2018 Revisions to: Technical guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandu, NMFS-OPR-59.

Norrman, E.B., Duque, S.D. and Evans, P.G. (2015). Bottlenose dolphins in Wales: Systematic mark-recapture surveys in Welsh waters. Natural Resources Wales Evidence Report Series, 85.

Normandeau, Exponent,Tricas, T. and Gill, A. (2011). Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. OCS Study BOEMRE 2011-09, U.S.

Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, California.

Northridge, S.P., Tasker, M.L., Webb, A. and Williams, J.M., (1995). Distribution and relative abundance of harbour porpoises (*Phocoena phocoena* L.), white-beaked dolphins (*Lagenorhynchus albirostris* Gray), and minke whales (*Balaenoptera acutorostrata* Lacepède) around the British Isles. ICES Journal of Marine Science, 52(1), pp.55-66.

O'Brien, J. and Berrow, S.D. (2006). Seaweed ingestion by a bottlenose dolphin. Irish Naturalists' Journal. 28(8), pp.338–9.

O'Cadhla, O., Keena, T., Strong, D., Duck, C. and Hiby, L. (2013). Monitoring and breeding population of grey seals in Ireland 2009 – 2012. Irish Wildlife Manuals No. 74. National Parks and Wildlife Services, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Ocean Renewable Power Company. (2014). Cobscook Bay Tidal Energy Project. 2014 Environmental Monitoring Report.

Onoufriou, J., Brownlow, A., Moss, S., Hastie, G. and Thompson, D. (2019) Empirical determination of severe trauma in seals from collisions with tidal turbine blades. Journal of Applied Ecology.

OSPAR (2009). Assessment of the environmental impacts of cables. London: OSPAR Commission Biodiversity Series. Publication no. 437/2009. 19 pp.

Otani, S., Naito, T., Kato, A. and Kawamura, A. (2000). Diving behaviour and swimming speed of a free-ranging harbour porpoise (Phocoena phocoena). Marine Mammal Science, Volume 16, Issue 4, pp 811-814, October 2000.

Oudejans, M.G., Visser, F., Englund, A., Rogan, E. and Ingram, S.N., (2015). Evidence for distinct coastal and offshore communities of bottlenose dolphins in the North East Atlantic. PloS one, 10(4), p.e0122668.

Parvin, S.J., Wor kman, R., Bourke, P. and Nedwell, J. (2005). Assessment of Tidal Current Turbine Noise at the Lynmouth site and predicted impact of underwater noise at Strangford Lough. Subacoustech Report No. 628R0104 to CMACS Ltd. .

Parvin, S.J., Nedwell, J.R. and Harland, E. (2007). Lethal and physical injury of marine mammals, and requirements for Passive Acoustic Monitoring. Subacoustech report no. 565R0212 prepared for the RK Government Department for Business, Enterprise and Regulatory Reform.

Parvin, S. J. and Brooker, A. G. (2008). Measurement and assessment of underwater noise from the Openhydro tidal turbine device at the EMEC facility, Orkney. Subacoustech Report No. 812R0207 to Openhydro Ltd. .

Paxton, C.G.M., Scott-Hayward, L., Mackenzie, M., Rexstad, E. and Thomas, L. (2016). Revised Phase III Data Analysis of Joint Cetacean Protocol Data Resources with Advisory Note, JNCC Report 517, ISSN 0963-8091: http://jncc.defra.gov.uk/page-7201.

Pesante, G., Evans, P.G.H., Anderwald, P., Powell, D. and McMath, M. (2008a). Connectivity of Bottlenose Dolphin in Wales: North Wales PhotoMonitoring Interim Report 2008. Marine Monitoring Report No. 62. 42 pp

Pesante, G., Evans, P.G.H., Baines, M.E. and McMath, M. (2008b). Abundance and Life History Parameters of Bottlenose Dolphin in Cardigan Bay: Monitoring 2005-2007. CCW Marine Monitoring Report No. 61. 7581 pp.

Pierpoint, C. (2001) Harbour porpoise distribution in Welsh coastal waters. Unpubl. report to the International Fund for Animal Welfare. 41pp.

Pierpoint, C. (2008). Harbour porpoise (Phocoena phocoena) foraging strategy at a high energy, near-shore site in south-west Wales, UK. Journal of the Marine Biological Association of the United Kingdom, 88(6), pp.1167-1173.

Planning Inspectorate (2015) Advice Note Seventeen: Cumulative effects assessment relevant to nationally significant infrastructure projects. https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2015/12/Advice-note-17V4.pdf

Polacheck, T. and Thorpe, L. (1990). The swimming direction of harbor porpoises in relationship to a survey vessel. *Report of the International Whaling Commission, 40*, pp.463-470.

Popper, A.N., Hawkins, A.D., Fay, R.R., Mann, D., Bartol, S., Carlson, T., Coombs, S., Ellison, W.T., Gentry, R., Halvorsen, M.B., Løkkeborg, S., Rogers, P., Southall, B.L., Zeddies, D. and Tavolga, W.N. (2014). Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report, ASA S3/SC1.4 TR-2014 prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. Springer and ASA Press, Cham, Switzerland.

Raum-Suryan, K.L. and Harvey, J.T., (1998). Distribution and abundance of and habitat use by harbor porpoise, Phocoena phocoena, off the northern San Juan Islands, Washington. Fishery Bulletin, 96(4), pp.808-822.

Read, A.J., (1990). Reproductive seasonality in harbour porpoises, *Phocoena phocoena*, from the Bay of Fundy. Canadian Journal of Zoology, 68(2), pp.284-288.

Read, A.J. and Westgate, A.J., (1997). Monitoring the movements of harbour porpoises (Phocoena phocoena) with satellite telemetry. Marine Biology, 130(2), pp.315-322.

Reid, J.B, Evans, P.G.H. and Northridge, S.P. (2003). Atlas of cetacean Distribution in North west European waters. JNCC, Peterborough.

Richardson, J., Greene, C.R., Malme, C.I. and Thomson, D.H. (1995). Marine Mammals and Noise. San Diego California: Academic Press.

Robertson, F., Wood, J., Joslin, J., Joy, R., and Polagye, B. (2018). Marine mammal behavioural response to tidal turbine sound, Final technical report for DE-EE0006385.

Robinson, K.P., O'Brien, J., Berrow, S., Cheney, B., Costa, M., Elsfield, S.M., Haberlin, D., Mandleberg, L., O'donovan, M., Oudejans, M.G. and O'Connor, I., (2012). Discrete or not so discrete: Long distance movements by coastal bottlenose dolphins in UK and Irish waters. Journal of Cetacean Research and Management 12: 365–371.

Robinson, S.P., Lepper, P.A. and Hazelwood, R.A. (2014). Good practice guide for underwater noise measurement. National Measurement Office, Marine Scotland, The Crown Estate. NPL Good Practice Guide No. 133, ISSN: 1368-6550.

Rogan, E. and Berrow, S.D., (1996). A review of harbour porpoises. Phocoena phocoena, in Irish waters. Report – International Whaling Commision 46, pp.595-606.

Rogan, E., Breen, P., Mackey, M., Cañadas, A., Scheidat, M., Geelhoed, S. & Jessopp, M. (2018). Aerial surveys of cetaceans and seabirds in Irish waters: Occurrence, distribution and abundance in 2015-2017. Department of Communications, Climate Action & Environment and National Parks and Wildlife Service (NPWS), Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland. 297pp.

Russell, D.J.F. and McConnell, B.J. (2014). Seal at-sea distribution, movements and behaviour. Report to DECC. URN: 14D/085. March 2014 (final revision).

Russell, D.J.F., McConnell, B.J., Thompson, D., Duck, C.D., Morris, C., Harwood, J. and Matthiopoulos, J. (2013). Uncovering the links between foraging and breeding regions in a highly mobile mammal. Journal of Applied Ecology, Vol 50, no. 2, pp. 499-509.

Russell, D.J.F., Brasseur, S.M.J.M., Thompson, D., Hastie, G.D., Janik, V.M., Aarts, G., McClintock, B.T., Matthiopoulos, J., Moss, S.E.W. and McConnell, B. (2014). Marine mammals trace anthropogenic structures at sea. Current Biology Vol 24 No 14: R638–R639.

Russell, D.J.F, Jones, E.L. and Morris, C.D. (2017). Updated Seal Usage Maps: The Estimated at-sea Distribution of Grey and Harbour Seals. Scottish Marine and Freshwater Science Vol 8 No 25, 25pp. DOI: 10.7489/2027-1.

Santos, M.B. and Pierce, G.J., (2003). The diet of harbour porpoise (*Phoceona phoceona*) in the North east Atlantic. Oceanography and Marine Biology: an Annual Review 2003, 41, 355–390.

Santos, M.B., Pierce, G.J., Ross, H.M., Reid, R.J. and Wilson, B. (1994). Diets of small cetaceans from the Scottish coast. International Council for the Exploration of the Sea, Marine Mammal Committee, C.M. 1994/N:11.

Santos, M.B., Pierce, G.J., Reid, R.J., Patterson, I.A.P., Ross, H.M. and Mente, E. (2001). Stomach contents of bottlenose dolphins (*Tursiops truncatus*) in Scottish waters. Journal of the Marine Biological Association of the United Kingdom. 81, pp.873-878.

Santos, M.B., Pierce, G.J., Learmonth, J.A., Reid, R.J., Ross, H.M., Patterson, I.A.P., Reid, D.G. and Beare, D. (2004). Variability in the diet of harbor porpoises (*Phocoena phocoena*) in Scottish waters 1992–2003. Marine Mammal Science, 20(1), pp.1-27.

Scheidat, M., Tougaard, J., Brasseur, S., Carstensen, J., van Polanen Petel, T., Teilmann, J., and Reijnders, P. (2011). Harbour porpoise (*Phocoena phocoena*) and wind farms: a case study in the Dutch North Sea. Environ. Res. Lett. 6 (April-June 2011) 025102.

Schmitt, P., Pine, M.K., Culloch, R.M., Lieber, L. and Kregting, L.T. (2018). Noise characterization of a subsea tidal kite. The Journal of the Acoustical Society of America, 144(5), pp.EL441-EL446.

SCOS (2014). SCOS Report. Scientific Advice on Matters Related to the Management of Seal Populations: 2014.

SCOS. (2017). SCOS Report. Scientific Advice on Matters Related to the Management of Seal Populations: 2017.

Scottish Natural Heritage. (2016). Assessing collision risk between underwater turbines and marine wildlife. SNH guidance note.

Sea Mammal Research Unit Ltd (SMRU Ltd) on behalf of The Crown Estate. (2010). Approaches to Marine Mammal Monitoring at Marine Renewable Energy Developments Final Report

Sea Watch Foundation. (2019). Wales Recent Sightings. Available from: http://seawatchfoundation.org.uk/legacy_tools/region.php?output_region=10

Sea Watch Foundation. (2012). Common Dolphin Factsheet. Available from: http://seawatchfoundation.org.uk/wp-content/uploads/2012/07/Common_Dolphin.pdf

Sharples R.J., Matthiopoulos, J. and Hammond, P.S. (2008). Distribution and movements of harbour seals around the coast of Britain: Outer Hebrides, Shetland, Orkney, the Moray Firth, St Andrews Bay, The Wash and the Thames. Report to DTI July 2008.

Sharples, R.J., Moss, S.E., Patterson, T.A. and Hammond, P.S. (2012). Spatial Variation in Foraging Behaviour of a Marine Top Predator (Phoca vitulina) Determined by a Large-Scale Satellite Tagging Program. PLoS ONE 7(5): e37216.

Shucksmith, R., Jones, N.H., Stoyle, G.W., Davies, A. and Dicks, E.F. (2009). Abundance and distribution of the harbour porpoise (Phocoena phocoena) on the north coast of Anglesey, Wales, UK. *Journal of the Marine Biological Association of the United Kingdom, 89*, pp.1051–1058.

Simon, M., Nuuttila, H., Reyes-Zamudio, M.M., Ugarte, F., Verfub, U. and Evans, P.G. (2010). Passive acoustic monitoring of bottlenose dolphin and harbour porpoise, in Cardigan Bay, Wales, with implications for habitat use and partitioning. Journal of the *Marine Biological Association of the United Kingdom, 90*(8), pp.1539-1545.

Skov, H. and Thomsen, F. (2008). Resolving fine-scale spatio-temporal dynamics in the harbour porpoise Phocoena phocoena. *Marine Ecology Progress Series*, 373, pp.173-186.

Skrovan, R.C., Williams, T.M., Berry, P.S., Moore, P.W. and Davis, R.W. (1999). The diving physiology of bottlenose dolphins (*Tursiops truncatus*). II. Biomechanics and changes in buoyancy at depth. Journal of Experimental Biology, 202(20), pp.2749-2761.

SLR (2015). Proposed Environmental Effects Monitoring Programs 2015 - 2020 Fundy Ocean Research Centre For Energy (FORCE). [online] Available at: http://fundyforce.ca/wp-content/uploads/2012/05/SLR-REPORT.pdf

Smolker, R.A., Richards, A.F., Connor, R.C. and Pepper, J.W. 1992. Sex differences in patterns of association among Indian Ocean bottlenose dolphins. Behaviour 123: 38-69.

Sonntag, R.P., Benke, H., Hiby, A.R., Lick, R. and Adelung, D. (1999). Identification of the first harbour porpoise (Phocoena phocoena) calving ground in the North Sea. *Journal of Sea Research, 41*(3), pp.225-232.

Sørensen, T.B. and Kinze, C.C., (1994). Reproduction and reproductive seasonality in Danish harbour porpoises, Phocoena phocoena. *Ophelia, 39(*3), pp.159-176.

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr., C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A., and Tyack, P.L. (2007). Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, 33 (4), pp. 411-509.

Sparling, C. and Smith, K. (2019). Defining Project Envelopes for Marine Energy Projects: Review and Tidal Energy Test Facility and Marine Mammals Case Study. Report Number SMRUC-NRW-2016-009 Provided to Natural Resources Wales, February 2019 (Unpublished).

Sparling, C., Sams, C., Stephenson, S., Joy, R., Wood, J., Gordon, J., Thompson, D., Plunkett, R., Miller, B. and Gotz, T. (2015). The use of Acoustic Deterrents for the mitigation of injury to marine mammals during pile driving for offshore wind farm construction. ORJIP Project 4, Stage 1 of Phase 2. Final Report.

Sparling, C., Gillespie, D., Hastie, G., Gordon, J., Macaulay, J., Malinka, C., Wu, M. and McConnell, B. (2016). Scottish Government Demonstration Strategy: Trialling Methods for Tracking the Fine Scale Underwater Movements of Marine Mammals in Areas of Marine Renewable Energy Development. Scottish Marine and Freshwater Science, 7, p.114.

Sparling, C., Lonergan, M. and McConnell, B. (2018). Harbour seals (*Phoca vitulina*) around an operational tidal turbine in Strangford Narrows: No barrier effect but small changes in transit behaviour. Aquatic Conservation: Marine and Freshwater Ecosystems, 28(1), pp.194-204.

Stern, S.J. (1992). Surfacing rates and surfacing patterns of minke whales (*Balaenoptera acutorostrata*) off Central California, and the probability of a whale surfacing within visual range. Report of the International Whaling Commission 42, 379-385.

Stringell, T., Millar, C., Sanderson, W., Westcott, S. and McMath, A. (2014). When aerial surveys won't do: Grey seal pup production in cryptic habitats of Wales. Journal of the Marine Biological Association of the United Kingdom, 94(6): 1155–-1159.

Strong, P. and Morris, S.R. (2010). Grey seal (*Halichoerus grypus*) disturbance, ecotourism and the Pembrokeshire Marine Code around Ramsey Island. J. Ecotourism 9(2): 117–132.

Strong P.G., Lerwill J., Morris S.R. and Stringell T.B. (2006). Pembrokeshire marine SAC grey seal monitoring 2005. CCW Marine Monitoring Report, no. 26, unabridged version (restricted under license), 54 pp.

Subacoustech (2014). Underwater noise modelling of tidal devices and other associated noise at the Perpetuus Tidal Energy Centre off the coast of the Isle of Wight, England. Subacoustech Report No. E432R0105.

Sveegaard, S., Teilmann, J., Berggren, P., Mouritsen, K.N., Gillespie, D. and Tougaard, J., (2011). Acoustic surveys confirm the high-density areas of harbour porpoises found by satellite tracking. *ICES Journal of Marine Science, 68*(5), pp.929-936.

Sveegaard, S., Nabe-Nielsen, J., Stæhr, K.J., Jensen, T.F., Mouritsen, K.N. and Teilmann, J. (2012). Spatial interactions between marine predators and their prey: herring abundance as a driver for the distributions of mackerel and harbour porpoise. *Marine Ecology Progress Series, 468*, pp.245-253.

Teilmann, J., Dietz, R., Larsen, F., Desportes, G., Geertsen, B.M., Andersen, L.W., Aastrup, P. and Hansen, J.R., (2004). Satellite tracking of porpoises in Danish and adjacent waters. Faglig rapport fra DMU, no. 484, Danmarks Miljøundersøgelser, Silkeborg.

Teilmann, J., Carstensen, J., Dietz, R., Edrén, S. and Andersen, S. (2006). Final report on aerial monitoring of seals near Nysted Offshore Wind Farm Technical report to Energi E2 A/S. Ministry of the Environment Denmark.

Teilmann, J., Larsen, F. and Desportes, G. (2007). Time allocation and diving behaviour of harbour porpoises (*Phocoena phocoena*) in Danish and adjacent waters. Journal of Cetacean Research and Management 9(3): 201-210.

Teilmann, J., Tougaard, J. and Carstensen, J. (2012). Effects on harbour porpoises from Rodsand 2 Off-shore Wind Farm. Scientific Report from DCE: Danish Centre for Environment and Energy, (42).

Theobald, P.D., Robinson, S.P., Lepper, P.A., Hayman, G., Humphrey, V.F., Wang, L. and Mumford, S.E. (2011). The measurement of underwater noise radiated by dredging vessels during aggregate extraction operations. 4th International Conference and Exhibition on Underwater Acoustic Measurements: Technologies & Results.

Thompson, D. (2012). Assessment of Risk to Marine Mammals from Underwater Marine Renewable Devices in Welsh waters (on behalf of the Welsh Government). Phase 2: Studies of Marine Mammals in Welsh High Tidal Waters. Annex 1 Movements and Diving Behaviour of Juvenile Grey Seals in Areas of High Tidal Energy. RPS document reference: JER3688 R 120712 HT.

Thompson, D. (2015). Parameters for collision risk models. Report by Sea Mammal Research Unit, University of St Andrews, for Scottish Natural Heritage.

Thompson, P.M. and Miller, D. (1990). Summer foraging activity movements of radio-tagged common seals (*Phoca vitulina* L.) in the Moray Firth, Scotland. J. Appl. Ecol. 27: 492-501.

Thompson, P.M., McConnell, B.J., Tollit, D.J., Mackay, A., Hunter, C. and Racey, P.A. (1996). Comparative distribution, movements and diet of harbour and grey seals from the Moray Firth, N.E. Scotland. *Journal of Applied Ecology. 33*, pp.1572-1584.

Thompson, D., Bexton, S., Brownlow, A., Wood, D., Patterson, T., Pye, K., Lonergan, M. and Milne, R. (2010). Report on recent seal mortalities in UK waters caused by extensive lacerations. Sea Mammal Research Unit, Scottish Oceans Institute, University of St Andrews, Scotland.

Thompson, D., Onoufriou, J., Brownlow, A. and Morris, C. (2014). Data based estimates of collision risk: an example based on harbour seal tracking data around a proposed tidal turbine array in the Pentland Firth. Report by the Sea Mammal Research Unit, University of St Andrews, for Scottish Natural Heritage and Marine Scotland.

Thompson, D., Brownlow, A., Onoufriou, J. and Moss, S. (2016). Collision risk and impact study: field tests of turbine blade-seal carcass collisions. Report to Scottish Government No MR 5.

Thomsen, F., Lüdemann, K., Kafemann, R. and Piper, W. (2006). Effects of offshore wind farm noise on marine mammals and fish, on behalf of COWRIE Ltd.

Todd,V.L.G., Todd, I.B., Gardiner, J.C., Morrin, E.C.N., MacPherson, N.A., DiMarzio, N.A. and Thomsen, F. (2014). A review of impacts of marine dredging activities on marine mammals. – ICES Journal of Marine Science, doi: 10.1093/icesjms/fsu187.

Tolley, K.A. and Rosel, P.E. (2006). Population structure and historical demography of eastern North Atlantic harbour porpoises inferred through mtDNA sequences. Marine Ecology Progress Series, 327, pp.297-308.

Tollit, D.J., Black, A.D., Thompson, P.M., Mackay, A., Corpe, H.M., Wilson, B., Parijs, S.M., Grellier, K. and Parlane, S. (1998). Variations in harbour seal *Phoca vitulina* diet and dive-depths in relation to foraging habitat. *Journal of Zoology*. 244(2), pp.209-222.

Tougaard, J., Carstensen, J., Wisch, M.S., Teilmann, J., Bech, N., Skov, H. and Henriksen, O.D. (2005). Harbour porpoises on Horns reef—effects of the Horns Reef Wind farm. Annual Status Report 2004 to Elsam. NERI, Roskilde (Also available at: www.hornsrev.dk).

Tougaard, J., Carstensen, J. and Teilmann, J. (2009a). Pile driving zone of responsiveness extends beyond 20 km for harbour porpoises (*Phocoena phocoena* (L.)) (L). J. Acoust. Soc. Am., 126, pp. 11-14.

Tougaard, J., Henriksen, O.D. and Miller. L.A. (2009b). Underwater noise from three types of offshore wind turbines: estimation of impact zones for harbour porpoise and harbour seals. Journal of the Acoustic Society of America 125(6): 3766.

Tynan, C.T., Ainley, D.G., Barth, J.A., Cowles, T.J., Pierce, S.D. and Spear, L.B., (2005). Cetacean distributions relative to ocean processes in the northern California Current System. Deep Sea Research Part Ii: *Topical studies in Oceanography, 52*(1-2), pp.145-167.

Veneruso, G. and Evans, P.G.H. (2012a). Connectivity of Bottlenose Dolphins in Welsh Waters: North Wales Photo-Monitoring Interim Report. Report to Countryside Council for Wales. Sea Watch Foundation. 17pp.

Veneruso, G. and Evans, P.G.H. (2012b). Bottlenose Dolphin and Harbour Porpoise Monitoring in Cardigan Bay and Pen Llyn a‟r Sarnau Special Areas of Conservation. CCW Monitoring Report No. 95. 66pp.

Westcott, S. (2002). The distribution of grey seals *(Halichoerus grypus)* and census of pup production in North Wales 2001. CCW Contract Science Report. No. 499. 157 pp.

Westcott, S.M. and Stringell, T.B. (2003). Grey seal pup production for North Wales, 2002. CCW Marine Monitoring Report No. 5. 55 pp

Westcott, S.M. and Stringell, T.B. (2004). Grey seal distribution and abundance in North Wales, 2002-2003. CCW Marine Monitoring Report No. 13. 80 pp.

Westgate, A.J., Head, A.J., Berggren, P., Koopman, H.N. and Gaskin, D.E. (1995). Diving behaviour of harbour porpoises *Phocoena phocoena*. Canadian Journal of Fisheries and Aquatic Sciences 52, 1064-73.

Windsland, K., Lindstrom U., Nilssen, K.T. and Haug, T. (2007). Relative abundance and size composition of prey in the common minke whale diet in selected areas of the north-eastern Atlantic during 2000-04. J. Cetacean Res. Manage, 9(3), pp.167-178.

Williams, T.M. (2009). Encyclopedia of Marine Mammals 1140-47. ed Perrin, W.F., Würsig, B. and Thewissen, J.G.M. Academic Press.

William, F.P., Bernd, W. and Thewissen, J.G.M. (2002). Encyclopedia of marine mammals.

Williams, A.D., Williams, R., Heimlich-Boran, J.R., Evans, P.G.H., Tregenza, N.J.C., Ridoux, V., Liret, C. and Savage, S. (1996). A preliminary report to an investigation into bottlenose dolphins (*Tursiops truncatus*) of the English Channel: A collaborative approach. European Research on Cetaceans. 10, pp.217-220.

Wilson, S. (2014). The impact of human disturbance at seal haul-outs. A literature review for the Seal Conservation Society. http://www.pinnipeds.org/attachments/article/199/Disturbance%20for%20SCS%20-%20text.pdf.

Wilson, B., Thompson, P.M., Hammond, P.S. (1997). Habitat use by bottlenose dolphins: seasonal distribution and stratified movement patterns in the Moray Firth Scotland. *The Journal of Applied Ecology 34,* pp.1365–1374.

Wilson, B., Reid, R.J., Grellier, K., Thompson, P.M. and Hammond, P.S. (2004). Considering the temporal when managing the spatial: a population range expansion impacts protected areas based management for bottlenose dolphins. Animal Conservation 7: 331–338.

Wilson, B. Batty, R. S., Daunt, F. and Carter, C. (2007). Collision risks between marine renewable energy devices and mammals, fish and diving birds. Report to the Scottish Executive. Scottish Association for Marine Science, Oban, Scotland, PA37 1QA.

Wisniewska, D. M., Johnson, M., Teilmann, J., Rojano-Doñate, L., Shearer, J., Sveegaard, S., Miller, L. A., Siebert, U and Madsen, P. T. (2016). Ultra-High Foraging Rates of Harbor Porpoises Make Them Vulnerable to Anthropogenic Disturbance. Current Biology. May 26, 2016 DOI: https://doi.org/10.1016/j.cub.2016.03.069.

Wisniewska, D.M., Johnson, M., Teilmann, J., Siebert, U., Galatius, A., Dietz, R. and Madsen, P.T. (2018). High rates of vessel noise disrupt foraging in wild harbour porpoises (*Phocoena phocoena*). Proc. R. Soc. B 285: 20172314. http://dx.doi.org/10.1098/rspb.2017.2314.

Wither, A., Bamber, R., Colclough, S., Dyer, K., Elliott, M., Holmes, P., Jenner, H., Taylor, C. and Turnpenny, A. (2012). Setting new thermal standards for transitional and coastal (TraC) waters. *Marine Pollution Bulletin. 64*, pp. 1564 - 1579.

WODA (2013). Technical Guidance on: Underwater Sound in Relation to Dredging. World Organisation of Dredging Associations.

Wood, C.J. (1998). Movement of bottlenose dolphins around the south-west coast of Britain. Journal of Zoology, 246(2), pp.155-163.

Xodus (2015). Deep Green Project EIA: Technical Studies, Underwater Noise Modelling.

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Morlais Project
Environmental Statement

Chapter 13: Offshore Archaeology and Cultural Heritage

Volume I

Applicant: Menter Môn Morlais Limited

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Chapter 13: Offshore Archaeology and Cultural Heritage

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Making Sense of the Marine Environment ™

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GLOSSARY OF ABBREVIATIONS

AEZ	Archaeological Exclusion Zone
COWRIE	Collaborative Offshore Wind Research into the Environment
DBA	Desk Based Assessment
DECC	Department of Energy and Climate Change
EIA	Environmental Impact Assessment
ES	Environmental Statement
GAT	Gwynedd Archaeological Trust
HER	Historic Environment Record
JLDP	Joint Local Development Plan
MDZ	Morlais Demonstration Zone
MPS	Marine Policy Statement
NMRW	National Monuments Record of Wales
NPS	National Policy Statements
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
OfDA	Offshore Development Area
PAD	Protocol for Archaeological Discoveries
RCAHMW	Royal Commission on the Ancient and Historical Monuments of Wales
ROV	Remotely Operated Vehicle
RoW	Receiver of Wreck
TAN	Technical Advice Note
TWAO	Transport and Works Act Order
UKHO	United Kingdom Hydrographic Office
USAAF	United States Army Air Force
WNMP	Welsh National Marine Plan
WWII	Second World War

GLOSSARY OF TERMINOLOGY

Aviation archaeology	The remains of crashed aircraft and archaeological material associated with historic aviation activities.
Glacial	A glacial period is a period of time within an ice age that is marked by colder temperatures and glacier advances. Interglacial correspond to periods of warmer climate between glacial periods. There are three main periods of glaciation within the last 1 million years, the Anglian, the Wolstonian and the Devensian which ended about 12,000 years ago. The Holocene period corresponds to the current interglacial.
Holocene	The present epoch (late 1900s onwards)
Maritime archaeology	The remains of boats and ships and archaeological material associated with prehistoric and historic maritime activities.
Mesolithic	10000 to 4000 BC The Middle Stone Age, falling between the Palaeolithic and Neolithic and marking the beginning of a move from a hunter gatherer society towards a food producing society.
Palaeoenvironmental analysis	The study of sediments and the organic remains of plants and animals to reconstruct the environment of a past geological age.
Palaeogeographic features	Features seen within sub-bottom profiler data (buried) and multibeam bathymetry data (sea floor) interpreted as representing prehistoric physical landscape features such as former river channels (palaeochannels).
Palaeolithic	500000 to 10000 BC The Old Stone Age defined by the practice of hunting and gathering and the use of chipped flint tools. This period is usually divided into Lower, Middle and Upper Palaeolithic.
Seabed features	Features seen on the seafloor in the sidescan sonar or multibeam bathymetry data which are interpreted to represent heritage assets, or potential heritage assets. Also includes magnetic anomalies which may represent shallow buried ferrous material of archaeological interest.
Seabed prehistory	Archaeological remains on the seabed corresponding to the activities of prehistoric populations that may have inhabited what is now the seabed when sea levels were lower.

13. OFFSHORE ARCHAEOLOGY AND CULTURAL HERITAGE

13.1. INTRODUCTION

1. Menter Môn Morlais Limited (Menter Môn) proposes the development of 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ). The development of the Morlais Project (the Project) will support the development of renewable energy technology objectives of the Anglesey and Gwynedd Joint Local Development Plan (JLDP), providing a consented tidal technology demonstration zone which supports installation, testing and commercial demonstrations of tidal energy devices. The Project will also provide opportunities for the local communities via direct employment and support of the local supply chain.

2. The Project will include permanent communal infrastructure for tidal technology developers which provides a shared route to a local grid connection via nine export cable tails, a Landfall Substation, and an onshore electrical cable route to a grid connection via a Switchgear Building and Grid Connection Substation.

3. The purpose of this chapter is to provide an assessment of possible impacts which may arise through the development of the Project on offshore archaeology and cultural heritage. This chapter describes the baseline environment, identifies potential impacts which may arise and their related receptors, presents an impact assessment and associated results, and where applicable proposes mitigation measures. This chapter has been prepared by MarineSpace Ltd on behalf of Royal HaskoningDHV.

4. The Project will install multiple technology types within the MDZ, and so the consent application is based on a Project Design Envelope (also known as a Rochdale Envelope), determined through knowledge of existing technology and the direction of future developments. Hence, the potential effects on offshore archaeology and cultural heritage have been assessed conservatively using realistic ‘worst-case’ scenarios for the Project.

5. This chapter has been prepared by MarineSpace Ltd on behalf of Menter Môn.

13.2. POLICY, LEGISLATION AND GUIDANCE

6. This section outlines the relevant national and regional policy and guidance and industry guidance which has be used to support the compilation of this ES Chapter.

7. An overview of the relevant legislative context for the Project is provided in **Chapter 2, Policy and Legislation**.

13.2.1. Industry Guidance

8. Industry guidance on requirements, included in the Environmental Impact Assessment (EIA) methodology adopted (**Section 13.4**), ensures that this assessment conforms to archaeological best practice and the standards detailed in the following documents:

   - Code of Practice for Seabed Development (Joint Nautical Archaeology Policy Committee, 2008);

- Collaborative Offshore Wind Research into the Environment (COWRIE) Guidance for the cumulative impacts on the historic environment from offshore renewable energy (Wessex Archaeology, 2007);
- Conservation Principles for the Sustainable Management of the Historic Environment in Wales (Cadw, 2011);
- Historic Environment Guidance for Wave and Tidal Energy (Firth, 2013);
- Managing Heritage Impact Assessment in Wales (Cadw, 2017a);
- Managing Conservation Areas in Wales (Cadw, 2017b);
- Marine Geophysics Data Acquisition, Processing and Interpretation: Guidance Note (English Heritage, 2013);
- Model Clauses for Archaeological Written Schemes of Investigating: Offshore Renewables Projects (The Crown Estate 2010);
- Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector (Gribble and Leather, 2011);
- Protocol for Archaeological Discoveries (PAD) (The Crown Estate, 2014);
- Standard and Guidance for Historic Environment Desk Based Assessment (DBA) (Institute for Archaeologists, 2014); and
- Welsh Government Technical Advice Note (TAN) 24: The Historic Environment (Welsh Government, 2017a);

13.2.2. Legislation and Policy Context

9. Assessment specific legislation and policy relating to the marine historic environment within Welsh territorial waters have been collated and assessed. The most notable and relevant examples to the Project for offshore archaeology and cultural heritage are listed below. Further detailed descriptions can be found in **Appendix 13-1** (**Volume III**).

13.2.2.1. Global Legislation and Policy

10. Relevant global policy and legislation to offshore archaeology and cultural heritage are as follows:

- The World Heritage Convention (1972);
- United Nations Convention on the Law of the Sea (1982);
- International Council of Monuments and Sites Charter on the Protection and Management of Underwater Cultural Heritage (1996) (the Sofia Charter); and
- UNESCO Convention on the Protection of the Underwater Cultural Heritage (2001).

13.2.2.2. Relevant European Legislation and Policy

11. Relevant European policy and legislation to offshore archaeology and cultural heritage are as follows:

- European Convention on the Protection of the Archaeological Heritage (Revised) (1992) (the Valletta Convention); and
- European Landscape Convention (2000).

13.2.2.3. UK Legislation and Policy

12. Relevant UK policy and legislation to offshore archaeology and cultural heritage are as follows:

- The Protection of Wrecks Act (1973):
- Section One; and
- Section Two;
- The Ancient Monuments and Archaeological Areas Act (1979);
- The Merchant Shipping Act (1995);
- The Protection of Military Remains Act (1996); and
- The UK Marine Policy Statement (MPS) (HM Government, 2011) and UK High Level Marine Objectives (HLMO).

13.2.2.4. National Policy Statements

13. The Project is seeking consent for a Transport and Works Act Order (TWAO) from the Welsh Government and a Marine Licence from Natural Resources Wales (NRW). Its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP); therefore, guidance relevant to NSIPs is considered appropriate to use for this Project. Guidance that is relevant to assessing impacts on marine archaeology and cultural heritage for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to this chapter topic include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3), July 2011 (DECC, 2011b).

14. Details of specific policies within EN-1 and EN-3 used to inform this assessment are provided in **Table 13-1** below. The specific assessment requirements for offshore archaeology and cultural heritage are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 13-1 NPS EN-1 and EN-3 Assessment Requirements Relevant to Offshore Archaeology and Cultural Heritage

NPS Requirement	NPS Reference	ES Reference
"As part of the ES the applicant should provide a description of the significance of the heritage assets affected by the proposed development and the	EN-1 Paragraph 5.8.8	The significance and value of the archaeological receptors considered in this chapter of the

NPS Requirement	NPS Reference	ES Reference
contribution of their setting to that significance. The level of detail should be proportionate to the importance of the heritage assets and no more than is sufficient to understand the potential impact of the proposal on the significance of the heritage asset."		ES, including the contribution of setting to that significance is detailed throughout **Section 13.7.** Issues relating to the setting of onshore heritage assets have been considered as part of **Chapter 20, Onshore Archaeological and Cultural Heritage**.
"Where a development site includes, or the available evidence suggests it has the potential to include, heritage assets with an archaeological interest, the applicant should carry out appropriate desk-based assessment and, where such desk-based research is insufficient to properly assess the interest, a field evaluation. Where proposed development will affect the setting of a heritage asset, representative visualisations may be necessary to explain the impact."	EN-1, Paragraph 5.8.9	This chapter of the ES is based upon the results of a desk-based assessment which identifies the presence of archaeological receptors within the offshore study area (see **Section 13.5.2** and **Appendix 13-1, Volume III**).
"The applicant should ensure that the extent of the impact of the proposed development on the significance of any heritage assets affected can be adequately understood from the application and supporting documents."	EN-1, Paragraph 5.8.10	This chapter of the ES provides an account of the potential impacts of the Project upon heritage assets and their significance (**Section 13.7**).
"Consultation with the relevant statutory consultees (including English Heritage or Cadw) should be undertaken by the applicants at an early stage of the development."	EN-3, Paragraph 2.6.140	Consultation has been undertaken with relevant statutory consultees, as outlined in **Section 13.3**, **Table 13-3**. Consultation will be on going throughout the development process.
"Assessment should be undertaken as set out in Section 5.8 of EN-1. Desk-based studies should take into account any geotechnical or geophysical surveys that have been undertaken to aid the windfarm design."	EN-3, Paragraph 2.6.141	The assessment has been undertaken in accordance with Section 5.8 of EN-1, as detailed above. Geophysical and geotechnical studies have underpinned the assessment (**Section 13.5.3** and Partrac, 2018).
"The assessment should also include the identification of any beneficial effects on the historic marine environment, for example through improved access or the contribution to new knowledge that arises from investigation."	EN-3, Paragraph 2.6.142	Any beneficial effects to the offshore archaeology and cultural heritage resource resulting from the Project have been identified and incorporated as part of **Section 13.7**.
"Where elements of an application (whether offshore or onshore) interact with features of historic maritime significance that are located onshore, the effects should be assessed in accordance with the policy at Section 5.8 of EN-1."	EN-3, Paragraph 2.6.143	Potential impacts of the Project upon onshore heritage assets have been considered in **Chapter 20, Onshore Archaeology and Cultural Heritage**.
"PINS should be satisfied that OWFs and associated infrastructure have been designed sensitively taking into account known heritage assets and their status (for example designated features)."	EN-3, Paragraph 2.6.144	Embedded mitigation measures are detailed in **Section 13.7.1.3**, and further impact-specific mitigation measures, such as the

NPS Requirement	NPS Reference	ES Reference
"Avoidance of important heritage assets, including archaeological sites and historic wrecks, is the most effective form of protection and can be achieved through the implementation of archaeological exclusion zones (AEZ) around such heritage assets which preclude development activities within their boundaries"	EN-3, Paragraph 2.6.145	implementation of AEZs are provided in **Sections 13.7.2** and **Section 13.7.3**.
"Where requested by applicants, PINS should consider granting consents that allow for micro-siting to be undertaken within a specified tolerance. This allows changing to be made to the precise location of infrastructure during the construction phase so that account can be taken of unforeseen circumstances such as the discovery of marine archaeological remains."	EN-43, Paragraph 2.6.145	Micro-siting is a mitigation measure proposed in **Section 13.7.2.1.5** to minimised impacts to known wreck sites.

13.2.2.5. Welsh Legislation and Policy

15. Relevant Welsh policy and legislation to offshore archaeology and cultural heritage are as follows:

- The Planning (Wales) Act (2015);
- The Well-Being of Future Generations (Wales) Act (2015);
- The Historic Environment (Wales) Act (2016);
- National Planning Policy in Wales (Planning Policy Wales, edition 10, 2018) (Welsh Government, 2018) and the Historic Environment (Wales) Act 2016.; and
- Draft Welsh National Marine Plan (WNMP) (Welsh Government, 2017b).

16. By adopting the MPS, the Welsh Government committed to the requirement to introduce the WNMP, which is currently under consultation (discussed further in **Chapter 2, Policy and Legislation**). The draft WNMP makes reference to policies relevant to the Project, and those specific to offshore archaeology are detailed in **Table 13-2**.

Table 13-2 National and Regional Policy Requirements Relevant to Offshore Archaeology

Policy Description	ES Reference
Draft WNMP: SOC_05 - Historic Assets	
Proposals should demonstrate how potential impacts on historic assets and their settings have been taken into consideration at an early stage and should, in order of preference: a) avoid adverse impacts on historic assets and their settings; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be adequately addressed, proposals should present a clear and	An assessment of the existing and potential maritime archaeological resources is presented in desk based archaeological assessment in **Appendix 13-1** (**Volume III**). A summary has been presented in this chapter (**Section 13.6-13.8**). The setting of onshore assets has been undertaken as part of the onshore archaeology DBA and ES **Chapter 20, Onshore Archaeology and Cultural Heritage**.

Policy Description	ES Reference
convincing justification for proceeding. Opportunities to enhance historic assets are encouraged.	Identification of the impacts and the appropriate method of avoidance, minimisation or mitigation has been discussed in **Section 13.7**.
JLDP: Policy AMG 6 - Protecting Sites of Regional or Local Significance	
Proposals that are likely to cause direct or indirect significant harm to Local Nature Reserves (LNR), Wildlife Sites (WS) 1 or regionally important geological / geomorphologic sites (RIGS) must have overriding economic and social benefit and not cause unacceptable harm	An assessment of the existing and potential palaeolandscape resources is presented in desk based archaeological assessment in **Appendix 13-1** (**Volume III**). A summary has been presented in this chapter, **Section 13.6**.

17. Within Wales, there are four regional archaeological trusts that have advisory roles to Cadw; Cadw is the Welsh Government's historic environment service. These are Glamorgan-Gwent Archaeological Trust, Dyfed Archaeological Trust, Gwynedd Archaeological Trust and Clwyd-Powys Archaeological Trust. Gwynedd Archaeological Trust (GAT) cover the region for this Project and provided advice as part of the Gwynedd Archaeological Planning Service.

13.3. CONSULTATION

18. **Table 13-3** summarises relevant consultation responses on the offshore elements of the Project received prior to and during preparation of the ES and which were considered in this Chapter. A full list of consultation responses and how they have been taken into account in finalising the Project is presented in **Chapter 6, Consultation**.

Table 13-3 Consultation Responses

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Summary of Scoping Opinion	Impacts to historic wrecks and submerged military aviation heritage: The Scoping Report has not identified physical disturbance to artefacts within the marine area. As noted by Cadw (see Appendix 1 of this Scoping Opinion), the locations of historic wrecks and submerged vessels on maps may not be accurate. Therefore the assessment should consider the potential for submerged archaeological remains and vessels, particularly along the cable route where the potential for physical disturbance is at its highest.	The physical disturbance of artefacts has been assessed in **Appendix 13-1** (**Volume III**) and summarised in **Section 13.7**. The assessment has considered the potential for submerged archaeological remains, this has been captured in **Appendix 13-1** (**Volume III**) and summarised in **Section 13.7**.
Planning Inspectorate	2018 ▪ Summary of Scoping Opinion	Indirect disturbance from sediment: In addition to assessing the potential impacts of changes to sediment during operation, the ES should consider the potential for indirect effects from	Indirect disturbance of sediment is discussed in **Appendix 13-1** (**Volume III**) and summarised in **Section 13.7**.

Consultee	Date/Document	Comment	Response
		sediment during construction and decommissioning.	
Cadw and NRW	2018 ▪ Summary of Scoping Opinion	It is noted that the locations of historic wrecks and submerged vessels are likely to be imprecise and therefore it cannot be assumed that the locations provided on maps are accurate. The study needs to take account of this and consider potential for submerged archaeological remains and vessels – particularly along the cable route where potential for physical disturbance is at its highest. The Royal Commission on the Ancient and Historic Monuments should be consulted for advice regarding the choice and application of survey techniques suitable for establishing the potential for maritime heritage impacts.	Historic records have been assessed as well as recent geophysical data to provide a combined assessment; results are discussed in **Appendix 13-1** (**Volume III**) and summarised in **Section 13.6**.
Cadw	▪ 2018 ▪ Summary of Scoping Opinion	The Royal Commission on the Ancient and Historic Monuments of Wales is the primary source of information for marine historic assets.	The Royal Commission on the Ancient and Historic Monuments of Wales were consulted, see **Appendix 13-1** (**Volume III**) and summarised in **Section 13.5.2, 13.6.2** and **13.6.3**.
Royal Commission for Ancient and Historic Monuments Wales	▪ 2019 ▪ Email Correspondence	The potential for scouring to destabilise sites at some distance from the installation would remain at concern to take forward into the post construction monitoring proposals. The methodology for determining the AEZ extent should be included in the ES and in the WSI.	Potential for scouring is covered within **Chapter 7, Metocean Conditions and Coastal Processes.** Future monitoring is noted and will be included in the WSI. The methodology for determining the AEZ extent is explained in **Section 13.7.2.1.5** and **Appendix 13-1** (**Volume III**). Noted to also be included in the WSI.

13.5. METHODOLOGY

13.5.1. Study Area

19. For the purposes of this assessment, a study area comprising the offshore MDZ and export cable corridor (ECC), which are comprised by the Offshore Development Area (OfDA), with an additional 2 km buffer up to the mean high water springs (MHWS) has been utilised (**Figure 13-1 and 13-2, Volume II**). Note that the buffer is reduced to 300 m around the landfall area. This is to avoid repetition and duplication of effort, as this area is under consideration as part of the onshore archaeological assessment, which also considers a 1 km study area around the onshore infrastructure (**Chapter 20, Onshore Archaeology and Cultural Heritage**).

20. The size of the study area ensures that data sources provide sufficient information about the Project proposed development site and its surrounding landscape from which to assess known and potential impacts on the heritage resource. This in turn provided a clearer indication of the Project proposed development site's history, context and archaeological potential.

13.5.2. Data Sources – Desk Study

21. A wide variety of information sources and reference materials have been consulted to inform the assessment of the nature, extent and significance of the known and potential heritage resource. Information has been collated from five heritage databases, comprising:

- The United Kingdom Hydrographic Office (UKHO) for Wrecks, Obstructions and Fouls records;
- List of wrecks designated under the Protection of Military Remains Act, 1986;
- Cadw:
  - World Heritage Sites;
  - Protected Wrecks;
  - Scheduled Monuments;
  - Listed Buildings;
  - Registered Parks and Gardens; and
  - Registered Landscapes.
- Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) for National Monuments Record Wales (NMRW) data;
- Gwynedd Archaeological Trust for Historic Environment Record (HER) data;
- The Receiver of Wreck for record of droits relating to recoveries made from the area; and
- Secondary sources consulted include relevant literature from journals, publications and unpublished archaeological reports.

22. Evidence from these data sources have been collated and used in inform this assessment. A list of relevant data can be found in **Appendix 13-1** (**Volume III**).

13.5.3. Data Sources – Site-Specific Surveys and Reports

23. A site-specific geophysical survey across the MDZ has been undertaken to inform the assessment. The primary data utilised in the assessment is as follows:

- Geophysical survey undertaken by Partrac in 2018 (Partrac, 2018) of the MDZ plus a 1 km buffer. Including:
    - Multibeam bathymetry data;
    - Sidescan sonar data;
    - Magnetometer data; and
    - Sub-bottom profiler (boomer) data.
- Subtidal grab sample survey undertaken by Ocean Ecology in 2018 (Ocean Ecology, 2018);
- Offshore Archaeological Desk Based Assessment (**Appendix 13-1, Volume III**);
- Heritage records mentioned above; and
- Secondary sources consulted include relevant literature from journals, publications and unpublished archaeological reports, as well as recent assessments and geophysical work in the region.

24. Gazetteers of all sites, finds and geophysical anomalies from the offshore study area are presented in Offshore Archaeology Desk Based Assessment (DBA) (**Appendix 13-1, Volume III**).

25. All cultural heritage assets have been allocated a unique reference number with a 'MS' prefix and illustrated on the accompanying figures. Further discussion and details for all the entries can be found in the accompanying technical appendix (**Appendix 13-1, Volume III**).

26. Cultural heritage assets within the intertidal part of the offshore site study area have been assigned a number from MS_UKHO_ or MS_DBA_0001 upwards.

27. Chronology in this report is presented as years Before Present (BP) and, where relative dates are available, as BC/AD calendar dates.

13.5.4. Impact Assessment Methodology

28. The EIA Methodology stated in **Chapter 5, EIA Methodology** has been used and adapted for the assessment of historic assets. Further detail is provided below on the method and significance criteria used for impact assessment within this chapter.

29. Following identification of the heritage assets within the site and their significance, the review identifies the proposed changes and assesses the impacts of these changes upon the historic environment. The impact assessment makes specific reference to any alterations to the evidential, historic, aesthetic and communal values of the heritage assets.

30. The approach to making balanced assessments for the Project has been guided by Royal HaskoningDHV, MarineSpace and technical specialists using available data, new data, experience and expert judgement. Impacts are considered to include direct impacts, indirect impacts, inter-relationships between impacts and cumulative impacts.

31. For each effect, the assessment identifies receptors within the study area that are sensitive to that effect and implements a systematic approach to understand the impact pathways and the level of impacts on given receptors. The process considers the following:

- The sensitivity of a receptor to the effect;
- The probability that an effect-receptor interaction will occur;
- The magnitude of the effect;
- The determination and (where possible) qualification of the level of impact on a receptor, considering the probability that the effect-receptor interaction will occur, the spatial and temporal extents of the interaction and the significance of the resulting impact; and
- The level of certainty at all stages.

13.5.5. Sensitivity of Heritage Assets

32. The overall receptor sensitivity is determined by considering a combination of value, adaptability, tolerance and recoverability. This is achieved through applying known research and information on the status and sensitivity of the feature under consideration coupled with professional judgement and past experience.

33. In summary, the sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected, and is defined by the following factors:

- **Vulnerability**: whether a particular effect has the ability to impact a receptor;
- **Adaptability**: the degree to which a receptor can avoid or adapt to an effect;
- **Tolerance**: the ability of a receptor to accommodate temporary or permanent change without a significant adverse effect;
- **Recoverability**: the temporal scale over, and extent to, which a receptor will recover following an effect; and
- **Value**: a measure of the receptor's conservation importance, rarity and worth.

34. In order to define the sensitivity of a receptor, the guidelines presented in **Table 13-4** have been adopted in this ES. Note that for heritage assets direct physical impacts will be permanent and irreversible. However, indirect impacts such as changes to sedimentation may be reversible or subject to alteration following removal or decommissioning of the development.

35. Any loss of sediment and erosion of heritage assets will not be reversible, but where heritage assets are protected by the accumulation of deeper sediment, this may be considered a reversible change.

Table 13-4 Definitions of the Sensitivity Levels for Environmental Receptors

Sensitivity	Description
High	Individual receptor has very limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Medium	Individual receptor has limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Low	Individual receptor has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact.
Negligible	Individual receptor is generally tolerant to and can accommodate or recover from the anticipated impact.

36. It should be noted that the sensitivity criterion is a composite one; combining value (see **Section 13.5.6**) with sensitivity. In some instances, the inherent value of a receptor is recognised by means of designation, and the 'value' element of the composite criterion recognises and gives weight in the assessment to that designation. However, irrespective of the recognised value, all receptors will exhibit a greater or lesser degree of sensitivity to the potential changes brought about by the proposed scheme. It should be noted that the assessment of sensitivity is a matter of judgement applied by professional experts based on the receptors within the relevant study area.

13.5.6. Receptor Value

37. The UK MPS indicates that authorities should take account of the particular nature of the interest in the (heritage) assets and the value they hold for this and future generations.

38. Both designated and non-designated heritage assets can hold heritage value. Value considers whether, for example, the receptor is rare, has protected status or has importance at a local, regional, national or international scale. Designated heritage assets, such as Protected Wrecks, have high value.

39. For non-designated assets, significance (value) is best defined by Cadw's 'Conservation Principles' (2011), which describes value as a combination of evidential value; historical value; aesthetic value; and communal value. Evidential value derives from the physical fabric of an asset and its ability to provide evidence relating to how the asset was made and used and how this changed through time. Historical value can derive from particular aspects of past ways of life, or association with notable families, persons, events or movements – it is the connection between past events and society with the present. Aesthetic value relates to the design, construction and craftmanship of an asset.

40. It can include setting and views to and from the asset, which may have changed through time. Communal value derives from the meanings that an historic asset has for the people who relate to it, or for whom it figures in their collective experience or memory. It may be commemorative, spiritual or symbolic, such as meaning for identity or collective memory.

41. It is important to understand that high value and sensitivity are not necessarily linked within a particular impact. A receptor could be of high value but have a low or negligible sensitivity to an effect. **Table 13-5** provides definitions for the value afforded to a receptor based on importance with regard to legislation and guidance.

Table 13-5 Definitions of the Value Levels

Value	Definition
High	Internationally or nationally important. Within a marine or intertidal context, high value heritage assets include: World Heritage Sites and heritage assets of acknowledged international importance, or that can contribute significantly to acknowledged international research objectives. Sites designated under the Protection of Wrecks Act, Ancient Monuments and Archaeological Areas Act or Protection of Military Remains Act. Grade I and Grade II* structures designated under the Listed buildings and Conservation Areas Act Additionally, in line with the UK Marine Policy Statement, any remains which are not currently designated but have equivalent significance to a designated asset are also considered to be of high value.
Medium	Within a marine or intertidal context, medium value receptors include: Heritage assets that are not designated and that do not meet the criteria for designation (e.g. as a Protected Wreck or scheduled monument) but display evidential, historic, aesthetic or communal value as identified by Conservation Principles. Heritage assets, or groups of assets or landscapes, that contribute to regional research objectives, particularly those identified in the research framework for North West Wales.
Low	Within a marine or intertidal context, low value receptors include: Heritage assets displaying limited evidential, historic, aesthetic or communal value as identified by Conservation Principles Heritage assets, or groups of assets, that contribute to a limited degree to regional research objectives, particularly those identified in the research framework for North West Wales
Negligible	Heritage assets with very little or no surviving archaeological interest, and little or no evidential, historic, aesthetic or communal value as identified by Conservation Principles Heritage assets or groups of assets that cannot appreciably contribute to acknowledged regional research objectives.
Uncertain	Heritage assets for which the importance of the resource has not been ascertained. Archaeological resources the importance of which cannot be ascertained.

13.5.7. Magnitude of Effect

42. In order to predict the significance of an impact, it is fundamental to establish the magnitude and probability of an impact occurring through a consideration of:

- Scale or spatial extent: the area over which an effect occurs (small scale to large scale or a few individuals to most of the population);
- Duration: the time for which the effect occurs (short term to long term);
- Likelihood of impact occurring;
- Frequency: how often the effect occurs;
- Nature of change relative to the baseline: positive or negative; and
- Reversibility: the degree of change relative to existing environmental conditions.

43. **Table 13-6** is in line with the wider methods used in this EIA for judging magnitude of effect but relates specifically to heritage assets.

Table 13-6 Generic Guidelines Used in the Determination of Magnitude of Effect

Magnitude	Description
High	Total loss of resource and/or integrity of the resource; or severe damage to key characteristics, features or elements (adverse) such that the heritage asset is lost or its significance is totally altered. Permanent / irreplaceable change, which is certain to occur. Large scale improvement of resource or attribute quality; extensive restoration or enhancement (beneficial).
Medium	Loss of, or alteration to key characteristics, features or elements; measurable change in significance, attributes, quality or vulnerability (adverse) such that the heritage asset and its significance is altered. Improvement to, or addition of key characteristics, features or elements of the resource; improvement to attribute quality (beneficial).
Low	Minor loss of, or small alterations to, one or a small number of characteristics, features or elements; noticeable change in attributes, quality or vulnerability (adverse). Minor improvement to, or addition of, one or a small number of characteristics, features or elements; very minor improvement to attribute quality (beneficial).
Negligible	No change or unquantifiable change to the receptor and its significance.

13.5.8. Impact Significance

44. Subsequent to establishing the sensitivity and magnitude, the impact significance is predicted by using quantitative or qualitative criteria, as appropriate, to ensure a robust assessment. The significance of the potential impacts is assessed on the scale, degree or intensity of disturbance to the baseline conditions. Four levels of magnitude are used: high; medium; low; or negligible, as defined in **Table 13-6**.

45. Impact statements carry a degree of subjectivity, as they are based on expert judgement regarding the effect-receptor interaction that occurs and on available data. As such, impact statements should be qualified appropriately. Where possible the matrix presented in **Table 13-7** has been used to aid assessment of impact significance, combined with the application of expert judgement, to facilitate a consistent approach throughout the EIA.

46. However, for each topic within the EIA, best practice methodology (based on the latest available guidance) has been followed and hence, when more appropriate, an alternative approach to the use of a matrix may be used.

47. By combining the magnitude of the impact and the sensitivity of the receptor in a matrix (see **Table 13-7**), the final significance of the impact (prior to the implementation of mitigation measures) can be obtained.

Table 13-7 Impact Assessment Matrix

		Negative Magnitude				**Beneficial Magnitude**			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

48. Definitions of impact significance are provided in **Table 13-8** and are defined in relation to marine legislation and policy regarding heritage assets. In the context of EIA, 'significant impacts' are taken to be those of moderate or major significance (as defined in **Table 13-8** below) and mitigation is proposed for all such impacts; albeit that appropriate mitigation, where available, will also be sought for all impacts. Whilst minor impacts would not be deemed to be significant in their own right, they may contribute to significant impacts through inter-relationships or cumulative impacts.

Table 13-8 Impact Significance Definitions

Value	Definition
Major Adverse	Substantial harm or total loss of the value of a designated heritage asset (or asset worthy of designation) such that Development should not be consented unless substantial public benefit is delivered by the Development.
Moderate Adverse	Less than substantial harm or total loss of the value of a designated heritage asset or an asset of designable quality such that the harm should be weighed against the public benefit delivered by the Development to determine consent. Harm to a non-designated heritage asset, of a greater degree than that perceived of as Slight Adverse, which should be taken into account in determining an application.
Minor Adverse	Harm to a non-designated heritage asset that can be adequately compensated through the implementation of a programme of industry standard mitigation measures. Less than substantial harm to the value of a designated heritage asset, of a lesser degree than that perceived as Moderate Adverse, but which should still be weighed against the public benefit delivered by the Development to determine consent.
Negligible	No discernible change in receptor.
Minor beneficial	Development will deliver a positive contribution and / or better reveal the value of a non-designated heritage asset.
Moderate beneficial	Development will deliver a positive contribution and / or better reveal the value of a designated heritage asset (or asset worthy of designation) such that an application should be treated favourably.
Major beneficial	Development will deliver a positive contribution and / or better reveal the value of a heritage asset of recognised international value such that an application should be treated very favourably.

49. It should be noted that any residual impact (the impact after the implementation of mitigation; see **Section 13.5.10** below) which remains at the level of 'moderate' or 'major' is regarded by the EIA Regulations as being significant.

13.5.9. Confidence

50. Once an assessment of a potential impact has been made, it is necessary to assign a confidence value to the assessment to assist in the understanding of the judgement. This is undertaken on a simple scale of high-medium-low, where high confidence assessments are made on the basis of robust evidence, with lower confidence assessments being based, for example, on extrapolation and use of proxies.

13.5.10. Mitigation Measures

51. Mitigation measures will be put in place for any significance impacts of moderate (negative) or above. Additionally, wherever possible any significance impacts where a negative outcome is expected will also be considered for mitigation.

52. A range of mitigation measures for impacts to heritage assets exist. Following the best practice guidance set out within the Model Clauses for Archaeological Written Schemes of Investigating: Offshore Renewables Projects (The Crown Estate 2010) and professional experience, such measures can include:

- Archaeological Exclusion Zones (AEZs);
- Archaeological input into geotechnical investigations and geo-archaeological assessment;
- Archaeological input into geophysical investigations and archaeological review of data;
- Watching briefs;
- Archaeological investigations using divers or Remotely Operated Vehicles (ROVs); and
- Protocols for Archaeological Discoveries (PADs).

53. Note that many of these measures also form part of the process of investigation and can be included at any stage of the development process.

13.5.11. Residual Impacts

54. Where further mitigation measures are identified, the significance of the residual environmental impact (i.e. the post-mitigation impact) has been re-assessed and residual impacts described.

55. Where no mitigation measure is proposed, a discussion explains why the impact cannot be reduced.

13.5.12. Cumulative Impact Assessment

56. Cumulative impacts are assessed through consideration of the extent of influence of changes to offshore heritage assets arising from the Project alone and those arising from the Project cumulatively or in combination with other developments including the 80 MW Minesto Holyhead Deep Green project. It is proposed that the export cable from the Minesto project links with that of the Project and that both projects have a joint landfall.

13.6. EXISTING ENVIRONMENT

57. The following section provides a summary of the existing environment, highlighting any known and potential archaeological and cultural resources in the offshore study area (**Figure 13-1 and 13-2, Volume II**). Further detail is provided in **Appendix 13-1** (**Volume III**).

58. Whilst relevant data sources have been consulted there are limitations when using this data to provide a review of the baseline environment. These include the following:

- There are limited studies of the glacial evolution of the study area and surrounding region, and due to the nature of the area as a complex site, the interpretation will not provide a complete record of the marine historic environment and does not preclude the subsequent discovery of further elements that are, at present, unknown; and

- Heritage record data, listed in **Section 13.5.2**, are limited to the information provided by the reporter, positions may not be accurate, and descriptions may vary.

13.6.1. Baseline Resource: Submerged Prehistory

59. In the British Isles, submerged prehistoric archaeology relates to the period from the earliest known human occupation in the Lower Palaeolithic (c.970,000 years BP) to the final inundation of the English Channel around 8,000-6,000 years BP, when the coastline assumed roughly its current form. Evidence from this period relates to palaeoenvironmental remains indicating formerly terrestrial landscapes that were exposed at times of glacially controlled sea level regression, including landscape features, or artefacts such as stone tools and faunal remains indicating human presence and use of this landscape.

60. North Wales has a complex history of repeated advances and retreats of ice sheets, with the corresponding changes sea level, erosional and depositional environments. The timescales between the retreat of the ice sheet after the Last Glacial Maximum (LGM) and the inundation of the Irish Sea region is debated, however there would have been a short length of time in the middle Holocene where regions between St George's Channel and the current coast line would have been exposed to the terrestrial environment.

13.6.1.1. Known Submerged Prehistoric Cultural Heritage Assets

61. No known submerged prehistoric sites exist in the study area. A palaeogeographical assessment was undertaken comprising a review of the marine geophysical data acquired in 2018 (Partrac, 2018) in conjunction with existing data on the known geology of the area (further detail can be found in **Appendix 13-1, Volume III**).

62. The sub-bottom profiler data indicated the presence of thin or infilled units of glacial till above outcropping and sub-cropping bedrock in the central and east of the MDZ. In the west of the MDZ more complex Quaternary deposits appear to be present, one unit appears to infill incised sections of the glacial till; is not certain from the acoustic data whether these channels relate to glacial processes, such as outwash from meltwater, or whether they represent post-glacial channel systems, potentially of Late Upper Palaeolithic or Holocene date. The former is thought to be most likely.

63. However, features relating to the retreating ice edge can be complex and dynamic, and features which begin as outwash channels for example can form the basis for later, post-glacial, palaeochannels. If the feature within the western part of the site have post-glacial phases, the deposits within may contain palaeoenvironmental remains which could inform our understanding of the Late Upper Palaeolithic and Mesolithic palaoeolandscape in this area. **Figure 13-1** (**Volume II**) displays the extent of the feature across the study area.

64. The majority of the site is characterised by high energy conditions (see **Chapter 7, Metocean Conditions and Coastal Processes**) which would not be conducive to the survival of extensive deposits of fine-grained materials. It is therefore unlikely that extensive deposits of this type exist. However, their existence within the site cannot be ruled out on the basis of the existing

data, thus within the western part of the site there is considered to be potential for palaeoenvironmental evidence dating to the Late Upper Palaeolithic and Mesolithic periods. The eastern and central parts of the site are characterised by exposed bedrock, till and modern marine sediments and as such are not of palaeoenvironmental interest.

13.6.1.2. Potential for Further Unknown Submerged Prehistoric Cultural Heritage Assets

65. The earliest deposits within the site relate to the Devensian glaciation. The site lay under an ice sheet until c.22,000 BP. Thus, there is no potential for in situ Lower or Middle Palaeolithic archaeological remains or palaeoenvironmental evidence. Redeposited Palaeolithic remains may occur within secondary contexts within the site; however, no such remains have been identified within the site or study area and the potential for such remains to occur is considered to be limited.

66. A series of possible channels identified within sub-bottom profiler data within the western part of the site may be of glacial or post-glacial origin. If the latter, then there is potential for palaeoenvironmental evidence relating to the Late Upper Palaeolithic and Mesolithic periods to be present within these areas.

67. Late Upper Palaeolithic archaeological remains tend to be found in cave sites. While the remains from Kendrick's cave in Llandudno indicate the presence of human groups in North Wales during this period, there is no evidence of activity within the site and study area. Taking into account the absence of cave sites within the area, the potential for such remains to be present within the site is low.

68. Conversely, Mesolithic activity is attested within the study area. If Holocene features such as palaeochannels were present within the western part of the site these may have formed a focus for Mesolithic activity. However, due to uncertainties within the data the presence of such features is not verified. In the face of this uncertainty there remains a potential for submerged Mesolithic remains to occur in association with potential Holocene deposits. If present, these deposits could also hold palaeoenvironmental evidence.

69. Eroded material from coastal sites such as shell middens and flint scatters dating to the Mesolithic period may also be present within the site. Any such remains would be out of context and would likely have been affected by marine processes.

70. By the end of the Mesolithic period the site is likely to have been submerged, and thus all later archaeological potential relates to maritime remains and remains of eroded material (**Section 13.6.2**).

13.6.2. Baseline Resource: Maritime Archaeology

71. Maritime archaeology spans all seafaring activities that cover the extent of human occupation of Britain. These activities range from early coastal settlers in the region during the prehistoric period, to Roman vessels supplying or defending the Fort at Holyhead and watch tower at Caer y Twr, to large wooden sailing ships assisting in the transport of copper from the mines on Anglesey through to modern day vessels. Over this time, sizable shipping activity is likely to have passed through the MDZ, and with the nature of the surrounding environment, there is potential for a number of losses en-route; further details are presented in the Offshore

Archaeology DBA (**Appendix 13-1, Volume III**). The assessment demonstrates that there is potential for the recovery of a variety of maritime archaeological material from within the study area, with particular potential for wrecks of post-medieval and modern date.

72. A maritime site is one which comprises of a vessel (whole or complete) and/or associated debris. Debris can comprise a single artefact through to an entire scatter of material, either associated with a wreck, or accidently or deliberately lost from a vessel.

73. It is important to note that the areas of exposed bedrock and coarser deposits within the application area have lower potential for the preservation of previously unknown shipwreck and maritime archaeological material. High energy areas are also less likely to result in the survival of articulated remains.

13.6.2.1. Known Maritime Cultural Heritage Assets

74. There are a number of items of potential archaeological interest located within the study area, identified using the geophysical data, these have been allocated archaeological potential and are summarised in **Table 13-9**. **Figure 13-2** (**Volume II**) displays the location of these items across the study area.

Table 13-9 Summary of Items of Archaeological Potential Identified Within the Study Area

Archaeological Potential	Description	Total within study area	Within OfDA
High	A contact almost certainly of anthropogenic origin and with a high potential of being of archaeological significance	6	4
Medium	A contact believed to be of anthropogenic origin but that would require further investigation to establish its archaeological potential	5	1
Low	A contact potentially of anthropogenic origin but that is unlikely to be of archaeological interest	18	10
Total		29	15

75. All items of high archaeological potential were identified as wrecks. Historic records were also used to identify any areas of potential and were cross referenced with these items. A total of five of the six high archaeological potential items were found to correlate to positions of recorded known and unknown wrecks; four of those, with associated records, were located within the MDZ (**Figure 13-2, Volume II**). Further details can be found in **Appendix 13-1** (**Volume III**).

76. The items of medium archaeological potential were identified as mounds, debris and magnetic anomalies; the one item of medium archaeological potential located within the ECC and MDZ was classified as a magnetic anomaly with no surficial expression indicating potential buried anthropogenic debris. The remaining items were located within the study area but outside of the OfDA. The items of low archaeological potential include items that were classified as debris, linear features some potentially cable, rope or scour and magnetic anomalies, and were identified across the study area.

77. A number of historic records of diver accounts and documented losses were located within the study area, mainly along the nearshore border of the MDZ and ECC, either were not seen in the

geophysical data or were just outside the geophysical data coverage and indicate potential that further disarticulated remains of wrecked vessels and potentially wrecked aircraft may survive within the site boundaries (**Section 13.6.2.2**).

13.6.2.2. Potential for Further Unknown Maritime Cultural Heritage Assets

78. As noted above (**Section 13.6.1.1**), the coarser sediments present within the application area have lower potential for the preservation and recovery of buried archaeological materials. Other factors also affect the presence and survival of wreck remains. Within the study area, navigational hazards such as the rocky coastline of Holy Island are likely to have resulted in the wrecking of vessels. This is borne out in the historical records of documented losses of shipwrecks, and in diver sightings of wreck sites which are focused around the coast. Although some positions derived from documents and diver sightings may be imprecise or inaccurate, as a whole they demonstrate the higher potential for wreck remains around the coast of Holy Island.

79. A relatively large number of diver records of wrecks are known within the study area. These records are generally focused around the nearshore area, and although the majority have not been located by geophysical surveys the potential for wreckage in the nearshore area remains relatively high, particularly given the number of documented losses reported for the area. This potential may be highest in sheltered locations such as gullies and in bays beneath sediment, in areas of lower energy where bedrock is not exposed.

80. In addition to the potential for wreck remains, there is also potential for maritime and related intertidal features and structures in Abrahams Bosom, relating to the use of the area as an embarkation and landing point from at least the post-medieval period.

13.6.3. Baseline Resource: Aviation

81. Since the birth of air transportation in the early 20th century, many thousands of military and civilian aircraft casualties have occurred in UK waters. The bulk of these are casualties of World War II. RAF Valley which lies approximately 10 km to the east-south-east of the MDZ, was constructed in 1940 as a military airfield, responsible for defending the north-west of England including the key centres of industry and protecting shipping in the Irish Sea. From 1943 it was used extensively by the United States Army Air Force (USAAF). The presence of this airfield in the vicinity of the site is likely to have influenced the potential for archaeological remains of aircraft in the area.

82. The ephemeral nature of aircraft wrecks ensures that many sites remain unknown and unrecorded and although records of aircraft losses at sea are extensive, they are seldom tied to an accurate position (James et al., 2010). There is therefore a significant discrepancy between the large number of reported losses of aircraft and the number of confirmed and charted sites on the seabed.

83. A guidance note published by English Heritage entitled Military Aircraft Crash Sites (English Heritage, 2002) outlined a case for recognising the importance of aircraft crash sites, specifically with regard to existing and planned development proposals which may have an impact on such sites. The guidance note argues that aircraft crash sites not only have significance for remembrance and commemoration, but they also have an implicit cultural value as historic

artefacts, providing information on the aircraft itself and also the circumstances of its loss (English Heritage, 2002). All military aircraft lost at sea are automatically protected under the terms of the Protection of Military Remains Act (1986) and may not be disturbed without a licence from the Ministry of Defence.

84. Site survival is largely determined by the cause of loss. With a few exceptions, aircraft come to be on the seabed as a result of an in-flight accident or enemy action and remains are often highly fragmented and widely dispersed as a result of mid-air explosion or the high impact of hitting the water at speed. Aircraft which come to rest on the seabed as a result of controlled ditching are more likely to be better preserved. The factors which determine the survival of an aircraft crash site are not yet fully understood, although marine environments generally offer favourable conditions for the preservation of artefacts, enhancing the potential for the survival of aircraft crash sites on the seabed.

85. Recently, an increasing number of aircraft wrecks have been discovered during aggregate dredging operations and survey work associated with offshore renewable energy development around the UK (Wessex Archaeology, 2008a) and it is now clear that these remains not only survive on the seabed but are widespread.

13.6.3.1. Known Aviation Cultural Heritage Assets

86. No confirmed and charted aircraft crash sites are recorded in the study area; however, a review of national and local historical records indicate a total of seven aircraft losses are recorded within the site and study area (**Section 13.6.3.2**).

87. The UKHO records a diver account of the wreckage of a liberator bomber on the seabed within the study area, to the north-east of North Stack, but outside of the site boundaries. This aircraft was not found on subsequent geophysical surveys and the UKHO amended their records to dead; recent surveys confirm the absence of an identifiable site. Separate reports indicate that aircraft wreckage has been identified off North Stack, and the propeller recovered and now forms part of a memorial monument. No position is recorded for this, however the description and UKHO record tally indicating that evidence of the aircraft wreckage may survive in this area of the seabed. Further detail is presented in **Appendix 13-1** (**Volume III**).

13.6.3.2. Potential for Further Unknown Aviation Cultural Heritage Assets

88. A total of seven recorded aircraft losses are recorded within the site and study area, all relate to WWII, with one a post-WWII plane. The documentary evidence indicates that a number of planes have been lost off South Stack and Holyhead Mountain, the loss locations are not confirmed but provide a general region of loss and indicate that these remains may have fallen within the site. Further detail on the recorded air craft losses is presented in **Appendix 13-1** (**Volume III**).

89. As with maritime archaeological material the survival of the physical remains of crashed aircraft on the seabed relates to the existence of favourable preservation conditions (Ward *et al.*, 1999). The majority of the site is characterised by outcropping bedrock, gravelly substrate with frequent boulders, in a high energy environment. Finer grained sediments in the bay areas in Abraham's Bosom and to the north of South Stack may represent the best preservation environments

available within the site. Remains are most likely to survive in these areas, though disarticulated wreckage could also survive within gullies and other isolated sheltered locations within the site.

13.7. IMPACT ASSESSMENT

13.7.1. Overview of Potential Impacts

90. Following the EIA methodology as detailed in **Section 13.4**, the following section lists and discusses the impacts and any mitigation required.

13.7.1.1. Impact Receptors

91. The potential risks (impacts) to marine archaeology and heritage resources from the proposed development have been considered. As already demonstrated in **Section 13.6**, marine archaeological sites in the study area may comprise prehistoric archaeology in the form of artefacts, palaeoenvironmental remains and cultural land surfaces, or the physical remains of maritime or aviation sites, features and isolated finds. Potentially sensitive archaeological receptors can be summarised under the themes and sub categories listed in **Table 13-10**.

Table 13-10 Archaeological Receptor Themes and Sub Categories Utilised in this Impact Assessment

Prehistoric Archaeology	Maritime Archaeology	Aviation Archaeology
In situ prehistoric archaeological material	Known, charted wreck sites	Known, charted aircraft crash sites
Palaeoenvironmental evidence	Recorded losses – uncharted maritime shipping casualties	Recorded aircraft losses – uncharted aviation sites
Isolated Prehistoric finds	Unknown, uncharted shipwrecks	Isolated aviation archaeological finds
	Isolated maritime finds	
	Remains relating to maritime activity including intertidal remains	

13.7.1.2. Worst Case Scenario

92. The offshore project area consists of the offshore cable corridor with landfall at Penrhos Feilw and the Project within the MDZ. The final design (including numbers of devices, layout configuration, requirement for scour protection etc.) has not yet been determined. Therefore, realistic worst-case scenarios in terms of potential impacts/effects on offshore archaeology and cultural heritage are adopted to undertake a precautionary and robust impact assessment (see **Chapter 4, Project Description**). The realistic worst-case scenarios used for offshore archaeology and cultural heritage are described in the sections below.

93. Cultural heritage assets can be affected by offshore tidal energy development in two ways:

- From the direct effect of the physical siting of the development; and
- From indirect changes to the physical marine environment.

94. Indirect impacts upon the setting of coastal heritage assets from the Project's offshore infrastructure are captured in **Chapter 20, Onshore Archaeology and Cultural Heritage.**

95. The nature of these effects, and the types of impact that may occur during the construction (**Section 13.7.2**), operation, maintenance and repowering (**Section 13.7.3**) and decommissioning (**Section 13.7.4**) are discussed below. This accompanies the description of the worst-case scenario for archaeology and cultural heritage in accordance with the Project Design Envelope approach.

13.7.1.2.1. Direct Impacts

96. Cultural heritage assets may be buried within seabed sediments or may rest upon the sea floor, either with or without height. As such, direct impacts to cultural heritage assets can occur during any development or related activity that makes contact with the sea floor or cuts through seabed deposits. Cultural heritage assets with height, such as wrecks, may also be impacted by development or activities that occur within the water column.

97. These impacts may occur during construction, operation) and maintenance (including repowering) and decommissioning, however, most impacts are anticipated to arise during the construction phase, when physical impacts such as foundation and cable laying are in progress. Impacts associated with vessel mooring can be incurred at any phase.

98. Direct impacts may have a significant effect upon both the receptor itself (archaeological deposits and material) and to the relationships between receptors and their wider environment (the physical setting or context of receptors). The examination of these relationships is often crucial to developing a full understanding of an asset.

99. The worst-case scenario for potential direct impacts to cultural heritage assets is associated with:

- The greatest potential area of contact with the seabed; and
- The greatest volume of disturbed seabed sediments.

100. The worst-case scenario for seabed impact upon cultural heritage assets is summarised from permanent impacts and temporary impacts on the seabed as whether the impact is permanent or temporary both impact the cultural heritage asset. These have been separated into impacts that make contact with the seabed surface (**Section 13.7.1.2.1.1**;**Table 13-11**) and that cause a seabed disturbance below the seabed surface (**Section 13.7.1.2.1.2**; **Table 13-12**).

13.7.1.2.1.1. Contact with the Seabed

101. The installation of project infrastructure, including anchor systems for Tidal Energy Converter (TEC) devices, seabed mounted devices, hubs and cables/cable protection, will all result in seabed impacts. Also, during all project phases, contact with the seabed will occur to the seabed via device, hubs and cable installation and also anchor deployments for installation barges. These impacts may affect cultural heritage receptors if any are present on the seabed at the same location as the impact and no mitigation is undertaken. Based on information provided in **Chapter 4, Project Description**, the following values have been calculated to define the worst-case parameters for contact with the seabed.

102. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50 % of the tenants will undertake repowering, i.e. for 50 % of the tenants, their infrastructure will be removed and replaced (potentially with different infrastructure by a different tenant). For the other 50 % of tenants, their infrastructure will remain over the lifetime of the Project.

103. In terms of impact assessment parameters, the repowering process has, therefore, been defined as per below:

- Initial temporary seabed disturbance via deployment of barge anchors to remove foundations, TEC's, hubs, inter-array cables and monitoring equipment for 50 % of the Tenants (berths);
- Further temporary seabed disturbance via re-installation (repowering) of foundations, TEC's, hubs, inter-array cables and monitoring equipment for the same 50 % of Tenants (berths); and
- Additional permanent habitat loss (over and above that via initial construction phase), due to placement of re-installed (repowered) foundations/TECs in different areas to where originally installed.

104. The operational phase values also include the temporary seabed disturbance that would arise from up to ten cable repair events.

Table 13-11 Worst Case Scenario for Seabed Surface Impact

Item	Worst Case (240 MW)	Unit	Comments
Construction Phase			
Foundations (Two options: Piled or gravity base)			
Foundations: Piled			
Piled foundations (devices)	3,675	m^2	21 m^2 per device (4 drills of 2.6 m diameter each) x 80 devices 4.5 m^2 per device (4 drills of 1.2 m diameter each) x 120 devices 15.9 m^2 per device (3 drills of 2.6 m diameter each) x 90 devices
Piled foundations (hubs)	2,214	m^2	15.9 m^2 per hub (3 drills of 2.6 m diameter each) x 60 hubs 21 m^2 per hub (4 drills of 2.6 m diameter each) x 60 hubs
Drill arisings	117,780	m^2	Maximum across entire Project if assumed sediment when deposited covered an area the same as the total sediment recovered. Disposal of material *in-situ.*
Foundations: Gravity Base			
Gravity Base Structures (GBS)	74,790	m^2	Max value across entire project. Based on anchor mooring systems for floating devices. Includes hubs.

Item	Worst Case (240 MW)	Unit	Comments
Cables			
Export Cable Footprint (cables and protection systems)	11,745	m^2	Up to 40.5 km of export cables (with split-pipe protection/shells and rock bags)
Array Cable Footprint (cables and protection systems)	30,040	m^2	Up to 204.5 km of array cables (with split-pipe protection/shells and rock bags)
Cable Tails	120	m^2	Total seabed footprint (cables and protection systems) Based on 9 x tails of 620 m length
Post-lay burial of cable	27,259	m^2	Area of sandwave field where post-lay burial via Mass-Flow Excavator (MFE) or dredger may be required
Trench for 9 x landfall cables	7,400	m^2	740 m length trench x 10m width – worst case scenario
Floating Cables			
Swept Area of Catenary Cables	2,055,000	m^2	For floating systems using seabed mounted foundations this is the area that could be subject to cable drag. Based on: ▪ 30 devices having swept area of 9,500 m^2 (large floating devices (Orbital, Magallanes)) ▪ 140 devices having swept area of 7,500 m^2 (medium floating devices (Tocardo UFS, Aquantis) & hubs) ▪ 240 devices having swept area of 3,000 m^2 (small floating devices (Instream, SME PLATO))
Buoys and Markers			
Footprint of Navigation Marker Buoys	540	m2	3 m diameter square gravity anchor (9 m^2) per anchor x 60 anchors/buoys
Footprint of ADCP moorings	280	m^2	7 m^2 per ADCP mooring x 40 units
Footprint of seabed mounted environmental monitoring units	112	m^2	14 m^2 per env monitoring unit x 8 units
Footprint of mooring for floating environmental monitoring units	45	m^2	9 m^2 per mooring x 5 units
Anchors			
Deployment of anchor blocks by barges during cable installation	100,240	m^2	Up to 8 x 25 m^2 (5 x 5 m) anchor blocks for a single barge = a total footprint per anchor deployment of 200 m^2 (8 x 25 m^2) Assumed that these types of anchor barges generally deploy a spread every 500 m. So, for every 500 m of cable installation a footprint of 200 m^2 of temporary seabed disturbance occurs (via the anchor blocks)

Item	Worst Case (240 MW)	Unit	Comments
			Combining all potential export, array and cable tails the total length of cables (full 240 MW) is 250.6 km Assumes the footprint of 200 m^2 every 500 m (0.5 km), or 400 m^2 every 1 km, and assumes all cables are installed using anchor barges Temporary disturbance impact of (400 m^2 x 250.6) = 100,240 m^2 (0.10 km^2) "
Deployment of anchor blocks by barges during TEC device installation	248,000	m^2	Max. no of devices set at 620 x small (0.3 MW devices) Assumed that deployment of each device requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2) Therefore, total temporary seabed disturbance = 620 x 400 m^2 = 248,000 m^2
Deployment of anchor blocks by barges during hub installation	48,000	m^2	Max. no of seabed mounted hubs set at = 120 Assumed that deployment of each hub requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2) Therefore, total temp. seabed disturbance = 120 x 400 m^2 = 48,000 m^2
Operational Phase (including Repowering and Cable Repairs)			
50 % of tenants' infrastructure (Foundations; TEC's; hubs' array cables; monitoring equipment) removed and replaced with new (different) tenant infrastructure *(Temporary seabed disturbance)*	377,400	m^2	Initial removal of tenant infrastructure from 50 % of berths • 50 % of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 • 50 % of anchor block value of tidal device installation = 124,000 m^2 • 50 % of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2 Subsequent re-installation (re-powering) of tenant infrastructure from 50 % of berths • 50 % of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 • 50 % of anchor block value of tidal device installation = 124,000 m^2 • 50 % of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2
New tenant infrastructure in 50 % of berths *(Permanent habitat loss)*	52,504	m2	

Item	Worst Case (240 MW)	Unit	Comments
Cable repairs	3,000	m^2	Up to 10 major cable repairs (5 days each) may be required throughout the Project life. It is assumed that up to 750 m of cable will be subject to repair works per event (7,500 m in total). Using same value of 400 m^2 temporary seabed disturbance per 1 km of cable works (400 x 7.5) = 3,000 m^2

105. The total area impacted assuming worst case scenario for seabed impact by surface area for installation is 2,652,450 m^2 with use of piled foundations or 2,603,571 m^2 with use of gravity base foundations. However, it must also be noted that there are different impacts dependent on the type of foundation used. Pile foundations will include impact on the seabed, but also the removal of sub-surface sediment and replacement *in situ*, whilst gravity base foundations will only impact the surficial seabed (**Chapter 4, Project Description**). Assuming worst case scenario for seabed impact, the same impact is assumed for decommissioning.

106. The total area impacted assuming worst case scenario for seabed impact by surface area during operation of the Project due to repowering and repairs is 432,904 m^2.

13.7.1.2.1.2. Disturbed Sub-surface Seabed Sediments

107. Where installation, operation or decommissioning require disturbing the seabed sediments these actions also have a potential impact. These sub-surface impacts could impact on remains including potential palaeolandscape deposits. Based on information provided in **Chapter 4, Project Description**, the following values have been calculated to define the worst-case parameters for seabed sediment disturbance.

108. The operational phase values include the seabed disturbance that would arise via repowering of up to 50 % of all devices and also up to 10 cable repair events, as discussed in **Section 13.7.1.2.1.1**.

Table 13-12: Summary of Worse-Case Scenario Disturbance of the Seabed

Item	Worst Case (240 MW)	Unit	Comments
Drill arisings	117,780	m^2	Maximum across entire Project if assumed sediment when deposited covered an area the same as the total sediment recovered (in m^3). Disposal of material in-situ.
Trench for 9x landfall cables - installation	7,400	m^2	740 m long trench x 10 m width in intertidal region (same sediment disturbed for recovery)
Trench for 9x landfall cables - recovery	7,400	m^2	As above
Post-lay burial of cable (Installation)	27,259	m^2	Area with a sandwave feature where post-lay burial via Mass-Flow Excavator (MFE) or dredger may be required
Excavation of cable (Decommission)	27,259	m^2	Possibly via MFE or dredger (impact counted twice due to potential migration of bedforms)

Item	Worst Case (240 MW)	Unit	Comments
Cable repairs	3,000	m^2	Up to 10 major cable repairs (5 days each) may be required throughout the Project life. It is assumed that up to 750 m of cable will be subject to repair works per event (7,500 m in total). Using same value of 400 m^2 temp seabed disturbance per 1 km of cable works (400 x 7.5) = 3,000 m^2
New tenant infrastructure in 50 % of berths	52,504	m^2	
Total	**242,602**	$\mathbf{m^2}$	Sub-surface area impacted during Installation, Operations and Decommissioning

13.7.1.2.2. Indirect Impacts

109. Indirect impacts may occur as a result of changes to prevailing physical processes caused by the development. In general, receptors exposed to marine processes will deteriorate faster than those buried within seabed sediments. As such, the assessment of the effect of indirect impacts from changes to physical processes is directly relevant to the assessment of marine physical processes as set out in **Chapter 7, Metocean Conditions and Coastal Processes**.

110. Very little mobile sediment exists on site, with sand areas existing only in the southwest or nearshore bays of the MDZ; scouring and/or sediment transport is not considered to be significant aspect of the development and therefore is not considered as an adverse effect.

13.7.1.3. Embedded Mitigation

111. The following assessment provides a summary of all impacts identified during scoping study and those which have been noted as the EIA has progressed. These impacts are not relevant to all stages of the Project, and thus impacts have been assessed within the stage of the Project at which they will occur (construction, operation and decommissioning). Further, these impacts are comprised of both direct and indirect impacts.

112. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the Project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible (see **Chapter 4, Project Description**). Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process. A range of different information sources has been considered as part of embedding mitigation into the design of the Project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

13.7.2. Potential Impacts during Construction

13.7.2.1. Construction Impact 1: Direct Physical Impact on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

13.7.2.1.1. Submerged Prehistory

113. Submerged prehistory encompasses both localised discrete sites and broader landscapes that may encompass a wider region. Each feature incurs different approaches in assessment of the sensitivity and magnitude of any effect, as well as the probability of its occurrence on those particular features. These features can be sorted into the following categories:

- **Potential in situ remains** including potential post-glacial fluvial systems within the western part of the site and potential for remains of Mesolithic date to be associated with fluvial systems, if post-glacial; and
- **Potential redeposited remains** including limited potential for redeposited Lower and Middle Palaeolithic remains, and potential for eroded material dating to the Mesolithic period and later.

114. The in situ palaeoenvironmental remains have been assessed with a potential of a medium archaeological value as they may be able to further our understanding of past environments. Any such remains would have no ability to recover from physical impacts, but they may cover an area broader than an individual location and therefore the overall sensitivity is considered to be medium. If *in situ* archaeological sites are associated with these potential channels, their early date and potential evidential value indicates that they could be of high archaeological value, with a high level of sensitivity due to them being discrete and localised. Impacts from the foundations within the areas of the possible channels would result in the loss of restricted areas of sediment from within the channels. This partial loss of discrete locations within an area with such palaeoenvironmental potential would result in a medium magnitude of change. Therefore, providing a significance of **moderate adverse impact**. If archaeological sites or isolated finds are present in association with the possible post-glacial channel, this may result in a loss of these sites. This loss could affect an entire prehistoric site and could result in a high magnitude of change and would result in an impact significance of **major adverse impact**.

115. Redeposited remains provide some evidence for the activities of past populations, however, without *in situ* contextual information this evidential value is limited, though secondary contexts can in some cases hold some evidential value. All redeposited remains have been assessed with a potential of a medium level of value. Additionally, as the redeposited material is already out of context, there is potential tolerance to accommodate removal from its current context. The overall sensitivity of these assets is considered to be medium. Redeposited isolated finds may also be disturbed by the construction of foundations or cable installation during construction. These impacts may result in further movement or removal of finds out of secondary situ, which are permanent and irreversible. However, the key aspects of significance of these finds relates to the physical properties of the artefacts rather than contextual information. The impacts will not alter these characteristics, and as such there is a low magnitude of change, which results in a **minor adverse impact.**

13.7.2.1.2. Known Maritime Cultural Heritage Assets

116. The baseline assessment identified four confirmed wreck sites within the MDZ, and two within the remainder of the study area. The original identities of the wrecks are unknown, with the potential association of one with the *Maarten Cornelis* (not definitively proven). Any wreck sites dating from pre-1815 are likely to be of high archaeological value and significance based on the rarity of surviving vessels from this period.

117. A further five items of (medium) archaeological potential were identified in the geophysical data; one within the MDZ and four outside of the MDZ but within the study area. These items may be part of a wider debris site or isolated items. While the value of such remains is dependent upon period, rarity and a range of other factors, the likely disarticulated nature of the remains indicates their evidential value may be more limited, and a medium level of value is most likely. Any such remains would also have no ability to recover from physical impacts, as such the overall sensitivity of these potential remains is medium.

118. Maritime assets are typically discrete sites that typically do not cover a large area of the seabed (a wreck or crash site with associated debris field). Discrete archaeological sites of this nature are easily impacted by activities that disturb the seabed and have a low ability to tolerate such impacts as they are usually permanent and irreversible. Due to the discrete nature of these cultural heritage assets, they are considered to have a low ability to tolerate adverse physical impact; therefore, are judged to have a high degree of sensitivity and magnitude of change. Any physical impact upon these types of cultural heritage assets would therefore be considered to be of **major adverse impact**.

13.7.2.1.3. Unknown Maritime Cultural Heritage

119. The baseline assessment identifies a relatively large number of diver records of wrecks and reports of wreck material to the Receiver of Wreck across the study area providing an indication of the archaeological potential of the area. There is also potential for maritime and related intertidal features and structures in Abrahams Bosom, relating to the use of the area as an embarkation and landing point from at least the post-medieval period. While the value of such remains is dependent upon period, rarity and a range of other factors, overall a medium level of value is most likely. Any such remains would also have no ability to recover from physical impacts, as such the overall sensitivity of these potential remains is medium. As the impacts would be permanent and irreversible, activities related to the worst-case scenario of the development could result in a high magnitude of change and would result in an impact significance of **major adverse impact**.

13.7.2.1.4. Unknown Aviation Receptors

120. There are no confirmed remains of aircraft wreckage within the site, and although documents and divers indicate the presence of remains within the area, there are no definitive locations for these remains. However, based on the documented losses and diver accounts there is considered to be potential for the remains of aircraft wreckage to be located within the site.

121. Remains of aircraft can automatically fall under the Protection of Military Remains Act, 1986. As such they represent archaeological remains of high value. The remains would have no ability to recover from physical impacts, as such the overall sensitivity of the any such remains is high. Activities related to the worst case scenario of the development would create impacts that would be permanent and irreversible. These activities could result in a high magnitude of change. This would result in a **major adverse impact**.

13.7.2.1.5. Mitigation

122. Mitigation for direct physical impacts during construction includes:

- **Creation of a Written Scheme of Investigation (WSI)** to cover all future works within the site and to include specification for archaeological involvement prepared in consultation, once the final layout details of the development site and offshore cable corridor is established. This document should be incorporated into the final Construction Environmental Management Plan (CEMP). The WSI would set out the design and implementation of a programme of detailed mitigation works, which will include future monitoring of the assets. This would comply with guidance current at the time of its development (presently Wessex Archaeology, 2007);
- **Mitigation by micro-siting and adoption of archaeological exclusion zones** (AEZs) around known wreck sites and contacts of high and medium potential identified in the geophysical data. No activities or development work are to take place within the AEZs and no devices, cables (including catenary cables) or other structures may extend to within the exclusion zones. The extent of each exclusion zone comprises a recommended footprint on the seabed and the water column above. The extent of the AEZs reflects the likely extent of the wreck with an appropriate buffer, determined by an expert using their knowledge and experience. The AEZs listed in **Table 13-15** (also **Appendix 13-1, Volume III**) are recommended based on the size of the contact, known dimensions of wrecks and any outlying debris, the potential significance of the contact, the likely impact of the development and the seabed dynamics within the area. Exclusion zone radii have been determined from the centre point of the item or cluster of items. The exclusion zones defined for the MDZ have been given slightly larger buffers than would be usual, due to the uncertainty in some of the development plans and potential for angular movement of the devices or cables in the water column (though not on the seabed) with the shifting tides. Exclusion zones have been defined in order to ensure that no equipment, vessels or other sources of potential impact stray in the vicinity of the items of potential archaeological significance during the construction, operation or decommissioning of the development;
- **Geoarchaeological assessment** should accompany any geotechnical campaigns which may take place within the site. Geoarchaeological work should follow best practice guidance set out in Offshore Geotechnical Investigations and Historic Environment Analysis: guidance for the renewable energy sector (Cowrie 2011), and Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects (The Crown Estate 2010). The assessment should include review of core logs to determine the potential for deposits of palaeoenvironmental and archaeological interest and follow a staged process which should be determined by the results of the assessment and may

include analysis, reporting and publication. This assessment would mitigate impacts to potential channel areas;

- Where possible, **mitigation by micro-siting and avoidance or modification** of construction foundation design for potential channel areas should be carried out (unless reporting is able to be undertaken or the archaeological value confirmed as low). Avoidance, limiting contact or development design resulting in no or low impact to the potential channels would provide mitigation such that there would be no significant effect on these potential channel features and any associated palaeoenvironmental and archaeological remains;
- **Implement the Protocol for Archaeological Discoveries (PAD)**, as part of the WSI, for Offshore Renewables Projects (The Crown Estate 2014), for the duration of the Project life. This protocol provides a system for identifying, recording, reporting and investigating any unexpected discoveries made during the course of the Project, including prehistoric material. If material is found, there are a range of next-step mitigation options including creation of temporary or permanent exclusion zones around areas in which archaeological sites or remains may exist. Implementation of the PAD would mitigate impacts upon channel features, potential wreck, aviation and unknown archaeological remains and isolated finds; and
- **A watching brief** should also be conducted in the intertidal zone. This is primarily to mitigate impacts upon potential maritime and intertidal remains. It would allow archaeological input in case any such remains are found and also serve to record any isolated or eroded finds from the coast. This would be particularly valuable due to the noted potential for eroded remains identified from those already listed within the recorded finds, for example, any that may be associated with the Late Iron Age and Romano-British settlement, which lies c. 200 m above the high-water mark (for further details refer to MS_DBA_0014; **Appendix 13-1, Volume III**).

123. It should be noted that potential impacts to items of low archaeological potential do not require mitigation. However, developers should maintain an operational awareness of the positions of low potential anomalies throughout their work and avoid were possible.

13.7.2.1.6. Residual Impact

124. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **negligible** significance.

13.7.2.2. Construction Impact 2: Indirect Physical Impacts on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

125. Possible indirect impacts during construction comprise either increased protection to, or deterioration of, cultural heritage assets due to changes in the processes acting upon them and their physical setting. Potential beneficial effects could result in the sediment movements which further bury and preserve cultural heritage assets, such as the deposition from piled foundations (dependent on sediment type). Negative effects would result from increased scour and exposure of potential cultural heritage assets enabling further degradation and destruction of the potential cultural heritage asset; this has greater potential to occur in the nearshore areas amongst recent marine sediments (sands). As discussed in **Section 13.7.2.1**, known and unknown cultural

heritage assets all assets are considered to have a medium to high value. Using the precautionary method, impacts are assumed to be of medium to high magnitude, leading to a **major adverse impact**.

13.7.2.2.1. Mitigation

126. For indirect physical impacts upon submerged prehistoric, known and unknown maritime and aviation cultural heritage assets during the construction phase, mitigation will be the same as **Section 13.7.2.1.5**; including adherence to and use of AEZs, as defined in Model Clauses for Archaeological Written Schemes of Investigation (The Crown Estate 2010), and onsite reporting of archaeological finds discovered during the operational phase via PAD.

13.7.2.2.2. Residual Impact

127. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **minor** and/or **negligible** significance.

13.7.3. Potential Impacts During Operation (and Repowering)

13.7.3.1. Operational Impact 1: Direct Physical Impacts on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

128. During the operational phase of the Project, ongoing maintenance works, repowering and replacement of the devices will be required. Though it is anticipated that these will occur within the already disturbed footprint of the development, using the worst case scenario, there is possibility for direct impacts upon cultural heritage assets through the anchoring of maintenance vessels and repairing of cables. Effects and impacts are the same as discussed in **Section 13.7.2.1**, and any direct impact upon known or unknown cultural heritage assets is judged to have a potential **major adverse impact**.

13.7.3.1.1. Mitigation

129. For direct physical impacts upon submerged prehistoric, known and unknown maritime and aviation cultural heritage assets during the operation phase, mitigation will be the same as **Section 13.7.2.1.5**; including adherence to and use of AEZs, as defined in Model Clauses for Archaeological Written Schemes of Investigation (The Crown Estate 2010), and onsite reporting of archaeological finds discovered during the operational phase via PAD.

13.7.3.1.2. Residual Impact

130. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **minor** and/or **negligible** significance.

13.7.3.2. Operational Impact 2: Indirect Physical Impacts on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

131. Similar to the construction phase (**Section 13.7.2.2**), possible indirect impacts during operation are possible. Indirect impacts comprise either increased protection to, or deterioration of, cultural heritage assets due to changes in the processes acting upon them and their physical setting. Potential beneficial effects could result in sediment movements which further bury and preserve archaeological cultural heritage assets, which due to the nature of the area burial outside of the nearshore areas, where bedforms are present, is unlikely (**Chapter 7, Metocean Conditions and Coastal Processes** and **Chapter 8, Marine Water and Sediment Quality**). Negative effects would result from increased scour and exposure of potential archaeological cultural heritage assets, enabling further degradation and destruction of the potential resource; this has greater potential to occur in the nearshore areas amongst recent marine sediments (sands) (**Chapter 7, Metocean Conditions and Coastal Processes)**.

132. As discussed in **Section 13.7.2.1**, known and unknown archaeological cultural heritage assets, all assets are considered to have a medium to high value. Using the precautionary method, impacts are assumed to be of medium to high magnitude, leading to a **major adverse impact**.

13.7.3.2.1. Mitigation

133. For indirect physical impacts upon submerged prehistoric, known and unknown maritime and aviation cultural heritage assets during the operation phase, mitigation will be the same as **Section 13.7.2.1.5**; including adherence to and use of AEZs, as defined in Model Clauses for Archaeological Written Schemes of Investigation (The Crown Estate 2010), and onsite reporting of archaeological finds discovered during the operational phase via PAD.

13.7.3.2.2. Residual Impact

134. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **minor** and/or **negligible** significance.

13.7.4. Potential Impacts During Decommissioning

13.7.4.1. Decommissioning Impact 1: Direct Physical Impact on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

135. During the decommissioning phase of the Project, possible direct impacts are currently assessed to be in line those identified with the construction phase. Though it is anticipated that these will likely occur within the already disturbed footprint of the development, using the worst case scenario, there is possibility for direct impacts upon cultural heritage assets through the removal of devises and cables and anchoring of vessels. Effects and impacts are the same as discussed in **Section 13.7.2.1**, and any direct impact upon known or unknown cultural heritage assets is judged to have a potential effect of **major** significance.

13.7.4.1.1. Mitigation

136. For direct physical impacts upon submerged prehistoric, known and unknown maritime and aviation cultural heritage assets during the decommissioning phase, mitigation will be the same as **Section 13.7.2.1.5**; including adherence to and use of AEZs, as defined in Model Clauses for Archaeological Written Schemes of Investigation (The Crown Estate 2010), and onsite reporting of archaeological finds discovered during the operational phase via PAD.

13.7.4.1.2. Residual Impact

137. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **minor** and/or **negligible** significance.

13.7.4.2. Decommissioning Impact 2: Indirect Physical Impacts on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

138. Possible indirect impacts during decommissioning comprise either increased protection to, or deterioration of, cultural heritage assets due to changes in the processes acting upon them and their physical setting. Potential beneficial effects could result in the sediment movements which further bury and preserve cultural heritage assets. Negative effects would result from increased scour and exposure of potential cultural heritage assets enabling further degradation and destruction of the potential cultural heritage asset; this has greater potential to occur in the nearshore areas amongst recent marine sediments (sands). As discussed in **Section 13.7.2.1**, known and unknown cultural heritage assets all assets are considered to have a **medium** to **high** value. The aim of decommissioning is return the seabed to its original state, therefore there should be a lower magnitude than assessed during construction, leading to a minor adverse impact.

13.7.4.2.1. Mitigation

139. For indirect physical impacts upon submerged prehistoric, known and unknown maritime and aviation cultural heritage assets during the decommissioning phase, mitigation will be the same as **Section 13.7.2.1.5**; including adherence to and use of AEZs, as defined in Model Clauses for Archaeological Written Schemes of Investigation (The Crown Estate 2010), and onsite reporting of archaeological finds discovered during the operational phase via PAD.

13.7.4.2.2. Residual Impact

140. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **minor** and/or **negligible** significance.

13.7.5. Cumulative Impacts

141. Of the projects listed in **Chapter 27, Cumulative and In-combination Effects**, the only one which could potentially have a cumulative or in-combination effect with the Project in respect of known and unknown cultural heritage assets is judged to be Minesto's Holyhead Deep project, which lies immediately to the west of the MDZ. All other projects listed are either too remote

from the Project for interactions between direct or indirect impacts or are located on land and thus do not affect the marine cultural heritage (see **Chapter 20, Onshore Archaeology and Cultural Heritage**).

142. A single 0.5 MW device was installed by Minesto in summer 2018 and an EIA scoping report was submitted to NRW in 2017 for an up to 80MW installation of tidal energy devices, delivered in a phased manner, located a short distance due west of the MDZ Project (the Holyhead Deep project). Based upon the geographical configuration of the Minesto Project Development Area (PDA) with respect to the Project, there is no cumulative direct impact on the known archaeological sites within the MDZ.

143. The main potential cumulative impact relates to the potential for these schemes to affect areas of palaeolandscape which may also be present and impacted by the Project. Following mitigation, there are no significant impacts posed to this potential receptor by the Project. The Minesto development likewise identified potential palaeogeographic features, which may be impacted by development. Following mitigation advised in the Minesto ES, the impacts upon these features were considered to be not significant. Thus, the cumulative effects of these developments on potential palaeolandscape features are considered to be **not significant**.

13.7.6. Inter-Relationships

144. **Table 13-13** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 13-13 Inter-Topic Relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Onshore Archaeology and Cultural Heritage	Chapter 20	Section 13.4.1	Both chapters consider the potential effects on known and unknown finds, including maritime, aviation and submerged prehistoric cultural heritage assets. Both chapters consider the mitigation required throughout the Project. **Chapter 20, Onshore Archaeology and Cultural Heritage** also considers the heritage specific viewpoints, which are not covered in this chapter.

13.7.7. Interactions

145. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 13-14**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 13-14 Potential Interaction Between Impacts

Potential interaction between impacts		
Construction/Decommissioning	1 Direct physical impact	2 Indirect physical impact
1 Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	-	Yes
2 Indirect physical impact on known known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Yes	-
Operation	1 Direct physical impact	2 Indirect physical impact
1 Direct physical impact on known known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	-	Yes
2 Indirect physical impact on known known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Yes	-

13.8. SUMMARY

146. This chapter has provided an overview on the potential impacts which may occur within the several stages associated with the development of the Project: construction, operation and maintenance, and decommissioning to offshore archaeology and cultural heritage assets within the MDZ.

147. **Table 13-16** collates the determinations of each of the impacts assessed and is presented as a summary of the determinations. The offshore archaeological and cultural heritage impact assessment has identified areas where impacts to the marine archaeological resource from construction of the Project and associated infrastructure can be anticipated. A list of AEZs identified during the DBA are provided in **Table 13-15** and displayed in **Figure 13-3 (Volume II)**. Through mitigation these impacts to known and potential heritage assets have been reduced to acceptable limits, and post-mitigation impacts can all be considered to be not significant.

Table 13-15 Summary of AEZs

Name	**MSDS reference**	**UKHO reference**	**Location (WGS884 UTM 30 N)**		**Exclusion zone (metres)**	**Area of OfDA**
			Easting	**Northing**		
Maarten Cornelis	MS_0003	7228	385206.3	5908885.0	100	Offshore
Unknown wreck	MS_0005	81387	384431.8	5910625.0	100	Offshore
Unknown wreck	MS_0004	81388	387178.1	5910210.8	125	Offshore
Unknown wreck	MS_0001	81389	384627.4	5908447.1	100	Offshore

Name	MSDS reference	UKHO reference	Location (WGS884 UTM 30 N)		Exclusion zone (metres)	Area of OfDA
			Easting	Northing		
Magnetic anomaly	MS_0011	-	387823.5	5906694.4	25	Cable route (ECC)

Table 13-16 Summary of Potential Impacts on Offshore Archaeology and Cultural Heritage Assets Associated with the Development of the Project

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase						
1. Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Not significant
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
2. Indirect physical impacts on known and unknown maritime, aviation and	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
submerged prehistoric cultural heritage assets	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Not significant
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
Operational Phase (including repowering)						
1. Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD)	Not significant

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
					Watching brief	
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
2. Indirect physical impacts on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Not significant
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD)	Not significant

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
					Watching brief (intertidal)	
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
Decommissioning						
1. Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Not significant
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
2. Indirect physical impacts on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Low	Medium	Minor Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant
	Discrete submerged prehistoric receptors	Low	High	Moderate Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Low	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Not significant
	Known maritime receptors	Low	High	Moderate Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Low	High	Moderate Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
	Unknown aviation receptors	Low	High	Moderate Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant

13.9. REFERENCES

Cadw (Welsh Government Historic Environment Service) (2011). Conservation Principles for the sustainable management of the historic environment in Wales. Available at: https://cadw.gov.wales/docs/cadw/publications/Conservation_Principles_EN.pdf [Accessed February 2019].

Cadw (Welsh Government Historic Environment Service) (2017a). Managing Heritage Impact Assessment in Wales. ISBN 978 1 4734 8702 4. Available at: https://cadw.gov.wales/historicenvironment/publications/conservationareas/?lang=en [Accessed February 2019].

Cadw (Welsh Government Historic Environment Service) (2017b). Managing Conservation Areas in Wales. ISBN 978 1 4734 8696 6. Available at: https://cadw.gov.wales/historicenvironment/publications/conservationareas/?lang=en [Accessed February 2019].

The Crown Estate (2010) Model Clauses for Archaeological Written Schemes of Investigation Offshore Renewables Projects. Document ref. 73340.05.

English Heritage (2002). Military Aircraft Crash Sites: Archaeological guidance on their significance and future management. English Heritage, London.

EH (English Heritage) (2013). Marine Geophysics Data Acquisition, Processing and Interpretation. Guidance Notes. Product Code 51811. Available at: https://historicengland.org.uk/images-books/publications/marine-geophysics-data-acquisition-processing-interpretation/mgdapai-guidance-notes/ [Accessed February 2019]

Firth, A. (2013) Historic Environment Guidance for Wave and Tidal Energy. Published by Fjordr Ltd on behalf of English Heritage, Historic Scotland and Cadw. ISBN 978 1 900915 69 4. Available at: https://historicengland.org.uk/images-books/publications/historic-environment-guidance-wave-tidal-energy/wavetidal/ [Accessed February 2019].

Gribble, J. and Leather, S. (for EMU Ltd) (2011) Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector. Commissioned by COWRIE Ltd (project reference GEOARCH-09). ISBN 978-0-9565843-6-6. Available at: https://www.historicenvironment.scot/media/2376/2011-01-offshore-geotechnical-investigations-and-historic-environment-analysis-guidance-for-the-renewable-energy-sector.pdf [Accessed February 2019].

HM Government (2011). UK Marine Policy Statement. ISBN: 978 0 10 851043 4. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf [Accessed February 2019].

James J.W.C., Pearce B., Coggan R.A., Arnott S.H.L., Clark R., Plim J.F., Pinnion J., Barrio Frojan C., Gardiner J.P., Morando A., Baggaley P.A., Scott G., and Bigourdan N. (2010) The South Coast Regional Environmental Characterisation. British Geological Survey on behalf of the Marine Aggregate Levy Sustainability Fund (MALSF). British Geological Survey Open Report OR/09/51.

Ocean Ecology. 2018. Morlais Demonstration Zone (MDZ) Benthic Ecology Characterisation Survey 2018. Technical Report to Marine Space, November 2018.

Partrac (2018) Morlais Demo Zone (MDZ) Hydrographic & Geophysical Survey. Volume 2 – Survey Report. Report No. P1830.

Royal HaskoningDHV (2014) Chapter 21: Marine Archaeology and Cultural Heritage. For Perpertuus tidal energy centre.

The Crown Estate, 2010. Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects.

The Crown Estate (2014) Protocol for Archaeological Discoveries: Offshore Renewables Projects. Published by Wessex Archaeology, Salisbury, on behalf of The Crown Estate.

Ward I.A.K., Larcombe P., and Veth P. (1999). A new Process-based Model for Wreck Site Formation. Journal of Archaeological Science, 26, 561-570.

Welsh Government (2017a) DRAFT Technical Advice Note 24: The Historic Environment. Available at: https://gov.wales/topics/planning/policy/tans/tan-24/?lang=en [Accessed February 2019].

Welsh Government (2017b) Draft Welsh National Marine Plan. Number: WG31640 [WG25663]. ISBN: 978-1-4734-5357-9 Available at: https://beta.gov.wales/draft-welsh-national-marine-plan [Accessed February 2019].

Welsh Government (2018) Planning Policy Wales. Edition 10. Available at: https://beta.gov.wales/sites/default/files/publications/2018-12/planning-policy-wales-edition-10.pdf [Accessed February 2019].

Wessex Archaeology Ltd (2007) Historical Environment Guidance for the Offshore Renewable Energy Sector. Commissioned by COWRIE Ltd (project reference ARCH-11-05), Available from: https://www.wessexarch.co.uk/sites/default/files/field_file/COWRIE_2007_Wessex_%20-%20archaeo_%20guidance_Final_1-2-07.pdf [Accessed February 2019].

Wessex Archaeology (2008a). Aircraft Crash Sites at Sea. A scoping Study. Archaeological Desk Based Assessment. Unpublished Report.

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Morlais Project
Environmental Statement

Chapter 14: Commercial Fisheries

Volume I

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-014

Chapter 14: Commercial Fisheries

Author: Marine Space

MarineSpace
Making Sense of the Marine Environment ™

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GLOSSARY OF ABBREVIATIONS

AIS	Automatic Identification System
ALARP	As Low As Reasonably Possible
CCW	Countryside Council for Wales
COWRIE	Collaborative Offshore Wind Research into the Environment
DCO	Development Consent Order
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ES	Environmental Statement
FLO	Fisheries Liaison Officer
FLOWW	Fishing Liaison with Offshore Wind and Wet Renewables
ICES	International Council for Exploration of the Seas
LSE	Likely Significant Effect
MCA	Maritime and Coastguard Agency
MCAA	Marine and Coastal Access Act
MDZ	Morlais Demonstration Zone
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MPS	Marine Policy Statement
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
NRA	Navigational Risk Assessment
NRW	Natural Resources Wales
NtM	Notice to Mariners
OWF	Offshore wind farm
PINS	Planning Inspectorate
VMS	Vessel Monitoring System
WFA	Welsh Fishermen's Association
WNMP	Wales National Marine Plan

GLOSSARY OF TERMINOLOGY

Beam trawl	A trawl net whose lateral spread during trawling is maintained by a beam across its mouth.
Bottom (demersal) otter trawling	Fishing whereby a single net is towed behind the vessel on the seabed.
Demersal	Living on or near the seabed.
ICES Statistical Rectangles	The spatial units by which fisheries data are recorded, collated and analysed.
Pelagic	Refers to fishing gear fished in the water column as opposed to seabed or fish present mid-water (e.g. herring, mackerel).
Potting	Fishing method whereby the fish are caught in portable traps laid onto the sea bed.

Scallop dredging	Fishing method used to catch scallops. Heavy dredges are towed along the seabed with teeth which rake scallops from the seabed.
VMS	Satellite tracking system used to track positions of EU vessels.
Whitefish	Refers to species such as cod, haddock and whiting

14. COMMERCIAL FISHERIES

14.1. INTRODUCTION

1. Menter Môn Morlais Limited (Menter Môn) proposes the development of 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ). The development of the Morlais Project (the Project) will support the development of renewable energy technology objectives of the Anglesey and Gwynedd Joint Local Development Plan, providing a consented tidal technology demonstration zone which supports installation, testing and commercial demonstrations of tidal energy devices. The Project will also provide opportunities for the local communities via direct employment and support of the local supply chain.

2. The Project will include permanent communal infrastructure for tidal technology developers which provides a shared route to a local grid connection via nine export cable tails, an onshore landfall substation, and an onshore electrical cable route to a grid connection via a grid connection substation.

3. This chapter provides a summary description of key aspects relating to existing commercial fisheries in the region, followed by an assessment of the magnitude and significance of the effects on the baseline conditions resulting from the construction, operation (repowering) and decommissioning of the Project, as well as those effects resulting from cumulative interactions with other existing or planned projects.

4. The Project will install multiple technology types within the MDZ, and so the consent application is based on a project design envelope (also known as the Rochdale Envelope), determined through knowledge of existing technology and anticipation of the direction of future developments. The project design envelope is provided in full in **Chapter 4, Project Description**. Hence, the potential effects on commercial fisheries have been assessed conservatively using realistic ‘worst case’ scenarios for the Project.

5. This chapter, inclusive of baseline information and environmental impact assessment has been undertaken by MarineSpace Ltd on behalf of Menter Môn.

14.2. POLICY, LEGISLATION AND GUIDANCE

6. This section outlines the relevant national and regional policy and guidance and industry guidance which has be used to support the compilation of this Commercial Fisheries Chapter.

7. An overview of the relevant legislative context for the Project is provided in **Chapter 2, Policy and Legislation.**

14.2.1. National Policy Statements

8. The Marine Policy Statement (MPS) adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made in order to enable sustainable development. The MPS sets out a vision of having ‘clean, healthy, safe, productive and biologically diverse oceans and seas’ by supporting the development of Marine Plans. It also sets out the framework for environmental, social and economic considerations that need to be considered in marine planning.

9. By adopting the MPS, the Welsh Government committed to the requirement to introduce Marine Plans for Wales. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the Wales National Marine Plan (WNMP).

10. The Plan is being developed in accordance with the Marine and Coastal Access Act (MCAA) 2009, the MPS and the Maritime Spatial Planning Directive, a draft version has been issued for consultation (discussed further in **Chapter 2, Policy and Legislation**).

11. Objective 10 of the MPS, "to maintain and enhance the resilience of marine ecosystems and the benefits they provide in order to meet the needs of present and future generations", is of relevance to this chapter as this covers policies and commitments on the wider ecosystem, set out in the MPS including those to do with the Marine Strategy Framework Directive and the Water Framework Directive, as well as other environmental, social and economic considerations.

12. Although this Project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP). Guidance that is relevant to assessing impacts on commercial fisheries for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision making documents for NSIPs. Those relevant to commercial fisheries include:

- NPS for Renewable Energy Infrastructure (EN-3), July 2011.

13. Details of specific policies within EN-3 used to inform this assessment are provided in **Table 14-1** below. The specific assessment requirements for commercial fisheries are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 14-1 NPS EN-3 Assessment Requirements Relevant to Commercial Fisheries

NPS Requirement	NPS Reference	ES Reference
"The construction and operation of offshore windfarms can have both positive and negative effects on fish and shellfish stocks."	EN-3, Paragraph 2.6.122	A detailed assessment of the impacts of the project on fish and shellfish species, including commercial species, is provided **Chapter 10, Fish and Shellfish Ecology**. Potential impacts on the commercial fisheries that target them are assessed within this chapter (**Section 14.7.4**, **Section 14.7.5** and **Section 14.7.6**).
Whilst the footprint of the offshore windfarm and any associated infrastructure may be a hindrance to certain types of commercial fishing activity such as trawling and longlining, other fishing activities may be able to take place within operational windfarms without unduly disrupting or compromising navigational safety. Consequently, the establishment of a windfarm can increase the potential for some fishing activities, such as potting, where this would not compromise any safety zone in place. The Planning Inspectorate should consider adverse or	EN-3, Paragraph 2.6.123	The potential impacts of the project alone and cumulatively with other projects are described in **Section 14.7.7**.

NPS Requirement	NPS Reference	ES Reference
beneficial impacts on different types of commercial fishing on a case by case basis.		
"In some circumstances, transboundary issues may be a consideration as fishermen from other countries may fish in waters within which offshore windfarms are sited."	EN-3 section 2.6.124	Consideration has been given to the potential impacts of the project on both UK and non-UK fleets in **Chapter 26, Cumulative, Transboundary and In-Combination Impact Assessment**.
"Early consultation should be undertaken with statutory advisors and with representatives of the fishing industry which could include discussion of impact assessment methodologies. Where any part of the proposal involves a grid connection to shore, appropriate inshore fisheries groups should be consulted."	EN-3, Paragraph 2.6.127	**Section 14.3** describes stakeholder consultation which has been undertaken to inform this chapter.
"The assessment by the applicant should include surveys of the effects on fish stocks of commercial interest and any potential reduction in such stocks, as well as any likely constraints on fishing activity within the project boundaries. Robust baseline data should have been collected and studies conducted as part of the assessment."	EN-3, Paragraph 2.6.129	A detailed assessment of the impacts of the project on fish and shellfish receptors is provided in **Chapter 10, Fish and Shellfish Ecology**. The likely constraints on fishing associated with the project are considered in this chapter (**Section 14.7.4**, **Section 14.7.5** and **Section 14.7.6**).
"Where there is a possibility that safety zones will be sought around offshore infrastructure, potential effects should be included in the assessment on commercial fishing."	EN-3, Paragraph 2.6.130	Consideration has been given in the assessment presented in **Section 14.7.4** to the implications of the implementation of safety zones.
"Where the precise extents of potential safety zones are unknown, a realistic worst case scenario should be assessed. Applicants should consult the MCA. Exclusion of certain types of fishing may make an area more productive for other types of fishing. The assessment by the applicant should include surveys of the effects on fish stocks of commercial interest and the potential reduction or increase in such stocks that will result from the presence of the windfarm development and of any safety zones."	EN-3, Paragraph 2.6.131	Consideration has been given to the implementation of safety zones for definition of the Worst-Case Parameters (**Table 14-10**) and for assessment of potential impacts on commercial fisheries (**Section 14.7**). Consideration is given in this chapter to the potential impact on commercial fisheries resulting from potential impacts associated with the Project on commercially exploited fish and shellfish species. A detailed assessment of the impacts of the project on fish and shellfish species, including those of commercial importance, is provided in **Chapter 10, Fish and Shellfish Ecology**.

14.2.2. Marine Policy Statement

14. The Marine Policy Statement (MPS) adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans and establishes how decisions affecting

the marine area should be made in order to enable sustainable development. The MPS sets out a vision of having 'clean, healthy, safe, productive and biologically diverse oceans and seas' by supporting the development of Marine Plans. It also sets out the framework for environmental, social and economic considerations that need to be considered in marine planning.

14.2.3. Wales National Marine Plan

15. By adopting the MPS, the Welsh Government committed to the requirement to introduce Marine Plans for Wales.

16. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the Welsh National Marine Plan (WNMP). The Plan is being developed in accordance with the Marine and Coastal Access Act (MCAA) 2009, the MPS and the Maritime Spatial Planning Directive, a draft version has been issued for consultation (discussed further in **Chapter 2, Policy and Legislation**).

17. Objective 10 of the WNMP, "to maintain and enhance the resilience of marine ecosystems and the benefits they provide in order to meet the needs of present and future generations", is of relevance to this chapter as this covers policies and commitments on the wider ecosystem, as set out in the MPS including those to do with the Marine Strategy Framework Objective Directive and the Water Framework Directive, as well as other environmental, social and economic considerations.

18. **Table 14-2** sets out specific national and regional policies relevant to the Project.

Table 14-2 National and Regional Policy Relevant to Commercial Fisheries

Policy Description	Reference	ES Reference
Draft WNMP		
Proposals that consider opportunities for coexistence with other compatible sectors are encouraged in order to optimise the value and use of the marine area and marine natural resources	ECON_02: Coexistence	The Project will explore opportunities for local fishing vessels to support the Project (**Section 14.7.4.5** and **14.7.5.5**)
Proposals that contribute to the well-being of coastal communities are encouraged.	SOC_02: Well-being of coastal communities	As above
Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01: Cumulative effects	Cumulative impacts are assessed in **Section 14.7.7** and in **Chapter 26**

14.2.4. Industry Guidance

19. This chapter takes into account the following legislation and guidance:

- Fishing Liaison with Offshore Wind and Wet Renewables (FLOWW) Group Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison (January 2014);
- Guidance on Commercial Fisheries Mitigation and Opportunities from Offshore Wind commissioned by Collaborative Offshore Wind Research into the Environment (COWRIE), (Blyth-Skyrme, 2010);
- Best Practice Guidance for Fishing Industry Financial and Economic Impact Assessments – guidelines based on outputs from a technical workshop organised by the UK Fisheries Economics Network (UFEN and Seafish, 2012);
- Scallop Fishing (Wales) Order (2010): bans scallop dredging within 1 nm of the Welsh coast; vessels fishing between 1-3 nm must be 10 m or less and not have more than 6 scallop dredges in total; vessels fishing between 3-6 nm must not have more than 8 scallop dredges; and vessels 6-12 nm must not have more than 14 scallop dredgers;
- The Welsh Government's Byelaw 9 (Annex 2) prohibits fishing with vessels exceeding 12 m in length (subject to certain exemptions) in the sea 0 to 6 nautical mile (nm)25 (0 to 11.1 km) from the shore (Welsh Government, 2014)[1];
- Inshore Fishery Legislation (North Wales, 0-6 nautical miles), including;
    - The Welsh Government's Byelaw 14 mandates a seasonal closure of the cockle fishery between 1st May and 31st August;
    - The Welsh Government's Byelaw 20 mandates a seasonal closure of the scallops *Pecten maximus* fishery between 1st June and 31st December in a specified inshore area;
    - The Welsh Government's Byelaw 21 prohibits the use of bottom towed fishing gear in the prohibited area;
    - The Welsh Government's Byelaw 30 which gives maximum daily quantity of shellfish landed; and
- Whelk Statutory Instrument is planned to be phased in from spring 2019.

[1] The Welsh Government is understood to have been working on an Order to update the restrictions currently in force under Byelaw 9, but these have not yet been implemented.

14.3. CONSULTATION

20. Consultation with statutory bodies and key stakeholders was undertaken through a formal process for the Project. Key responses of relevance to commercial fisheries have been summarised in **Table 14-3**.

Table 14-3 Consultation Responses

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Scoping Response	*Access to fishing grounds:* The loss or restricted access to traditional fishing grounds may have subsequent effects on alternative fishing grounds. Impacts from intensification of fishing in alternative fishing grounds should be fully assessed within the ES. The exclusion of certain types of fishing may make an area more productive for other types of fishing. The assessment should include detailed surveys of the effects on fish stocks of commercial interest and the potential reduction or increase in such stocks that will result from the presence of the TECs and of any safety or buffer zones.	These impacts are assessed in detail under **Sections 14.7.4.1**, **14.7.5.2** and **14.7.5.3**
Planning Inspectorate	2018 Scoping Response	*Potential impacts:* The ES should assess the likely significant effects resulting from target species being affected by the Proposed Works and not being able to migrate to inshore areas.	Likely Significant Effect (LSE) resulting from abundance of target species has been addressed in Section **14.7.5.3**
Planning Inspectorate	2018 Scoping Response	*Loss of or damage to fishing gear:* The potential for loss of or damage to fishing gear during all phases of the Proposed Works should be assessed.	Loss of or damage to fishing gear is assessed under **Section 14.7.4.4**
National Resource Wales (NRW) (for Planning Inspectorate (PINS))	2018 Scoping Response	We advise that vessels from Nefyn/Trevor should be mentioned when describing the baseline environment due to the potential that some of them utilise the area close to the proposed demonstration zone or their fisheries may be impacted by the development.	Vessels from Nefyn and Trefor have been considered as part of the baseline environment in **Section 14.5.3.1**
NRW (for PINS)	2018 Scoping Response	The potential impact of change in abundance of target species outlined in table 9.4 should also address the possibility of species movement being affected by development and not being able to migrate to inshore areas.	LSE resulting from abundance of target species has been addressed in **Section 14.7.5.3**
NRW	2018 Scoping Response	As the project progresses we recommend that you have regular meetings with Fishing Industry representatives starting at the top with the Welsh Fisherman's Association, and also more localised groups. We recommend that you follow the Fishing Liaison with Offshore Wind and Wet Renewables (FLOWW) best practice guidance for fisheries liaison to ensure continued liaison with the fishing industry through the planning	This recommendation has been duly noted. The WFA have been consulted with during the process of producing this chapter. The FLOWW Guidance has been followed when

<table>
<tr><th>Consultee</th><th>Date/Document</th><th>Comment</th><th>Response</th></tr>
<tr><td></td><td></td><td>stages and all subsequent stages of the project (FLOWW, 2014).</td><td>conducting Fisheries Liaison for this chapter. Several meeting requests have been issued over the course of the Project.</td></tr>
<tr><td>NRW</td><td>2018 Scoping Response</td><td>Vessels from Nefyn/Trevor should be included when describing the baseline environment due to the potential for them to utilise the area close to the proposed demonstration zone or their fisheries may be impacted by the development.</td><td>This comment has been addressed previously.</td></tr>
<tr><td>NRW</td><td>2018 Scoping Response</td><td>As noted in the shipping and navigation section of this scoping opinion, vessel traffic estimated from AIS data and VMS data only shows large vessels and does not account for smaller boats, for example the under 10 m fishing fleet and recreational fishing vessels. This needs to be addressed in the ES.</td><td>The traffic of smaller vessels has been assessed using visual and radar data as well as liaison with national fishing organisations; see Section 14.4.3.</td></tr>
<tr><td>NRW</td><td>2018 Scoping Response</td><td>The potential impact of change in abundance of target species outlined in table 9.4 should also address the possibility of species movement being affected by the development and not being able to migrate to inshore areas.</td><td>This comment has been addressed above.</td></tr>
<tr><td>Welsh Fishermen's Association (WFA)</td><td>2018 Navigational Consultation</td><td>Fishing Vessel Traffic Analysis:
Fishing vessel traffic on plot appears to be light. There is a plethora of under 10 m vessel that operate within the area;
Abrahams Bosom should be more populated. Pot buoys – head ropes inshore within 10 m contour;
July is a very active month and therefore, there should be more traffic than demonstrated on the plot. There is very little traffic at the end of February /start of March;
The Morlais Zone is not very fishing friendly due to the tidal conditions, except for at slack water.
Impacts
If the project were to go ahead fishing in the area would be sterilised due to snagging and gear loss issues – may get some fishermen attempting to set pots as lobsters will hide within devices which will create a new habitat;
Vessels will not be able to anchor in the zone if they run into difficulties;</td><td>The feedback from consultation has been included and used to inform the relevant sections of the chapter. Specifically:
Fishing vessel traffic for small vessels has been investigated and supplemented with additional data (Section 14.4.3)
Section 14.5.4 incorporates the comments with regards to fishing vessel traffic.
Comment about tidal conditions noted and incorporated.</td></tr>
</table>

Consultee	Date/Document	Comment	Response
		▪ At maximum capacity, a fishing boat would not attempt to navigate through the zones, even if they were lit.	
WFA	2018 Navigational Consultation	▪ Commented that a local fishermen who is a scalloper will not fish within local OWFs with >2 knots of tide as the risk of gear loss if too high; ▪ Considers that the tidal site is a much greater hazard than an OWF as cannot see all infrastructure. ▪ There is a risk of loss of power and drifting onto devices; ▪ It appears that for safety, all vessels will need to navigate around the outside of the MDZ. ▪	The feedback from consultation has been included and used to inform the relevant sections of the chapter, and also in **Chapter 12, Shipping and Navigation**.
WFA	2018 Navigational Consultation	*Inshore Passage:* ▪ Inshore passage is a manageable gap, however, the current makes it difficult to navigate; ▪ The inshore passage would not be navigable for a coaster; ▪ Collision risk will likely increase, however, does not consider increase will be appreciable. However, may be of concern for yachts/ powerboats in summer; ▪ Normal passage planning would allow 1-2 miles offing from a steep to dangerous coastline. *Anchoring* ▪ Abraham's Bosom is not a very good holding ground, no one anchors here if they can help it. Very quickly you are in 30 m plus water depths. *Mitigation* ▪ Engagement with stakeholders is key. Stakeholders must be informed the whole way along.	The feedback from consultation has been included and used to inform the relevant sections of this chapter, and also in **Chapter 12, Shipping and Navigation**.
NRW	2015 Scoping Response	It is not clear whether or not impacts to crab fisheries have been considered. This should be included in the ES, or, if this has been scoped out justification should be provided.	Crab fisheries have been assessed under two of the receptor groups (see **Section 14.4.4.1**) throughout this chapter.
NRW	2015 Scoping Response	FishMap Mon may provide useful information to inform this section of the EIA. The Fish Map Mon information was gathered to give a better	The data from FIshMap Mon that is available on the

Consultee	Date/Document	Comment	Response
		understanding of the fishery around Anglesey and help manage, protect and help maintain a sustainable fishery, and protect fishermen's livelihoods in the area. http://fishmapmon.naturalresourceswales.gov.uk/	Wales Marine Planning Portal was used for the baseline.

14.4. METHODOLOGY

14.4.1. Study Area

21. The specific study area for this chapter is generally defined by the International Council for the Exploration of the Seas (ICES) rectangle 35E5, within which the entire MDZ and export cable corridor lies (see **Figure 4-1, Volume II**). Ports data from the three key ports in the vicinity of the MDZ have been considered here, one of which lies outside of the ICES rectangle 35E5 boundary. Within the ICES rectangle 35E5, emphasis is placed on fishing activity that occurs within the actual MDZ zone and immediate (2 km) area.

14.4.2. Data Sources – Desk Study

22. Baseline conditions have been determined by undertaking a desktop review of published information and from consultation with key fishing organisations. The data sources used to inform the baseline description and impact assessment are listed below:

- Marine Management Organisation (MMO) UK fleet landings by selected ICES Rectangle (2012-2016);
- MMO UK and foreign fleet landings into the UK by port (2013-2017);
- Welsh Government, Marine Planning Portal, NRW – Sea Fish Atlas; (2010);
- MMO GIS dataset for UK and Non-UK >15m vessel fishing activity (2007-2010);
- MMO Fishing activity data for UK Vessels >15m, using Vessel Monitoring Systems data (2013-2016);
- MMO Marine Information System;
- FishMapMon;
- Lle – the Wales Marine Planning Portal[2]; and
- Consultation with national and regional fishing organisations via meetings and the Navigational Risk Assessment (NRA) process.

[2] http://lle.gov.wales/apps/marineportal/

14.4.3. Data Sources – Site-Specific Surveys and Reports

23. No site-specific surveys of commercial fishing activity in the area around the MDZ have been undertaken. However, project-specific consultation has been undertaken with regional and national fishing organisations and marine traffic data (radar, Automatic Identification System (AIS) and visual) collected as part of the NRA process has also been used to inform the existing environment section.

14.4.4. Impact Assessment Methodology

24. A detailed description of the Impact Assessment Methodology is provided in **Chapter 5, EIA Methodology** of this ES. A short summary is provided here for completeness, with additional detail provided for the specific receptor of this chapter (commercial fisheries).

25. A Project Design Envelope approach, often referred to the 'Rochdale Envelope', has been used in this assessment. This approach "defines a series of realistic maximum extents and magnitudes for the description of a development, so that a realistic 'worst case scenario' is assessed". **Chapter 4, Project Description**, sets out the parameters of the Project in as much detail as possible in order to complete the assessment.

26. Effects are changes in the existing environment that may arise during Project activities. Effects can result in impacts where a receptor is sensitive to them. Impacts can be considered as direct, indirect, inter-relationships, or cumulative (see **Chapter 5, EIA Methodology** for definitions).

27. The determination of each aspect of the receptor (sensitivity, value, magnitude) was considered for each species, using available evidence, including published data sources, and expert judgement.

14.4.4.1. Sensitivity

28. The sensitivity of the receptor (commercial fishing vessels) was considered in terms of its ability to adapt, tolerate and / or recover from potential impacts (**Table 14-5**), as well as taking into account its value (see **Table 14-6**). Sensitivity of the commercial fishery was based on the available literature, expert judgement, and consultation with local fisheries representatives.

29. Three main fishing receptors have been defined based on knowledge of fishing activity in this area gathered via review of existing data and consultation with local fishers. These receptors have been defined by the size and type of vessel, the predominant gear type used and also the geographic area of activity.

Table 14-4 Key Commercial Fishing Receptors Used in this Assessment

Receptor Group	Description
A) ≤10 m nearshore static gear vessels targeting crab/lobster in the nearshore region	Small (≤10 m) vessels setting static gear (pots) in the nearshore region around NW Anglesey. Nearshore region defined as between 0-1 km offshore. Part of the ECC lies within this 0-1 km nearshore region
B) ≤10 m and >10 m static gear vessels targeting whelk/crab/lobster in the MDZ	Mixture of ≤10 m and larger >10 m vessels setting static gear (pots) further offshore (1-5 km) than Group A. Their activity coincides with part of the ECC and also the main MDZ array.

C) >10 m mobile gear vessels targeting whitefish and/or scallops in the MDZ and surrounding area	Larger (>10 m) vessels that operate at least 2 km offshore. These vessels may occasionally fish within the MDZ but never within the ECC.

30. For all fishing receptors, it is important to recognise that sensitivity is not static over time. The operating environment for commercial fishing vessels changes from year to year reflecting changes in the parameters that guide the activities. For commercial fishing receptors, this includes changes to: the fisheries management regime (including area closures); the abundance and distribution of target species; changes in market prices and preferences; fuel costs; and in response to entrepreneurial behaviour by individual vessel operators.

31. Sensitivity to, and therefore the significance of, an impact, can thus change over time, as vessel operators adapt to new conditions, assuming the initial impact is not so severe as to render a business or operation unviable.

32. This capacity to adapt to changing circumstances is an important consideration when considering the sensitivity of a receptor to disturbance over time. Many receptors in the fishing sector are able to adapt to change by differing degrees, bearing in mind individual vessel capacity and restrictions beyond an individual's control, such as regulatory restrictions (e.g., quota). This capacity to adapt is considered for certain impacts in this assessment, including loss of access to historical fishing grounds or marks, and displacement. For these impacts, the level of disturbance assessed is forecast to diminish over time, as fishing vessels work to mitigate any disturbance experienced, in conjunction with mitigation measures put in place for the Project.

Table 14-5 Definitions of the Receptor Sensitivity Levels (Commercial Fisheries)

Sensitivity	Description
High	▪ Low spatial adaptability due to limited operational range and ability to deploy only one gear type. ▪ Limited spatial tolerance due to dependence upon a single ground. ▪ Low recoverability due to inability to mitigate loss of fishing area by operating in alternative areas
Medium	▪ Some spatial adaptability due to extent of operational range and/ or ability to deploy an alternative gear type. ▪ Moderate spatial tolerance due to dependence upon a limited number of fishing grounds. ▪ Limited recoverability with some ability to mitigate loss of fishing area by operating in alternative areas.
Low	▪ High spatial adaptability due to extensive operational range and/ or ability to deploy a number of gear types. ▪ High spatial tolerance due to ability to fish numerous fishing grounds. ▪ High recoverability due to ability to mitigate loss of fishing area by operating in a range of alternative areas within the wider region.
Negligible	▪ Category of fishing receptor with an extensive operational range and high method versatility. ▪ Vessel able to exploit a large number of fisheries.

14.4.4.2. Magnitude

33. In terms of commercial fishing activities, the magnitude of an impact on fishing receptors is defined based on the extent of the impact and duration of the impact. This takes into account the potential interactions between the construction, operation and maintenance (O&M), repowering and decommissioning phases of the Project and fishing activities by commercial fishing receptors.

34. The magnitude of the effect has been considered in terms of spatial extent, duration, likelihood, frequency, nature of change, and reversibility (where appropriate). Extent is the spatial extent over which the impact would occur in relation to the value of annual landed catch derived from a certain area. Extent therefore, estimates the area of historical fishing grounds or fishing marks that would be occupied by project infrastructure, activities and operations. As discussed previously, individual vessels within the commercial fishing sector have fishing grounds that are significantly smaller in area than the overall area fished by the local fleet, thus at individual vessel level, magnitude may be higher or lower than the fleet average.

35. Duration is defined as the length of time over which the impact would occur and is measured in fishing seasons. The profitability of commercial fishing vessels is often strongly linked to whether or not they supply bulk markets, in which case margins are typically tighter than for vessels supplying niche or high value markets.

36. However, all commercial fishing that targets seasonal fisheries is dependent on access to the fishery during the main season. Exclusion from fishing grounds for an entire season could, therefore, have serious implications for these sectors. Thus, duration of an impact is measured in terms of the length of time the impact would occur over fishing seasons.

37. **Table 14-6** outlines the criteria used for assessing magnitude of effect on commercial fisheries.

Table 14-6 Definitions of Magnitude of Effect (Commercial Fisheries)

Magnitude	Description
High	The impact would affect an area from which the majority of a commercial fishing receptor’s annual value of landings is caught. The effect would be permanent and/or result in irreplaceable change and would be certain to occur.
Medium	The impact would affect an area from which a moderate proportion of a commercial fishing receptor’s annual value of landings is caught. The effect would be long-term though reversible and is likely to occur.
Low	The impact would affect an area from which a minor proportion of a commercial fishing receptor’s annual value of landings is caught. The effect would be short- to medium-term though reversible change and could possibly occur.
Negligible	The impact would affect an area from which a very small proportion of a commercial fishing receptor’s annual value of landings is caught. Effect is sort-term, intermittent and reversible and unlikely to occur.

14.4.4.3. Impact significance

38. The significant of an impact can be determined by combining the magnitude of the impact and the sensitivity of the receptor using the matrix outlined in **Table 14-7**.

39. The matrix approach ensures a consistent approach and limits the subjectivity of the impact assessment arising from expert judgement. Definitions of the impact significance are provided in **Table 14-8**.

40. A confidence value of high, medium or low will be assigned to the assessment of potential impacts, based on the confidence in the evidence used to make the assessment.

Table 14-7 Impact Assessment Matrix

		Negative Magnitude				**Beneficial Magnitude**			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Table 14-8 Impact Significance Definitions

Value	**Definition**
Major	Major and significant disturbance to the receptor (commercial fishing activity) that could not be mitigated by a change in receptor operating patterns, and which risks rendering the receptor unviable.
Moderate	Moderate disturbance to the receptor (commercial fishing activity) that would be difficult to mitigate by a change in receptor operating patterns, and which could result in a reduction in receptor value.
Minor	Minor disturbance to the receptor (commercial fishing activity) that could be mitigated by a change in receptor operating patterns, and/or would not result in a significant reduction in receptor value.
Negligible	No discernible disturbance to the receptor (commercial fishing activity).

14.4.4.4. Mitigation measures

41. Where an impact assessment identifies that an aspect of the Project is likely to give rise to significant environmental impacts, mitigation measures have been proposed, targeted at avoiding impacts or reducing them to acceptable levels. These can comprise embedded mitigation or additional mitigation (see **Chapter 4, Project Description** for an overview of the embedded mitigation measures relevant to the Project). Additional mitigation measures are outlined where relevant in **Section 14.7**.

14.4.4.5. Cumulative Impact Assessment

42. Cumulative impacts are assessed through consideration of the extent of influence of changes to commercial fisheries from the Project alone and those arising from the Project cumulatively or in combination with other reasonably foreseeable plans and projects.

14.5. EXISTING ENVIRONMENT

43. The characterisation of the existing environment is undertaken using data sources listed in the Data Sources (**Section 14.4.2** and **14.4.3**) sections above plus other relevant literature.

44. The limitations exist with data used to inform the existing environment section of this chapter. These are outlined in **Table 14-9** and have been taken into account during the impact assessment:

Table 14-9 Data Sources and Associated Limitations

Data set	Limitation
Marine Management Organisation (MMO) UK fleet landings by selected ICES Rectangle (2012-2016)	▪ At the time of writing, data were only available up to and including 2016
MMO UK and foreign fleet landings into the UK by port (2013-2017)	▪ At the time of writing, data were only available up to and including 2017
Welsh Government, Marine Planning Portal, NRW – Sea Fish Atlas; (2010)	▪ Data gained from a one-off study in 2010, nothing more recent available
MMO GIS dataset for UK and Non-UK >15m vessel fishing activity (2007-2010)	▪ Data only available until 2010 due to data privacy ▪ Inshore fleet not generally represented as only >15m vessels
MMO Fishing activity data for UK Vessels >15m, using Vessel Monitoring Systems data (2013-2016)	▪ At the time of writing, data only available until 2016 ▪ Inshore fleet not generally represented as only >15m vessels

14.5.1. Welsh Context

45. The waters around Wales provide an important variety of fishing areas and species for commercial activity, with Welsh waters targeted by both large (>10 m) offshore vessels and smaller (≤10 m) inshore vessels as well as hand gatherers and commercial net fishermen for diadromous (migratory) species, including salmon and sea trout. The most common type of vessel in Welsh waters are vessels ≤10 m that typically fish in inshore waters, with the most frequent vessel length being between 5-6 m. Vessels >10 m fish both within and outside the 12 nm boundary of Welsh waters.

14.5.1.1. Welsh Target Fisheries

46. In Welsh waters, shellfish are the most important target species with a small amount of demersal fish also being targeted. Shellfish are the most landed species into Welsh ports by UK vessels, specifically scallops, whelks and crabs (Pantin et al., 2015). Other important shellfish species include lobster, Norway lobster, and razor clams. Key demersal target species include cod, haddock, ling, monkfish, plaice, ray, skate and sole. Pelagic fish landings from this area are mainly of herring and mackerel, and of relatively less economic importance compared to shellfish and demersal species.

47. Although shellfish species are the most important commercial species in Welsh waters, there is a lack of consistent and quality data for these species (with the possible exception of scallops) across all UK waters. As a result, sound stock assessments have not been achievable at regional levels (Pantin et al., 2015).

48. The whelk fishery comprises the largest current fishing area in Welsh waters (Pantin et al., 2015) at a total of 6,640 km^2. Brown crab and lobster also have large fishery areas. The main non-shellfish species that has the greatest fishing area is sea bass.

49. Another key characteristic of fisheries in Welsh waters is seasonality, with the majority of vessels targeting different species, using different gear types, at different times of the year so as to maximise income. Broad, regional-level seasonal trends for different fishing activity in Welsh waters are shown in **Plate 14-1**.

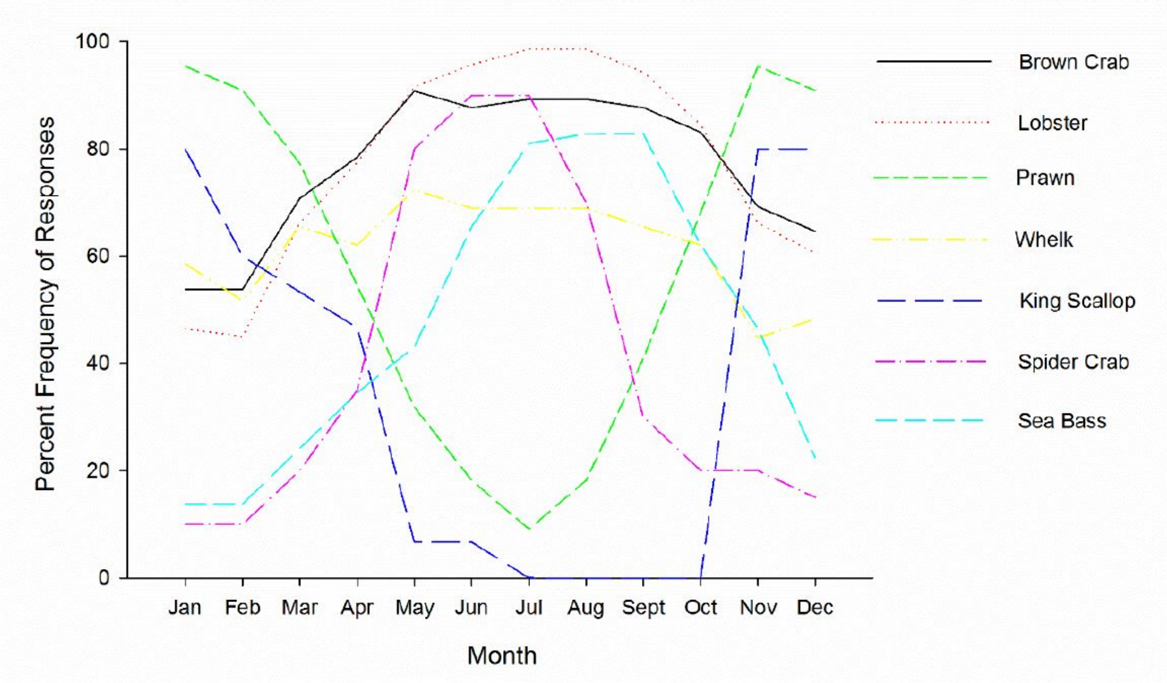

Plate 14-1 Seasonal Trends in Fishing Activity by Month in Welsh Waters, as reported by Fishers (from Pantin et al., 2015).

50. Different commercial species are targeted by different sectors of the fishing fleet. The inshore (predominantly ≤10 m) fishing fleet targets a wide range of species including bass, crabs, scallops, lobster and whelks in the nearshore region. Many of these species are of high quality and, therefore, high commercial value due to the methods of capture used and short time between capture and landing.

51. Potting for shellfish is the key fishing activity in Welsh coastal waters. Lobster, spider crab, brown crab, velvet crab, crayfish and prawns are all targeted. The whelk fishery in is also highly profitable.

52. Hand-gathering for cockles, mussels, periwinkles and razor clams occurs around the coast of Wales.

53. Beam trawling targeting plaice and sole is also conducted in Welsh waters, specifically off North Wales. Historically, scallop dredging was mainly south and west of the Isle of Man, but in 2007 efforts intensified within Cardigan Bay. Demersal trawling (using otter trawls for plaice, sole and rays through the summer, and whiting during winter) takes place mainly off South-west Wales. Beach seining catches bass or mullet in a number of localities around North Wales.

54. There are no established pelagic trawl fisheries around the coasts of Wales. Hand lining and rod and line fishing are widespread and occur both commercially and recreationally in inshore

waters, as is the use of set nets targeting particularly sea bass in summer but also rays and other species throughout the year (Evans and Hintner, 2012).

55. Recreational sea angling is particularly popular in the UK with Wales offering the opportunity to use a wide range of techniques and target species including shore fishing for bass, cod and whiting, as well as boat fishing for black bream and for tope. Though the main season for sea angling is the summer, it extends into late spring and winter in areas that are more accessible, including the waters around Anglesey.

14.5.1.2. Ports

56. The Welsh fleet operates from ports all over Wales, with the most active ports being Milford Haven, Fishguard, Holyhead, Saundersfoot and Swansea (MMO, 2016). Offshore fishing vessels are mainly concentrated at Milford Haven in the South and Holyhead in the North (MMO, 2016).

14.5.2. Fishing Activity in the Study Area

14.5.2.1. Spatial-Temporal Trends

57. The coastline in the study area is generally very rugged, dominated by rocky outcrops with extensive sandy beaches only near estuaries and in sheltered bays. As a consequence, fishing activity is restricted by prevailing westerly weather during the winter. There exist a few naturally protected areas around Holyhead and Anglesey (National Assembly Wales, 2000).

58. The majority of boats fish within 6 nm of the coast, potting for lobsters, crabs and whelks and netting for flatfish, cod, bass, mullet, herring, salmon and sea trout. Some vessels from ports in the study area and adjacent North Wales coast also participate in the Cardigan Bay scallop fishery, which generally takes place outside the 12-mile limit and involves vessels from other parts of the UK.

59. Large visiting beam trawlers fish the shallow bay between Anglesey and Cumbria, often landing into Holyhead and Liverpool to their own transport. Lobsters provide the main resource for many fishermen operating in the study area and greater waters of North Wales. Pots are generally set between April and November, although pots set in sheltered areas in winter take an important bycatch of velvet crabs. Brown crabs provide an important resource Anglesey, where boats of 5–8m set pots out to 6nm from the coast and larger boats, some equipped with vivier tanks, target brown crabs further offshore. Whelks are taken in pots set off Anglesey, as well as the Lleyn Peninsula, and further south in Cardigan Bay (Walmsley & Pawson, 2007).

14.5.2.2. Distribution of Fishing Effort

60. The spatial distribution of fishing activity/value in the study area (ICES rectangle 35E5) is presented below via the review and analysis of vessel monitoring systems (VMS) data obtained from the MMO for the period 2013-2016.

61. As shown in **Figure 14-3** (**Volume II**), ICES rectangle 35E5 had a moderate level of annual fishing effort (>96,000-192,000 kilowatt/days) during the years 2013, 2015 and 2016; while in in 2014 fishing effort was slightly lower (>48,000-96,000 kilowatt/days). In a regional context, ICES

rectangles further north have higher levels of annual fishing effort; while rectangles to the east and west have lower levels of fishing effort; and fishing levels directly to the south are typically the same or slightly higher than rectangle 35E5.

62. Fishing effort by >15m vessels using mobile gears in 35E5 was typically low (**Figure 14-4, Volume II**). Many of the subdivided areas of ICES rectangle 35E5 had no fishing effort by this fishing class, with the most common hours of fishing effort in the subdivisions being very low (<100 hours) (across all years), typically accruing a low value (<£10,000) (**Figure 14-5, Volume II**).The rectangles north of 35E5 have typically higher levels of effort and acquired value from this fishing activity.

63. Fishing by vessels >15m in the MDZ was low (<100 hours per year) and acquired a low monetary value (<£10,000) (**Figure 14-4** and **Figure 14-5, Volume II**), similar to the level of fishing for the full study area. This is true across the whole site in 2015 and 2016, and in the northern portion of the site in 2013 and 2014. There was no effort by fishing vessels >15 m using mobile gear in the southern portion of the MDZ in 2013 and 2014. This low level of activity reflects the difficult fishing conditions in and around the MDZ due to the tidal regime and relatively proximity to the coast.

64. Fishing effort by vessels >15 m using static gears in the MDZ are higher than those using mobile gears (**Figure 14-6, Volume II**). In 2013 and 2014, there was a medium level (100-500 hours) of fishing effort by vessels >15 m using static gear in the northern half of the MDZ, and no such fishing effort in the southern half. In 2015, the northern half of the MDZ was subject to the same amount of fishing level, but the southern half was subject to a higher level (500-1000 hours) of fishing effort. This higher level of fishing effort was reported across the whole MDZ in 2016. It can be inferred therefore that there was an overall increase in the fishing effort of vessels >15 m using static gears in the MDZ for the period 2013-2016.

65. The same trend is observed for value of landings from fishing vessels >15 m using static gear in the MDZ (**Figure 14-7, Volume II**). Value generated was very low (<£2,000) in the northern half of the MDZ during 2013 and 2014 (no value from the southern half as no effort); increasing to a moderate value (£2,000-8,000) across the MDZ in 2015; and was a maximum of up to £30,000 across the MDZ in 2016.

66. The waters in ICES rectangle 35E5, the study area, have high levels of fishing by vessels >15 m using static gears in comparison to nearby rectangles (**Figure 14-6, Volume II**). In 2013 there were generally low fishing levels throughout the waters off north-west Wales (most commonly <100 hours of effort in rectangles displayed in **Figure 14-6, Volume II**).Fishing effort was higher in these waters in 2014 and 2015, with more subdivided areas receiving fishing effort of >100 hours. In 2016, there was a notable shift in effort (and value) from the north of ICES rectangle 35E5 and the two rectangles north of ICES 35E5 (36E5 and 36E6) to the south of 35E5 and the ICES rectangle to the south (34E5), with the MDZ representing the northern limit of more intense fishing effort and value.

14.5.2.3. Key Commercial Species in the Study Area

67. Data on the total landed weight and value of landings by all vessels in the ICES rectangle 35E5 (the study area) for the period 2013-2017 have been obtained from the MMO and assessed.

Over this period in the study area, a total of 7,610 tonnes of fish (all species) was landed, with an equivalent value of £8,794,979. Of this, 1,748 tonnes (23 %) were landed by ≤10 m vessels and (23 %), and 5,861 tonnes (77 %) were landed by >10 m vessels.

68. The majority of this total weight landed was shellfish (7,599 tonnes; 99.8 %) species. Shellfish dominated the catches of vessels in both size groups (**Plate 14-2**). Of the total landings weight from vessels >10 m, 5,860 tonnes were of shellfish species, with the remaining one tonne being of demersal fish species. Vessels ≤10 m caught 9 tonnes of demersal fish species and 0.5 tonnes of pelagic fish species; the remaining 1,739 tonnes were of shellfish.

69. With respect to individual species, within ICES Rectangle 35E5, whelk was the most important commercially landed species, accounting for 5,142 tonnes of the total weight (68 %), and £5,042,329 of the total value (58 %) (**Plate 14-3**). Other important species in terms of greatest weight landed included queen scallops, scallops, lobsters, and crabs. Crustacea form a lesser part of the component of total landings of catches.

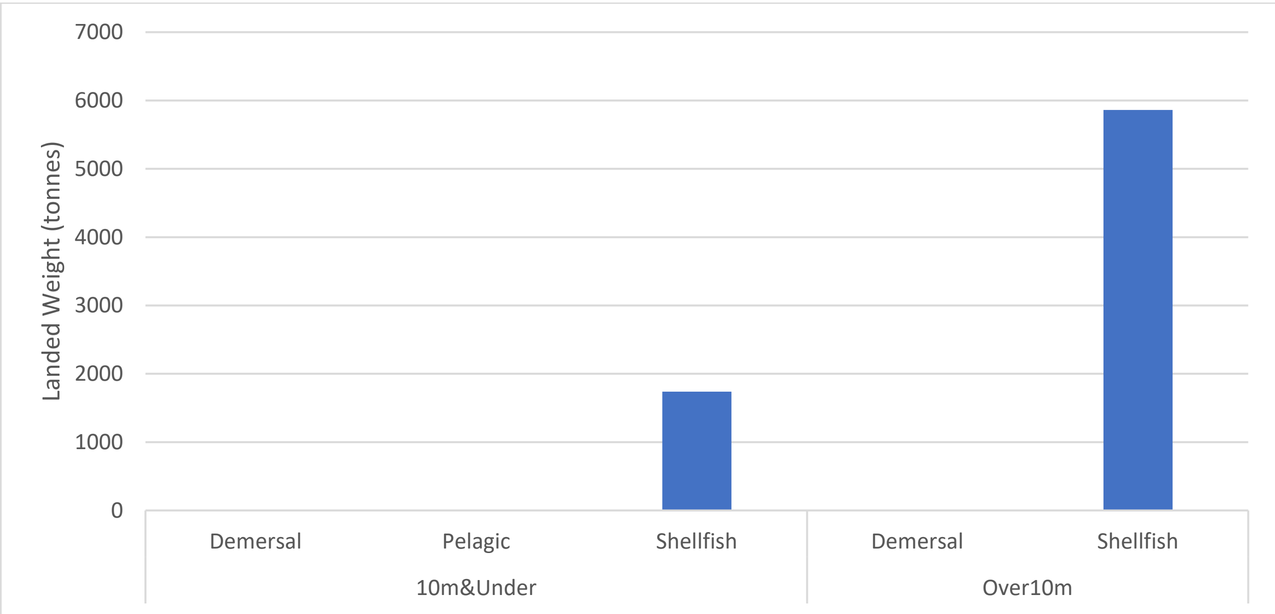

Plate 14-2 Sum of Landed Weight from ICES Rectangle 35E5 by Vessel Size and Species Group (2013-2017) (Source: MMO)

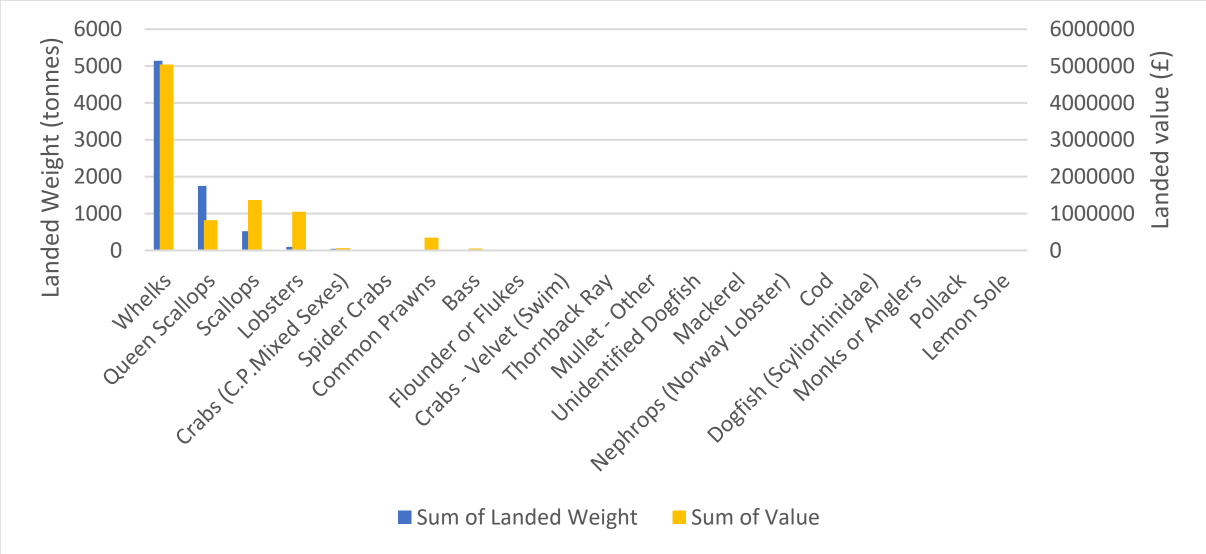

Plate 14-3 Species Caught within ICES Rectangle 35E5 by Sum of Landed Weight (Tonnes) and Corresponding Value (£) 2013-2017 (Source: MMO)

14.5.2.4. Temporal Trends in Landings

70. The landings by weight varied within ICES Rectangle 35E5 between 2013-2017 (**Plate 14-4**), however there is a general pattern in decrease of landed weight over the years. The greatest weight of landings recorded for the area was in 2013, totalling 2,087 tonnes, whereas the lowest year was 2017, with 1,292 tonnes landed. One deviation from this trend was 2016, which had a higher total landed weight (1,463 tonnes) than the previous two years.

71. This overall downwards trend is not apparent in the total value of landings however, which varied between years. The highest annual value of landings was £2,351,970 in 2016, more than £40,000 more than the next most valuable year, 2017. The years 2013-2015 were all of approximately similar total value of landings, within a range of approximately £20,000.

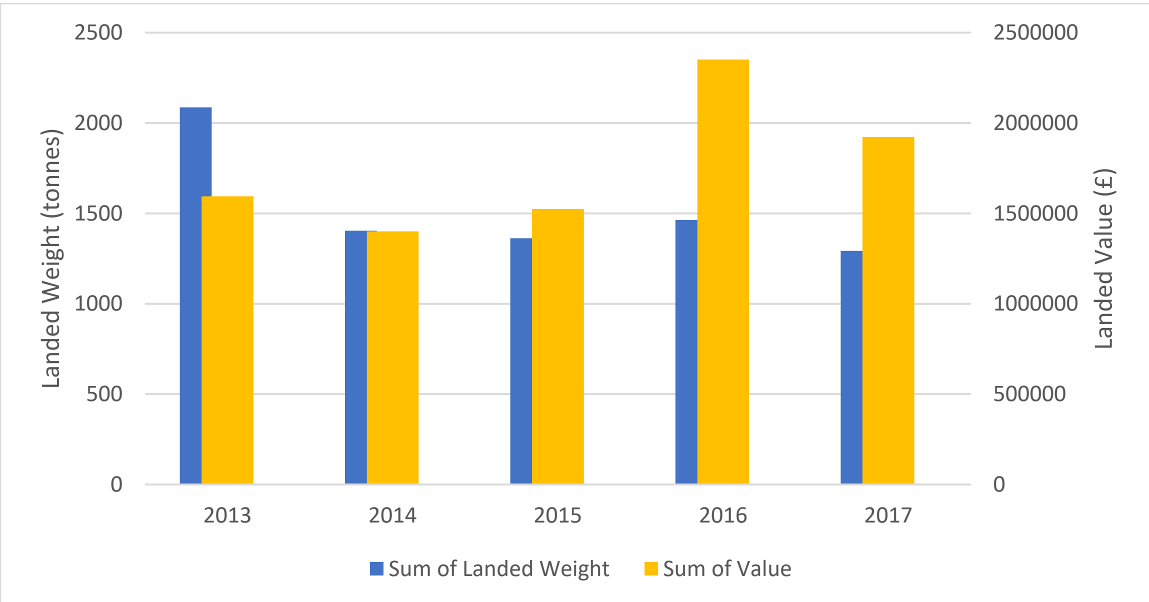

Plate 14-4 Annual Trends in Sum of Landed Weight and Value from ICES Rectangle 35E5: 2013-2017 (Source: MMO)

72. It should be noted that a general decrease in longlining activity has been reported by the WFA in the vicinity of the Project.

73. In terms of intra-annual variation, landed weight for all species/vessels combined over the period 2013-2017 peaked in June/July from ICES rectangle 35E5 (see **Plate 14-5**). The months April-May were also notably higher than the rest of the year, indicating a spring/early summer busy period of fishing in the vicinity of the study area. After the busy period there is a notable drop in both landed weight and value in August; the following months remain relatively consistent before another dip in winter months of December-February.

74. For the top five individual species landed in ICES rectangle 35E5, the study area, **Plate 14-6** details the key periods for landings by weight and value from MMO data. As whelk is the most landed species its seasonal trend follows closely that of the total landed weight across species. Conversely, scallop species show a peak away from the summer months; queen scallops have a peak in October, and for scallops (species unidentified) the peak is in November and January, with no landings at all during the summer months. Lobster and crab show a peak in June-July that declines steadily through autumn to a low in the winter months. This likely reflects that pots are most set between April and November, with fewer pots left out in the winter months.

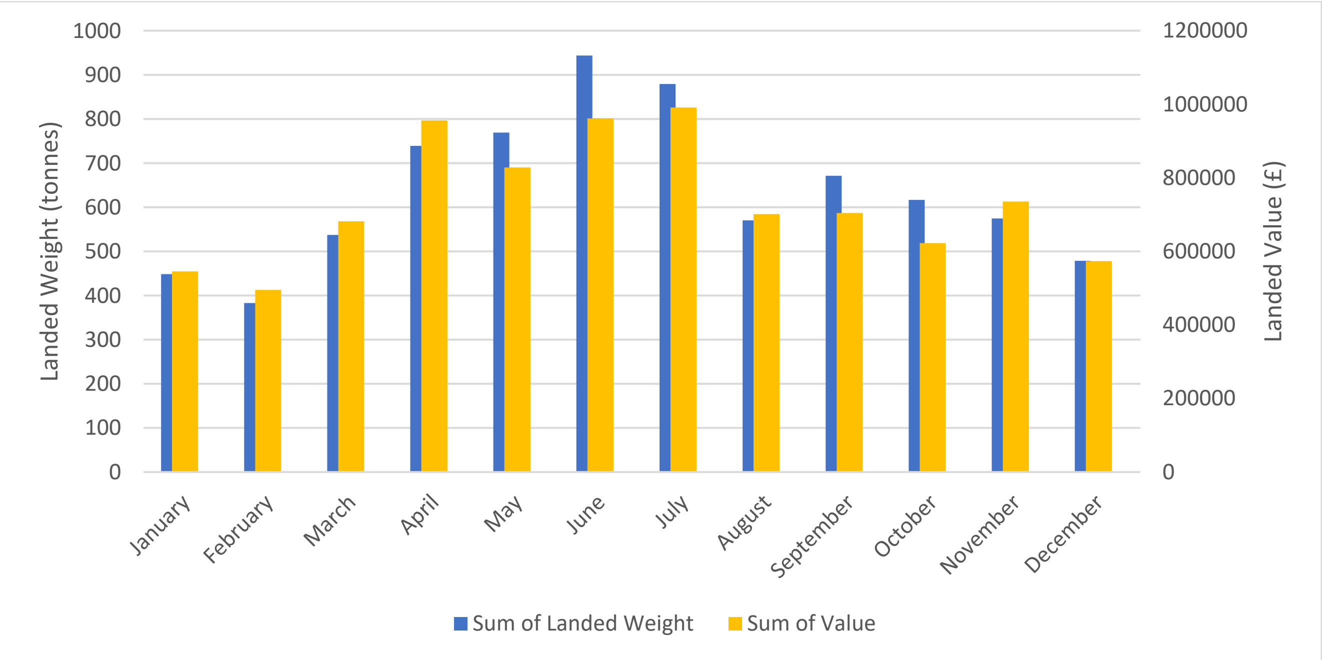

Plate 14-5 Seasonal Trends in Sum of Landed Weight and Value from ICES rectangle 35E5: 2013-2017 (Source: MMO)

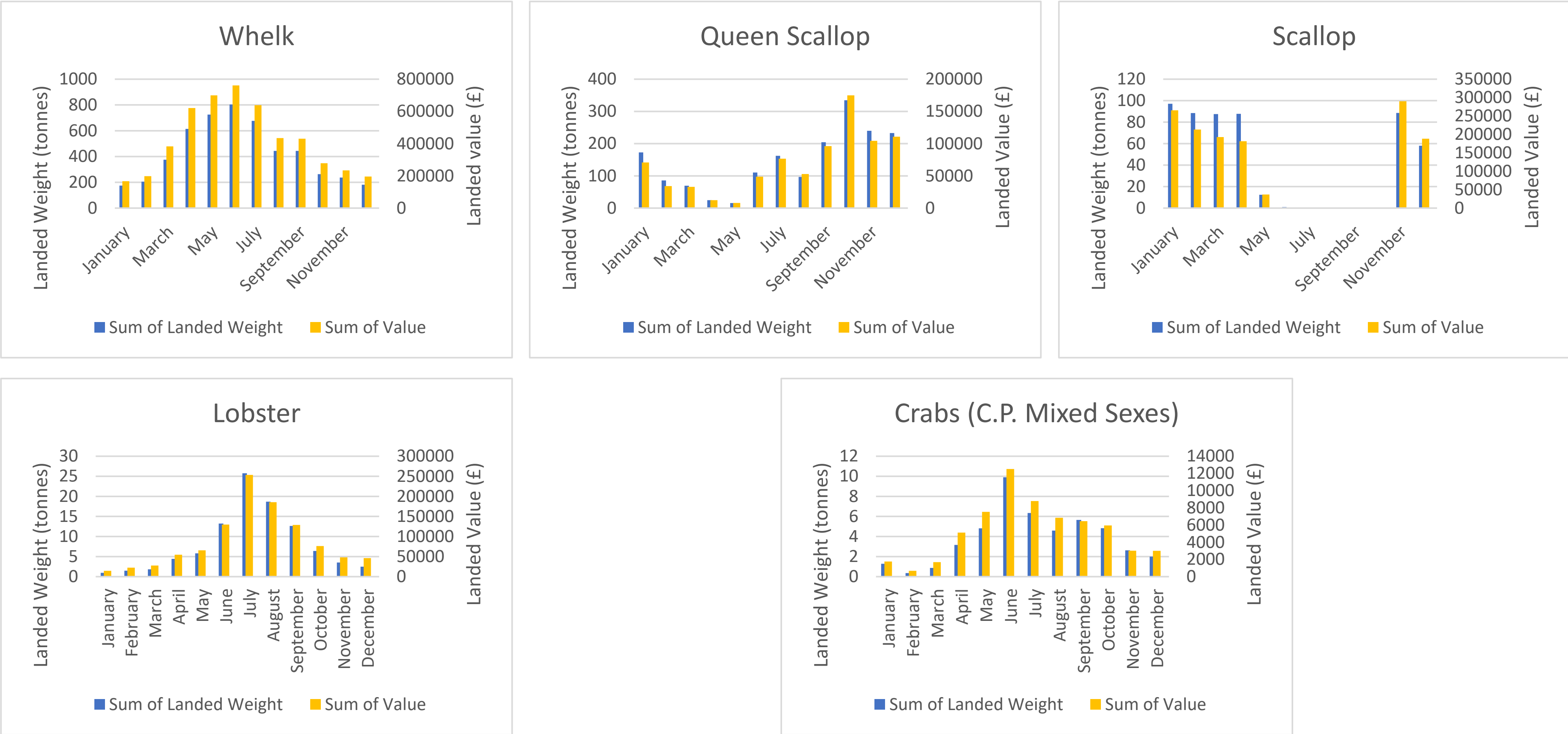

Plate 14-6 Seasonality in the Top 5 Species (35E5) by Landed Weight and Value: 2013-2017 (Source: MMO)

14.5.3. Local Ports

14.5.3.1. Ports by Relative Effort

75. The closest main fishing port to the MDZ is Holyhead port which is one of the most important traditional commercial fisheries hubs in Wales, one of a network of such ports around the north-west Wales coastline. Other fishing ports in this region include Amlwch, Morfa Nefyn, Beaumaris, Pwllheli, Caernarvon and Conway. **Table 14-10** lists the number of registered vessels at the main regional ports, based on the latest MMO vessel list (March, 2019).

Table 14-10 Registered Vessels by Ports (source, MMO, 2019)

Port	≤10 m vessels	>10 m vessels
Holyhead	18	1
Conway	14	1
Cemaes Bay	4	0
Caernarvon	6	0
Beaumaris	1	0
Amlwch	4	1
Bangor	4	0
Morfa Nefyn	8	0
Pwllheli	14	2

76. Fishing effort (kilowatt/days) for selected regional ports for the period 2013-2017 is displayed in **Figure 14-3** (**Volume II**). The port of Holyhead has a consistently high level of fishing effort (>40,000 kilowatt/days) in all years; Amlwch had the same high level of fishing effort in 2014-2016. Such a high level of fishing effort was reported for Morfa Nefyn in 2013, however this decreased to a medium level (19,000-40,000 kilowatt/days) in 2014-2016, akin to the levels reported for Conway and Penrhyn in most years. Other minor ports as displayed in **Figure 14-3** (**Volume II**) include Pwlhelli, Aberdaran, and Caenarvon, as these had moderate fishing effort (8,000-19,000 kilowatt/days) in at least one of the years.

77. A list of vessels likely to fish in or near the area was also compiled as part of the baseline assessment by the Fisheries Liaison Officer (FLO) for the Project. This identified a total of 44 vessels that may fish in or near the MDZ area (**Plate 14-7**). The most common port of origin was Holyhead, followed by Anglesey, Morfa Nefyn and Caenarvon. There was one vessel from each of Amlwch, Porth Colmon, Pwllheli and Trefor. The majority of vessels (42 of 44) were ≤10 m in length. Of the two vessels >10 m, one originated from Holyhead, and one originated from Pwllheli.

14.5.3.2. Target Species in Area by Port

78. Of the 44 vessels identified via the Project FLO in summer 2018, a total of 33 were identified as fishing for shellfish in or near the MDZ area. Only the >10 m vessel from Pwllheli was identified as fishing for scallops. This is not likely to be in the MDZ itself as the MDZ is not subject to fishing activity for scallops (see **Section 14.5.3.4**).

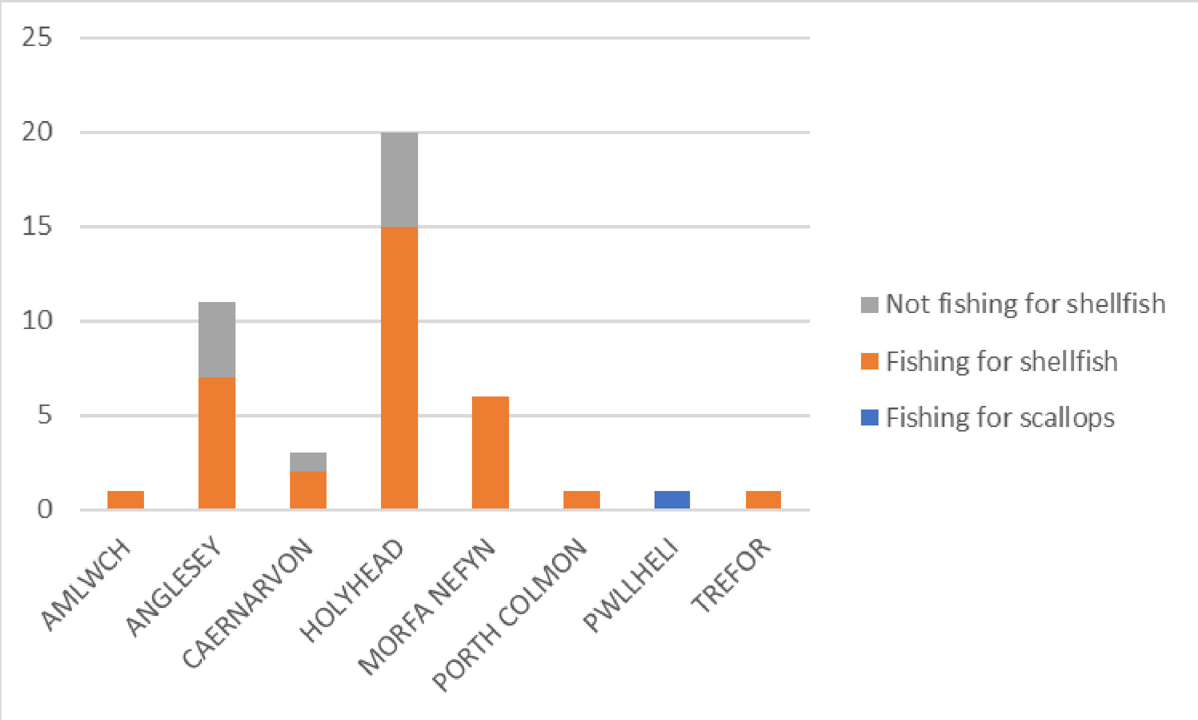

Plate 14-7 Key Fishing Activity by Local Ports

14.5.3.3. Landings from Key Ports

79. As can be inferred from **Plate 14-7**, the ports of Holyhead and Amlwch have consistently high effort (>40,000 kilowatt/days in ≥3 years for the period 2013-2017). The port of Morfa Nefyn had similarly high effort in 2013, though slightly lower in subsequent years. Nonetheless, Morfa Nefyn has been identified as an important port to consider as part of the consultation. As a result, Holyhead, Amlwch, and Morfa Nefyn have been assessed in terms of the landings into port.

80. For the port of Holyhead, the top five species landed are queen scallops, whelks, scallops, lobsters and crabs (**Plate 14-8**). The most landed species by weight and value is the queen scallop, which accounts for 8,892 tonnes with corresponding value of £4,354,767.

81. At Amlwch port the majority of landings in terms of weight and value are of whelks (**Plate 14-9**). Landings of this species between 2013-2017 totalled 2,961 tonnes with a corresponding value of £3,002,663. Other top landed species included queen scallops, scallops, lobsters, and crabs.

82. Similar to Amlwch, the landings at Morfa Nefyn are dominated by whelk, of which 1,885 tonnes with corresponding value of £1,646,768 was landed between 2013-2017 (**Plate 14-10**). Other important landed species included scallops, lobster, crabs (c.p. mixed sexes), and common prawns.

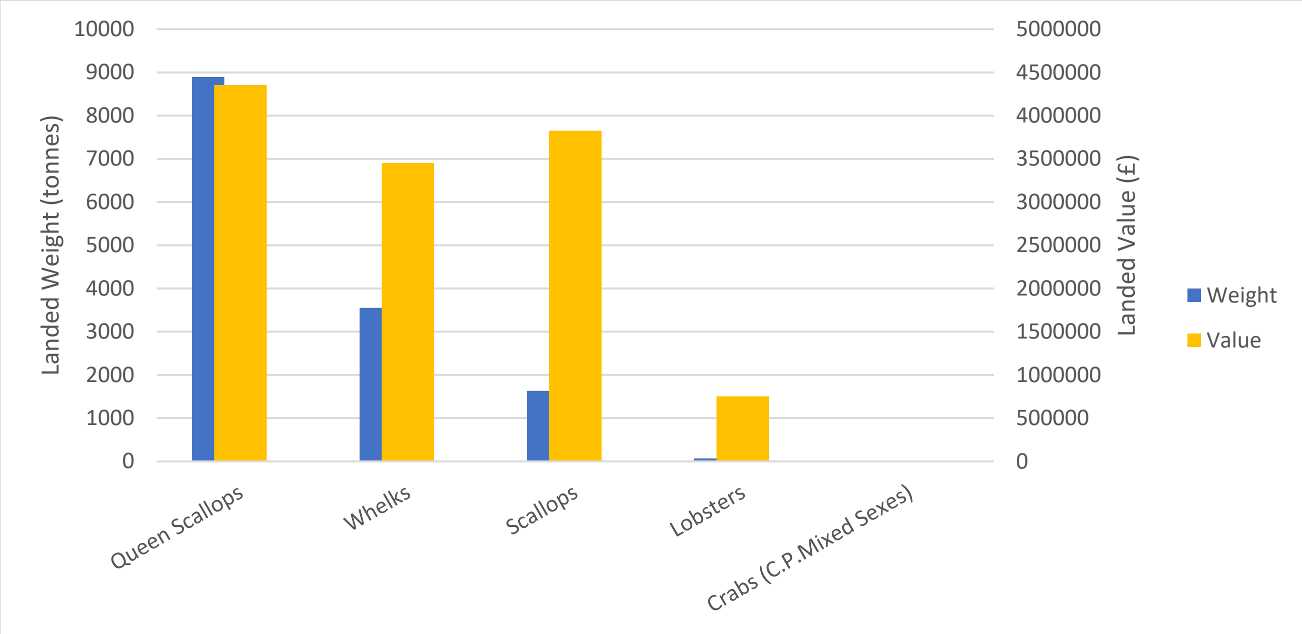

Plate 14-8 Top 5 Species in Terms of Landed Weight into Holyhead (2013-2017) (Source: MMO)

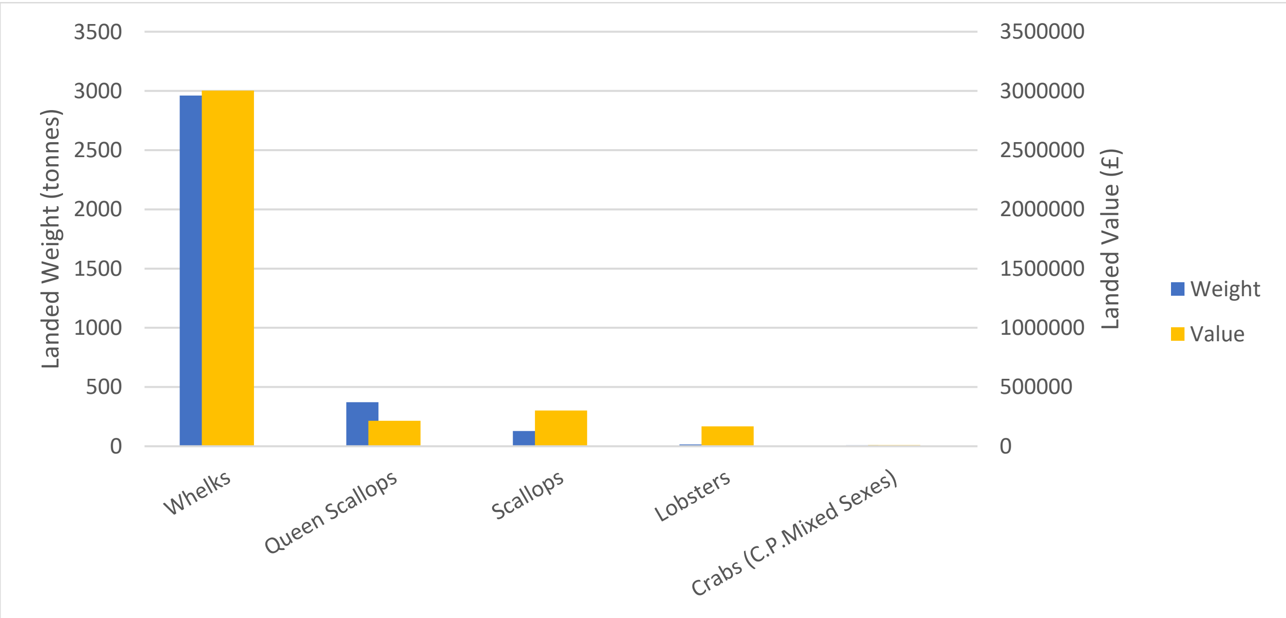

Plate 14-9 Top 5 Species in Terms of Landed Weight into Amlwch (2013-2017) (Source: MMO)

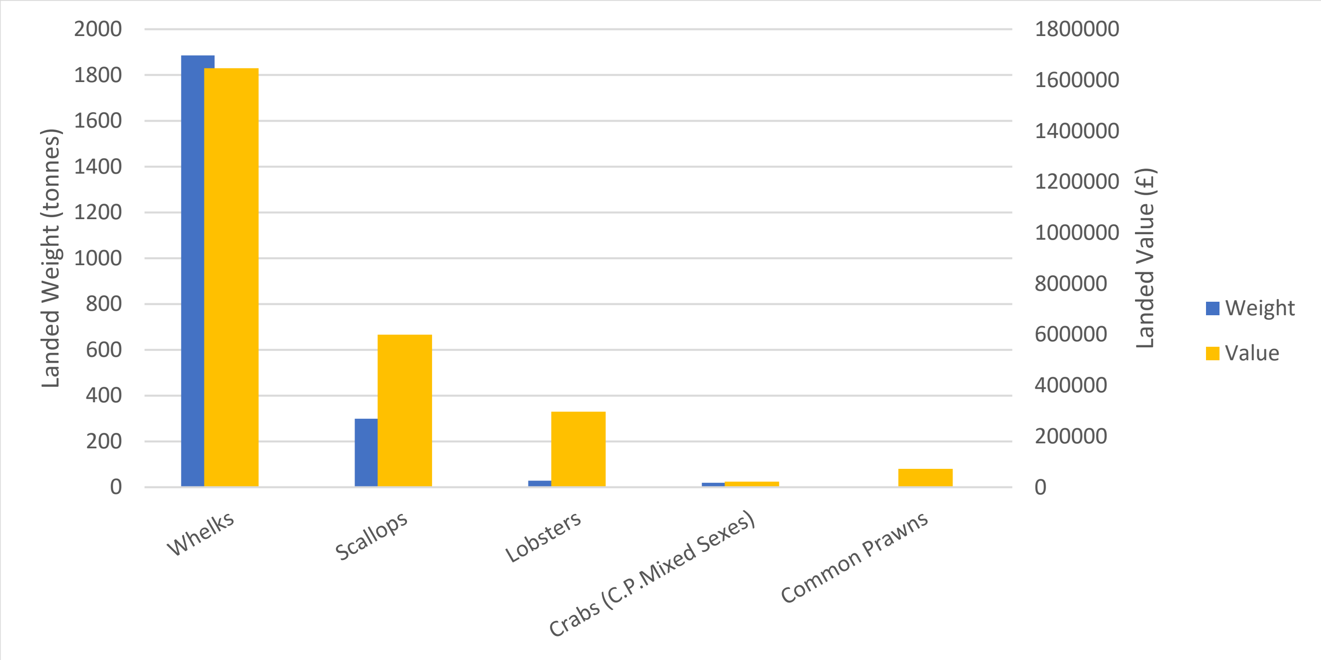

Plate 14-10 Top 5 Species in Terms of Landed Weight into Morfa Nefyn (2013-2017) (Source: MMO)

14.5.3.4. Fishing Activity in the Study Area and MDZ

83. Within the MDZ commercial fishing activity is relatively limited, primarily due to the strong tidal currents that exist in this area. In the nearshore region, defined as the eastern boundary of the MDZ up to the MHWS mark, but over-lapping with the export cable corridor (ECC), fishing activity increases, via ≤10 m static gear vessels.

84. **Figure 14-18a** and **Figure 14-18b** (**Volume II**) display information available via Lle, the Welsh Marine Planning Portal, which is itself based on information previously collated via the SeaFishMap and FishMapMon programmes. The FishMapMon project involved the collation of spatial data showing the distribution of various commercial and recreational fisheries around Anglesey by gear type. The data did not differentiate between different target species but by fishing activity type and was collated on the basis of responses from 48 commercial fishers, 543 recreational sea anglers and potters, and 26 charter boat operators.

85. This figure illustrates that mobile gear activity within the MDZ is limited to handlining, which only occurs in the small part of the MDZ that is within 1 km of the shore. No trawling occurs directly within the MDZ. The nearest trawling activity is light otter trawling which occurs in the deeper, lower tidal current areas to the west and south of the MDZ. Otter trawling only occurs in the northeast and southwest corner of the study area, more than 15 km from the MDZ. Heavy beam trawling occurs to the southwest of the MDZ, no nearer than 5 km away, but is more common widespread in other nearby ICES rectangles than 35E5 (the study area).

86. In terms of static gear activity, the MDZ lies within an area where static gear is deployed, both pots for crab/lobster and also whelks. The crab/lobster potting area almost completely overlaps the MDZ, with whelk pots deployed further offshore within parts of the MDZ that have muddy/fine sand sediments. Potting for whelks occurs throughout most of the study area, indicating a large

amount of suitable habitat. To the southeast of the MDZ and in common with other coastal areas around Anglesey, set nets are also deployed.

87. As the majority of the fishing fleet around Anglesey is focussed on scallop fishing and potting, the average size of the vessels is relatively small (<15 m). There are also several large vessels (>15 m) that operate in the area (a total of 6 in 2015) (MarineSpace, 2015). Although a significant fishery for some local vessels, fishing for king scallops is mostly focussed to the south in Caernarfon Bay and to the northeast of Anglesey; it does not occur in the MDZ. Fishing for queen scallops occurs in similar areas though over a smaller spatial extent and at lower intensity levels. It also does not occur in the MDZ. There are also small patches of mussel seed dredging at either end of the Menai Strait, in addition to Holyhead port. Light otter trawling of the lowest intensity level occurs in a similar area to scallop fishing, with areas of higher intensity levels along the coast where Anglesey meets north Wales.

88. The greatest extent of bottom set nets occurs offshore to the northeast of Anglesey and is typically of low intensity, though there are localised areas of higher intensity levels including one adjacent to the south coast of Holy Island, albeit not in the MDZ.

89. Angling of all types (charter boat, private boat and shore angling) occur throughout the coastal waters of Anglesey, including in the MDZ, though in limited numbers due to the tidal conditions.

90. Hand gathering by professionals occurs in the intertidal waters around Anglesey, though casual collection is restricted to the Menai Strait. It is not thought to occur on the coast adjacent to the MDZ.

14.5.3.5. Local Fishing Patterns and Species

91. Within the MDZ, catch in the nearshore (up to 10 m contour) comprises mostly velvet crab, green shore crab and lobster. Whelks are typically caught on a neap tide using baited pots on long lines. Beam trawlers are used to catch scallops during slack water. There is also fishing for skates in the deeper waters, using fixed netting or Danish ring netting methods.

92. It is reported by local fishermen that there are significant runs of pelagic fish in the study area, however, these are not targeted as no quota is available for them.

14.5.4. Fishing Vessel Traffic

93. In addition to data collated and assessed via MMO sources and local consultation, additional information on marine traffic (including fishing vessel activity) in the area around the MDZ was collected via three marine traffic surveys undertaken as part of the NRA process in Aug/Sep 2017; Mar/Apr 2017; and Apr 2019. The fishing vessel tracks as determined during the surveys are displayed in **Figure 14-9** (**Volume II**).

94. These surveys were undertaken to inform the Navigational Risk Assessment (NRA) for the Project, which forms part of **Chapter 15, Shipping and Navigation**.

95. Much of the official fisheries data from MMO sources and the first two Project-specific marine traffic surveys were presented to the WFA in a meeting in November 2018, and also during targeted stakeholder consultation undertaken to inform the NRA process. Whilst the WFA

accepted that commercial fishing activity was low within the main MDZ compared to other areas off the Welsh coast (primarily due to strong tidal conditions), they also commented that the marine traffic data showed a lower level of inshore vessel activity (potting) than they would have expected, as numerous vessels have been observed by fishermen to target this area (WFA, *pers. comm*, 2018). In particular, WFA highlighted during the consultation that the nearshore region of Abraham's Bosum where the nine export cables will make landfall is an area subject to a high intensity of potting by several vessels (WFA, *pers. comm*, 2018).

14.5.5. Summary of Existing Environment

96. Based on review of official MMO landings and activity data, combined with feedback from local consultation, review of registered vessel lists (March 2019) and data from Project-specific marine traffic (radar/visual) surveys, there is a low level of commercial fishing activity within the MDZ/ECC compared to other areas off the Welsh coast.

97. Trawling is concentrated offshore, north, south and west of the MDZ, as is scallop dredging. There appears to be targeted whelk fishery (static gear) within the MDZ but this is limited in scale compared to other fisheries for this species elsewhere off the Welsh coast. It should be noted that there appears to be limited appropriate habitat for whelks in the MDZ (see **Chapter 9, Benthic and Intertidal Ecology**), therefore this may be an artefact of the scale of data collection.

98. Within the study area (ICES rectangle 35E5), the key commercial species, based on weight and value of landings are whelk, scallops, crab and lobster. These same species are also the main ones landed at the three most important local ports, namely Holyhead, Amlwch and Morfa Nefyn.

99. The nearshore region supports a relatively high intensity of <10 m vessels deploying static gear for crab/lobster, and there is specific activity within the landfall/nearshore region (Abraham's Bosum).

14.6. IMPACT ASSESSMENT

14.7. OVERVIEW OF POTENTIAL IMPACTS

14.7.1. Overview

100. The following assessment provides a summary of all impacts identified during scoping study and those which have been noted as the EIA has progressed. Each impact is not necessarily relevant to all stages of the Project, and thus impacts have been assessed within the stage of the Project at which they will occur (construction, operation (including repowering) and decommissioning). Further, these impacts are comprised of both direct and indirect impacts.

101. Impacts are classified as follows:

- Direct impacts: these may arise from impacts associated with the construction, operation and maintenance, repowering or decommissioning of the Project;
- Indirect impacts: these may be experienced by a receptor that is removed (e.g. in space or time) from the direct impact (e.g. noise impacts upon fish which are a prey resource for fish or mammals); and

- Inter-relationships between impacts; or Cumulative impacts: these may occur as a result of the Project in conjunction with other existing or planned projects within the study area for each receptor.

14.7.2. Embedded Mitigation

102. The following assessment provides a summary of all impacts identified during scoping study and those which have been noted as the EIA has progressed. These impacts are not relevant to all stages of the Project, and thus impacts have been assessed within the stage of the Project at which they will occur (construction, operation and decommissioning). Further, these impacts are comprised of both direct and indirect impacts.

103. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the Project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process (see **Chapter 4, Project Description** for further details). A range of different information sources has been considered as part of embedding mitigation into the design of the Project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

14.7.3. Worst Case Parameters

104. The worst-case parameters assumed for each individual potential impact on commercial fisheries are detailed below in **Table 14-11**. Further information on the methodology used during each phase is provided in **Chapter 4, Project Description.**

Table 14-11 Commercial Fishing Impacts: Worst-Case Scenarios

Impact	Project Phase	Worst-Case Scenario Assumptions
Loss of access to fishing grounds due to construction activity	Construction / Decommissioning	Assumes full build out of 240 MW over a 10 year period. ▪ Device installation = total of 4,306 vessel days. In practice will be done by up to 3 separate vessels working in parallel. ▪ Hub installation = total of 1,800 vessel days (will be built in parallel with arrays – see below). ▪ Export cable installation = up to 180 days (9 x blocks of 20 days, with each block continuous, but the 9 blocks spread across a nominal 5 year out to 240 MW). ▪ Export cable protection installation = up to 108 days (9 x blocks of 12 days, to begin up to 1 month after commencement of export cable laying (above). ▪ Cable tail installation = up to 20 days for all 9 cable tails
Collision risk between commercial fishing vessels and construction vessels	Construction / Decommissioning	

Impact	Project Phase	Worst-Case Scenario Assumptions
		▪ Inter-array cable installation = up to 1,110 days (assumes no more than 2 arrays built in parallel at any time). During any construction phase, 500 m safety zones will be applied for around all construction vessels in order to enable safe working. This will include a rolling 500 m zone around any cable installation vessels.
Obstruction to regular fishing vessel transit routes	Construction / Decommissioning	Passage through the MDZ to regional fishing grounds will be affected during the construction phase due to the presence of installation vessel. During any construction phase, 500 m safety zones will be applied for around all construction vessels in order to enable safe working.
Interference with static fishing gear due to additional vessel traffic	Construction / Decommissioning	There will be daily installation vessel traffic between the selected installation port (likely to be Holyhead) and the MDZ. The increased passage of vessels in the area around the MDZ will increase the risk of damage to static gear along the routes that installation vessels may take from port to site.
Supply chain opportunities for local fishing vessels	Construction / Decommissioning	There may be the opportunity for commercial fishing vessels to provide marine operation support during the construction phase of the Project. Based on the Menter Môn Fisheries Supply Chain Study (MarineSpace, 2015), the main areas of opportunity in construction and maintenance support, in addition to the estimated maximum number of vessel days for each support type, are as follows: ▪ Support for mooring installation vessels during the maximum of 7,189 days for installation ▪ Debris recovery: 2 instances during construction, assume 1 day each: 2 days ▪ Navigational marker buoy deployment, servicing and recovery – maximum total of 60 marker buoys, assumed total 4 days for deployment (240 days total), 4 days per year for maintenance during life cycle of Project (37 years) (8,880 days total) – 9,120 days ▪ Guard vessels/safety standby – 2 guard vessels required on standby during installation (up to 10 year build out) (total of 7,300 days); 1 guard vessel per maintenance activity, which is assumed to last 2 days per month through life cycle (37 years) (888 days total); 8,188 days ▪ Crew transfers (divers, engineers etc.) and transport of small maintenance parts – one vessel required in call-off capacity during construction (3,650 days); one vessel required per one

Impact	Project Phase	Worst-Case Scenario Assumptions
		maintenance activity which will be required per month, each lasting 2 days: 8,188 days ▪ Dive/diver equipment support – 10 days per Project (of which there are 80, totalling 800 days) during construction; 2 days per month during operation; 8,188 days ▪ Site visits – 5 half-day trips per year during Project (37 years): 92.5 days
Collision risk between commercial fishing vessels and project infrastructure	Operation	For full 240 MW, may be up to: ▪ 620 small devices within the MDZ ▪ Up to 120 seabed mounted hubs or up to 93 floating hubs ▪ Up to 60 navigation marker buoys ▪ Up to 5 environmental monitoring platforms ▪ Up to 9 export cables ▪ Up to 740 array cables
Loss of access to fishing grounds and displacement of fishing effort to adjacent grounds	Operation	For full 240 MW, may be up to: ▪ 620 small devices within the MDZ ▪ Up to 120 seabed mounted hubs or up to 93 floating hubs ▪ Up to 60 navigation marker buoys ▪ Up to 5 environmental monitoring platforms ▪ Up to 9 export cables ▪ Up to 740 array cables Assumed for worst-case that all fishing activity excluded from entire 35.0 km^2 of the MDZ array area over lifetime of the Project. Assumed that nearshore static gear vessels could still operate in cable corridor in operational phase.
Reduction in abundance of target species and reduced supply of catch to established local buyers	Operation	For full 240 MW, may be up to: ▪ 620 small devices within the MDZ ▪ Up to 120 seabed mounted hubs or up to 93 floating hubs ▪ Up to 60 navigation marker buoys ▪ Up to 5 environmental monitoring platforms ▪ Up to 9 export cables ▪ Up to 740 array cables Presence of these devices have potential to affect local fish stocks/target species. These have been assessed in **Chapter 10, Fish and Shellfish Ecology** as having a worst-case scenario of a minor adverse impact on any fish/shellfish receptor group. Worst case for each receptor group: ▪ Crab/lobster (nearshore) – no pathway for negative effect on target species

Impact	Project Phase	Worst-Case Scenario Assumptions
		▪ Whelk/Crab/Lobster (MDZ) – complete loss of target fishery in MDZ ▪ Whitefish and/or Scallops – complete loss of target fishery in the Project area
Presence of seabed fasteners	Operation	Up to 204.5 km of array and 40.5 km of export cable will be deployed for the full 240 MW capacity with the majority surface-laid on seabed. Also associated mooring chains and anchor blocks, device foundations, and seabed monitoring equipment, Will be distributed across the MDZ and all have potential to create fasteners to commercial fishing gear.
Supply chain opportunities for local fishing vessels	Operation	As per above parameters for supply chain opportunities during Construction/Decommissioning.
Impacts via repowering	Operation	As repowering will take place within the operational phase of the project, during which it has been assumed all fishing activity will be excluded from the MDZ for safety reasons, there will be no additional impact on commercial vessels over and above those already assessed within existing operational impacts.

14.7.4. Potential Impacts during Construction

14.7.4.1. Construction Impact 1: Loss of Access to Fishing Grounds due to Construction Activity

105. For the worst-case assumptions detailed in **Table 14-11**, it is assumed that the full 240 MW will be built out over a series of phases.

106. Due to the phased approach, fishing activity will not be excluded from the entire MDZ area (35 km^2) and export cable corridor during construction; instead there is expected to be a progressive increase in the area of seabed made inaccessible to fishing activity as construction progresses, until the maximum capacity is installed. However, as some construction activities may be conducted in parallel across the offshore site (combined MDZ and ECC), a conservative worst-case scenario is applied for this impact assessment, whereby fishing activity is assumes as excluded from the entire site (35 km^2) for the duration of the construction period.

107. During construction it will be necessary to implement a safety zone of up to a 500 m radius on a rolling basis around areas wherever installation activities are taking place at any given time. This is in line with industry standard guidance notes[3]. Safety zones minimise the risk of collision between installation vessels in the area and ensure the safety of all personnel involved in

[3] DECC, 2011: Applying for Safety Zones around Offshore Renewable Energy Installations.

construction works. All vessels, including fishing vessels, will be temporarily excluded from such safety zones.

108. Similar 500 m exclusion zones will be implemented around cable installation vessels for the duration of cable installation works.

109. As detailed in the existing environment section of this chapter (**Section 14.5**), commercial fishing activity in the main MDZ array area is low compared to other areas off the Welsh coast. The three main receptors defined in this assessment all have differing sensitivity, based on the criteria set out in **Table 14-5**.

14.7.4.1.1. ≤10 m Nearshore Static Gear Vessels Targeting Crab/Lobster in the Nearshore Region

110. The sensitivity of this commercial fisheries receptor group, comprising ≤10 m vessels that deploy static gear in the nearshore (0-1 km) region in and around Abraham's Bosom, is judged to be Medium as although these vessels have some spatial adaptability, this is relatively limited, as is their ability to deploy alternative gear types and to fish different grounds.

111. The main element of construction activity that will affect this receptor is the installation of the up to 9 export cable and cable tails/HDD works in the nearshore region. These works will be staggered over the construction period, with the duration of each export cable installation predicted to be approximately 20 days with a further 20 days to install the 9 cable tails. After each export cable installation, it is assumed that there would then be a gap of several months (possibly years) before more export cable installation is undertaken. Of this 20 days of works per export cable only approximately 5 days (25 %) of works will be focused in the nearshore region in/around Abrahams Bosum. The remainder of works will be within the MDZ. The 20 days of cable tail works will take place in the immediate nearshore region, i.e. within 1km of the landfall area, where the main scope for disturbance to his ≤10 m static gear vessel receptor group exists.

112. Therefore, the magnitude of this effect is Low in the nearshore region that this receptor group utilises, due to the relatively short-term nature of works and the fact that the area affected would only represent an area where a minor proportion of catches from these vessels was obtained (assumed that these <10 m vessels deploy static gear along the entire nearshore region off NW Anglesey, not just in this single, small embayment.

113. An assessment of a **minor adverse** impact significance on <10 m vessels deploying static gear in the nearshore region is made.

14.7.4.1.2. ≤10 m and >10 m Static Gear Vessels Targeting Whelk/Crab/Lobster in the MDZ

114. Within the MDZ, a small number of vessels deploy static gear, with a focus on whelk as the main target species, with crab and lobster also be targeted in some areas. The sensitivity of this receptor group of vessels is judged to be Low as they have a high spatial adaptability and ability to fish numerous other fishing grounds in the wider area.

115. Vessels will be affected by potential construction activity within the MDZ, including export and array cable installation and device deployments. The worst-case scenario for installation of 240 MW of devices, associated infrastructure (hubs) and also array cables and export cables

within the boundary of the MDZ has been estimated as 10 years (see **Table 14-11**). However, it is important to recognise that continuous construction and installation activity over 10 years is unlikely to occur in reality. Instead, there would be periods of relatively intense construction activity during which fishing activity would be disrupted, interspersed with periods of low activity.

116. Noting the intermittent nature of such construction activity, and the fact that the MDZ array area represents an area where only a minor proportion of annual landings from this receptor group of vessels is taken, the magnitude of effect is defined as Low.

117. This results in a **minor adverse** impact significance on ≤10 m and >10 m vessels targeting whelk (and crab/lobster) further offshore in the MDZ from loss of access to fishing grounds during construction.

14.7.4.1.3. >10 m Mobile Gear Vessels Targeting Whitefish and/or Scallops in the MDZ and Surrounding Area

118. The third commercial fishing receptor identified via the baseline review are >10 m mobile gear vessels targeting whitefish and/or scallops. Based on data collated as part of this assessment, including area-specific information from FishMapMon and Lle, fishing activity by these larger mobile gear vessels occurs at a low intensity in and around the MDZ compared to other areas off the North Wales coast.

119. The sensitivity of these vessels is judged to be Low as they exhibit high spatial adaptability (due to extensive operational range) and also are able to operate in a range of alternative areas across the region.

120. As the MDZ and cable corridor area does not appear to be a particularly important fishing ground for this receptor type and is assessed as only contributing a small proportion of the annual value of landings for these vessels, the magnitude of effect is judged to be Negligible.

121. This results in a **negligible** impact significance on >10 m vessels targeting whitefish and/or scallops further offshore in the MDZ via loss of access to fishing grounds during construction

14.7.4.1.4. Mitigation

- Local fishermen to be notified of timing and location of planned construction works via Notice to Mariners;
- Project-specific FLO to be appointed during construction phase; and
- All construction vessels to exhibit appropriate lighting and markings at all times.

14.7.4.1.5. Residual Impact

- <10 m nearshore static gear vessels: **minor adverse impact.**
- <10 m and >10 m static gear vessels in MDZ area: **minor adverse impact.**
- >10 m mobile gear vessels in/around MDZ area: **negligible impact.**

14.7.4.2. Construction Impact 2: Collision Risk Between Commercial Fishing Vessels and Construction Vessels

122. The worst-case parameters for construction are detailed above. It is clear that due to the scale of the proposed Project, there will be periods of very high construction activity in and around the site for a period of up to 10 years. However, this level of activity will not be constant and will be in shorter, focused periods of construction, within discrete parts of the site, sometimes alone, and sometimes in parallel with other activities in other parts of the site.

123. During construction, there will be an increased risk of collision between fishing vessels and construction vessels (including main device/cable installation vessels and smaller support vessels) due to the construction activity. As this specific impact relates to navigational safety, it has been assessed formally via the Navigation Risk Assessment (NRA) process, with key conclusions presented in **Chapter 12, Shipping and Navigation.**

124. In summary however, this assessment concluded that whilst risk of collision between fishing vessels and construction traffic did exist, this could be reduced to a Low risk level by careful planning of traffic routeing and promulgation of this information to local vessels.

14.7.4.3. Construction Impact 3: Obstruction to Regular Fishing Vessel Transit Routes

125. During construction, in addition to specific potential collision risk impacts (as above), potential also exists for the presence of construction and support vessels to create obstructions to fishing vessels wishing to transit this area to reach other fishing grounds and/or to return to local ports to land catch.

126. During construction there will be a 500 m safety zone around all major installation vessels, and also a rolling 500 m exclusion zone around any cable installation vessels. Where infrastructure has been deployed but not fully installed or commissioned, i.e. surface laid cables, guard vessels and/or safety marker buoys will be used to mark affected areas. All this will result in fishing vessels that currently pass through either the MDZ array or the ECC to reach fishing grounds and/or return to local ports such as Holyhead potentially having to take alternative routes to avoid any exclusion zones.

127. This has the potential to create impacts on fishing vessels via increased steaming time with subsequent increased fuel usage (cost) and also requiring some (smaller) vessels to adopt routes that may push them closer inshore to avoid the MDZ (increased risk due to proximity of coast) or further offshore (increased risk due to further distance offshore, with related larger sea conditions that may be unsuitable for smaller vessels).

14.7.4.3.1. ≤10 m Nearshore Static Gear Vessels Targeting Crab/Lobster in the Nearshore Region

128. The sensitivity of this commercial fisheries receptor group, which is focused on the <10 m vessels that deploy static gear in the nearshore region in and around Abraham's Bosom, is judged to be Medium because although they have some spatial adaptability, this is relatively limited, as is their ability to deploy alternative gear types and fish different grounds.

129. The main element of construction activity that will affect this receptor is the installation of the up to 9 export cable and cable tails/HDD works in the nearshore (0-1 km) region. These works will be staggered during construction, with the duration of each export cable installation predicted to be approximately 20 days with a further 20 days to install all of the 9 cable tails. After each export cable installation, it is assumed there will be a gap of several months (possibly years) before more export cable installation is undertaken. Of the 20 days of works per export cable, only an estimated 5 days (25 %) of works will be focused in the nearshore region in and around Abrahams Bosom (remainder of works will be within the MDZ and any parts of the ECC >1 km offshore. All 20 days of cable tail works will take place in the nearshore region, where the main scope for disturbance to the <10 m static gear vessel receptor group exists.

130. The magnitude of impact is Low in the nearshore region that this receptor group utilises, due to the fact that for the majority of time, even during peak construction periods, these vessels will be able to use existing inshore transit routes to and from port.

131. This results in a **minor adverse** impact significance on this receptor group.

14.7.4.3.2. ≤10 m and >10 m Static Gear Vessels Targeting Whelk/Crab/Lobster in the MDZ

132. Within the MDZ, a small number of vessels deploy static gear, with a focus on whelk as the target species, although crab and lobster will also be targeted in certain areas. The sensitivity of this receptor group is judged to be Low as they have a high spatial adaptability and ability to fish numerous other fishing grounds in the area (WFA, *pers. comm*, 2018).

133. These vessels will be affected by potential construction activity within the MDZ, including export and array cable installation and device deployments. The worst-case scenario for installation of 240 MW of devices, associated infrastructure (hubs), plus array and export cables within the boundary of the MDZ has been estimated as up to 10 years. However, it is important to recognise that construction and installation activity will not be constant for this length of time. Instead, there would be periods of relatively intense construction activity during which fishing activity would be disrupted, interspersed with periods of less, or no activity.

134. Many vessels will work within a number of fishing grounds in the study area and whilst there may be some disruption to steaming routes/times if they had to avoid areas of construction activity, the magnitude of this effect is judged to be Low as such disruption will be short-term.

135. This results in a **minor adverse** impact significance on ≤10 m and >10 m vessels targeting whelk (and crab/lobster) further offshore in the MDZ from obstruction to regular fishing transit routes.

14.7.4.3.3. >10 m Mobile Gear Vessels Targeting Whitefish and/or Scallops in the MDZ and Surrounding Area

136. The third commercial fishing receptor identified via the baseline review are >10 m mobile gear vessels targeting whitefish and/or scallops. Based on data collated as part of this assessment, including area-specific information from FishMapMon and Lle, fishing activity by these larger mobile gear vessels occurs at a low intensity in and around the MDZ compared to other areas off the North Wales coast. The sensitivity of these vessels is judged to be Low as they exhibit

high spatial adaptability (due to extensive operational range) and also are able to operate in a range of alternative areas across the region.

137. As the MDZ and cable corridor area does not appear to be a particularly important fishing ground for this receptor type and is assessed as only contributing a small proportion of the annual value of landings for these vessels, the magnitude of effect is judged to be Negligible. This negligible effect magnitude also recognises that these larger vessels will have greater capacity and ability to alter transit routes around the MDZ as/when construction activity is underway.

138. A **negligible** impact on >10 m vessels targeting whitefish and/or scallops in the MDZ and surrounding area is assessed.

14.7.4.3.4. Mitigation

- Local fishermen to be notified of all location and timing of planned construction works via Notice to Mariners;
- Project-specific FLO to be appointed during construction phase;
- If required following consultation with the local fishing industry, agreed transit routes around/through the MDZ to potentially be developed during the construction phase. This approach has been successfully adopted on OWF projects around the UK coast; and
- All construction vessels to exhibit appropriate lighting and markings at all times.

14.7.4.3.5. Residual Impact

- ≤10 m nearshore static gear vessels: **minor adverse impact.**
- ≤10 m and >10 m static gear vessels in MDZ area: **minor adverse impact.**
- >10 m mobile gear vessels in/around MDZ area: **negligible impact.**

14.7.4.4. Construction Impact 4: Interference with Static Fishing Gear due to Additional Vessel Traffic

139. During the construction phase, there will be a much greater amount of vessel traffic in and around the MDZ. This includes transit of construction vessels between the site and the local port designated as the construction base. This increased level of traffic will include small, fast support vessels as well as larger construction/cable installation vessels.

140. Due to proximity of the MDZ to the coast, the area around the MDZ and any transit routes to/from local ports is likely to have a large amount of static gear deployed by vessels. This is a reflection of the main nearshore fishery in this region, namely potting for crab and lobster. The combination of increased (non-fishing) vessel traffic and large amounts of static gear has the potential to create impacts via damage and/or loss of gear, with the subsequent financial impacts on local fishermen.

14.7.4.4.1. ≤10 m Nearshore Static Gear Vessels Targeting Crab/Lobster in the Nearshore Region

141. This receptor group is the one most susceptible to the impact of damage or loss of gear due to additional vessel traffic as they will be the primary source of the static gear in the area. The sensitivity of this receptor group is assessed as Medium because they have some spatial adaptability, although this is relatively limited, as is their ability to deploy alternative gear types and fish different grounds.

142. Assuming that construction vessels may transit to and from the site on an almost daily basis during the construction phase, passing through areas where large amounts of static gear are expected and in an area from which a moderate proportion of this receptor group's annual value of landings is caught, the magnitude of this impact is assessed as Medium. The impact would be long-term though reversible and is likely to occur.

143. This results in an assessment of **moderate adverse** impact significance on this receptor group.

14.7.4.4.2. ≤10 m and >10 m Static Gear Vessels Targeting Whelk/Crab/Lobster in the MDZ

144. Within the MDZ and surrounding area, a small number of vessels also deploy static gear, with a focus on whelk as the target species, even though crab and lobster will also be targeted in certain areas. The sensitivity of this receptor group is assessed as Low as they have a high spatial adaptability and ability to fish numerous fishing grounds.

145. As described for the ≤10 m nearshore receptor, the magnitude of this impact is assessed as Medium due to the high potential level of construction vessel activity and potentially high amount of static (whelk pots) gear in the area in which vessel transits may occur.

146. This results in a **minor adverse** impact on this receptor via potential loss/disruption of static gear by construction vessels.

14.7.4.4.3. >10 m Mobile Gear Vessels Targeting Whitefish and/or Scallops in the MDZ and Surrounding Area

147. The third commercial fishing receptor identified via the baseline review are >10 m mobile gear vessels targeting whitefish and/or scallops. Based on data collated as part of this assessment, including area-specific information from FishMapMon and Lle, fishing activity by these larger mobile gear vessels occurs at a low intensity in and around the MDZ compared to other areas off the North Wales coast. The sensitivity of vessels in this receptor group to this potential impact is assessed as Negligible as it relates to potential loss/damage to static gear.

148. The magnitude of impact is assessed as negligible due to relating to static gear.

149. This results in a **negligible** impact on this receptor via potential loss/disruption of static gear by construction vessels.

14.7.4.4.4. Mitigation

- Local fishermen to be notified of location and timing of planned construction works via Notice to Mariners;

- Project-specific FLO to be appointed during construction phase; and
- Key areas of static gear deployment to be provided by local fishermen and used to develop agreed transit routes around/through the MDZ that aim to minimise damage to static gear.

14.7.4.4.4.1. Residual Impact

- ≤10 m nearshore static gear vessels: **minor adverse** impact.
- ≤10 m and >10 m static gear vessels in MDZ area: **negligible** impact.
- >10 m mobile gear vessels in/around MDZ area: **negligible** impact.

14.7.4.5. Construction Impact 5: Supply Chain Opportunities for Local Fishing Vessels

150. During the construction phase of the Project, commercial opportunities other than core fishing activities may arise for suitable local commercial fishing vessels. The scope for commercial fishing vessels to potentially provide support to this Project was assessed in detail in a study commissioned by Menter Môn in 2015 and delivered by MarineSpace and Aquatera (MarineSpace, 2015) (**Appendix 14.1**).

151. This study considered the following:

- Tidal energy industry requirements (for marine services);
- Vessels / skills / equipment needed to enable requirements;
- Local supply chain (this involved engagement with Anglesey fisheries community to assess type and suitability of available vessels and skills and review the potential and appetite for diversification;
- A summary of options for collaboration between tidal sector and commercial fishing industry; and
- Recommendations and proposed Key Actions.

152. With respect to the construction phase of potential tidal projects (in this case the Morlais Project), the study identified the following areas of potential support that could be provided by local commercial fishing vessels:

- Support for mooring installation vessels – floating tidal devices require moorings and whilst it would likely require larger stable vessels for the main installation process, additional support would likely be required during the O&M phase, i.e. checking and/or re-positioning of surface marker buoys;
- Debris recovery – there will inevitably be debris or lost objects that needs to be recovered from incidents during the operational phase. Depending on the size of the debris this could potentially be recovered by fishing vessels using grapples and/or nets;
- Navigational marker buoy deployment, servicing and recovery – marker buoys are a (MCA) requirement during the operational phase and these will need regular checking and potential servicing back onshore;

- Guard vessels / safety standby – guard vessels may be a MCA requirement during certain stages of the construction phase. Many fishing vessels will be able to perform this task;
- Fisheries Liaison Officer (FLO) services – with the fishing industry being one of the most important stakeholders to offshore projects, FLO's are usually employed to act as the main point of communication between the Project and local fishing communities. A FLO will be required throughout the lifetime of a project;
- Crew transfers (divers, engineers etc.) and transport of small components/parts needed in the construction phase. Personnel will be required to be transported to the site during the construction phase, and often small maintenance parts will need to be shipped out;
- Diver/diver equipment support – divers may be required during construction activities. Vessels would be required to transport them to site and to support equipment; and
- Site visits for project developers, stakeholders and PR – The Project is a high-profile project and it is expected that there will be a significant amount of interest from stakeholders, hence it is expected that vessels would be needed to provide site visits during the construction phase.

153. The study found that the value of potential contracts associated with vessel use in the MDZ could be as much as £3.5m over the next 10 years if the Project develops as envisaged (MarineSpace, 2015). This includes up to £1.4m during the construction phase.

154. This requirement for vessels during all stages of the planned projects around Anglesey presents a significant opportunity for local vessel owners and operators. Established marine service providers and charter vessel operators from elsewhere in the UK, as well as on Anglesey e.g. Holyhead Towing, will also be interested in these opportunities. This could also represent further opportunities for personnel with offshore experience to act as crew and vessel support, where specific experience of the conditions around Anglesey will be particularly valuable.

155. Menter Môn have a remit to maximise the economic benefit to Anglesey hence are keen to work with the local commercial fishing sector to take advantage of these opportunities where possible.

14.7.4.5.1. ≤10 m Nearshore Static Gear Vessels Targeting Crab/Lobster in the Nearshore Region

156. The sensitivity of this receptor group is assessed as Medium as although they have some spatial adaptability, this is relatively limited, as is their ability to deploy alternative gear types and fish different grounds.

157. The magnitude of impact (beneficial) is judged to be Low. Due to the type and size of vessels within this receptor group, opportunities for formal project-related marine operational support during the construction phase may be more limited than for larger vessels. This is mainly due to the equipment/deck-space available on smaller vessels and the need to ensure compliance with at least the following requirements:

- Compliance with MGN 280 (Code of Practice for Small Vessels in Commercial Use for Sport, Pleasure, Workboats and Pilot boats under 24m;

- Compliance with SCV (Small Commercial Vessel) Code;
- Holds a valid SCV certificate for Area Categories 2 / 3 (for operation up to 60 / 20 miles from a safe haven; and
- Appropriate Employers Liability and Third Party Liability cover under the terms and conditions of its own insurance.

158. The vessel Skipper or one or more of the crew will also need to hold the following certification, or be able to demonstrate the following competencies:

- Basic Sea Survival Course Certificate;
- Evidence of First Aid Training;
- Radio Operator's Certificate;
- Medical Fitness Certificates;
- Evidence of Radar Training;
- Approved Engine Course (if towing or lifting over 1000 tonnes); and
- RYA Professional Practices and Responsibilities (PPR).

159. Overall, although potential marine operation supply chain opportunities will arise for this receptor group, only a **minor beneficial** impact significance is assessed on this receptor group.

14.7.4.5.2. ≤10 m and >10 m Static Gear Vessels Targeting Whelk/Crab/Lobster in the MDZ

160. Further offshore, within the MDZ array and surrounding area, a small number of larger vessels also deploy static gear, with a focus on whelk as the target species, even though crab and lobster will also be targeted in certain areas. The sensitivity of this receptor group is judged to be Low as they have a high spatial adaptability and ability to fish numerous fishing grounds.

161. All the same opportunities as outlined above will apply to this receptor group, although the fact that larger (>10 m vessels) make up this receptor mean that they will be more suited/capable of undertaking some of these activities. Therefore, the magnitude of effect is judged to be Medium.

162. This results in a **minor beneficial** impact significance for this receptor group.

14.7.4.5.3. >10 m Mobile Gear Vessels Targeting Whitefish and/or Scallops in the MDZ and Surrounding Area

163. As this is a beneficial impact being assessed, the definition of receptor sensitivity requires slight amendment. For the purpose of this assessment, the sensitivity of this receptor is judged to be Medium, with the criteria defined as "moderate vessel suitability to provide marine operation support during the construction phase".

164. This judgement is based on the larger vessel size represented by this receptor group, with associated increased vessel/equipment/staff capabilities and certifications compared to smaller (<10 m) vessels).

165. The magnitude of this potential impact is assessed as Medium. For receptor sensitivity, a slightly amended criteria has been used to define magnitude of this effect: “effect will potentially provide a moderate source of revenue for a vessel and is likely to occur”. This is based on the potential for this type of larger (>10 m) vessels to support the Project (as identified in the 2015 Supply Chain Study commissioned by Menter Môn; MarineSpace, 2015)

166. Therefore, a **moderate beneficial** impact significance is predicted for this receptor group via support on marine operations during the construction phase of the Project.

14.7.4.5.4. Mitigation

167. No mitigation required. However, to increase opportunities for local fishing vessels to support the Project, the Action Plan provided as part of the 2015 study (MarineSpace, 2015) (**Appendix 14.1, Volume III**) should be reviewed and, where appropriate updated. Discussions should then be held between Menter Môn and the local fishing community to identify what needs to be done to maximise these opportunities.

14.7.4.5.5. Residual Impact

- ≤10 m nearshore static gear vessels: **minor (beneficial) impact**
- ≤10 m and >10 m static gear vessels in MDZ area: **minor (beneficial) impact**
- >10 m mobile gear vessels in/around MDZ area: **moderate (beneficial) impact**

14.7.5. Potential Impacts during Operational Phase

14.7.5.1. Operational Impact 1: Collision Risk between Commercial Fishing Vessels and Project Infrastructure

168. The worst-case parameters for the operational phase are detailed in **Table 14-11**. It is clear that due to the scale of the proposed Project, there will be a large amount of infrastructure within the site during the operational phase, including surface devices, mid-water devices, seabed mounted devices, electrical cables, mooring cables, monitoring platforms and navigation buoys.

169. In terms of the worst-case scenario for this effect, it has been assumed that all commercial fishing activity will be excluded from the main MDZ site during the operational phase to reduce risk of collision between fishing vessels and project infrastructure. As this specific impact relates to navigational safety, it has been assessed formally via the Navigation Risk Assessment (NRA) process, with key conclusions presented in **Chapter 12, Shipping and Navigation.**

170. In summary, a range of potential impacts on fishing vessels were identified within the NRA, including contact between fishing vessels and devices; contact between fishing vessels and other (construction) vessel types; snagging/obstruction; and grounding of fishing vessels.

171. The overall severity of consequences on fishing vessels during the operational phase (including repowering) were considered to be major (C4) due to the potential for loss of life and notable damage to vessel(s). The frequency of occurrence was considered remote (F5) due to the presence of embedded mitigations. This indicated an overall risk ranking of (C4 x F5) = As Low As Reasonably Possible (ALARP).

14.7.5.2. Operational Impact 2: Loss of Access to Fishing Grounds and Displacement of Fishing Effort onto Adjacent Grounds

172. Noting from the above that the worst-case scenario assumes no fishing activity will be permitted within the main MDZ (array) area in order to minimise risk of vessel/project infrastructure collision, this will have a consequent effect of (a) reducing the amount of available fishing grounds for certain vessels and (b) pushing any displaced vessels onto adjacent grounds which may result in increased competition/pressure with vessels that already fish such areas.

14.7.5.2.1. ≤10 m Nearshore Static Gear Vessels Targeting Crab/Lobster in the Nearshore Region

173. This receptor group is the least susceptible to this impact as their activity is focussed outside the MDZ, within the nearshore region (0-1km). As there will be no permanent project infrastructure on the sea surface in this area, i.e. devices/hubs which will all be located within the MDZ array, fishing could continue in this area in the operational phase. Seabed infrastructure in the form of export cables and cable protection will be installed in this region but with appropriate care, static gear, which is the main gear type used in this area, will be able to deployed.

174. The sensitivity of this receptor group is assessed as Medium as although they have some spatial adaptability, this is relatively limited, as is their ability to deploy alternative gear types and fish different grounds.

175. Assuming that, as detailed above, deploying static gear in the nearshore area between the MDZ array and the coast can continue in the operational phase, and that these vessels are not completely displaced from this area, the magnitude of this impact is assessed as Negligible. The impact would be long-term though reversible and is likely to occur.

176. This results in a **minor adverse** impact on this receptor.

14.7.5.2.2. ≤10 m and >10 m Static Gear Vessels Targeting Whelk/Crab/Lobster in the MDZ

177. Further offshore, within the MDZ array and surrounding area, a small number of vessels also deploy static gear, with a focus on whelk as the target species, even though crab and lobster will also be targeted in certain areas. The sensitivity of this receptor group is judged to be Low as they have a high spatial adaptability and ability to fish numerous fishing grounds.

178. The magnitude of this effect is judged to be Medium because vessels will be displaced from their potential fishing ground for the entire operational phase, i.e. long-term effect.

179. This results in a **minor adverse** impact significance on this receptor group due to potential loss/disruption of static gear by construction vessels.

14.7.5.2.3. >10 m Mobile Gear Vessels Targeting Whitefish and/or Scallops in the MDZ and Surrounding Area

180. The third commercial fishing receptor identified via the baseline review are >10 m mobile gear vessels targeting whitefish and/or scallops. Based on data collated as part of this assessment, including area-specific information from FishMapMon and Lle, fishing activity by these larger mobile gear vessels occurs at a low intensity in and around the MDZ compared to other areas off the North Wales coast. The sensitivity of these vessels to this potential impact is judged to be Negligible as these vessels have an extensive operational range and high method versatility and the MDZ site does not represent a key fishing ground for them (due to tidal conditions).

181. The magnitude of impact assessed as Low as only a minor proportion of these commercial fishing receptor's annual value of landings is caught in this area.

182. This results in a **negligible** impact significance on this receptor group as a result of loss of access to fishing grounds within the MDZ and displacement onto adjacent fishing grounds.

14.7.5.2.4. Mitigation

- Where local vessels are able to demonstrate a clear loss in annual income due to loss of fishing grounds within the MDZ, Menter Môn will enter into discussions on appropriate forms of financial assistance.

14.7.5.2.5. Residual Impact

- <10 m nearshore static gear vessels: **minor adverse impact.**
- <10 m and >10 m static gear vessels in MDZ area: **minor impact.**
- >10 m mobile gear vessels in/around MDZ area: **negligible impact.**

14.7.5.3. Operational Impact 3: Reduction in Abundance of Target Species and Reduced Supply of Catch to Established Local Buyers

183. The presence of the MDZ Project, with associated active tidal devices and electrical infrastructure has the potential to alter the abundance of target fish species in the area via a range of effects (noise, EMF, barrier effect etc). All impacts on fish and shellfish have been assessed in **Chapter 10, Fish and Shellfish Ecology**. The assessments presented in that chapter concluded no more than minor adverse impacts on any fish/shellfish receptor group and therefore, it is assessed that there will be no significant reduction in target species for commercial fisheries in this offshore site due to the MDZ Project.

14.7.5.3.1. ≤10 m Nearshore Static Gear Vessels Targeting Crab/Lobster in the Nearshore Region

184. The sensitivity of this receptor group is assessed as Medium as although they have some spatial adaptability, this is relatively limited, as is their ability to deploy alternative gear types and fish different grounds.

185. There is no identified pathway by which the key target species for this receptor group (crab/lobster) could reduce in abundance due to the presence of project infrastructure (cables) in this nearshore region. In fact, the presence of subsea cables and associated cable protection may create new forms of refuge habitat for these species, possibly even leading to increased abundances.

186. The magnitude of this effect is judged to be Negligible as no reduction in abundance in crab/lobster in this nearshore region is predicted over the operational phase.

187. This results in a **minor adverse** impact on this receptor.

14.7.5.3.2. ≤10 m and >10 m Static Gear Vessels Targeting Whelk/Crab/Lobster in the MDZ

188. Further offshore, within the MDZ array and surrounding area, a small number of vessels also deploy static gear, with a focus on whelk as the target species, even though crab and lobster will also be targeted in certain areas. The sensitivity of this receptor group is assessed as Low as they have a high spatial adaptability and ability to fish numerous fishing grounds.

189. As it is assumed that these vessels will not be able to fish within the MDZ, the focus of this assessment is the potential for these vessel's target species (crab/lobster/whelk) to reduce in abundance due to the Project. As detailed above, the assessment on fish and shellfish receptors presented in **Chapter 10, Fish and Shellfish Ecology** have not predicted any significant reductions in abundance of any species via the MDZ Project. There is also a possibility that the removal of fishing pressure from the MDZ area (albeit it is noted that this activity is already low in this area) will actually enable stocks of crab/lobster/whelk to expand, potentially benefiting the wider area, where fishing would still be permitted.

190. Overall, even with potential beneficial impacts on stocks due to reduced fishing pressure, the magnitude of this impact is assessed as Low due to no reduction in abundance in key commercial target species within the MDZ is predicted over the operational phase.

191. This results in a **minor adverse** impact significance for this receptor group.

14.7.5.3.3. >10 m Mobile Gear Vessels Targeting Whitefish and/or Scallops in the MDZ and Surrounding Area

192. The sensitivity of these vessels to this potential impact is assessed as Negligible as these vessels have an extensive operational range and high method versatility and the MDZ site does not represent a key fishing ground for them (due to tidal conditions).

193. The magnitude of impact is assessed as Low, as only a minor proportion of these commercial fishing receptor's annual value of landings is caught in this area.

194. This results in a **negligible** impact on this receptor.

14.7.5.3.4. Mitigation

195. None proposed.

14.7.5.3.5. Residual Impact

- ≤10 m nearshore static gear vessels: **minor adverse impact.**
- ≤10 m and >10 m static gear vessels in MDZ area: **minor impact.**
- >10 m mobile gear vessels in/around MDZ area: **negligible impact.**

14.7.5.4. Operational Impact 4: Presence of Seabed Fasteners

196. The presence of the MDZ Project, with all its associated active tidal devices, mooring equipment (chains/cables) and electrical infrastructure, including surface-laid subsea cables, has the potential to create a series of seabed fasteners for commercial fishing vessels operating in this region.

197. As this potential impact is primarily a safety issue for commercial fishing vessels, it has been fully considered and assessed as part of the NRA process (see **Appendix 15., Volume III**) and presented in **Chapter 15, Shipping and Navigation.**

198. In summary however, this impact was identified, assessed and provided with a risk score of 5.13 which equates to an overall risk ranking of ALARP.

199. With respect to the individual fishing receptor groups that form the basis of this assessment, additional comment is provided.

14.7.5.4.1. ≤10 m Nearshore Static Gear Vessels Targeting Crab/Lobster in the Nearshore Region

200. The sensitivity of this receptor group is assessed as Medium because although they have some spatial adaptability, this is relatively limited, as is their ability to deploy alternative gear types and fish different grounds.

201. Even though the majority of subsea project infrastructure will be located within the MDZ array area, and not within the nearshore region where these vessels predominantly fish, there will be some project infrastructure in this area, in particular up to nine subsea export cables. As sediment cover is greater in parts of the nearshore region, such as the ‘Abraham’s Bosom’ embayment, the sections of the subsea cables in this area may be buried to approximate depths of 0.5-1.5 m, therefore reducing the scope for interaction with (static) fishing gear. However, in nearshore regions where sediment cover is less and thus, burial is not possible, these unburied cables may well represent seabed fasteners.

202. The magnitude of this effect is assessed as Low because exposed cables would only affect an area that represented a minor proportion of the annual value of landings caught by this receptor group.

203. This results in a minor **adverse** impact significance for this receptor group.

14.7.5.4.2. ≤10 m and >10 m Static Gear Vessels Targeting Whelk/Crab/Lobster in the MDZ

204. Within the MDZ array and surrounding area, a small number of vessels also deploy static gear, with a focus on whelk as the target species, even though crab and lobster will also be targeted

in certain areas. The sensitivity of this receptor group is assessed as Low because they have a high spatial adaptability and ability to fish numerous fishing grounds.

205. As it is assumed that these vessels will not be able to fish within the MDZ due to navigational safety issues, a Negligible impact is assessed due to no route existing for interaction between these vessels and any potential seabed fasteners.

206. This results in a **negligible** impact significance for this receptor group (assuming that these vessels do not fish in the MDZ area in operational phase).

14.7.5.4.3. >10 m Mobile Gear Vessels Targeting Whitefish and/or Scallops in the MDZ and Surrounding Area

207. The sensitivity of these vessels to this potential impact is assessed as Negligible as these vessels have an extensive operational range and high method versatility and the MDZ site does not represent a key fishing ground for them (due to tidal conditions).

208. As for the previous receptor group, it has been assumed that these vessels will not be able to fish within the MDZ due to navigational safety issues. Therefore, a Negligible magnitude of impact is assessed, resulting in a **Negligible** impact significance predicted due to no scope for interaction between these vessels and potential seabed fasteners.

14.7.5.4.4. Mitigation

209. Project embedded mitigation, as detailed in **Chapter 4, Project Description**, includes:

- Ensuring devices marked as per International Association of Lighthouse Authorities (IALA) Guidance and Aids to Navigation;
- Promulgation of information via Notices to Mariners (NtM);
- GPS off station alarm / SCADA monitoring system;
- Site boundaries marked in accordance with Trinity House;
- Surveyed and charted as required by UKHO;
- Restrict Navigation through the MDZ;
- Exclusion of fishing within the MDZ; and
- Establish no anchoring areas.

14.7.5.4.5. Residual Impact

- ≤10 m nearshore static gear vessels: **negligible impact.**
- ≤10 m and >10 m static gear vessels in MDZ area: **negligible impact.**
- >10 m mobile gear vessels in/around MDZ area: **negligible impact.**

14.7.5.5. Operational Impact 5: Supply Chain Opportunities for Local Fishing Vessels

210. During the operational (and maintenance/repowering) phase of the Project, commercial opportunities other than core fishing activities may arise for suitable local commercial fishing vessels. The scope for commercial fishing vessels to potentially provide support to this Project was assessed in detail in a study commissioned by Menter Môn in 2015 and delivered by MarineSpace and Aquatera (MarineSpace, 2015).

211. This study considered the following:

- Tidal energy industry requirements (for marine services);
- Vessels / skills / equipment needed to enable requirements;
- Local supply chain (this involved engagement with Anglesey fisheries community to assess type and suitability of available vessels and skills and review the potential and appetite for diversification;
- A summary of options for collaboration between tidal sector and commercial fishing industry; and
- Recommendations and proposed Key Actions.

212. With respect to the operational and maintenance/repowering phase of potential tidal projects (in this case the Morlais Project), the study identified the following areas of potential support that could be provided by local commercial fishing vessels:

- Support for mooring installation vessels – floating tidal devices require moorings and whilst it would likely require larger stable vessels for the main installation process, additional support would likely be required during the O&M phase, i.e. checking and/or re-positioning of surface marker buoys;
- Debris recovery – there will inevitably be debris or lost objects that needs to be recovered from incidents during the operational phase. Depending on the size of the debris this could potentially be recovered by fishing vessels using grapples and/or nets;
- Navigational marker buoy deployment, servicing and recovery – marker buoys are a (MCA) requirement during the operational phase and these will need regular checking and potential servicing back onshore;
- Guard vessels / safety standby – guard vessels may be a MCA requirement during certain stages of the operational phase. Many fishing vessels will be able to perform this task;
- Fisheries Liaison Officer (FLO) services – with the fishing industry being one of the most important stakeholders to offshore projects, FLO’s are usually employed to act as the main point of communication between the Project and local fishing communities. An FLO will be required throughout the lifetime of a project;

- Crew transfers (divers, engineers etc.) and transport of small maintenance parts – Personnel will be required to be transported to the site during the operational phase, and often small maintenance parts will need to be shipped out;
- Diver/diver equipment support – divers may be required during O&M activities. Vessels would be required to transport them to site and to support equipment; and
- Site visits for project developers, stakeholders and PR – the Project is a high-profile project and it is expected that there will be a significant amount of interest from stakeholders, hence it is expected that vessels would be needed to provide site visits during the operational phase.

213. The study found that the value of potential contracts associated with vessel use in the MDZ could be as much as £3.5M over the next 10 years if the Project develops as envisaged (MarineSpace, 2015). This includes up to £300k/year during the operational lifetime of the Project.

214. This requirement for vessels during all stages of the planned projects around Anglesey presents a significant opportunity for local vessel owners and operators. Established marine service providers and charter vessel operators from elsewhere in the UK, as well as on Anglesey e.g. Holyhead Towing, will also be interested in these opportunities. This could also represent further opportunities for personnel with offshore experience to act as crew and vessel support, where specific experience of the conditions around Anglesey will be particularly valuable.

215. Menter Môn, the third-party managers of the Project, have a remit to maximise the economic benefit to Anglesey hence are keen to work with the local commercial fishing sector to take advantage of these opportunities where possible.

14.7.5.5.1. ≤10 m Nearshore Static Gear Vessels Targeting Crab/Lobster in the Nearshore Region

216. The sensitivity of this receptor group is judged to be Medium as although they have some spatial adaptability, this is relatively limited, as is their ability to deploy alternative gear types and fish different grounds.

217. The magnitude of this (beneficial) effect is judged to be Low. Due to the type and size of vessels within this receptor group, opportunities for formal project-related marine operational support may be more limited than for larger vessels. This is mainly due to the equipment/deck-space available on smaller vessels and also the need to ensure compliance with at least the following requirements:

- Compliance with MGN 280 (Code of Practice for Small Vessels in Commercial Use for Sport, Pleasure, Workboats and Pilot boats under 24m;
- Compliance with SCV (Small Commercial Vessel) Code;
- Holds a valid SCV certificate for Area Categories 2 / 3 (for operation up to 60 / 20 miles from a safe haven; and

- Appropriate Employers Liability and Third Party Liability cover under the terms and conditions of its own insurance.

218. The vessel Skipper or one or more of the crew will also need to hold the following certification, or be able to demonstrate the following competencies:
   - Basic Sea Survival Course Certificate;
   - Evidence of First Aid Training;
   - Radio Operator's Certificate;
   - Medical Fitness Certificates;
   - Evidence of Radar Training;
   - Approved Engine Course (if towing or lifting over 1000 tonnes); and
   - RYA Professional Practices and Responsibilities (PPR).

219. Overall, although potential marine operation supply chain opportunities will arise for this receptor group, only a **minor beneficial** impact significance is predicted on this receptor group.

14.7.5.5.2. ≤10 m and >10 m Static Gear Vessels Targeting Whelk/Crab/Lobster in the MDZ

220. Further offshore, within the MDZ array and surrounding area, a small number of larger vessels also deploy static gear, with a focus on whelk as the target species, even though crab and lobster will also be targeted in certain areas. The sensitivity of this receptor group is judged to be Low as they have a high spatial adaptability and ability to fish numerous fishing grounds.

221. All the same opportunities as outlined above will apply to this receptor group, although the fact that larger (>10 m vessels) make up this receptor mean that they will be more suited/capable of undertaking some of these activities. Therefore, the magnitude of effect is judged to be Medium.

222. This results in a **minor beneficial** impact significance on this receptor group.

14.7.5.5.3. >10 m Mobile Gear Vessels Targeting Whitefish and/or Scallops in the MDZ and Surrounding Area

223. As this is a beneficial impact being assessed, the definition of receptor sensitivity requires slight amendment. For the purpose of this assessment, the sensitivity of this receptor is judged to be Medium, with the criteria defined as "moderate vessel suitability to provide marine operation support during the O&M phase".

224. This judgement is based on the larger vessel size represented by this receptor group, with associated increased vessel/equipment/staff capabilities and certifications compared to smaller (<10 m) vessels).

225. The magnitude of this potential effect is judged to be Medium. As for receptor sensitivity, a slightly amended criteria has been used to define magnitude of this effect: "effect will potentially

provide a moderate source of revenue for a vessel and is likely to occur". This is based on the potential for this type of larger (>10 m) vessels to support the Project (as identified in the 2015 Supply Chain Study commissioned by Mentor Môn; MarineSpace, 2015)

226. Therefore, a **moderate beneficial** impact significance is predicted on this receptor group via support on marine operations during the O&M phase of the Project.

14.7.5.5.4. Mitigation

227. No mitigation required. However, to increase opportunities for local fishing vessels to support the Project, the Action Plan provided as part of the 2015 study (MarineSpace, 2015) (**Appendix 14.1, Volume III**) should be reviewed and, where appropriate updated. Discussions should then be held between Menter Môn and the local fishing community to identify what needs to be done to maximise these opportunities.

14.7.5.5.5. Residual Impact

- ≤10 m nearshore static gear vessels: **minor (beneficial) impact.**
- ≤10 m and >10 m static gear vessels in MDZ area: **minor (beneficial) impact.**
- >10 m mobile gear vessels in/around MDZ area: **moderate (beneficial) impact.**

14.7.5.6. Operational Impact 6: Impacts during repowering

228. During the operational (and maintenance) phase of the Project, repowering will also be undertaken.

229. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50 % of the tenants will undertake repowering, i.e. for 50 % of the tenants, their infrastructure will be removed and replaced (potentially with different infrastructure by a different tenant). For the other 50 % of tenants, their infrastructure will remain over the lifetime of the project.

230. As repowering will take place within the operational phase of the project, during which it has been assumed all fishing activity will be excluded from the MDZ for safety reasons, there will be no additional adverse impact on commercial vessels over and above those already assessed within existing operational impacts.

231. Potential beneficial impacts from supply chain support have already been assessed for the entire operational phase, inclusive of repowering (see Operational Impact 5).

14.7.6. Potential Impacts during Decommissioning

232. The same type of potential impacts that arose through the construction phase would occur during decommissioning, including:

- Loss of access to fishing grounds (due to decommissioning activity);
- Collision risk between commercial fishing vessels and decommissioning vessels;
- Obstruction to regular fishing vessel transit routes;

- Interference with static fishing gear due to additional vessel traffic; and
- Supply chain opportunities for local fishing vessels.

233. In addition, the operational phase impact from “seabed fasteners may occur if decommissioning is done over a long time period (likely).

234. The sensitivity of the three receptor groups is judged to remain the same as per the construction phase impacts, and the magnitude of effect is also judged to be the same (although, in practice, will likely be less for decommissioning compared to construction). Therefore, the same conclusions on impact significance are predicted (see **Table 14-14**).

14.7.7. Cumulative Impacts

235. A draft list of projects and plans that, together with the Project, have the potential to result in cumulative or in-combination impacts is given in **Appendix 26.1** (**Volume III**).

236. For this Cumulative Impact Assessment (CIA) the consideration of which projects may result in cumulative or in-combination impacts on commercial fisheries receptors has been based upon the Project-specific impact assessment and expert judgement.

237. As described in this chapter, the majority of impacts on commercial fisheries receptors associated with the Project have a spatial extent that is limited to the site and the immediate surroundings. As such it is only projects that will affect the immediate local environment that shall be screened in for consideration in the cumulative assessment. A nominal buffer of ~20 km has been chosen as a worst-case maximum extent over which impacts may overlap i.e. accumulate.

238. Any projects beyond 20 km are screened out of this CIA (this includes the proposed Nova/ YnNi Llŷn tidal project in Bardsey Sound which is located >50 km from the MDZ) on the basis that they are beyond the spatial extent of impacts from the Project. In addition, any projects that do not involve any construction in the marine environment have also been screened out.

239. On this basis, the only identified project considered within this cumulative assessment is Minesto’s Holyhead Deep project which is located less than 1 km from the western boundary of the MDZ. A single 0.5 MW device was installed in summer 2018 but an EIA scoping report for an up to 80 MW development was submitted to NRW in 2017.

14.7.7.1. Potential Cumulative Impacts During Construction

240. The main potential cumulative impacts on commercial fisheries receptors during construction relate to:

- Loss of access to fishing grounds due to construction activity occurring in both the MDZ and Minesto sites at the same time;
- Increased collision risk between commercial fishing vessels and construction vessels associated with both these sites;
- Obstruction to regular fishing vessel transit routes due to construction works occurring in both the Minesto and MDZ sites at the same time;

- Interference with static fishing gear due to additional construction vessel traffic from both the Minesto and MDZ sites; and
- Increased supply chain opportunities for local fishing vessels.

241. The significance of these impacts from the Project alone have been fully considered and assessed in preceding sections. The main receptor groups that will potentially be affected by cumulative impacts are the <10 m and >10 m static gear vessels in MDZ area and the >10 m mobile gear vessels in/around MDZ area.

242. The main MDZ assessment concluded that these receptor groups would be impacted during the construction phase of the MDZ, via the impacts listed above. It is assumed that the same type of impacts (disruption/loss of access to fishing grounds/collision risk etc.) will occur cumulatively if construction is carried out at the same time on the MDZ and Minesto sites. Therefore, scope exists for these impacts to increase in significance.

243. However, when considered in detail, even with the adverse impacts occurring at the same time, the magnitude of effect is not judged to increase to a degree that would alter the overall impact significance, i.e. from “moderate” used in some of the MDZ assessments to “high”. This is based on the fact that the criteria for a high magnitude effect to arise on any of these receptors is an effect “*that affects an area from which the majority of a commercial fishing receptor’s annual value of landings is caught*”. Even when the MDZ and Minesto projects are considered together, any disruption/loss of access/damage to gear, will not be focused on an area that represents where the majority of a vessels annual catches are made.

244. Therefore, for the adverse impacts on commercial fishing receptors that may arise cumulatively via the MDZ and Minesto project, the significance is judged to remain no greater than **minor adverse.**

245. For the beneficial impact (supply chain opportunities), the same principles apply in that if construction on the MDZ and Minesto sites was undertaken at the same time, potential exists for cumulative beneficial impacts.

246. Even with two potential sources of supply chain support from the two projects, the conclusions on impact significance presented for the MDZ Project alone are judged to remain valid, i.e. there will be a beneficial impact ranging from **minor beneficial** to **moderate beneficial** for the main fish receptor groups, with the most benefit potentially for >10 m vessels with more capacity to work in both the MDZ and Minesto sites.

247. This conclusion is presented on the basis that the amount of additional supply chain opportunities from the two projects considered together, whilst greater than for the MDZ alone, will not be great enough to increase the significance of beneficial impact using the criteria in the impact assessment methodology, i.e. to increase the impact significance to a major beneficial impact for the >10 m vessels receptor group, it would have to be assumed that the two projects together would “*potentially provide a major source of revenue for a vessel and is likely to occur*”.

14.7.7.2. Potential Cumulative Impacts During Operation (and Repowering)

248. The main potential cumulative impacts on commercial fisheries receptors during the operational phase relate to:

- Collision risk between commercial fishing vessels and project infrastructure in the MDZ and Minesto sites;
- Loss of access to fishing grounds and displacement of fishing effort onto adjacent grounds due to presence of MDZ and Minesto infrastructure;
- Reduction in abundance of target species and reduced supply of catch to established local buyers due to presence of MDZ and Minesto projects;
- Presence of seabed fasteners within both sites; and
- Supply chain opportunities for local fishing vessels for both the MDZ and Minesto sites.

249. As per the construction phase impacts, the significance of these impacts from the Project alone have been fully considered and assessed in preceding sections. The main receptor groups that will potentially be affected by cumulative impacts in the operational phase are again the ≤10 m and >10 m static gear vessels in MDZ area and the >10 m mobile gear vessels in/around MDZ area.

250. The main MDZ assessment concluded that these receptor groups would be impacted during the operational phase of the MDZ, via the impacts listed above. It is assumed that the same type of impacts (disruption/loss of access to fishing grounds/collision risk etc.) will occur cumulatively if both sites are operational at the same time. Therefore, scope exists for these impacts to increase in significance.

251. However, when considered in detail, even with the adverse operational phase impacts occurring at the same time, the magnitude of effect is not judged to increase to a degree that would alter the overall impact significance, i.e. from “moderate” used in some of the MDZ assessments to “high”. This is based on the fact that the criteria for a high magnitude effect to arise on any of these receptors is an effect “*that affects an area from which the majority of a commercial fishing receptor’s annual value of landings is caught*”. Even when the MDZ and Minesto projects are considered together, the area of disruption/loss of access/damage to gear from both sites combined (MDZ; 35km^2 plus Minesto AfL area of 9.1 km^2 = 44.1 km^2) , will not equate to the high magnitude effect criteria (an area that represents where the majority of a vessels annual catches are made).

252. Therefore, for the operational phase adverse impacts on commercial fishing receptors that may arise cumulatively via the MDZ and Minesto project, the significance is judged to remain no greater than Minor Adverse.

253. For the beneficial impact (supply chain opportunities), the same principles apply in that if the operational phase of the MDZ and Minesto sites overlapped (which is expected), potential exists for cumulative beneficial impacts.

254. However, even with two potential sources of supply chain support from the two projects, the conclusions on impact significance presented for the MDZ Project alone are judged to remain

valid, i.e. there will be a beneficial impact ranging from **minor beneficial** to **moderate beneficial** for the main fish receptor groups, with the most benefit potentially for >10 m vessels with more capacity to work in both the MDZ and Minesto sites.

255. This conclusion is presented on the basis that the amount of additional supply chain opportunities from the two projects considered together, whilst greater than for the MDZ alone, will not be great enough to increase the significance of beneficial impact using the criteria in the impact assessment methodology, i.e. to increase the impact significance to a major beneficial impact for the >10 m vessels receptor group, it would have to be assumed that the two projects together would “potentially provide a major source of revenue for a vessel and is likely to occur”.

14.7.7.3. Potential Cumulative Impacts During Decommissioning

256. The same type and significance of cumulative impacts as described for the construction phase would potentially arise if decommissioning of the MDZ and Minesto projects occurred simultaneously, resulting in no greater than **minor adverse** impacts.

14.7.8. Inter-relationships

257. **Table 14-12** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 14-12 Inter-Topic Relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Fish and Shellfish Ecology	Chapter 10	Section 14.7.5	Both chapters consider the potential effects of the Project impacts on any fish/shellfish receptor group
Shipping and Navigation	Chapter 15	Section 14.7.4 and 14.7.5	Both chapters consider the potential effects of the Project on access to the to area and effects on vessel movements

14.7.9. Interactions

258. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 14-13**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 14-13 Potential Interaction Between Impacts

Potential interaction between impacts					
Construction/Decommissioning	1. Loss of access to fishing grounds	2. Collision risk	3. Obstruction	4. Interference with static fishing gear	5. Supply chain opportunities
1. Loss of access to fishing grounds due to construction activity	-	No	Yes	Yes	No

Potential interaction between impacts					
2. Collision risk between commercial fishing vessels and construction vessels	No	-	No	Yes	No
3. Obstruction to regular fishing vessel transit routes	Yes	No	-	Yes	No
4. Interference with static fishing gear due to additional vessel traffic	Yes	Yes	Yes	-	No
5. Supply chain opportunities for local fishing vessels	No	No	No	No	-
Operation	1. Collision risk	2. Loss of access to fishing grounds	3. Reduction in abundance of target species	4. Presence of seabed fasteners	5. Supply chain opportunities
1. Collision risk between commercial fishing vessels and project infrastructure	-	No	No	Yes	No
2. Loss of access to fishing grounds and displacement of fishing effort onto adjacent grounds	No	-	Yes	No	No
3. Reduction in abundance of target species and reduced supply of catch to established local buyers	No	Yes	-	No	No
4. Presence of seabed fasteners	Yes	No	No	-	No
5. Supply chain opportunities for local fishing vessels	No	No	No	No	-

14.8. SUMMARY

259. This chapter has provided an overview on the potential impacts which may occur on commercial fisheries within the several stages associated with the development of the Project: construction, operation and maintenance, and decommissioning.

260. For clarity on the assessment, and to recognise the differing sensitivity of size/types of fishing vessels to potential impacts, three “receptor groups” have been defined and used within the assessment:

- ≤10 m nearshore static gear vessels targeting crab/lobster in the nearshore region;
- ≤10 m and >10 m static gear vessels targeting whelk/crab/lobster in the MDZ; and

- >10 m mobile gear vessels targeting whitefish and/or scallops in the MDZ and surrounding area.

261. **Table 14-14** collates the determinations of each of the impacts assessed and is presented as a summary of the determinations. It is evident that the vast majority of the impacts to commercial fisheries receptors throughout the various stages of development are likely to be of minor adverse significance, even when assessed with the worse-case scenario. Some potential moderate adverse impacts are predicted but with successful implementation of appropriate mitigation measures, these will be reduced to minor adverse/negligible significance.

262. These assessment conclusions reflect the fact that even though commercial fishing activity has been assumed to be completely excluded from the main MDZ array site for the lifetime of the Project, only a low level of activity currently occurs in this area, therefore, exclusion will not create significant impacts on vessels who will be able to target alternative grounds (as they currently do).

263. Potential beneficial impacts may arise on commercial fishing receptors via opportunities to support marine operations at all Project stages. A detailed review of these opportunities was presented in a study commissioned by Menter Môn in 2015 (MarineSpace, 2015).

Table 14-14 Summary of Potential Impacts on Commercial Fisheries Associated with the Development of the Project

Potential Impact	Impact Magnitude	Receptor Sensitivity	Impact Significance	Additional Mitigation Measures	Residual Impact
Construction Phase					
1. Loss of access to fishing grounds due to construction activity	Medium Low Low	≤10 m nearshore static: Low ≤>10 m MDZ static: Low >10 m MDZ mobile: Negligible	Minor adverse Minor adverse Negligible	▪ Local fishermen to be notified of all planned construction works via Notice to Mariners; ▪ Project-specific FLO to be appointed during construction phase; ▪ All construction vessels to exhibit appropriate lighting and markings at all times; and ▪ Construction activities to be planned as far as possible so that they are focussed in discrete areas at any one time, i.e. not spread out across entire site. ▪ Where local vessels are able to demonstrate a clear loss in annual income due to loss of fishing grounds within the MDZ, Menter Môn will enter into discussions on appropriate forms of financial assistance.	Minor adverse Minor adverse Negligible

Potential Impact	Impact Magnitude	Receptor Sensitivity	Impact Significance	Additional Mitigation Measures	Residual Impact
2. Collision risk between commercial fishing vessels and construction vessels					See Chapter 12 – Shipping & Navigation
3. Obstruction to regular fishing vessel transit routes	Medium Low Low	≤10 m nearshore static: Low ≤>10 m MDZ static: Low >10 m MDZ mobile: Negligible	Minor adverse Minor adverse Negligible	As per Impact 1 plus: ▪ Where required, agreed transit routes around/through the MDZ to be developed and agreed between Menter Môn and local fishing vessels. This approach has been successfully adopted on OWF projects around the UK coast;	Minor adverse Minor adverse Negligible
4. Interference with static fishing gear due to additional vessel traffic	Medium Low Negligible	≤10 m nearshore static: Medium ≤>10 m MDZ static: Medium >10 m MDZ mobile: Negligible	Moderate adverse Minor adverse Negligible	As per above 1 plus: ▪ Key areas of static gear deployment to be provided by local fishermen and used to develop agreed transit routes around/through the MDZ that aim to minimise damage to static gear.	Minor adverse Negligible Negligible
5. Supply chain opportunities for local fishing vessels	Medium Medium Medium	≤10 m nearshore static: Low ≤>10 m MDZ static: Low >10 m MDZ mobile: Medium	Minor beneficial Minor beneficial Moderate beneficial	No mitigation required. However, to increase opportunities for local fishing vessels to support the Project, the Action Plan provided as part of the 2015 study (MarineSpace, 2015, **Appendix 14.1, Volume III**) should be reviewed and, where appropriate	Minor beneficial Minor beneficial Moderate beneficial

Potential Impact	Impact Magnitude	Receptor Sensitivity	Impact Significance	Additional Mitigation Measures	Residual Impact
				updated. Discussions should then be held between Menter Môn and the local fishing community to identify what needs to be done to maximise these opportunities.	
Operational Phase (including repowering)					
1. Collision risk between commercial fishing vessels and project infrastructure					See Chapter 12 – Shipping & Navigation
2. Loss of access to fishing grounds and displacement of fishing effort onto adjacent grounds	Negligible Medium Low	≤10 m nearshore static: Medium ≤>10 m MDZ static: Low >10 m MDZ mobile: Negligible	Minor adverse Minor adverse Negligible	Where local vessels are able to demonstrate a clear loss in annual income due to loss of fishing grounds within the MDZ, Menter Môn will enter into discussions on appropriate forms of financial assistance.	Minor adverse Minor adverse Negligible
3. Reduction in abundance of target species and reduced supply of catch to established local buyers	Negligible Low Low	≤10 m nearshore static: Medium ≤>10 m MDZ static: Low >10 m MDZ mobile: Negligible	Minor adverse Minor adverse Negligible	None proposed	Minor adverse Minor adverse Negligible
4. Presence of seabed fasteners	Low Negligible Negligible	≤10 m nearshore static: Medium <≤>10 m MDZ static: Low >10 m MDZ mobile: Negligible	Minor adverse Negligible Negligible	▪ Ensuring devices marked as per International Association of Lighthouse Authorities (IALA) Guidance and Aids to Navigation ▪ Promulgation of information via NtM; ▪ GPS off station alarm / SCADA monitoring system;	Negligible Negligible Negligible

Potential Impact	Impact Magnitude	Receptor Sensitivity	Impact Significance	Additional Mitigation Measures	Residual Impact
				▪ Site boundaries marked in accordance with Trinity House; ▪ Surveyed and charted as required by UKHO; ▪ Restrict Navigation through the MDZ; ▪ Exclusion of fishing within the MDZ; and ▪ Establish no anchoring areas.	
5. Supply chain opportunities for local fishing vessels	Low Medium Medium	≤10 m nearshore static: Medium ≤>10 m MDZ static: Low >10 m MDZ mobile: Medium	Minor beneficial Minor beneficial Moderate beneficial	No mitigation required. However, to increase opportunities for local fishing vessels to support the Project, the Action Plan provided as part of the 2015 study (MarineSpace, 2015; **Appendix 14.1, Volume III**) should be reviewed and, where appropriate updated. Discussions should then be held between Menter Môn and the local fishing community to identify what needs to be done to maximise these opportunities	Minor beneficial Minor beneficial Moderate beneficial
6. Impacts via repowering	As repowering will take place within the operational phase of the project, during which it has been assumed all fishing activity will be excluded from the MDZ for safety reasons, there will be no additional adverse impact on commercial vessels over and above those already assessed within existing operational impacts (above). Potential beneficial impacts from supply chain support have already been assessed for the entire operational phase, inclusive of repowering (see Operational Impact 5).				
Decommissioning					

Potential Impact	Impact Magnitude	Receptor Sensitivity	Impact Significance	Additional Mitigation Measures	Residual Impact
As per impacts 1-5 in construction phase					

14.9. REFERENCES

Evans, P.G.H. and Hintner, K. (2012) A Review of the Direct & Indirect Impacts of Fishing Activities on Marine Mammals in Welsh waters. CCW Policy Research Report No. 12/5: 1-172.

MarineSpace (2015). Marine Services Supply Chain Study for Tidal Energy Industry. Report by MarineSpace (and Aquatera) for Menter Môn, May 2015.

Nautilus (2000). *Study into Inland and Sea Fisheries in Wales*. Prepared for National Assembly of Wales. Final Report: August 2000.

NRW (Natural Resources Wales) (2010). Sea Fish Atlas. Available online at: http://lle.gov.wales/apps/marineportal/ [Accessed February 2018]

Pantin, J.R., Murray, L.G., Hinz, H., Le Vay, L., and Kaiser, M.J. (2015). *The Inshore Fisheries of Wales: a study based on fishers' ecological knowledge.* Fisheries & Conservation report No. 42, Bangor University. 60pp.

Walmsley S.A. and Pawson, M.G. (2007). The coastal fisheries of England and Wales, Part V: a review of their status 2005–6. Sci. Ser. Tech Rep., Cefas Lowestoft, 140: 83pp.

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Morlais Project
Environmental Statement

Chapter 15: Shipping and Navigation

Volume I

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-015

Chapter 15: Shipping and Navigation

Author: Marine Space

MarineSpace
Making Sense of the Marine Environment ™

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GLOSSARY OF ABBREVIATIONS

AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ASD	Admiralty Sailing Directions
ATBA	Area To Be Avoided
CD	Chart Datum
COLREGS	International Regulations for Preventing Collisions at Sea
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
EIA	Environmental Impact Assessment
ERCoP	Emergency Response Co-operation Plan
ES	Environmental Statement
FSA	Formal Safety Assessment
GIS	Geographic Information System
GPS	Global Positioning System
HMCG	Her Majesty's Coast Guard
HSE	Health and Safety Executive
IALA AISM	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICW	In Collision With
IMO	International Maritime Organisation
JLDP	Joint Local Development Plan
kWh	Kilowatt Hour
LOA	Length Over All
m	Metre
MAIB	Maritime Accident Investigation Branch
Marico or Marico Marine	Marine and Risk Consultants Ltd
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
MMO	Marine Management Organisation
MDZ	Morlais Demonstration Zone
nm	Nautical Mile
NPS	National Policy Statement
NRA	Navigation Risk Assessment
NSIP	Nationally Significant Infrastructure Project
NTM	Notice To Mariners
O&M	Operation and Maintenance
OREI	Offshore Renewable Energy Infrastructure
PHA	Preliminary Hazard Analysis
PINS	Planning Inspectorate
PPE	Personal Protective Equipment
RACONS	Radar and Beacon

RHIB	Rigid Hull Inflatable Boat
RNLI	Royal National Lifeboat Institution
ROI	Republic of Ireland
RYA	Royal Yachting Association
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SMS	Safety Management System
SOLAS	Safety Of Life At Sea
TSS	Traffic Separation Schemes
UK	United Kingdom
UKC	Under Keel Clearance
VMS	Vessel Monitoring System

15. SHIPPING AND NAVIGATION

15.1. INTRODUCTION

1. Menter Môn Morlais Limited (Menter Môn) proposes the development of 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ). The development of the Morlais Project (the Project) will support the development of renewable energy technology objectives of the Anglesey and Gwynedd Joint Local Development Plan (JLDP), providing a consented tidal technology demonstration zone which supports installation, testing and commercial demonstrations of tidal energy devices. The Project will also provide opportunities for the local communities via direct employment and support of the local supply chain.

2. The Project will include permanent communal infrastructure for tidal technology developers which provides a shared route to a local grid connection via nine export cable tails, an onshore landfall substation, and an onshore electrical cable route to a grid connection via a grid connection substation.

3. This chapter of the Environmental Statement (ES) describes the current shipping and navigation activity in the vicinity of the MDZ. The impact of the potential interaction between the Project and vessel activity is assessed for the construction, operation and maintenance (including repowering) and decommissioning phases of the Project. Where appropriate, mitigation measures are proposed to ensure the identified effects are avoided, removed, or minimised, where possible. Potential cumulative impacts are also considered.

4. More details of the baseline data collected and the assessment undertaken are provided in **Appendix 15.1, Volume III**.

5. This chapter has links with **Chapter 2, Policy and Legislation**, **Chapter 14, Commercial Fisheries**, **Chapter 16, Marine Infrastructure and Other Users** and **Chapter 25, Socio-Economics, Tourism and Recreation**.

6. This chapter has been prepared by MarineSpace Ltd on behalf of Menter Môn.

15.2. POLICY, LEGISLATION AND GUIDANCE

7. The assessment within this chapter has been guided and informed by the following key relevant legislation, guidance and policy. Further detail on legislation and policy in relation to the wider Project is provided in **Chapter 2, Policy and Legislation**.

15.2.1. National Policy Statements

8. Although this Project is not seeking a Development Consent Order (DCO), its size (up to 240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP). Guidance that is relevant to assessing impacts on shipping and navigation for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to shipping and navigation include:

   - NPS for Renewable Energy Infrastructure (EN-3), July 2011.

9. Details of specific policies within EN-3 used to inform this assessment are provided in **Table 15-1** below. The specific assessment requirements for shipping and navigation are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 15-1 NPS EN-3 Assessment Requirements Relevant to Shipping and Navigation

NPS Requirement	NPS Reference	ES Reference
"Site selection should have been made with a view to avoiding or minimising disruption or economic loss to the shipping and navigation industries"	NPS EN-3 Para 2.6.162	**Chapter 3, Site Selection and Consideration of Alternatives** and **Appendix 15.1** (**Volume III**)
"Negative impacts on less strategically important shipping routes should be reduced to As Low as Reasonably Practicable (ALARP)"	NPS EN-3 Para 2.6.163	Impact assessment is provided in **Section 15.6** and a Navigation Risk Assessment is provided in **Appendix 15.1** (**Volume III**).
"A detailed Search and Rescue (SAR) Response Assessment should be undertaken prior to the commencement of construction"	NPS EN-3 Para 2.6.164	See **Sections 15.6.3** and **15.6.4.** The Project will adhere to the MCA Guidance on Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response.
"The scheme must be designed to minimise the effects on recreational craft: The extent and nature of any obstruction of or danger to navigation which is likely to be caused by the development will be considered".	NPS EN-3 Para 2.6.166	Impact assessment is provided in **Section 15.6** and a Navigation Risk Assessment is provided in **Appendix 15.1** (**Volume III**).

15.2.2. Marine Policy Statement

10. The Marine Policy Statement (MPS) adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made in order to enable sustainable development. The MPS sets out a vision of having 'clean, healthy, safe, productive and biologically diverse oceans and seas' by supporting the development of Marine Plans. It also sets out the framework for environmental, social and economic considerations that need to be considered in marine planning.

15.2.3. Wales National Marine Plan

11. By adopting the MPS, the Welsh Government committed to the requirement to introduce Marine Plans for Wales.

12. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the Welsh National Marine Plan (WNMP). The Plan is being developed in accordance with the Marine and Coastal Access Act (MCAA) 2009, the MPS and the Maritime Spatial Planning Directive, a draft version has been issued for consultation (discussed further in **Chapter 2, Policy and Legislation**).

13. Objective 10 of the WNMP, "to maintain and enhance the resilience of marine ecosystems and the benefits they provide in order to meet the needs of present and future generations", is of relevance to this chapter as this covers policies and commitments on the wider ecosystem, as set out in the MPS including those to do with the Marine Strategy Framework Objective Directive

and the Water Framework Directive, as well as other environmental, social and economic considerations.

15.2.4. Relevant Guidance

14. The Environmental Impact Assessment (EIA) Regulations (see **Chapter 2, Policy and Legislation**) is the only legislation directly relevant to this assessment. However, there are a number of guidance documents available which provide further detail on the aspects of the shipping and navigation environment that should be assessed and how the assessment should be undertaken.

15. Guidance on the assessment requirement was primarily sought from the Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 543 (M+F) which replaces MGN 371. MGN 543 advises the correct methodology to evaluate navigation safety around Offshore Renewable Energy Installations (OREIs). The full list of guidance used is as follows:

- MGN 543 Guidance on UK Navigational Practice, Safety and Emergency Response Issues;
- MGN 372 Guidance to Mariners Operating in the Vicinity of UK OREIs;
- MGN 166 Guidelines for Voyage Planning;
- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures;
- International Maritime Organisation (IMO) Formal Safety Assessment. Revised Guidelines for Formal Safety Assessment (FSA) MSC-MEPC.2/Circ.12/Rev.2;
- Royal Yachting Association (RYA) Position on Offshore Energy Developments;
- Regulatory expectations on moorings for floating wind and marine devices – HSE and MCA 2017;
- Cumulative Impact Assessment Guidelines issued by RenewableUK in June 2013;
- Planning Inspectorate (PINS) ‘Advice Note 9: Rochdale Approach’; and
- International Regulations for Preventing Collisions at Sea 1972 (as amended) (COLREGS).

15.3. CONSULTATION

16. Stakeholder consultation has been undertaken via the EIA scoping process undertaken in April 2018 as well as targeted consultation with local and national consultees, as part of the Preliminary Hazard Analysis (PHA) (Phase 1 - National) and the Navigational Risk Assessment (NRA) (Phase 2 – Local and National). The PHA and NRA consultations were undertaken in accordance with guidance set out in MGN 543.

17. **Table 15-2** presents a summary of the key issues raised in the 2018 Scoping Opinion and in the consultation carried out as part of the NRA, with reference to the ES sections relevant to the specific comment.

Table 15-2 Consultation Responses

Date/Document	Comment	Response
Planning Inspectorate		
Scoping Report 2018	"Vessel movements: The ES should detail the anticipated vessel movements during all phases of the Proposed Works. These should be presented on a worst case basis."	Noted and assessed in **Chapter 15, Shipping and Navigation, Sections 15.6.3, 15.6.4** and **Appendix 15.1** (**Volume III**)
	"Search and rescue: The ES should also assess the implications of the Proposed Works on search and rescue operations."	Noted and assessed in **Chapter 15, Shipping and Navigation, Section 15.6.3** and **Appendix 15.1** (**Volume III**). **The Project will adhere to the MCA Guidance on Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response.**
Trinity House Lighthouse Service		
Scoping Report 2018	Within section 9.4 Shipping, Navigation and Marine Infrastructure, I advise that the navigation risk assessment should be undertaken in accordance with MGN 543 (which supersedes MGN 371).	The NRA has been completed in accordance with MGN 543 as specified.
	The applicant should also note that separate risk assessments are likely to be required for each deployment of TEC/arrays, in due course, as this project progresses.	Noted.
NRW		
Scoping Report 2018	There is concern about the impact the proposed Array may have on the safety of navigation. In particular, the changes to vessel routing with the reduction in navigable depth, the constriction placed on recreational, commercial and fishing vessels operating in or transiting the area and accessing ports and harbours, and the resulting increase in the frequency of encounters. The Environmental Statement must provide details of the possible impact on navigational issues for both commercial and recreational craft, specifically: • Collision Risk, • Navigational Safety, • Visual intrusion and noise, • Risk Management and Emergency response, • Marking and lighting of site and information to mariners,	Noted and assessed in **Chapter 15, Shipping and Navigation** and **Appendix 15.1** (**Volume III**).

Date/Document	Comment	Response
	• Effect on small craft navigational and communication equipment, • The risk to drifting recreational craft in adverse weather or tidal conditions, • The likely squeeze of small craft into the routes of larger commercial vessels	
Scoping Report 2018	The EIA must assess the safety of navigational channels and obstacles to navigation from Tidal Energy Converters (TEC's)/supporting infrastructure and support vessels. Avoiding any potential for collision during any stage of the project is of absolute importance.	Noted and assessed in **Chapter 15, Shipping and Navigation, Sections 15.6.3, 15.6.4** and **Appendix 15.1** (**Volume III**).
Scoping Report 2018	A Navigational Risk Assessment (NRA) will need to be submitted in accordance with MGN 543 (and MGN 372) and the MCA Methodology for Assessing the Marine Navigation Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI). This NRA should be accompanied by a detailed MGN 543 Checklist which can be downloaded from the MCA website. We note that the Scoping currently refers to MGN 371 which has been superseded by MGN 543.	The NRA has been completed in accordance with MGN 543 as specified. The MGN 543 checklist is included as an Annex to **Appendix 15.1** (**Volume III**). Please note, however, some of the listed requirements are to be covered at the device specific NRA stage given the lack of available information (such as a device specific layout) at this stage.
Scoping Report 2018	It should be noted that separate risk assessments are likely to be required for each deployment of TEC/arrays, in due course, as this project progresses.	Noted. Final mitigation plans will be agreed prior to the construction once the final details are known.
Scoping Report 2018	The shipping and navigation study should include radar and manual observations in addition to AIS data to ensure vessels of less than 300gt are captured and should be completed within 24 months prior to the Environmental Statement submission. Casualty information from the MAIB and RNLI would also be good data sources, in establishing the risk profile for the area. We note that the Scoping report currently states 'existing AIS and vessel data collected previously in the study area will be	See **Chapter 15, Shipping and Navigation, Section 15.4.3**. AIS data were collected over a two week period in the summer during 2017 and two week period in the winter during 2019 to better understand the traffic profile of vessels transiting the project area and any potential impacts the Project may have upon navigation. Six months of AIS data from between October 2017 and March 2018 were additionally sourced to account for any

Date/Document	Comment	Response
	undertaken, utilising existing data sets where available'.	seasonal variances in ferry activity and usage of the poor weather routes. To overcome the limitations posed by utilisation of AIS alone and in line with MGN 543 requirements, winter and summer radar surveys were undertaken for representative summer and winter periods. On the advice of the MCA, an additional project-specific marine traffic survey (winter #2) was undertaken in April 2019. This was to remove the risk of the original winter #1 data being invalidated due it being collected greater than two years from the date of ES submission. Casualty information from the MAIB was obtained and is reviewed in **Section 15.5.3.1** and **Appendix 15.1** (**Volume III**).
Scoping Report 2018	AIS data should not be used as an absolute measure of recreational traffic, as the substantial volume of yachts without AIS are not accounted for. The UK Coastal Atlas of Recreational Boating, available on licence from the RYA, or via the Marine Management Organisation's Marine Information System, provides relative AIS intensity data, general boating areas, and locations of clubs and training centres.	See **Chapter 15, Shipping and Navigation, Section 15.4.3** Noted. Boating density within the Coastal Atlas is based on AIS data only and, therefore, includes primarily large racing yachts and does not reflect the activity of small, non-AIS carrying coastal recreational vessels that represent a considerable proportion of recreational traffic. The combination of AIS and radar collected for the NRA is therefore, considered to provide greater accuracy and therefore, the data provided within the Coastal Atlas was not deemed necessary.
Scoping Report 2018	The NRA should address safe Under Keel Clearance (UKC) for the maximum drafts of vessel both observed and anticipated, from which a realistic UKC assessment should be undertaken. The MCA's Under Keel Clearance Policy paper can be found on their website.	Under Keel Clearance is assessed in the **Appendix 15.1** (**Volume III**) in accordance with MCA - Guidance to Developers in Assessing Minimum Water Depth over Tidal Devices (2014)
Scoping Report 2018	The marking of offshore wave and tidal energy installations should be based on recommendations of the IALA, and the offshore structures marking can be found on the IALA website.	All marking and lighting will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures and will be determined through consultation with Trinity House.
Scoping Report 2018	Consideration will need to be given to the implications of the site size and location on SAR resources and Emergency Response Co-operation Plans (ERCOP) for both construction and operation phases. Any additional Search and Rescue requirements, as per MGN 543 Annex 5, will be discussed	See **Chapter 15, Shipping and Navigation, Sections 15.6.3** and **15.6.4.** The Project will adhere to the MCA Guidance on Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response.

Date/Document	Comment	Response
	and agreed at the approval stage and recorded in a SAR checklist.	
Scoping Report 2018	Particular attention should be paid to cabling routes and where appropriate burial depth for which a Burial Protection Index study should be completed and, subject to the traffic volumes, an anchor penetration study may be necessary. If cable protection is required e.g. rock bags, concrete mattresses, a 5 % reduction in surrounding depths referenced to Chart Datum is acceptable. This will be particularly relevant where depths are decreasing towards shore and potential impacts on navigable water increase.	Cable burial and changes to charted depth arising from tidal turbines and the burial depth of cabling, where applicable, should be surveyed and marked on navigational charts.
Scoping Report 2018	Cable Corridor 4 runs to the south of the major shipping route of the Holyhead to Dublin ferry route by 5 km. The ES will need to appropriately assess this in relation to maintaining safe navigation and provide reassurance that this can be undertaken with suitable protection and the absolute minimal level of disruption.	Please refer to **Chapter 4, Project Description** for details of the proposed cable route and landfall in Abraham's Bosom which succeed the Scoping Report. Final mitigation plans will be agreed prior to the construction once the final details are known. This will include a Communications and Liaison Plan, Aids to Navigation Plan, Emergency response Co-operation Plan and array specific Navigation Risk Assessment Plan which will be submitted prior to construction and device deployments.
Scoping Report 2018	All cable laying should be charted with the data freely available to marine users and suitable protection in the form of burial or rock placement must be implemented to prevent cable snag which through abrasion will damage the cable and potentially cause damage to the vessel or crew and potentially vessel obstruction.	Noted. Final mitigation plans will be agreed prior to the construction once the final details are known. This will include a Communications and Liaison Plan, Aids to Navigation Plan, Emergency Response Co-operation Plan and array specific Navigation Risk Assessment Plan which will be submitted prior to construction and device deployments.
Scoping Report 2018	The assessment in the ES should incorporate the effects of tidal arrays, associated infrastructure, and any proposed exclusion zones on recreational routes, general sailing areas, racing areas, and access to boating facilities and anchorages.	Noted and assessed in **Chapter 15, Shipping and Navigation Section 15.6** and **Appendix 15.1** (**Volume III**).
Scoping Report 2018	MCA, UKHO, and GLAs guidance on charting, marking, and lighting of tidal infrastructure should be followed.	All marking and lighting will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures and will be determined through consultation with Trinity House.
Scoping Report 2018	MGN 543 Annex 2 requires that hydrographic surveys should fulfil the requirements of the International Hydrographic Organisation (IHO) Order 1a standard, with the final data supplied as a digital full density data set, and survey reports to the MCA Hydrography	Noted.

Date/Document	Comment	Response
	Manager. Failure to report the survey or conduct it to Order 1a might invalidate the Navigational Risk Assessment if it was deemed not fit for purpose.	
Scoping Report 2018	Any application for safety zones will need to be carefully assessed and additionally supported by experience from the development and construction stages	Noted. Safety Zones are assessed in **Chapter 15, Shipping and Navigation Section 15.6.** Safety Zones would be monitored and enforced through active monitoring arrangements such as guard vessels and control centre. Final mitigation plans will be agreed prior to the construction once the final details are known.
MCA		
October 2018 (PHA)	Concerns on: 1. Size of the project area – a Safety Zone would result in a large area that will be unavailable for navigation;	Noted. Safety Zones are assessed in **Chapter 15, Shipping and Navigation Section 15.6.** Safety Zones would be monitored and enforced through active monitoring arrangements such as guard vessels and control centre. Final mitigation plans will be agreed prior to the construction once the final details are known.
	2. Cutting an established inshore navigation route;	The Project does not "cut" any established inshore navigation route although the NRA does consider the impact of narrowing the available sea space within the inshore route and pinch points. See **Chapter 15, Shipping and Navigation Sections 15.6.3.6** and **15.6.4.6** and **Appendix 15.1** (**Volume III**).
	3. Access through site;	Noted. Passage through the area is assessed in **Chapter 15, Shipping and Navigation Section 15.6** and **Appendix 15.1** (**Volume III**).
	4. Impacts on SAR activities; and	See **Chapter 15, Shipping and Navigation, Sections 15.6.3, 15.6.4.** The Project will adhere to the MCA Guidance on Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response.
	5. Need to collect site-specific radar data to inform EIA	See **Chapter 15, Shipping and Navigation, Section 15.4.3** AIS data were collected over a two week period in the summer during 2017 and two week period in the winter during 2019 to better understand the traffic profile of vessels transiting the project area and any potential impacts the Project may have upon navigation.

Date/Document	Comment	Response
		Six months of AIS data from between October 2017 and March 2018 were additionally sourced to account for any seasonal variances in ferry activity and usage of the poor weather routes. To overcome the limitations posed by utilisation of AIS alone and in line with MGN 543 requirements, winter and summer radar surveys were undertaken for representative summer and winter periods.
Chamber of Shipping		
October 2018 (PHA)	Primary Concerns: 1. Proximity to the Dublin/ Holyhead ferry route and the impact it may have upon adverse weather routing.	Noted. The northern boundary of the Project has been designed to minimise impact to the ferry routes and adverse weather routes and ferry routes and adverse weather routing are assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3.3, 15.6.3.4, 15.6.4.1** and **15.6.4.2**.
	2. Under Keel Clearances (UKC) particularly in the northern most zones.	Under Keel Clearance is assessed in the **Appendix 15.1** (**Volume III**) in accordance with MCA - Guidance to Developers in Assessing Minimum Water Depth over Tidal Devices (2014).
	3. Site layout uncertainty (distribution of devices of varying depth).	Noted. Final mitigation plans will be agreed prior to the construction once the final details are known. This will include a Communications and Liaison Plan, Aids to Navigation Plan, Emergency Response Co-operation Plan and array specific Navigation Risk Assessment Plan which will be submitted prior to construction and device deployments.
	4. Potential for the adoption of a full site Exclusion Zone.	Noted. Final mitigation plans will be agreed prior to the construction once the final details are known. This will include a Communications and Liaison Plan, Aids to Navigation Plan, Emergency Response Co-operation Plan and array specific Navigation Risk Assessment Plan which will be submitted prior to construction and device deployments.
	5. Need for NRA to consider cruise ships in this region	Noted. Cruise Ships are assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3.2** and **15.6.4.1**.
	6. Impact on local anchorages.	Local anchorages are assessed in **Appendix 15.1** (**Volume III**).
	7. Noted that the eastern boundary is highly utilised and there needs to be adequate clearance for the inshore route. Pointed out that no-one will sail at the site boundary rather, sailing will occur at a safe distance	The NRA does consider the impact of narrowing the available sea space within the inshore passage and pinch points.

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	from the eastern boundary, resulting in a very narrow navigable channel.	See **Chapter 15, Shipping and Navigation Sections 15.6.3.6** and **15.6.4.6** and **Appendix 15.1** (**Volume III**).
	8. If cables are not to be buried then sufficient protection needs to be in place e.g. gabions.	Noted. The impacts of the export cables are assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3.9** and **15.6.4.9**.
	9. Questioned whether the top zone could be re-located to the south of the current extent. Minimum 20m UKC should be maintained in Northern extent of the site.	Due to the availability of the tidal resource re-locating the northern most zone to the south of the Project has not been considered. However, the proposed site layout now outlines no devices with an UKC of less than 20m will be deployed in the northern most zone.
	10. Concern that level of activity attributed to installation and major maintenance may be far greater than that of a normal offshore renewable project and hence may cause increased activity and safety zone necessity in the area.	Noted. Safety Zones are assessed in **Chapter 15, Shipping and Navigation Section 15.6.** Safety Zones would be monitored and enforced through active monitoring arrangements such as guard vessels and control centre. Final mitigation plans will be agreed prior to the construction once the final details are known.
Trinity House		
October 2018 (PHA)	Marking and lighting will be fundamental to the project.	All marking and lighting will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures and will be determined through consultation with Trinity House.
	As much of the area should be left open for navigation as possible.	Noted.
	Would not like to see a site wide Safety Zone. Commented that at Minesto, a 12m UKC was proposed which is unacceptable. A 20m minimum UKC has been agreed at Minesto.	Noted. Safety Zones are assessed in **Chapter 15, Shipping and Navigation Section 15.6.** Under Keel Clearance is assessed in the **Appendix 15.1** (**Volume III**) in accordance with MCA - Guidance to Developers in Assessing Minimum Water Depth over Tidal Devices (2014).
	Restricted areas could be put in place but as much of the area should remain open for navigation as possible.	Noted.
	Policed Safety Zones should only be in place during construction and maintenance.	Safety Zones would be monitored and enforced through active monitoring arrangements such as guard vessels and control centre. Final mitigation plans will be agreed prior to the construction once the final details are known.

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	Considered that all devices should be charted, even seabed devices – either as individual devices or as whole areas.	Devices will be charted and marked in accordance with MCA guidelines and following review of the final design layout with the MCA, Trinity House and Chamber of Shipping.
	The operator is to ensure that the devices remain at the stated depths and in the state agreed.	Noted. It is anticipated that devices will be fitted with depth monitoring systems and be subject to periodic maintenance surveys.
	Buoyage should be monitored by the control centre (and guard vessel) and defects reported by the operators to TH.	All marking and lighting will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures and will be determined through consultation with Trinity House. Buoyage will be maintained and defects reported.
Welsh Fishermen's Association		
November 2018 (NRA)	Fishing vessel traffic on plot appears to be light. There is a plethora of under 10s that operate within the area. Abrahams Bosom should be more populated. Pot buoys – head ropes inshore within 10m contour. July is a very active month and therefore, there should be more traffic than demonstrated on the plot. There is very little traffic at the end of February / start of March.	Noted. There are limitations with AIS in that many fishing vessels under 10m are not equipped with AIS which is why radar surveys were also undertaken and this supplemented by fishing intensity data as recorded by the MMO using the Vessel Monitoring System (VMS). Fishing vessel activity and the impact of the Project on fishing vessels is discussed in **Chapter 15, Shipping and Navigation Sections 15.5.3.1.1, 15.6.3.5** and **15.6.4.5**.
	The MDZ is not very fishing friendly due to the tidal conditions, except for at slack water.	Noted.
	If the project were to go ahead fishing in the area would be sterilised due to snagging and gear loss issues – may get some fishermen attempting to set pots as lobsters will hide within devices which will create a new habitat.	Fishing vessel activity and the impact of the Project on fishing vessels is discussed in **Chapter 15, Shipping and Navigation Sections 15.5.3.1.1, 15.6.3.5** and **15.6.4.5**.
	Vessels will not be able to anchor in the zone if they run into difficulties.	Noted.
	At maximum capacity, a fishing boat would not attempt to navigate through the zones, even if they were lit. There is a risk of loss of power and drifting in to the devices	Noted.
	It appears that vessels will have to navigate around the outside of the Zone.	There will still be an inshore passage route available and the NRA does consider the impact of narrowing the available sea space and pinch points particularly for recreational and smaller fishing vessels.

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		See **Chapter 15, Shipping and Navigation Sections 15.6.3, 15.6.4** and **Appendix 15.1** (**Volume III**).
	Inshore passage is a manageable gap, however, the current makes it difficult to navigate. The inshore passage would not be navigable for a coaster. Normal passage planning would allow 1-2 miles offing from a steep-to danger.	The NRA does consider the impact of narrowing the available sea space and pinch points. See **Chapter 15, Shipping and Navigation Sections 15.6.3, 15.6.4** and **Appendix 15.1** (**Volume III**).
	Collision risk will likely increase, however, WFA does not consider increase will be appreciable. However, may be of concern for yachts/ powerboats in summer.	Collision and allision for fishing vessels are assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3, 15.6.4** and **Appendix 15.1** (**Volume III**).
	Required UKC should allow for worst case wave height and vessel draught. 8m minimum UKC required for fishing vessels to navigate over devices.	An UKC of 8m has been used for fishing vessel impact assessment. Under Keel Clearance is assessed in the **Appendix 15.1** (**Volume III**) in accordance with MCA - Guidance to Developers in Assessing Minimum Water Depth over Tidal Devices (2014).
	The separation between / spread of devices will be of highest concern.	Noted. Final mitigation plans will be agreed prior to the construction once the final details are known. This will include a Communications and Liaison Plan, Aids to Navigation Plan, Emergency Response Co-operation Plan and array specific Navigation Risk Assessment Plan which will be submitted prior to construction and device deployments.
	To navigate through windfarms a skipper requires parallel index lines on the radar to navigate safely through the devices. This would be more difficult with tidal devices.	Noted. Final mitigation plans will be agreed prior to the construction once the final details are known. This will include a Communications and Liaison Plan, Aids to Navigation Plan, Emergency Response Co-operation Plan and array specific Navigation Risk Assessment Plan which will be submitted prior to construction and device deployments.
	Cardinal mark the whole zone.	All marking and lighting will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures and will be determined through consultation with Trinity House.
	One of the rights of navigation is that you should be able to run to a safe haven if you get caught. Holyhead is the only close safe-haven. If this option were to be lost, then vessels would be very stuck.	Noted. Final mitigation plans will be agreed prior to the construction once the final details are known. This will include a Communications and Liaison Plan, Aids to Navigation Plan, Emergency Response Co-operation Plan and array specific Navigation Risk Assessment Plan which

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		will be submitted prior to construction and device deployments.
Harbour Master		
November 2018 (NRA)	Confirmed that the traffic plots were similar to what he would have anticipated other than the fishing vessel activity shown in the inshore area was less than he would have expected.	Noted. There are limitations with AIS in that many fishing vessels under 10m are not equipped with AIS which is why radar surveys were also undertaken and this supplemented by fishing intensity data as recorded by the MMO using the Vessel Monitoring System (VMS).
	Considered that the width of the inshore passage between Holy Island and the zone is too narrow for small vessel navigation except during clement weather conditions.	The NRA does consider the impact of narrowing of the inshore route, the available sea space and pinch points for recreational vessels. See **Chapter 15, Shipping and Navigation Sections 15.6.3.6** and **15.6.4.6** and **Appendix 15.1**(**Volume III**).
	Suggested an additional hazard to be considered of a vessel losing power and then being swept/blown down on to the devices.	This has been considered and would result in allision of a vessel with a tidal device which is considered in the Hazard Risk Assessment in the NRA and the impacts to all vessel types. See **Chapter 15, Shipping and Navigation Sections 15.6.3** and **15.6.4** and **Appendix 15.1** (**Volume III**).
	Considered that the current Stena and Irish Ferries vessels require approximately 20m to safely navigate at all states of tide and in all weather conditions.	The proposed site layout now outlines no devices with an UKC of less than 20m will be deployed in the northern most zone.
Local Recreation and RYA		
November 2018 (NRA)	Recreational traffic under-represented within plot. Last weekend of July to bank holiday weekend of August represents busiest period.	Noted. There are limitations with AIS in that many vessels under 10m are not equipped with AIS which is why radar surveys were also undertaken. Vessel traffic surveys have been conducted in accordance with MCA guidelines. See **Appendix 15.1** (**Volume III**). It is acknowledged that the vessel traffic data may not show peak periods of activity but it is still felt to be representative and suitable for impact assessment.
	The inshore passage is widely used by recreational vessels, particularly areas around Abrahams Bosom, South Stack and North Stack.	Noted.
	There are many kayakers active in the area that follow the coast line around Holyhead and utilise the inshore passage.	Noted.

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	Holyhead Sailing Club participates in racing around Anglesey. They race out of Holyhead harbour and will cross the northern portion of the site.	Noted.
	TBSC races around the stacks and can travel around 1 km off the South Stack when racing to and from Holyhead.	Noted.
	The proposed zone has the potential to have a long-term impact on the recreational use around the island.	The impacts on recreational users is assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3.6 15.6.4.6** and **Appendix 15.1** (**Volume III**).
	The primary concern is the restriction of the inshore passage which is essential to recreational vessels.	The NRA does consider the impact of narrowing of the inshore route, the available sea space and pinch points for recreational vessels. See **Chapter 15, Shipping and Navigation Sections 15.6.3.6** and **15.6.4.6** and **Appendix 15.1** (**Volume III**).
	Concerned about the visual impact surface devices may have on tourism.	Visual impacts discussed in **Chapter 24, Seascape, Landscape and Visual Impact Assessment**.
	If vessels transit too close to the shore, then there is a risk of wash deflecting off of the shore which is hazardous to small vessels. At least a 2-mile offing would be required to clear the over-falls. It is considered that there is an increased risk of collision due to navigating within a reduced area. Questioned whether the increase in survey vessels will increase traffic density in the inshore passage	The NRA does consider the impact of narrowing of the inshore route, the available sea space and pinch points for recreational vessels. See **Chapter 15, Shipping and Navigation Sections 15.6.3.6** and **15.6.4.6** and **Appendix 15.1** (**Volume III**).
	Large racing yachts have a draught of <2.5m. Therefore, in good weather if devices are >3m below CD then most would be able to transit above them. In poor weather safe UKC will increase to allow for wave heights. In this case a minimum of 6-7m is recommended.	Under Keel Clearance is assessed in the **Appendix 15.1** (**Volume III**) in accordance with MCA - Guidance to Developers in Assessing Minimum Water Depth over Tidal Devices (2014).
	Holyhead is the only nearby safe-haven for running for shelter. Caernarvon is not accessible during poor weather.	Noted.
	Surface mounted devices would represent a considerable hazard to a yacht making for Holyhead in a gale and it is, therefore, the preference of TBSC, not to have surface mounted devices within the project. Recreational vessels would be taking a severe risk attempting to transit through the site at night should it be populated with surface and near surface devices.	The impacts on recreational users is assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3.6 15.6.4.6** and **Appendix 15.1** (**Volume III**).

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	If the devices are under water with a sufficient UKC preference would be that there is no buoy at the surface to maintain navigation. Anything at the surface with the potential to break free should be avoided.	Under Keel Clearance is assessed in the **Appendix 15.1** (**Volume III**) in accordance with MCA - Guidance to Developers in Assessing Minimum Water Depth over Tidal Devices (2014).
	It was commented that buoys are hazardous in themselves and are difficult to maintain.	All marking and lighting will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures and will be determined through consultation with Trinity House.
	Swept depth should be given on chart.	Noted. Changes to charted depth arising from tidal turbines and the burial depth of cabling should be surveyed and marked on navigational charts. Devices will be monitored during operations.
RNLI		
November 2018 (NRA)	AIS/Radar plots showed less fishing activity in the area than they would have expected though the other plots appeared representative.	Noted. There are limitations with AIS in that many fishing vessels under 10m are not equipped with AIS which is why radar surveys were also undertaken and this supplemented by fishing intensity data as recorded by the MMO using the Vessel Monitoring System (VMS). Fishing vessel activity and the impact of the Project on fishing vessels is discussed in **Chapter 15, Shipping and Navigation Sections 15.5.3.1.1, 15.6.3.5** and **15.6.4.5**.
	Whelkers attempt to fish in the deep -water area however the tidal race makes it difficult except at neap tides.	Noted.
	SS Waverley comes close to shore when it visits.	Noted. Cruise Ships are assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3.2** and **15.6.4.1**.
	If blowing hard from the north, some of the larger vessels shelter at Caernarvon Bay/ behind Anglesey.	Noted.
	Stated that if he were making a passage through inshore passage, he does not believe that there would be sufficient spacing between the devices and the cliffs to navigate safely except in benign conditions. 3-4 cables off South Stack should normally be required with windage around the stack as, if engine was to fail during a westerly, then the vessel would be too close to shore. Fishing vessels would struggle in an inshore passage of this size.	The NRA does consider the impact of narrowing of the inshore route, the available sea space and pinch points for recreational vessels. See **Chapter 15, Shipping and Navigation Sections 15.6.3.6** and **15.6.4.6** and **Appendix 15.1** (**Volume III**).

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	RNLI considers 6-8m under keel clearance is necessary for small vessels (<2.5m draught) to navigate safely over submerged devices in all states of tide and weather conditions.	
	Vessels from south – west Ireland will definitely transit through the zone when running for shelter. Vessels will no longer be able to do this if the area is fully populated with surface devices and instead will have to go around the site. In which case it should be properly marked. South Stack is the beacon used as a waypoint for vessels coming in (vessels from Ireland etc).	Traffic surveys did not indicate significant transits through the development site but collision and allision for all vessel types is assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3** and **15.6.4** and **Appendix 15.1** (**Volume III**). All marking and lighting will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures and will be determined through consultation with Trinity House.
	RNLI questioned what the spacing of the devices will be. RNLI believe having them close may be a good thing as they will be clearly visible and vessels are not left wondering where the other devices are and it will encourage vessels to go around the entire site rather than attempting to get through.	Noted. Final design and layout is yet to be finalised. This will include a Communications and Liaison Plan, Aids to Navigation Plan, Emergency Response Co-operation Plan and array specific Navigation Risk Assessment Plan which will be submitted prior to construction and device deployments.
	Radar reflectors / RACONS on all four corners. Consider AIS on all four corners.	All marking and lighting will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures and will be determined through consultation with Trinity House. In consultation with Trinity House they advised “It is Trinity House’s preference that devices and buoys not be marked with AIS as the over proliferation of AIS can cause confusion on ships’ radar and ECDIS displays.”
	The RNLI has already responded to an incident involving a recreational vessel colliding with a Minesto Buoy. The radar reflector on the buoy was lost and the mast of the yacht broke. Vessels commonly break-down to the south of the proposed zone close to Careg Hen and drift northwards into the proposed project zone. Searches have been undertaken within the project area. For example, a multivessel search line approach was undertaken for a missing fisherman within the area.	Noted.

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Stena Line		
November 2018 (NRA)	The presence of surface devices at the northern boundary may impact ferry operations.	Noted. Ferry Routes and adverse weather routing are assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3.3, 15.6.3.4, 15.6.4.1** and **15.6.4.2**.
	Device breakout and stated device depth not being maintained would be of concern.	Noted. Changes to charted depth arising from tidal turbines and the burial depth of cabling should be surveyed and marked on navigational charts. Devices will be monitored during operations.
	Visibility of surface devices due to low height above water surface is a concern. Mark project zone on charts and ensure ECDIS is up to date. Ensure surface devices are clearly visible – however, if the zone is densely populated with surface devices which are all lit, run the risk of the whole zone being lit.	All marking and lighting will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures and will be determined through consultation with Trinity House.
	Consider devices >15m below CD in the northern most sub-zones	The final design layout is yet to be determined but suitable mitigations measures will be implemented. Under Keel Clearance is assessed in the **Appendix 15.1** (**Volume III**) in accordance with MCA - Guidance to Developers in Assessing Minimum Water Depth over Tidal Devices (2014).
Irish Ferries		
November 2018 (NRA)	The northern most two sub-zones and the top of the western sub-zone would clip the SW poor weather route. Normal weather route would be restricted. Adequate space must be left to allow Irish Ferries and Stena to cross.	Noted. Ferry Routes and adverse weather routing are assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3.3, 15.6.3.4, 15.6.4.1** and **15.6.4.2**.
	The route south to the “waiting area” passes directly through the MDZs. An adequate UKC to allow continued navigation would be 2 x draughts below the keel (total 3 draughts). This would result in a 20m minimum clearance as with Minesto. Devices with >20m clearance only in northern most zones.	Suitable UKC for Ferries has been set at 20m for the purpose of Impact Assessment. Under Keel Clearance is assessed in the **Appendix 15.1** (**Volume III**) in accordance with MCA - Guidance to Developers in Assessing Minimum Water Depth over Tidal Devices (2014).
	Consideration should be given to virtual buoys – they do not require a physical object to be present within the water, however, are detectable by vessel’s AIS. If surface devices were to be deployed then the northern most zone boundary should be clearly marked.	All marking and lighting will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures and will be determined through consultation with Trinity House. In consultation with Trinity House they advised “It is Trinity House’s preference that devices and buoys not be marked with AIS as the over proliferation of AIS

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		can cause confusion on ships' radar and ECDIS displays."
	Ensure that for all seabed devices that all supporting equipment (e.g.: cables and hubs) are on the seabed to maintain navigability. Also that they believe that the impact of the project to ferries will be less than to other vessel types such as recreational vessels.	Noted. All devices will be surveyed and monitored to ensure they maintain their specified depth. Changes to charted depth arising from tidal turbines and the burial depth of cabling should be surveyed and marked on navigational charts. Devices will be monitored during operations.
	The presence of the Morlais Project will prevent vessels approaching the ferry route from the south.	Noted.
	Noted that in terms of diversions - a Traffic Separation Scheme (TSS) may be implemented in a day and would likely cause much greater diversions than those that would result from the Morlais Project.	Noted.
RYA		
December 2018 (NRA)	Considered the inshore route to be too narrow and that navigation in the inshore route will be restricted. Small recreational vessels rely on this route and there is a risk of these vessels being forced into the over-falls. During fine weather and in the daytime this route may be navigable, however, it would be difficult /unsafe to navigate in poor weather and at night.	The NRA does consider the impact of narrowing of the inshore route, the available sea space and pinch points for recreational vessels. See **Chapter 15, Shipping and Navigation Sections 15.6.3.6** and **15.6.4.6** and **Appendix 15.1** (**Volume III**).
	Deploying a mixture of device types will be a concern as this would cause confusion. In this case at full capacity it would likely have to be an Area To Be Avoided (ATBA) forcing vessels to take the inshore or outshore route.	Noted. Final mitigation plans will be agreed prior to the construction once the final details are known.
	90 % of recreational vessels have a draught of 3m or less. A recreational vessel should not go through a swell greater than 3m. At all states of weather / tide 8m (from CD) of UKC would be required as a minimum to maintain navigation. Recommends that the MCA UKC methodology is utilised for the assessment of UKC.	Suitable UKC for Recreational users has generally been set at 8m for the purpose of Impact Assessment. Under Keel Clearance is assessed in the **Appendix 15.1** (**Volume III**) in accordance with MCA - Guidance to Developers in Assessing Minimum Water Depth over Tidal Devices (2014).
	Devices to be appropriately marked and lit - Trinity House to advise on this. Zone boundary to be marked on navigation charts and lit. Sub-surface devices not to be marked with buoys to maintain navigation.	All marking and lighting will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures and will be determined through consultation with Trinity House.

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	Locate surface devices / devices <8m below CD away from the eastern boundary.	Noted. This has been proposed as an additional mitigation measure. Final mitigation plans will be agreed prior to the construction once the final details are known.
	Relocate the eastern boundary to allow 4 cables of space for the inshore passage/ to accommodate the spread of the existing tracks.	Noted. This could be an additional mitigation measure. Final mitigation plans will be agreed prior to the construction once the final details are known.
	Explained that the RYA holds recreational vessel density data.	Noted. Similarly to the data held within the coastal atlas, this density data is based on AIS data and as such provides a less accurate picture than the combined radar and AIS data utilised within the assessment as a large proportion of recreational users do not carry AIS. The combination of summer and winter RADAR surveys and AIS data utilised within the NRA meets the requirements of MGN 543 and as such the use of RYA density data was not deemed necessary.
	Pointed out that wind farms are more visible and require around 1 km spacing between turbines.	Noted.
Chamber of Shipping		
December 2018 (NRA)	Commented that the two weeks' summer and two weeks' winter ferry data did not cover any period when the ferries were using their "Foul Weather Route" in SW gales. Additionally commented that March/April did not reflect what was understood to be winter. The standard ferry tracks overlap the northern two E/W zones; The "Foul Weather Route" passes through the northern two E/W zones plus through the northers half of the N/S zone; Commented that the northern E/W was more of a hazard to inbound (east going) ferries as, if having to alter course to starboard IAW the ColReg, it will force them close or into the northern E/W zone.	The data acquired is in accordance with the requirements MGN 543 but a further six-months of winter AIS data has also been included for analysis within the NRA. Noted. Ferry Routes and adverse weather routing are assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3.3, 15.6.3.4, 15.6.4.1** and **15.6.4.2**. The proposed site layout now outlines no devices with an UKC of less than 20m will be deployed in the northern most zone.
	Requested that a mitigation measure of only devices below 20m CD are deployed in the northern two E/W zones and the northern half of the N/S zone be considered.	UKC of 20m has been considered for Ferries and additional mitigation measures of excluding devices to deployed less than 20m below CD have been considered.
	Considered that Cruise ship routing was discretionary and could navigate to the west of the zones. The draught of larger cruise ships can be greater than for ferries.	Noted. Cruise Ships are assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3.2** and **15.6.4.1**.

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	Surprised about how few fishing vessels were contained in the radar/AIS data and expected to see more inshore activity.	Noted. There are limitations with AIS in that many fishing vessels under 10m are not equipped with AIS which is why radar surveys were also undertaken and this supplemented by fishing intensity data as recorded by the MMO using the Vessel Monitoring System (VMS). Fishing vessel activity and the impact of the Project on fishing vessels is discussed in **Chapter 15, Shipping and Navigation Sections 15.5.3.1.1, 15.6.3.5** and **15.6.4.5**.
	Considered that inshore route is not practical for coastal shipping and they would navigate to the West of the MDZs. Commented that the inshore route appeared to be narrow for recreational and fishing vessels which may cause them to deviate onto other routes should surface devices be used. Should submerged devices be used, small vessels could safely navigate over.	The NRA does consider the impact of narrowing of the inshore route, the available sea space and pinch points for recreational and fishing vessels. See **Chapter 15, Shipping and Navigation Sections 15.6.3.1, 15.6.4** and **Appendix 15.1** (**Volume III**).
	Understood the need for the Rochdale approach but would prefer to have more detail on the device deployment plan.	Device deployment plans are not known at this stage but will be provided as they are finalised.
	Considered that the proposed Morlais site would increase Navigation Risk of: Collision – squeezing traffic into a smaller area. Contact (Allision) – The devices introduce new surface and submerged objects in the area.	Collision and allision for all vessel types is assessed in **Chapter 15, Shipping and Navigation Sections 15.6.3, 15.6.4** and **Appendix 15.1** (**Volume III**).
	SAR restrictions / access difficulties if surface devices are utilised and a sufficient distance for navigation is not maintained between devices.	See **Chapter 15, Shipping and Navigation, Sections 15.6.3, 15.6.4.** The Project will adhere to the MCA Guidance on Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response.
	Stated that the CoS supported the proposed Morlais site in principle provided that suitable navigational safety compromises and mitigation measures are agreed.	Noted.
MCA and Trinity House		
January 2019 (NRA consultation on the PHA and approach to NRA document)	The initial concern is the size of the project area. Reiterated that the layout once agreed will need to ensure clear lines of sight and navigational channels between devices to maintain search and rescue access especially at night, in poor visibility and high sea states.	Noted. See **Chapter 15, Shipping and Navigation, Sections 15.6.3, 15.6.4.** The Project will adhere to the MCA Guidance on Offshore Renewable Energy Installation: Requirements, Advice and

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	Reiterated that while the MCA is supportive of Offshore Renewable Energy development, its remit is to ensure that the safety of navigation is preserved, and Search and Rescue capability is maintained. Surface and surface breaking devices should, therefore, be aligned in straight rows that allow RNLI vessels to have continued access.	Guidance for Search and Rescue and Emergency Response. Final mitigation plans will be agreed prior to the construction once the final details are known.
	Concerns over restricting the inshore route.	The NRA does consider the impact of narrowing of the inshore route, the available sea space and pinch points for recreational and fishing vessels. See **Chapter 15, Shipping and Navigation Sections 15.6.3.1, 15.6.4** and **Appendix 15.1** (**Volume III**).
	Explained that Trinity House often has a vessel with a heli-pad working off South Stack lighthouse which typically would be located at a distance of up to 1.5 miles off of South Stack. Should Trinity House's access to South Stack lighthouse be restricted, this would be of significant operational concern.	During consultation it was noted by Trinity House that once per year it has a vessel with a heli-pad located up to 1.5 nm off of South Stack in order to carry out routine maintenance. Additionally, approximately every 7 years the vessel would be present for an extended time to support major maintenance activities such as; painting, battery change or modernisation. This information has been included in the NRA.
	Pointed out that there are no adequate examples of the alternative poor weather ferry routes within the passenger vessel plot.	An additional six months of winter AIS data has been purchased which contained examples of poor weather routes including a ferry anchoring at Abraham's Bosom.
	Pointed out that the fishing vessel traffic looked light with only examples of vessels en-transit passing through the MDZ.	Noted. There are limitations with AIS in that many fishing vessels under 10m are not equipped with AIS which is why radar surveys were also undertaken and this supplemented by fishing intensity data as recorded by the MMO using the Vessel Monitoring System (VMS).
	Questioned why the hazard 'Impact to Fishing' was scored as high for both the baseline and residual risk score.	This was due to the risk of gear catching on the devices causing both a hazard to the fishing gear and the project. It is considered, therefore, that this hazard cannot be mitigated to a level that would reduce the risk of fishing to acceptable levels and as such it is recommended that fishing be excluded within the MDZ.
	Pointed out that Safety Zones are only really effective if there are monitoring arrangements i.e. a guard vessel on site.	Noted. Safety Zones are assessed in **Chapter 15, Shipping and Navigation Section 15.6.** Safety Zones would be monitored and enforced through active monitoring arrangements such as guard vessels and

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		control centre. Final mitigation plans will be agreed prior to the construction once the final details are known.
	Questioned where the requirement for an ERCoP will be addressed.	This had been included as an embedded mitigation measure and is included within the NRA. See **Appendix 15.1** (**Volume III**).
	Questioned how C&IC impacts had been addressed within the PHA.	A high-level assessment had been undertaken and that Cumulative impacts are addressed. See **Chapter 15, Shipping and Navigation Section 15.6.6** and **Appendix 15.1** (**Volume III**).
	Enquired after the feedback received from local stakeholder consultation, particularly fishing and recreational users.	See Consultation Meeting Notes in **Appendix 15.1** (**Volume III**).
	Pointed out that there had been some updates to existing legislation / guidance: Annex 5 of MGN 543 – Revised ERCoP / SAR guidance IMO circular in relation to updated FSA Guidance (with reference to MGN 543)	Noted. The NRA was undertaken in accordance with this updated guidance/legislation.

15.4. METHODOLOGY

15.4.1. Study Area

18. The location of the MDZ is given within **Figure 15-1** (**Volume II**). The MDZ is located to the west of Holy Island, Anglesey, 500 m off South Stack and occupies a total area of 35 km^2 and has been nominally sub-divided in to eight indicative subzones (see **Figure 4-1, Volume II**).

15.4.2. Data Sources – Desk Study

19. The main data sources used to identify the baseline navigational features and activity in the vicinity of the Project were:

- Automatic Identification System (AIS) data;
- Radar data;
- GIS shapefiles;
- Maritime Incident Data (Maritime Accident Investigation Branch (MAIB) 1997-2017;
- Admiralty Sailing Directions – West Coast of England and Wales Pilot, NP37, 19th Edition, 2014; and
- UK Admiralty Charts: 1970, 1413 (All cartography in this report, unless otherwise stated, is to WGS84 UTM Zone 30N standard. All marine charts are in a Mercator projection. Charts are not suitable for navigational purposes).

15.4.3. Data Sources – Site-Specific Surveys and Reports

20. Project-specific marine traffic surveys which collected AIS, radar and visual data were undertaken as per **Table 15-3**. These surveys collected data over two week periods in the summer and winter, in line with MGN543 recommendations.

21. The following were assessed through the analysis of these marine traffic data:

- Location of the MDZ relative to areas used by any type of marine craft;
- Numbers, types and sizes of vessels presently using the MDZ including; course, name, IMO Number and nationality where possible;
- Non-transit uses of the areas, e.g. fishing, recreation, racing or military purposes;
- Presence of transit routes used by coastal or deep-draught vessel on passage; and
- Alignment and proximity of the development site relative to adjacent shipping lanes.

22. Further information was gathered through consultation with key stakeholders including representatives of recreational and fishing organisations, and the local harbour master.

23. Six months of AIS data from between October 2017 and March 2018 were additionally sourced to account for any seasonal variances in ferry activity and usage of the poor weather routes.

24. To overcome the limitations posed by utilisation of AIS alone and in line with MGN 543 requirements, winter and summer RADAR surveys were undertaken for representative summer and winter periods.

25. The data collected for utilisation within the NRA is summarised within **Table 15-3**.

Table 15-3 Project-Specific Marine Traffic Data Collection

Data Type	Season	Duration	Time Period
AIS	Summer	2 weeks	26th August to 9th September 2017
RADAR	Summer	2 weeks	26th August to 9th September 2017
AIS	Winter	2 weeks	05th April to 19th April 2019
RADAR	Winter	2 weeks	05th April to 19th April 2019
AIS	Winter*	6 Months	1st October 2017 to 31st March 2018
* AIS data purchased from Marine Traffic, not from survey.			

15.4.4. Impact Assessment Methodology

26. **Chapter 5, EIA Methodology** outlines the Impact Assessment Methodology used for other Chapters. The Navigation Risk Assessment Methodology for the impact assessment in this chapter is detailed within **Appendix 15.1** (**Volume III**).

27. The approach is similar to that outlined in **Chapter 5, EIA Methodology** in that it seeks to make a balanced assessment and is based on the 'source-pathway-receptor' conceptual model process used to provide a systematic and auditable approach to understanding the potential for

effects to arise, the spatial extents of the effect-receptor interactions, impact pathways, and potential impact significance.

28. The difference is that for the impact assessment methodology used in this chapter the outcomes are expressed as a Hazard Risk Score which is then translated into different terminology to that used in **Chapter 5, EIA Methodology** such as Negligible, Low Risk, As Low as Reasonably Practical (ALARP), Significant or High.

29. The objective is to use embedded mitigation and additional mitigations measures to reduce the risk to ALARP or better. This would be equivalent in the EIA Methodology outlined in **Chapter 5, EIA Methodology** to introducing mitigation measure to reduce Major and Moderate impacts to Minor or better.

15.4.5. Formal Risk Assessment Methodology

30. A shipping and navigation receptor can only be sensitive if there is a pathway through which an impact can be transmitted between the source activity and the receptor. This risk assessment was conducted in accordance with the International Maritime Organisation (IMO) Formal Safety Assessment (FSA) methodology for risk assessments.

31. Hazard identification is the first fundamental step in the risk assessment process and was informed by analysis and feedback from stakeholders. Key navigation hazards were identified and grouped with the identified vessel types operational in the vicinity of the MDZ to form the list of potential impacts for assessment. The hazards were then assessed as a factor of likelihood (frequency) and consequence. This approach considered two scenarios; “most likely” and the “worst credible”. The quantified values of frequency and consequence were then combined using the Marico HAZMAN ll software to produce a risk score for each hazard and collated into a “Ranked Hazard List”. Risk control measures were then suggested that may reduce the hazard to ALARP.

32. Risk is the product of a combination of consequence of an event and the frequency with which it might be expected to occur. In order to determine navigation risk a Formal Safety Assessment (FSA) approach to risk management is used. International Maritime Organisation (IMO) Guidelines define a hazard as “something with the potential to cause harm, loss or injury”, the realisation of which results in an accident. The potential for a hazard to be realised can be combined with an estimated or known consequence of outcome. This combination is termed “risk”. Risk is therefore a measure of the frequency and consequence of a particular hazard.

15.4.5.1.1. General Risk Matrix

33. The combination of consequence and frequency of occurrence of a hazard is combined using a risk matrix which enables hazards to be ranked and a risk score assigned. The resulting scale can be divided into three general categories:

1. Acceptable;
2. As Low as Reasonably Practicable (ALARP); and
3. Intolerable.

34. At the low end of the scale, frequency is extremely remote and consequence minor, and as such the risk can be said to be “acceptable”, whilst at the high end of the matrix, where hazards are defined as frequent and the consequence catastrophic, then risk is termed “intolerable”. Every effort should be made to mitigate all risks such that they lie in the “acceptable” range.

35. Where this is not possible, they should be reduced to the level where further reduction is not practicable. This region, at the centre of the matrix is described as the ALARP region. It is possible that some risks will lie in the “intolerable” region, but can be mitigated by measures, which reduce their risk score and move them into the ALARP region, where they can be tolerated, albeit efforts should continue to be made when opportunity presents itself to further reduce their risk score.

36. The FSA methodology used determines where to prioritise risk control options for the navigational aspects of a project site. The outcome of this risk assessment process should then act as the basis for a Navigation Safety Management System, which can be used to manage navigational risk.

15.4.5.1.2. Hazard Identification

37. Hazard identification is the first and fundamental step in the risk assessment process and was undertaken using the results of the analysis and feedback from local stakeholders.

38. The project phases were assessed individually due to their different navigational risk exposure and magnitude, i.e. the different nature of the operations, the vessels involved, and the potential cost of any consequences.

15.4.5.1.3. Risk Matrix Criteria

39. Frequency of occurrence and likely consequence are both to be assessed for the “most likely” and “worst case” scenario. It should be noted that within the NRA (**Appendix 15.1, Volume III**) reference is made to “worst credible scenarios” which is equivalent to “worst case scenario”. Frequencies were assessed according to the levels set out in **Table 15-4** below.

Table 15-4 Frequency Criteria

Scale	Description	Definition	Operational Interpretation
F5	Frequent	An event occurring in the range once a week to once an operating year.	One or more times in 1 year
F4	Likely	An event occurring in the range once a year to once every 10 operating years.	One or more times in 10 years 1 - 9 years
F3	Possible	An event occurring in the range once every 10 operating years to once in 100 operating years.	One or more times in 100 years 10 – 99 years
F2	Unlikely	An event occurring in the range less than once in 100 operating years.	One or more times in 1,000 years 100 – 999 years
F1	Remote	Considered to occur less than once in 1,000 operating years (e.g. it may have occurred at a similar site, elsewhere in the world).	Less than once in 1,000 years >1,000 years

40. Using the assessed notional frequency for the "most likely" and "worst case" scenarios for each hazard, the probable consequence associated with each hazard was assessed in terms of damage to:

- People - Personal injury, fatality etc.;
- Property – Project and third party;
- Environment - Oil pollution etc.; and
- Business - Reputation, financial loss, public relations etc.

41. Consequences were assessed according to the levels set out in **Table 15-5**.

Table 15-5 Consequence Categories and Criteria

Category	People	Property	Environment	Business
C1	**Negligible** Possible very minor injury (e.g. bruising)	**Negligible** Costs <£10k	**Negligible** No effect of note. Tier1 may be declared but criteria not necessarily met. Costs <£10k	**Negligible** Costs <£10k
C2	**Minor** (single minor injury)	**Minor** Minor damage Costs £10k – £100k	**Minor** Tier 1 – Tier 2 criteria reached. Small operational (oil) spill with little effect on environmental amenity. Costs £10K–£100k	**Minor** Bad local publicity and/or short-term loss of revenue Costs £10k – £100k
C3	**Moderate** Multiple minor or single major injury	**Moderate** Moderate damage Costs £100k - £1M	**Moderate** Tier 2 spill criteria reached but capable of being limited to immediate area within site Costs £100k -£1M	**Moderate** Bad widespread publicity Temporary suspension of operations or prolonged restrictions to project Costs £100k - £1M
C4	**Major** Multiple major injuries or single fatality	**Major** Major damage Costs £1M -£10M	**Major** Tier 3 criteria reached with pollution requiring national support. Chemical spillage or small gas release Costs £1M - £10M	**Major** National publicity, Temporary closure or prolonged restrictions on project operations Costs £1M -£10M
C5	**Catastrophic** Multiple fatalities	**Catastrophic** Catastrophic damage Costs >£10M	**Catastrophic** Tier 3 oil spill criteria reached.	**Catastrophic** International media publicity. Project site closes. Operations

Category	People	Property	Environment	Business
			International support required. Widespread shoreline contamination. Serious chemical or gas release. Significant threat to environmental amenity. Costs >£10M	and revenue seriously disrupted for more than two days. Ensuing loss of revenue. Costs >£10M

15.4.5.1.4. Hazard Data Review Process

42. Frequency and consequence data were assessed for each hazard. This was subsequently influenced by the views and experience of the many stakeholders, whose contribution was greatly appreciated, as well as historic incidents where available.

43. It should be noted that the hazards were scored on the basis of the “status quo” i.e. with all existing embedded mitigation measures taken into consideration. The outcome of this process was then checked for consistency against the assessments made in previous and similar risk assessments.

44. Having decided in respect of each hazard which frequency and consequence criteria are appropriate for the five consequence categories in both the “most likely” and “worst case” scenarios, eleven risk scores were obtained using the following matrix **Table 15-6**.

Table 15-6 Risk Factor Matrix Used for Hazard Assessment

Consequences	C5 (catastrophic)	5	6	7	8	10
	C4 (major)	4	5	6	7	9
	C3 (moderate)	3	3	4	6	8
	C2 (minor)	1	2	2	3	6
	C1 (negligible)	0	0	0	0	0
	Frequency	F1: Remote (>1,000 years)	F2: Unlikely (100-1,000 years)	F3: Possible (10-100 years)	F4: Likely (1 to 10 years)	F5: Frequent (Yearly)

45. Where:

Risk Number	Risk
0 to 1.9	Negligible
2 to 3.9	Low Risk
4 to 6.9	As Low as Reasonably Practical (ALARP)
7 to 8.9	Significant Risk
9 to 10.0	High Risk

46. It should be noted that occasionally, a “most likely” scenario will generate a higher risk score than the equivalent “worst case” scenario; this is due to the increased frequency often

associated with a "most likely" event. For example, in the case of a large number of small contact events, the total damage might be of greater significance than a single heavy contact at a much lesser frequency.

15.4.5.1.5. Hazard Ranking

47. The risk scores obtained from the above process were then analysed further to obtain four indices for each hazard as follows:

- The average risk score of the four categories in the "most likely" set;
- The average risk score of the four categories in the "worst case" set;
- The maximum risk score of the four categories in the "most likely" set; and
- The maximum risk score of the four categories in the "worst case" set.

48. These scores were then be combined in Marico Marine's hazard management software "HAZMAN" to produce a single numeric value representing each of the four indices. The hazard list was then sorted in order of the aggregate of the four indices to produce a "Ranked Hazard List" with the highest risk hazards prioritised at the top.

49. Mitigation measures that could be employed to reduce the likelihood or consequence of the hazards occurring were then identified. Risk controls were reviewed and discussed, and recommendations made as to which would be suitable for the Project. Risk controls were proposed that show the greatest reduction in risk to the highest scoring identified hazards and following feedback from consultees.

15.5. EXISTING ENVIRONMENT

50. The following sections present a description of the existing baseline features and shipping activity recorded in the vicinity of the MDZ.

15.5.1. Regional Context

51. The largest ports in the area are Liverpool located on mainland UK, Dublin located on mainland Republic of Ireland (ROI) and Holyhead, situated on Anglesey. Shelter is listed within the Admiralty Sailing Directions (ASD) as available at all times in Holyhead Outer Harbour. In bad weather or at the request of the vessel, Liverpool Pilots will board vessels off Point Lynas at 53˚25'000 N; 4˚17'39 W.

52. South Stack Lighthouse is located at 53˚18'41 N; 4˚41' 98 W. The light is shown throughout 24 hours.

53. The closest Traffic Separation Scheme (TSS) is the Off Skerries TSS (53˚22'.88 N; 4˚52'27 W to 53˚32'18 N; 4˚31' 78 W). Off Skerries was established for vessels rounding the northwest coast of Anglesey. Rule 10 of The International Regulations for Preventing Collisions at Sea (COLREGS) applies. Laden tankers are to avoid the area between the southeast boundary of the TSS and the coast.

54. An un-adopted TSS is located at the entrance to Holyhead Harbour. The RNLI provides all-weather and inshore lifeboats around the coast for saving life at sea. The RNLI stations near to the MDZ are given within **Table 15-7**. At each of these stations crew and lifeboats are available on a 24-hour basis throughout the year.

55. The closest HM Coastguard SAR station to the MDZ is situated at Caernarfon Airport. The base has been operated by Bristow Helicopters Ltd on behalf of HMCG since it opened in 2015.

56. Anchorages in vicinity of the proposed MDZ are given within **Table 15-8.**

Table 15-7 RNLI Stations near to the MDZ

Station	Location	Lifeboats
Holyhead New Harbour	53˚19'.17N 4˚38'.56W	Christopher Pearce – Severn Class Mary and Archie Hooper – D Class
Trearddur Bay	53°16'.57"N 4°37'.49"W	Hereford Endeavour- B Class Clive and Imelda Rawlins – D Class

Table 15-8 Nearby Anchorages

Anchorage	Description
Abraham's Bosom	53˚17'.81N 4˚40'.97W - Anchorage in offshore winds. A below water rock lies below the water surface (Pen – las rock) close to the northern entrance to the bay with foul ground extending 1 cable southwest from the rock.
Trearddur Bay	53˚16'.63N 4˚37'.28W Temporary anchorage in offshore winds.

57. For details regarding other Infrastructure and Marine Users within the area please refer to **Chapter 16, Infrastructure and Other Users**.

15.5.2. Physical Environment

58. Wind, wave and tidal data for the area were used as input to the NRA process. This is presented in **Chapter 7, Metocean Conditions and Coastal Processes** of the ES.

15.5.3. Marine Traffic Survey

59. This section presents analysis of the maritime traffic survey data within the study area and intersecting the development site. Data have been collected using AIS and radar and cover 2 x two week periods from 2017 through to 2019; one winter periods and one summer period. Further analysis of historical AIS data from a 6 month period covering from October 2017 to March 2018 was also included.

60. All vessel tracks recorded by AIS and RADAR between 26th August and 19th September 2018 and 5th April and 19th April 2019 are shown in **Figure 15-2** (**Volume II**). Immediately evident is the inshore passage utilised by smaller low-draught vessels such as; recreational craft, workboats and small fishing vessels and the ferry route to the north of the MDZ utilised by Irish Ferries and Stena Line (see **Figure 15-7, Volume II**).

15.5.3.1. Density Analysis

61. Density analysis was undertaken using a fixed Cartesian grid system to count the number of vessel transits through each given 100 m² cell.

62. Vessel transit density from the summer 2017 and winter 2019 radar and AIS surveys is represented within **Figure 15-3** (**Volume II**). The inshore passage and ferry route to the north of the MDZ are clearly evident, demonstrating the highest traffic densities.

63. Vessel transit density per month across the MDZ for the winter 2017 / 2018 period (from AIS only) is depicted in **Figure 15-4** (**Volume II**). It is evident that traffic density of larger vessels carrying AIS is low within the MDZ during winter with <4 transits per month across all sub-zones, with up to 12 transits per month occurring in the northern most 200 m of the MDZ, reflecting the presence of the ferry route there.

15.5.3.1.1. Analysis by Vessel Type

64. Analysis according to vessel type has been undertaken to establish existing traffic patterns within the proposed MDZ. Following assessment of the primary vessel types present within the area, vessel types were grouped in to the categories outlined in **Table 15-9** for analysis.

Table 15-9 Vessel Categories

Ref	Vessel Type Category	Draught	Including
1	Commercial Ship	>3m	Cargo vessels, tankers, dredgers, survey vessels (draught >3m), buoy laying vessels, commercial fishing vessels/ fish carriers.
2	Passenger Vessel	>3m	Ferries, cruise ships
3	Fishing Vessel	<3m	Fishing Vessels
4	Recreational Vessel	<3m	Yachts, power boats, kayaks, canoes
5	Other Vessel	<3m	Tugs and tows, survey vessels, RNLI, construction and maintenance vessels, cable laying vessels.

<u>Commercial Ships</u>

65. The tracks of commercial vessels >3 m draught (including cargo, tankers and dredgers) recorded during two-weeks of winter 2019 and two weeks of summer 2017 are shown in **Figure 5-5** (**Volume II**).

66. There was one vessel of this category within the winter dataset; the general cargo vessel *Halenic* (unladen draught 3.2 m, laden draught 5.5 m). This vessel transited 0.2 nm from the western boundary of the MDZ. There were two vessels of this category within the summer dataset; the buoy laying vessel *Patricia* (draught 4.5 m) and the dredger *DEO Gloria* (draught 3.3 m). No tankers were recorded within either dataset.

<u>Passenger Ferries</u>

67. Irish Ferries and Stena Line operate to the north of the proposed MDZ as shown in **Figure 15-6** (**Volume II**) and **Figure 15-7** (**Volume II**). Typically, the ferries transit clear of the northern zone boundary, however, occasionally pass within the northern two sub-zones and the western

sub-zone during poor weather conditions. A summary of poor weather routing from consultation is given within **Table 15-10**.

Table 15-10 Consultation Feedback in Relation to Poor Weather Routing

Consultee	Feedback
Stena Line	▪ During a SW gale (rare but considered to be the most difficult) 046˚ line is utilised, which takes the vessel through the MDZ. ▪ Alternative weather routing plus 100 % cargo lashing must be taken with a forecast of >4m waves. ▪ Ferries do not transit near to the tidal race.
Irish Ferries	▪ The ferries will not normally operate in 5m waves. Irish Ferries has a 2.5m sea state limit. ▪ 7˚ Poor weather route is utilised in SW gales and when sea state is building up to 3.5m significant waves. ▪ Holyhead Deep is considered to be an Area to Be Avoided (ATBA) during high seas as this is the main area of wave build up. ▪ Irish Ferries avoid navigating too close to shore due to wave build up. Irish Ferries never transit closer than half a mile to shore. ▪ Usage of the alternative poor weather routes varies. For example: they were utilised for approximately 3 weeks in 2017 (mainly within November) and 3 days in 2018. ▪ Waiting area to the south of the MDZs rarely utilised (2 times in 13 years by the Ulysses and similar usage by Epsilon).
Holyhead Harbour Master	▪ Seas in the vicinity of the Holyhead Deep can be particularly rough and the area is avoided by the ferries.

68. Six months of AIS data from between October 2017 and March 2018 was sourced to account for any seasonal variances in ferry activity and usage of the poor weather routes. The data includes Class A and Class B vessels.

69. The ferry *Epsilon* is noted in **Figure 15-16** (**Volume II**) transiting through the proposed MDZ to anchor at Abrahams Bosom on 03rd March 2018. Although this is considered a rare event (**Table 15-10**), alternative poor weather/emergency anchor routes would likely need to be established, should devices with an UKC of <20 m be deployed within the proposed MDZ.

70. In addition to ferries, five transits were made by four unique cruise ship vessels; *Hebridean Sky* (draught 4.2 m), *Corinthian* (draught 4 m), *Variety Voyage*r (draught 3.4 m) and *Balmoral* (draught 2.1 m) within the two-week summer 2017 dataset. The cruise ships, while infrequent, are noted occupying a larger portion of the proposed MDZ and are present within all eight sub-zones. Cruise ships undertake thorough passage planning and, in contrast to ferries, cruise ships may more easily alter passage plans to accommodate offshore infrastructure.

Naval Vessels

71. Naval vessels may not broadcast AIS given the sensitive nature of their operations and, as such, may be under-represented within the datasets. **Figure 15-8** (**Volume II**) shows the tracks naval vessels recorded within the summer and winter 2017 surveys.

72. Two transits by one unique vessel, the military training vessel *Smit Don*, were recorded within the proposed MDZ within the winter dataset. One transit by *Smit Don* was recorded within the northern most sub-zone of the proposed MDZ within summer. *Smit Don* has a recorded draught of <3 m.

Other Vessels

73. **Figure 15-9** (**Volume II**) shows an assortment of other vessel types which are active near the Project, including; tugs and tows, survey vessels, RNLI vessels, construction and maintenance vessels and cable laying vessels. This vessel category is active across the entirety of the proposed MDZ and is primarily comprised of vessels with draught <3 m. *MV Seekat C* is noted undertaking Project related surveys within the summer dataset with other category vessels more prolific in summer than in winter.

Fishing Vessels

74. This section analyses the fishing vessel activity in the study area, based on the maritime traffic survey. Further information is provided in **Chapter 14, Commercial Fisheries**.

75. Holyhead is one of three main commercial fishing ports in Wales. The tracks of fishing vessels during summer and winter from radar and AIS are given in **Figure 15-10** (**Volume II**). The Admiralty Sailing Directions (ASD)[1] details that within this region, inshore trawlers *'may be encountered at any time in depths of 25 m to 35 m' and that pots may be found up to 10 miles offshore'.* The tracks within the inshore passage and those actively fishing within the eastern portion of the proposed MDZ are comprised of smaller fishing vessels that do not carry AIS while the majority of fishing vessels on transit are larger vessels carrying AIS. It is noted that vessels engaged in fishing are more prevalent within summer than winter where the majority of vessels are on transit through the proposed MDZ.

76. Fishing data from AIS and radar has been supplemented by fishing intensity data as recorded by the MMO using the Vessel Monitoring System (VMS). VMS is required on vessels greater than 15 m Length Over-All LOA and effort is presented in kW hours (kWh) (calculated by multiplying the time associated with each VMS report in hours by the engine power of the vessel concerned at the time of the activity).

77. Fishing intensity from VMS in the vicinity of the MDZ is shown within **Figure 15-11** (**Volume II**). Intensity is determined to be low at less than 20,000 kWh per year, particularly to the west of the MDZ where the intensity falls to <5,000 kWh per year.

Recreational Vessels

78. The tracks of recreational vessels are given within **Figure 15-12** (**Volume II**). Most tracks are concentrated close to shore with small recreational craft, including yachts, primarily utilising the

[1] United Kingdom Hydrographic Office - Admiralty Sailing Directions : West Coast of England Pilot (2014) , NP37, 19th Edition, Chapter 7 – North-West Coast of Wales Including The Island of Anglesey and the Menai Strait.

inshore passage to the east of the MDZ. The density of recreational vessels increases substantially in summer where the area occupied by these vessels is much greater, overlapping the eastern portion of the proposed MDZ, particularly in the vicinity of South Stack. In consultation with the recreational users and RYA in November 2018, August was described as the busiest month as a result of favourable weather conditions and the school holidays.

Analysis by Vessel Length

79. Vessel transits by LOA from AIS between 1st October 2017 and 31st March 2018 are shown in **Figure 15-13** (**Volume II**). The majority of vessels transiting through the MDZ are <21 m LOA corresponding to; recreational, fishing and other vessel categories. All vessels transiting through the proposed MDZ with a LOA >167 m transited within the northern most two sub-zones and the western-most sub-zone with the exception of *Epsilon* (see **Figure 15-6, Volume II**) which transited through the proposed MDZ to anchor at Abrahams Bosom on 3rd March 2018.

Maritime Incidents

80. **Figure 15-14** (**Volume II**) shows marine accidents investigated by the MAIB in proximity to the MDZ between 1997 and 2017. There were 14 separate MAIB incidents recorded within 1 nm, of which, one is considered navigationally significant; a collision between a fishing boat and a recreational dive boat on 31st August 2015. The incident was described by the MAIB as follows:

'Collision between a dive RHIB and fishing vessel - A diving boat had divers in the water and was stationary displaying the appropriate flag, when a fishing vessel came towards them at speed and despite seeing the diving vessel did not slow down.'[2]

81. It was noted during consultation with the RNLI Holyhead in November 2018 that an incident had occurred at the adjacent Minesto operated Holyhead Deep tidal energy site, whereby a yacht made contact with a project buoy resulting in loss of the radar reflector on the buoy and the mast of the yacht.

82. RNLI Callouts are shown within **Figure 15-15** (**Volume II**). A total of 125 callouts occurred within 1 nm of the proposed MDZ, or approximately 16 per year. Of these, 56 callouts (45 %) involved recreational vessels, and 10 or 8 % involved fishing vessels. 9 % of callouts were in response to a person in the water and 25 % were in response to persons stranded on the adjacent beach cliffs. One callout was in response to a military vessel that experienced a machinery failure. 23 % of callouts reported machinery failure as the cause for assistance. 50 % of callouts were answered by Holyhead Lifeboat station and 50 % by Trearddur Bay Lifeboat station.

83. A total of 21 callouts occurred within the MDZ, of which, 12 or 57 % were in response to recreational vessels. 50 % of callouts within the MDZ occurred in 2008 and 2012, the busiest years for callouts. There were two callouts per year between 2014 and 2016 within the MDZ.

[2] Marine Accident Investigation Branch (2015)

15.6. IMPACT ASSESSMENT

15.6.1. Overview of Potential Impacts

84. The main navigation effects of the MDZ are assessed as:

- Restriction of vessel navigation; and
- Increased risk of vessel allision, between vessels and the tidal devices (surface piercing superstructures and subsea elements), and collision between vessels and other vessels due to reduced sea room.

85. **Table 15-11** provides a list of the potential impacts on Shipping and Navigation that may arise during activities undertaken during each phase of the Project.

Table 15-11 Potential Impacts of the Project Phases on Shipping and Navigation

Phase	Potential Impact
Construction	Impact 1: Potential Impacts on commercial vessels (safe operations) Impact 2: Potential Impacts on commercial vessel routing Impact 3: Potential impacts on passenger vessels (safe operations) Impact 4: Potential impacts on passenger vessel routing Impact 5: Potential impacts on commercial fishing vessels Impact 6: Potential impacts on recreational craft Impact 7: Potential impacts on other vessels Impact 8: Potential impacts on emergency response operations Impact 9: Subsea export cables
Operation and Maintenance (including Repowering)	Impact 1: Potential impacts on commercial vessels (safe operations) Impact 2: Potential impacts on commercial vessel routing Impact 3: Potential impacts on passenger vessels (safe operations) Impact 4: Potential impacts on passenger vessel routing Impact 5: Potential impacts on commercial fishing vessels Impact 6: Potential impacts on recreational craft Impact 7: Potential Impacts on other vessels Impact 8: Potential impacts on emergency response operations Impact 9: Subsea export cable
Decommissioning	Impact 1: Potential Impacts on commercial vessels (safe operations) Impact 2: Potential Impacts on commercial vessel routing Impact 3: Potential impacts on passenger vessels (safe operations) Impact 4: Potential impacts on passenger vessel routing Impact 5: Potential impacts on commercial fishing vessels Impact 6: Potential impacts on recreational craft Impact 7: Potential impacts on other vessels Impact 8: Potential impacts on emergency response operations Impact 9: Subsea export cables

15.6.2. Worst Case Parameters

86. In order to assess the potential impact of the MDZ on shipping and navigation, a worst-case layout has been assumed throughout the Navigation Risk Assessment (both surface and sub-surface) within the NRA. As a finalised layout was not available for the assessment, the NRA assumes any combination of device types may be deployed up to a maximum 240 MW (worst-case capacity).

Table 15-12 NRA Assumptions

Assumption	Description
Utilisation of worst-case maximum capacity (240 MW)	The proposed installed capacity of the Project was increased in response to industry demand. The Project is seeking consent for an array of up to 240 MW installed capacity.
Any device type may be deployed within any sub-zone	The Project will install multiple technology types; therefore, the consent application will be based on the Project Design Envelope (Rochdale Envelope) approach. Device types will be determined through consideration of the direction of future developments and technology.
Maximum 9 x 33 kV export cables	A series of seabed installed cables will be laid between individual offshore electrical hubs and the landfall location. The cable routes have not yet been determined, however, they will make landfall at Abrahams Bosom.
Project Design (Rochdale) Envelope Approach	No defined, device specific layout was provided prior to undertaking the NRA. The application will be based on the Project Design (Rochdale) Envelope approach to maintain maximum layout and device flexibility.
Embedded mitigation measures are in place prior to construction	Embedded mitigation listed within **Appendix 15.1** (**Volume III**) are assumed to be in place and as such are reflected in the scores.

15.6.2.1. Construction Programme

87. The construction of offshore works (for installation of tidal devices and associated cabling and infrastructure) would be phased over a period of several years, taking up to 15 days per device or hub and up to 1.5 days for each inter-array cable, up to 20 days for each offshore cable, and up to 12 days for each phase of cable protection. Up to nine separate cable laying and protection campaigns are possible. The HDD at the landfall would be completed over a four- to six-month period with two months for offshore cable tail installation.

15.6.2.2. Repowering

88. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50 % of the tenants will undertake repowering, i.e. for 50 % of the tenants, their infrastructure will be removed and replaced (potentially with different infrastructure by a different tenant). For the other 50 % of tenants, their infrastructure will remain over the lifetime of the Project.

15.6.2.3. Embedded Mitigation

89. Mitigation and safety measures will be applied to the development appropriate to the level and type of risk determined during the EIA. Possible specific additional mitigation measures to be employed will be selected in consultation with the MCA navigation safety branch and other relevant statutory stakeholders where required, dependent on the final design.

90. Embedded mitigation measures are described further in the NRA (**Appendix 15.1, Volume III**) and will be in place throughout the relevant phases of the Project. Possible additional mitigation measures are described further in the NRA (**Appendix 15.1, Volume III**).

91. These embedded mitigation measures are (see **Appendix 15.1, Volume III** for further information):

- Compliance with applicable guidance and regulations (including COLREGs and SOLAS);
- Ensuring devices marked as per International Association of Lighthouse Authorities (IALA) Guidance and Aids to Navigation and in accordance with Trinity House;
- Promulgation of information to local stakeholders via Notice to Mariners and other appropriate Maritime Safety Information dissemination methods;
- Selection of appropriate construction/decommissioning and maintenance vessels;
- Global Positioning System off station alarm / Supervisory Control and Data Acquisition (SCADA) monitoring system;
- Incidents and near misses are reported and investigated by developer and operators;
- Surveyed and charted as required by United Kingdom Hydrographic Office;
- Formulation and implementation of an Emergency Response Co-operation Plan (ERCoP);
- Passage plans for construction/decommissioning and maintenance craft; and
- Consideration of weather and sea state during construction/decommissioning planning

15.6.3. Potential Impacts During Construction

15.6.3.1. Construction Impact 1: Potential Impacts on Commercial Vessels (Safe Operations)

92. The winter marine traffic survey only identified one commercial vessel >3 m draft and the summer marine traffic surveys only two commercial vessels >3 m draft within the study area at the time of the studies; one of which (the *MZV Equator*) was transiting within the Off Skerries TSS well clear of the MDZ.

93. Traffic is most dense offshore across the most northern part of the MDZ. The main flow of commercial vessels was southwest / northeast and vice versa transiting through all zones of the MDZ. One of the commercial vessels intersecting the MDZ was a dredger. This vessel was transiting northwest, destination Garston.

94. The impacts potentially associated with commercial vessels were raised at the consultation meetings with the Chamber of Shipping, see **Appendix 15.1** (**Volume III**).

95. Potential impacts may also affect ports or harbours utilised / in the vicinity of MDZ traffic, dependent or where staging areas are to be located.

96. During the construction phases there would be an increase in marine traffic associated with the vessels required to carry out these operations. This could increase the risk to other vessels operating within proximity of the offshore site or those vessels engaged in the construction phase. It is also possible that there could be an increased risk of vessels alliding with the tidal devices, due to the fact that either the devices are part constructed/decommissioned or navigational aids (e.g. lights and markings) may not all be present.

97. Close consultation and co-operation with ports where construction vessels or operations are to be based will reduce the potential for impacts.

98. Potential impacts identified as part of the assessment include:

- Contact: Commercial Ship with Surface Device;
- Contact: Commercial Ship with Mid-Water Device (<8 m below CD);
- Contact: Commercial Ship with Mid-Water Device (>8 m below CD);
- Contact: Commercial Ship with Sea-Bed Device >20 m UKC;
- Collision: Commercial Ship ICW Commercial Ship;
- Collision: Commercial Ship ICW Passenger Vessels;
- Collision: Commercial Ship ICW Fishing Vessel;
- Collision: Commercial Ship ICW Recreational Vessel;
- Collision: Commercial Ship ICW Other Vessel;
- Snagging/ Obstruction: Commercial Ship; and
- Breakout of device / device not at stated depth

99. The overall severity of consequences for the construction phase are considered to be moderate (C3) due to the potential for notable damage to infrastructure / vessel(s) and interruption to construction (including impacts on businesses). The frequency of occurrence is considered remote (F1) due to low vessel density and the presence of embedded mitigations.

100. This indicates an overall risk ranking of (C3 x F1) = **Low Risk**. An exception is Breakout of device / device not at stated depth (C4 X F3) = **ALARP**.

15.6.3.1.1. Additional Mitigation

101. Associated possible additional mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;

- Restrict Navigation through the MDZ;
- Only deploy devices that provide at least 20 m UKC as shown within **Figure 4-1** (**Volume II**);
- Use of guard vessel(s) to monitor passing traffic;
- Implementation of Safety Zones;
- Temporary navigation aids as required by Trinity House;
- Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known;
- Construction vessels to be marked in accordance with COLREGS; and
- Check device surveys.

15.6.3.1.2. Residual Impact

102. If all the mitigations measures as detailed are utilised then the overall impact would be reduced but would still remain as **Low Risk**.

15.6.3.2. Impact 2: Potential Impacts on Commercial Vessel Routing

103. Very few commercial vessels intersected the development site (**Appendix 15.1, Volume III**).

104. As already noted, there would be increased activity associated with these phases at the offshore site. There would also be deviations for transiting traffic associated with the avoidance of any 500 m rolling navigational safety zones in use. However, the early notification of the works through the promulgation of information will ensure that all receptors, including regular operators, are kept informed, enabling them to safely passage plan and anticipate the works taking place.

105. Potential impacts identified as part of the assessment include:

- Impact on Commercial Vessel Routing – Commercial vessel forced to take alternative route due to presence of the site.

106. The overall severity of consequences for the construction phases are considered to be minor (C2). The frequency of occurrence is considered remote (F1) due to the presence of embedded mitigations. This indicates an overall risk ranking of (C2 x F1) = **Low Risk.**

15.6.3.2.1. Additional Mitigation

107. Associated additional embedded mitigation measures that could be utilised would be as shown for Impact 1 (**Section 15.6.3.1**).

15.6.3.2.2. Residual Impact

108. If all the mitigations measures as detailed are utilised then the overall impact would be reduced but would still remain as **Low Risk**.

15.6.3.3. Impact 3: Potential Impacts on Passenger Vessels (Safe Operations)

109. Irish Ferries and Stena Line ferries operate to the north of the proposed MDZ as shown in **Appendix 15.1** (**Volume III**). Typically, the ferries transit clear of the northern zone boundary; however, occasionally pass within the northern two sub-zones and the western sub-zone during poor weather conditions. A summary of poor weather routing from consultation is given within **Appendix 15.1** (**Volume III**).

110. Traffic is most dense offshore across the most northern part of the MDZ. The main flow of passenger vessels was east / west and vice versa, as expected given the ferries routes in this area. In addition to ferries, five transits were made by four unique cruise ship vessels; Hebridean Sky (draught 4.2m), Corinthian (draught 4m), Variety Voyager (draught 3.4m) and Balmoral (draught 2.1m) within the two-week summer 2017 dataset. The cruise ships, while infrequent, are noted occupying a larger portion of the proposed MDZ. *Epsilon* is noted in **Appendix 15.1** (**Volume III**) transiting through the proposed MDZ to anchor at Abrahams Bosom on 03rd March 2018 although this is considered a rare event.

111. The impacts potentially associated with passenger vessels were raised at the consultation meetings with the Ferry Companies, Holyhead Harbour Master and the Chamber of Shipping, see **Appendix 15.1** (**Volume III**).

112. Potential impacts may also affect ports or harbours utilised / in the vicinity of MDZ traffic, dependent or where staging areas are to be located.

113. During the construction phases there would be an increase in marine traffic associated with the vessels required to carry out these operations. This could increase the risk to other vessels operating within proximity of the offshore site or those vessels engaged in the construction phase. It is also possible that there could be an increased risk of vessels alliding with the tidal devices, due to the fact that either the devices are part constructed/ or navigational aids (e.g. lights and markings) may not all be present.

114. Close consultation and co-operation with ports where construction vessels or operations are to be based will reduce the potential for impacts within port limits.

115. Potential impacts identified as part of the assessment include:

- Contact: Passenger Vessels with Surface Device;
- Contact: Passenger Vessels with Mid-Water Device (<8m below CD);
- Contact: Passenger Vessels with Mid-Water Device (>8m below CD);
- Contact: Passenger Vessels with Sea-Bed Device >20m UKC;
- Collision: Passenger Vessels ICW Commercial Ship;

- Collision: Passenger Vessels ICW Passenger Vessels;
- Collision: Passenger Vessels ICW Fishing Vessel;
- Collision: Passenger Vessels ICW Recreational Vessel;
- Collision: Passenger Vessels ICW Other Vessel;
- Snagging / Obstruction: Passenger Vessels; and
- Breakout of device / device not at stated depth.

116. The overall severity of consequences for the construction phases are considered to be moderate (C3) due to the potential for notable damage to infrastructure / vessel(s), possible pollution and interruption to construction (including impacts on businesses). The frequency of occurrence is considered unlikely (F2) due to the presence of embedded mitigations. This indicates an overall risk ranking of (C3 x F2) =**Low Risk.** Exceptions are Contact Passenger Vessels with Mid-Water Device (<8m below CD) where the increased (F3) frequency gives a risk ranking (C3 X F3) = **ALARP;** Collision Passenger Vessel ICW Passenger Vessel (C4 X F3) = **ALARP** and Breakout of device / device not at stated depth (C4 X F3) = **ALARP**.

15.6.3.3.1. Additional Mitigation

117. Associated possible additional mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Restrict Navigation through the MDZ;
- Only deploy devices that provide at least 20 m UKC as shown within **Figure 4-1** (**Volume II**);
- Redesign the Northern Boundary;
- Use of guard vessel(s) to monitor passing traffic;
- Implementation of Safety Zones;
- Temporary navigation aids as required by Trinity House;
- Undertake device specific NRA’s prior to deployments, i.e. once exact locations and scale/type of device deployment is known;
- Construction vessels to be marked in accordance with COLREGS; and
- Appropriate spacing of devices.

15.6.3.3.2. Residual Impact

118. If all the mitigations measures as detailed are utilised then the overall impact would be reduced but would still remain as **Low Risk**. With regard to Contact Passenger Vessels with Mid-Water Device (<8m below CD) where the increased (F3) frequency gives a risk ranking (C3 X F3) = **ALARP** then restricting the deployment of devices greater than 20m below CD as shown within **Figure 4-1** (**Volume II**) would reduce this to **Low Risk.** An exception is Collision: Passenger Vessel ICW Passenger Vessel which remains as **ALARP** driven by major (C4) Consequences.

15.6.3.4. Impact 4: Potential Impacts on Passenger Vessel Routing

119. Whilst cruise ships are seen to intersect the development site (**Appendix 15.1, Volume III**); they undertake thorough passage planning and, in contrast to ferries, cruise ships may more easily alter passage plans to accommodate offshore infrastructure.

120. Ferries frequently intersected the development site (**Appendix 15.1, Volume III**) to the north of the MDZ and during poor weather ferries were seen transiting right across the MDZ.

121. As already noted, there would be increased activity associated with these phases at the offshore site. There would also be deviations for transiting traffic associated with the avoidance of any 500m rolling navigational safety zones in use. However, the early notification of the works through the promulgation of information will ensure that all receptors, including regular operators, are kept informed, enabling them to safely passage plan and anticipate the works taking place. This would potential require discussions with the ferry companies to look at alternate poor weather routing if possible, or staging the construction works during the summer period, as is likely, to avoid the increase in poor weather routing during the winter.

122. Potential impacts identified as part of the assessment include:

123. Impact on Passenger Vessel Routing – Passenger vessel forced to take alternative route due to presence of the site. The overall severity of consequences for the construction phase are considered to be moderate (C2). The frequency of occurrence is considered likely (F5) due to the interaction of the proposed MDZ with ferry standard operational and poor weather routing. This indicates an overall risk ranking of (C2 x F5) = ALARP.

15.6.3.4.1. Additional Mitigation

124. Associated additional embedded mitigation measures that could be utilised would be as shown for Impact 3 (**Section 15.6.3.3.1**) with the addition of:

- Provisions made for continued use of ferry poor weather routing or alternative routes to be established.

15.6.3.4.2. Residual Impact

125. If all the mitigation measures as detailed are utilised then the residual impact would be reduced to **Low Risk**.

15.6.3.5. Impact 5: Potential Impacts on Fishing Vessels

126. Holyhead is one of three main commercial fishing ports in Wales. Catch types within the vicinity of the MDZ include; velvet crab, lobster, green shore crab, whelks, scallops and skate. Fishing activity in the MDZ, as indicated by local fishermen, is dominated by static gear, which are used to target shellfish species. Prawns also feature highly in the MMO landings data (MMO, 2018), as well as bass. Skate were also highlighted as a key species during consultation. There is generally no pelagic fishing due to no quotas being available to fish species here.

127. Three receptor groups were used in the Commercial Fisheries Assessment, A) ≤10m nearshore static gear vessels targeting crab/lobster in the nearshore region; B) ≤10m and >10m static gear vessels targeting whelk/crab/lobster in the MDZ; and C) >10m mobile gear vessels targeting whitefish and/or scallops in the MDZ and surrounding area (see **Chapter 14, Commercial Fisheries**).

128. The tracks of fishing vessels during summer and winter from radar and AIS are given in **Appendix 15.1** (**Volume III**) and show that tracks within the inshore passage and those actively fishing within the eastern portion of the proposed MDZ are comprised of smaller fishing vessels that do not carry AIS while the majority of fishing vessels on transit are larger vessels carrying AIS.

129. Fishing intensity from VMS in the vicinity of the MDZ is shown within **Appendix 15.1** (**Volume III**). Intensity is determined to be low at less than 20,000 kWh per year, particularly to the west of the zone where the intensity falls to <5,000 kWh per year.

130. Both the MMO data and observations during the marine traffic surveys indicated that the fishing vessels engaged in potting (static gear) were the most common vessels in proximity to the development site. Larger vessels carrying AIS with other gear types do not seem to operate in the area and were only observed on transit through the MDZ.

131. Static gear fishing vessels are regular users of the area in general, weather and conditions dependent, and operate with no notable impact on the other receptors transiting the area. These static gear vessels were densest between the development site boundary and the shore, in keeping with the gear being used.

132. The impacts potentially associated with fishing vessels were raised at the consultation meetings with the Welsh Fishing Association and Holyhead Harbour Master, see **Appendix 15.1** (**Volume III**).

133. Potential impacts identified as part of the assessment include:

- Contact: Fishing Vessels with Surface Device;
- Contact: Fishing Vessel with Mid-Water Device (<8m below CD);
- Contact: Fishing Vessel with Mid-Water Device (<8m below CD);
- Contact: Fishing Vessel with Sea-Bed Device >20m UKC;
- Collision: Fishing Vessel ICW Commercial Vessel;

- Collision: Fishing Vessel ICW Passenger Vessel
- Collision: Fishing Vessel ICW Fishing Vessel;
- Collision: Fishing Vessel ICW Recreational Vessel;
- Collision: Fishing Vessel ICW Other Vessel;
- Grounding: Fishing Vessel;
- Snagging/ Obstruction: Fishing Vessel; and
- Breakout of device / device not at stated depth.

134. Due to the gear type and activity of fishing vessels operating in proximity to the development site, the subsea structures present a risk with regard to interaction between devices and fishing gear. There is also risk posed by works traffic transiting to / from the development site.

135. The overall severity of consequences for the construction phase are considered to be moderate (C3) due to the potential for notable damage to infrastructure / vessel(s) and interruption to construction (including impacts on businesses). The frequency of occurrence is considered frequent (F3). This indicates an overall risk ranking of (C3 x F3) = **ALARP**.

15.6.3.5.1. Additional Mitigation

136. Associated possible additional mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Restrict Navigation through the MDZ;
- Exclusion of fishing within the MDZ;
- Only deploy devices that allow at least 8 m UKC along eastern boundary;
- Re-design eastern boundary of the MDZ;
- Ensure appropriate alignment and spacing of devices;
- Ensure regular programme of device condition surveys;
- Use of Guard vessel(s) to monitor passing traffic;
- Enhanced cable protection;
- Implementation of Safety Zones;
- Temporary navigation aids as required by Trinity House;

- Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known; and .
- Construction vessels to be marked in accordance with COLREGS

15.6.3.5.2. Residual Impact

137. Re-designing the eastern boundary of the MDZ was considered as a possible additional mitigation measure but was excluded as it was considered an unacceptable measure effecting the viability of the development. Therefore, this additional mitigation measure has not been included when assessing the residual impact.

138. Mid Water Devices <8m below CD present a great risk to commercial fishing vessels along with the possibility for Grounding of fishing vessels and snagging/obstruction. This is best reduced by considering additional mitigation measures particularly the exclusion of fishing within the MDZ. The severity of consequences for the construction phase would still be considered to be minor (C2). The frequency of occurrence could then be reduced to unlikely (F2) due to the presence of additional mitigations. This indicates an overall risk ranking of (C2 x F2) = **Low Risk**.

15.6.3.6. Impact 6: Potential Impacts on Recreational Craft

139. Recreational craft includes a variety of vessels, all generally have similar characteristics; small in size with relatively shallow keels (<3m) including yachts, powerboats, kayaks and canoes.

140. Recreational craft are highly influenced by season, daylight, fair weather and tidal conditions. This insight is consistent with the observations of the marine traffic survey, where during the summer, gate analysis (**Appendix 15.1, Volume III**) identified 52 % of all transits were by recreational craft making them the most prolific receptor, both in proximity to the development site and intersecting the development site.

141. Most tracks for recreational vessels are concentrated close to shore with craft, including yachts, primarily utilising the inshore passage to the east of the MDZ. The density of recreational vessels increases substantially in summer where the area occupied by these vessels is much greater, overlapping the eastern portion of the proposed MDZ. In consultation, August was described as the busiest month as a result of favourable weather conditions and the school holidays. It is likely therefore that the vessel track analysis underrepresents the recreational vessel activity in the summer months and vessel traffic may be more numerous around late July and August.

142. Although not observed on the traffic survey peak traffic is likely to be during the days with planned events taking place such as Holyhead and Trearddurr Bay Sailing Club Races events during the summer.

143. The impacts potentially associated with recreational vessels were raised at the consultation meetings with the Recreational Users, the RYA, Holyhead Harbour Masters and the RNLI see **Appendix 15.1** (**Volume III**).

144. As noted for other receptors, recreational craft are also susceptible to the impacts associated with construction activities. Although, less so to partially constructed / installed devices, as long as there is sufficient UKC.

145. Potential impacts identified as part of the assessment include:

- Contact Recreational Vessel with Surface Device;
- Contact Recreational Vessel with Mid-Water Device (<8m below CD);
- Contact Recreational Vessel with Sea-Bed Device >20m UKC;
- Collision: Recreational Vessel ICW Commercial Vessel;
- Collision: Recreational Vessel ICW Passenger Vessel;
- Collision: Recreational Vessel ICW Fishing Vessel;
- Collision Recreational Vessel ICW Recreational Vessel;
- Collision Recreational Vessel ICW Other Vessel;
- Grounding Recreational Vessel;
- Snagging/ Obstruction Recreational Vessel; and
- Breakout of device / device not at stated depth

146. The overall severity of consequences for the construction phase are considered to be moderate (C3) due to the potential for loss of life and notable damage to vessel(s). The frequency of occurrence is considered possible (F3). This indicates an overall risk ranking of (C3 x F3) = ALARP. There is one exception, Grounding: Recreational Vessel which was scored as Significant Risk due to the increased frequency of occurrence (C3 x F5). Mitigation measures are required to reduce the risk of Grounding: Recreational Vessel. The following mitigation measures should be considered to reduce this hazard to ALARP: Devices >8m below CD to be deployed along the eastern boundary; and redesign of the Eastern boundary.

15.6.3.6.1. Additional Mitigation

147. Associated possible additional mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Restrict Navigation through the MDZ;
- Only deploy devices that allow at least 8 m UKC along eastern boundary (to reduce the risk of Grounding Recreational Vessel to ALARP);
- Re-design eastern boundary of the MDZ (to reduce the risk of Grounding Recreational Vessel to ALARP);

- Ensure appropriate alignment and spacing of devices;
- Ensure regular programme of device condition surveys;
- Use of guard vessel(s) to monitor passing traffic;
- Establish no anchoring areas;
- Enhanced cable protection;
- Implementation of Safety Zones;
- Temporary navigation aids as required by Trinity House;
- Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known; and
- Construction vessels to be marked in accordance with COLREGS.

15.6.3.6.2. Residual Impact

148. Re-designing the eastern boundary of the MDZ was considered as a possible additional mitigation measure but was excluded as it was considered an unacceptable measure effecting the viability of the development. Therefore, this additional mitigation measure has not been included when assessing the residual impact.

149. If all the mitigation measures as detailed are utilised, with the exception of redesigning the eastern boundary, then the overall impact would be reduced to **Low Risk**.

15.6.3.7. Impact 7: Potential Impacts on Other Vessels

150. The professional nature of the vessels engaged in the operations associated with these phases will ensure this risk is as low as possible. The types of vessels which may be used in the project construction phase would be SOLAS (and other relevant conventions / codes) compliant. They would be operating in line with their safety management system (SMS) and using the appropriate Personal Protective Equipment (PPE).

151. Potential impacts identified as part of the assessment include:

- Contact Other Vessel with Surface Device;
- Contact Other Vessel with Mid-Water Device (<8m below CD);
- Contact Other Vessel with Sea-Bed Device >20m UKC;
- Collision: Other Vessel ICW Commercial Vessel;
- Collision: Other Vessel ICW Passenger Vessel;
- Collision: Other Vessel ICW Fishing Vessel;

- Collision Other Vessel ICW Recreational Vessel;
- Collision Other Vessel ICW Other Vessel;
- Grounding Other Vessel;
- Snagging/ Obstruction Recreational Vessel; and
- Breakout of device / device not at stated depth

152. The overall severity of consequences for the construction phases are considered to be moderate (C3) due to the potential for loss of life and notable damage to vessel(s). The frequency of occurrence is considered likely (F4) due to the presence of embedded mitigations. This indicates an overall risk ranking of (C3 x F4) **= ALARP**.

15.6.3.7.1. Additional Mitigation

153. Associated additional embedded mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Restrict Navigation through the MDZ;
- Use of guard vessel(s) to monitor passing traffic;
- Temporary navigation aids as required by Trinity House; and
- Construction vessels to be marked in accordance with COLREGS

15.6.3.7.2. Residual Impact

154. If all the mitigation measures as detailed are utilised then the overall impact would be reduced to **Low Risk**.

15.6.3.8. Impact 8: Potential Impacts on Emergency Response Operations

155. The device types and tidal technologies covered within the Project Design Envelope, as noted within **Chapter 4, Project Description** are such that they presents less of an obstruction to aerial SAR activities than other renewable technologies (OWF's). However, as highlighted in consultation with the MCA appropriate alignment and spacing of devices is key to SAR operations and clear lines of sight and navigational channels between devices to maintain SAR access especially at night.

156. The impacts potentially associated with Emergency Response vessels were raised at the consultation meetings with the RNLI and MCA see **Appendix 15.1** (**Volume III**).

157. Depending on the tidal device types installed, the recovery and evacuation of persons from the water in the development site would potentially be impacted due to surface piercing superstructure which could complicate recovery operations.

158. An ERCoP will be in place for all phases of the MDZ development. In addition, the vessels undertaking work at the development site will have some level of self-rescue capability, as required by SOLAS or their Flag State regulations.

159. The capability of those vessels engaged in work at the development site will also lend extra resilience to any response required. As will the guard vessel(s) during the phases where this is engaged.

160. Potential impacts identified as part of the assessment are the same for SAR as for other vessels e.g. Contact RNLI vessel with mid water device etc. as well as:

- Restricted SAR in the MDZ during an emergency.

161. The overall severity of consequences for all phases are considered to be moderate (C3). The frequency of occurrence is considered. This indicates an overall risk ranking of (C2 x F2) = **Low.** An exception is Contact RNLI Vessel with Mid-Water Device (<8m below CD) which scored as **ALARP.**

15.6.3.8.1. Additional Mitigation

162. Associated possible additional mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Restrict Navigation through the MDZ;
- Only deploy devices that allow at least 8 m UKC along eastern boundary;
- Re-design eastern boundary of the MDZ;
- Ensure appropriate alignment and spacing of devices;
- Ensure regular programme of device condition surveys;
- Use of guard vessel(s) to monitor passing traffic;
- Implementation of Safety Zones;
- Temporary navigation aids as required by Trinity House; and
- Construction vessels to be marked in accordance with COLREGS.

15.6.3.8.2. Residual Impact

163. Re-designing the eastern boundary of the MDZ was considered as a possible additional mitigation measure but was excluded as it was considered an unacceptable measure effecting the viability of the development. Therefore, this additional mitigation measure has not been included when assessing the residual impact.

164. If all the mitigations measures as detailed are utilised, with the exception of redesigning the eastern boundary, then the overall impact would be reduced but would still remain as **Low Risk**.

15.6.3.9. Impact 9: Subsea Infrastructure – Potential Impacts on all Receptors

165. The construction phase will involve a large specialist vessel(s) to undertake the work within the offshore site. This activity would be protected by the use of a rolling navigational safety zone and guard vessels. The cable would be protected by the most suitable method, as detailed within **Chapter 4, Project Description**; this could include cable burial or alternative protection (rock bags, mattresses or split-pipe).

166. Potential impacts identified as part of the assessment include:

- Vessel anchoring on or dragging anchor over subsea equipment; and
- Fishing gear interaction with subsea export cable.

167. The overall severity of consequences are considered to be minor (C2). The frequency of occurrence is considered possible (F3). This indicates an overall risk ranking of (C2 x F3) = **Low Risk**. An exception is Snagging / Obstruction: Fishing Vessel which scored as (C2 x F5) **ALARP.**

15.6.3.9.1. Additional Mitigation

168. Associated additional embedded mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Exclusion of Fishing within MDZ;
- Restrict Navigation through the MDZ;
- Only deploy devices that allow at least 8 m UKC along eastern boundary;
- Re-design eastern boundary of the MDZ;
- Ensure appropriate alignment and spacing of devices;
- Ensure regular programme of device condition surveys;
- Use of guard vessel(s) to monitor passing traffic;
- Implementation of Safety Zones;
- Temporary navigation aids as required by Trinity House;
- Construction vessels to be marked in accordance with COLREGS; and
- Cable protection by burial (where possible), rock bags, burial, mattresses or split pipe.

15.6.3.9.2. Residual Impact

169. Re-designing the eastern boundary of the MDZ was considered as a possible additional mitigation measure but was excluded as it was considered an unacceptable measure effecting the viability of the development. Therefore, this additional mitigation measure has not been included when assessing the residual impact.

170. If all the mitigation measures as detailed are utilised, with the exception of redesigning the eastern boundary, then the overall impact would be reduced but would still remain as **Low Risk**.

15.6.4. Potential Impacts During the Operation and Maintenance (including Repowering) Phases

15.6.4.1. Impact 1: Potential Impacts on Commercial Vessels (Safe Operations)

171. The operation and maintenance (including repowering) phases will see a reduced level of project related traffic activity and is expected to decline over the lifetime of this phase as technologies bed in and tidal devices require less attention. Developers are expected to visit each TEC up to 15 times annually for both planned and unplanned maintenance activities. Many developers plan to undertake at least monthly routine inspection / maintenance using small vessels. A worst-case scenario of one five-hour visit to each device on site per month may be foreseeable. Conversely, the operational phase will see increased utilisation of the MDZ and a larger device footprint.

172. Potential impacts identified as part of the assessment include:

- Contact: Commercial Ship with Surface Device;
- Contact: Commercial Ship with Mid-Water Device (<8m below CD);
- Contact: Commercial Ship with Mid-Water Device (>8m below CD);
- Collision: Commercial Ship ICW Commercial Ship;
- Collision: Commercial Ship ICW Passenger Vessels;
- Collision: Commercial Ship ICW Fishing Vessel;
- Collision: Commercial Ship ICW Recreational Vessel;
- Collision: Commercial Ship ICW Other Vessel;
- Snagging/ Obstruction: Commercial Ship; and
- Breakout of device / device not at stated depth.

173. The overall severity of consequences for commercial vessels during the operation and maintenance (including repowering) phases are considered to be moderate (C3) due to the potential for notable damage to infrastructure / vessel(s). The frequency of occurrence is considered remote (F1) due to the low commercial traffic density and presence of embedded mitigations. This indicates an overall risk ranking of (C3 x F1) = **Low**.

15.6.4.1.1. Additional Mitigation

174. Associated possible additional mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Restrict Navigation through the MDZ;
- Check devices surveys;
- Only deploy devices that provide at least 20 m UKC as shown within **Figure 4-1** (**Volume II**);
- Use of Guard vessel(s) to monitor passing traffic; and
- Exclusion of fishing within the MDZ (applicable to break out of device/device not at stated depth)

15.6.4.1.2. Residual Impact

175. If all the mitigations measures as detailed are utilised then the overall impact would be reduced but would still remain as **Low**.

15.6.4.2. Impact 2: Potential Impacts on Commercial Vessel Routing

176. As noted above, project related vessel activity during this phase would be much reduced. Only maintenance and/or repowering works taking place in the development site would have any impact on the receptor.

177. Potential impacts remain the same as the construction phase.

178. The overall severity of consequences for the operation and maintenance (including repowering) phases are considered to be minor (C2). The frequency of occurrence is considered likely (F4). This indicates an overall risk ranking (C2 x F4) = **Low.**

15.6.4.2.1. Additional Mitigation

179. Associated possible additional mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Restrict Navigation through the MDZ;
- Check device surveys;
- Only deploy devices that provide at least 20 m UKC as shown within **Figure 4-1** (**Volume II**); and
- Use of Guard vessel(s) to monitor passing traffic.

15.6.4.2.2. Residual Impact

180. If all the mitigations measures as detailed are utilised then the overall impact would be reduced but would still remain as **Low**.

15.6.4.3. Impact 3: Potential Impacts on Passenger Vessels (Safe Operations)

181. Once again it is anticipated that there will be a decrease in project related marine traffic as compared to the construction phases of the project.

182. Potential impacts identified as part of the assessment are as per Impact 3 for the Construction Phase (**Section 15.6.3.3**).

183. The overall severity of consequences for the operational and maintenance (including repowering) phases are considered to be moderate (C3) due to the potential for notable damage to infrastructure / vessel(s) and possible pollution. The frequency of occurrence is considered unlikely (F2) due to the presence of embedded mitigations. This indicates an overall risk ranking of (C3 x F2) = **Low**. The exception is Contact Passenger Vessels with Mid-Water Device (<8m below CD) where the slight increased frequency of likely (F4) gives a risk ranking of (C3 x F4) = **ALARP** and Collision: Passenger Vessel ICW Passenger Vessel (C4 x F2) = **ALARP.**

15.6.4.3.1. Additional Mitigation

184. Associated possible additional mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Restrict Navigation through the MDZ;
- Check device surveys;
- Only deploy devices that provide at least 20 m UKC as shown within **Figure 4-1** (**Volume II**);
- Redesign Northern Boundary; and
- Use of Guard vessel(s) to monitor passing traffic.

15.6.4.3.2. Residual Impact

185. If all the mitigation measures as detailed are utilised then the overall impact would be reduced but would still remain as **Low Risk**. With regard to Contact Passenger Vessels with Mid-Water Device (<8m below CD) where the increased (F4) frequency gives a risk ranking (C3 X F4) = **ALARP**, restricting the deployment of devices in the north to greater than 20m below CD would reduce this to **Low Risk**. An exception is Collision: Passenger Vessel ICW Passenger Vessel which remains as **ALARP** driven by major (C4) Consequences.

15.6.4.4. Impact 4: Potential Impacts on Passenger Vessel Routing

186. As previously stated, ferries frequently intersected the development site (**Appendix 15.1, Volume III**) to the north of the MDZ and during poor weather ferries were seen transiting right across the MDZ.

187. Potential impacts identified as part of the assessment include:

- Impact on Passenger Vessel Routing: Passenger vessel forced to take alternative route due to presence of site.

188. The overall severity of consequences for the operational and maintenance phase (including repowering) are considered to be minor (C2). The frequency of occurrence is considered frequent (F5). This indicates an overall risk ranking of (C2 x F5) = **ALARP.**

15.6.4.4.1. Additional Mitigation

189. Associated possible additional mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Restrict Navigation through the MDZ;
- Check device surveys;
- Only deploy devices that provide at least 20 m UKC as shown within **Figure 4-1** (**Volume II**);
- Redesign Northern Boundary;
- Use of Guard vessel(s) to monitor passing traffic; and
- Provisions made for continued use of ferry company poor weather routing or alternative routes to be provided.

15.6.4.4.2. Residual Impact

190. If all the mitigation measures as detailed are utilised then the overall impact would be reduced to **Low Risk**.

15.6.4.5. Impact 5: Potential Impacts on Fishing Vessels

191. Potential impacts identified as part of the assessment include:

- Contact: Fishing Vessels with Surface Device;
- Contact: Fishing Vessel with Mid-Water Device (<8m below CD);
- Contact: Fishing Vessel with Mid-Water Device (>8m below CD);

- Contact: Fishing Vessel with Sea-Bed Device >20m UKC;
- Collision: Fishing Vessel ICW Commercial Vessel;
- Collision: Fishing Vessel ICW Passenger Vessel;
- Collision: Fishing Vessel ICW Fishing Vessel;
- Collision: Fishing Vessel ICW Recreational Vessel;
- Collision Fishing Vessel with Other Vessel types;
- Grounding Fishing Vessel;
- Snagging/ Obstruction Fishing Vessel; and
- Breakout of device / device not at stated depth.

192. The overall severity of consequences for the operation and maintenance (including repowering) phases are considered to be minor (C2). The frequency of occurrence is considered possible (F3) due to the presence of embedded mitigations. This indicates an overall risk ranking of (C2 x F3) = **Low Risk**. Exceptions are Contact Fishing Vessel with Mid-Water Device <8 below CD (C2 x F5) **ALARP** and Snagging / Obstruction Fishing Vessel (C2 x F5) **ALARP**.

15.6.4.5.1. Additional Mitigation

193. Associated possible additional mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Exclusion of fishing within the MDZ;
- Only deploy devices that allow at least 8 m UKC along eastern boundary;
- Re-design eastern boundary of the MDZ;
- Ensure appropriate alignment and spacing of devices; and
- Check device surveys.

15.6.4.5.2. Residual Impact

194. Re-designing the eastern boundary of the MDZ was considered as a possible additional mitigation measure but was excluded as it was considered an unacceptable measure effecting the viability of the development. Therefore, this additional mitigation measure has not been included when assessing the residual impact.

195. If all the mitigation measures as detailed are utilised, with the exception of redesigning the eastern boundary, then the overall impact would be reduced but would still remain as **Low Risk**.

15.6.4.6. Impact 6: Potential Impacts on Recreational Craft

196. In the same manner as the other noted receptors, the reduction in project traffic levels will further reduce the impact of collision with project related vessels. Potential impacts remain the same as the construction phase.

197. The overall severity of consequences for the operation and maintenance (including repowering) phases are considered to be minor (C2). The frequency of occurrence is considered possible (F3) due to the presence of embedded mitigations. This indicates an overall risk ranking (C2 x F3) = **Low Risk.** Exceptions scored as ALARP include; Contact Recreational Vessel with Surface Device (C2 x F5) and Contact Recreational Vessel with Mid-Water Device (<8m below CD) (C2 x F5).

198. The hazard 'Grounding: Recreational Vessel' was scored as significant due to the increased frequency of occurrence (C3 x F5). Mitigation measures are required to reduce the risk of 'Grounding: Recreational Vessel.

15.6.4.6.1. Additional Mitigation

199. Associated additional embedded mitigation measures that could be utilised, as identified in the NRA, include:

- Restrict navigation through the MDZ;
- Continuous Monitoring by Marine Co-ordination Centre;
- Only deploy devices that allow at least 8 m UKC along eastern boundary;
- Re-design eastern boundary of the MDZ;
- Check device surveys
- Ensure appropriate alignment and spacing of devices; and
- Establish no anchoring areas

15.6.4.6.2. Residual Impact

200. The hazard 'Grounding: Recreational Vessel' was scored as significant. Mitigation measures are required to reduce the risk of 'Grounding: Recreational Vessel'.

201. The following mitigation measures were considered to reduce this hazard to ALARP:

- Devices >8m below CD to be deployed along the eastern boundary; and
- Redesign Eastern boundary.

202. Re-designing the eastern boundary of the MDZ was considered as a possible additional mitigation measure but was excluded as it was considered an unacceptable measure effecting the

viability of the development. Therefore, this additional mitigation measure has not been included when assessing the residual impact.

203. If all the mitigation measures as detailed are utilised, with the exception of redesigning the eastern boundary, then the overall impact would be reduced to **ALARP**.

15.6.4.7. Impact 7: Potential Impacts on Other Vessels

204. While project specific traffic would be reduced, the same high levels of operational planning would take place. The vessels engaged in this phase would likely be different from those in the other phases, especially those concerned solely with personnel transfers, etc. They would still be compliant with the relevant shipping safety codes and have a suitable SMS and correct PPE for the tasks taking place. Potential impacts remain the same as the construction phase. Associated possible mitigation measures remain similar to the construction phase with the exception of guard vessels and temporary navigation aids which are not applicable for the operational phase.

205. The overall severity of consequences for the operation and maintenance (including repowering) phases are considered to be minor (C2. The frequency of occurrence is considered Possible (F3) due to the reduction of project related traffic and presence of embedded mitigations. This indicates an overall risk ranking of (C2 x F3) = **Low Risk.**

15.6.4.7.1. Residual Impact

206. If all mitigation measures as detailed are utilised then the overall impact would be reduced but would remain **Low Risk**.

15.6.4.8. Impact 8: Potential Impacts on Emergency Response Operations

207. As with construction, an ERCoP will be in place for all phases of the Morlais development. In addition, the vessels undertaking maintenance and/or repowering work at the development site will have some level of self-rescue capability, as required by SOLAS or their Flag State regulations. However, as highlighted in consultation with the MCA appropriate alignment and spacing of devices is key to SAR operations and clear lines of sight and navigational channels between devices to maintain SAR access especially at night.

208. The capability of those vessels engaged in work at the development site will also lend extra resilience to any response required. As will the guard vessel(s) during maintenance activities, where this is engaged, operation dependent. Potential impacts remain the same as the construction phase.

209. The overall severity of consequences for all phases are considered to be minor (C2) due to the potential for loss of life. The frequency of occurrence is considered unlikely (F2). This indicates an overall risk ranking of (C2 x F2) = **Low.** The exceptions are Contact RNLI Vessel with Mid-Water Device (<8m below CD) = (C2 x F4) **ALARP** and Contact RNLI Vessel with Surface Device = (C2 x F4) **ALARP**.

210. Associated possible additional mitigation measures that could be utilised, as identified in the NRA, include:

- Continuous Monitoring by Marine Co-ordination Centre;
- Restrict Navigation through the MDZ;
- Only deploy devices that allow at least 8 m UKC along eastern boundary;
- Re-design eastern boundary of the MDZ;
- Ensure appropriate alignment and spacing of devices; and
- Check device surveys.

15.6.4.8.1. Residual Impact

211. Re-designing the eastern boundary of the MDZ was considered as a possible additional mitigation measure but was excluded as it was considered an unacceptable measure effecting the viability of the development. Therefore, this additional mitigation measure has not been included when assessing the residual impact.

212. If all the mitigation measures as detailed are utilised, with the exception of redesigning the eastern boundary, then the overall impact would be reduced but would remain **Low Risk**. The exceptions are Contact RNLI Vessel with Mid-Water Device (<8m below CD) = (C2 x F4) **ALARP** and Contact RNLI Vessel with Surface Device = (C2 x F4) **ALARP.**

15.6.4.9. Impact 9: Subsea Infrastructure – Potential Impacts on all Receptors

213. The subsea cable will be protected and the risk mitigated to ALARP.

214. Potential impacts remain the same as the construction phase.

215. Associated mitigation measures remain the same as the construction phase.

216. The overall severity of consequences for all phases are considered to be minor (C2). The frequency of occurrence is considered unlikely (F2) due to the presence of embedded mitigations. This indicates an overall risk ranking of (C2 x F2) = **Low Risk.** An exception is Snagging / Obstruction: Fishing Vessel which scored as (C2 x F5) **ALARP.**

15.6.4.9.1. Residual Impact

217. If all the mitigations measures as detailed are utilised then the overall impact would be reduced but would remain **Low Risk**. The hazard Snagging / Obstruction: Fishing Vessel which scored as (C2XF5) would be reduced to **Low Risk.**

15.6.5. Potential Impacts During Decommissioning

218. It is likely that decommissioning of individual structures will be the responsibility of the individual developers, as overseen by Mentor Môn. Decommissioning of the site comprises the complete removal of all infrastructure associated with the tidal energy project. Offshore decommissioning methodologies would vary considerably between devices but would be expected to be similar to the construction phase in reverse. For the purpose of this chapter, it is assumed that cables

are required to be removed as this represents the worst-case scenario in terms of impacts. Therefore, it can be assumed that all impacts identified as having the potential to arise during the construction phase (**Section 15.6.3**) may also occur during the decommissioning phase.

219. As the methodologies for decommissioning are expected to be similar to construction it can be assumed that the same impacts arise and can be applied to the decommissioning phase. It should be noted that this is a highly precautionary assessment as it is likely that the impacts from decommissioning will be less than those from construction (PTEC, 2014).

15.6.6. Cumulative Impacts

220. Cumulative impacts refer to the impact upon receptors, proposed developments and activities and any other foreseeable project proposals arising from the presence of the MDZ.

221. The approach to cumulative assessment considers the Cumulative Impact Assessment Guidelines issued by RenewableUK in June 2013.

222. In assessing the potential cumulative impacts, it is important to bear in mind that proposed and in development projects may or may not actually be taken forward. Relevant projects/ plans that are already under construction are likely to contribute to cumulative impact, whereas projects/ plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval or may not ultimately be built.

223. Projects that were identified and informed this approach are outlined within **Table 15-13.**

Table 15-13 Other Developments Considered in Cumulative Impact Assessment

Development Type	Project	Distance from Morlais (km)	Status
Tidal	Holyhead Deep	1	In Development
Oil and Gas	P2292	61	Operational
Wind Farm	Rhyl Flats	66	Operational
Wind Farm	Gwynt y Mor	67.5	Operational
Wind Farm Extension	Gwynt y Mor	67.5	Proposed
Wind Farm	North Hoyle	81.5	Operational
Aggregate Extraction	Area 457	70	Operational
Aggregate Extraction	Area 392 / 393	73	Operational

224. For the purposes of the cumulative assessment, the Holyhead Deep Tidal project with an aspirational maximum total installed capacity of 80 MW, is the only project currently in the planning phase considered to fall within the assessment study area, and as such the impact assessment has been driven by the cumulative impacts arising from this site. The assessed scenario is, therefore, outlined in **Table 15-14**.

Table 15-14 Assessed Scenario

Impact	Scenario	Justification

Cumulative Impact due to Increased Vessel Activity	Multiple offshore developments require construction and maintenance vessel activity as they transit to and from their bases of operation.	Potential increases in collision risk.
Cumulative Impact on Vessel Routing	Commercial shipping, fishing boats and recreational craft must all operate to avoid these developments and any works taking place. This reduces the available sea room available, concentrating them in smaller areas, potentially bringing them into conflict.	Change in vessel routing across multiple sites due to multiple developments.
Cumulative Impact from Cable Routes	Multiple cable routes that cross over one another may reduce the navigable depth of water.	Reduction in depth and increased maintenance works vessels.

225. The results of the cumulative risk assessment are given in **Table** 15-15. The determination of risk was assessed to be a factor of the likelihood of the impact occurring and the consequence, should it occur. The criteria of frequency and consequence and risk score definitions are outlined within the risk assessment methodology (**Appendix 15.1, Volume III**).

Table 15-15 Cumulative Risk Assessment

Impact	Description	Likelihood	Consequence	Risk Score	Impact
Impact from increased vessel Activity	Vessels associated with the Morlais and Holyhead Deep projects may interact with one another. The level of additional vessel activity from each project will be higher during construction and decommissioning. This has the potential to increase collision risk.	Unlikely	Minor	2	**Low Risk**
Impact on Vessel Routing	The cumulative impact of these developments will result in a loss of navigable sea room which may require vessels to be rerouted which has the potential to increase the risk elsewhere. Primary cumulative impacts to routing are the inshore passage and impact upon vessels such as ferries utilising the northern ferry route, search and rescue and Holyhead Deep maintenance vessels.	Unlikely	Minor	2	**Low Risk**
Impact from Cable Route	The cables are to be unburied with cable protection. Multiple cable routes are required for the project, which may result in a decrease in the charted depth in some areas and an increase in vessel activity during the construction and decommissioning phases.	Unlikely	Minor	2	**Low Risk**

15.7. SUMMARY

226. This chapter has provided an overview on the potential impacts on shipping and navigation that may occur within the construction, operation and maintenance, and decommissioning phases of the Morlais project.

227. The impacts presented in this chapter were identified and quantified via a formal NRA process (see **Appendix 15.1, Volume III**). The assessment included allision / collision risk modelling (including UKC) and a formal safety assessment for all phases of the developments, as well as an assessment of cumulative and in-combination effects.

228. The risk assessment was undertaken according to FSA methodology as adopted by the IMO and detailed within the NRA methodology.

229. **Table 15-16** collates the determinations of each of the impacts assessed and is presented as a summary of the determinations. In line with the terminology adopted by the NRA and presented in this chapter, severity of consequence and frequency of occurrence are used rather than magnitude of effect and sensitivity of receptor. All the risks/impacts presented below also assume that embedded mitigation defined in preceding sections are successfully implemented. Where additional mitigation measures are proposed, these are listed.

230. It's is evident from the Impact Assessment for Navigation and Shipping that the Morlais Development Zone will impact navigation and that a range of additional mitigation measures will be required to reduce the potential impacts and risk during the construction, operations and maintenance (including repowering) and decommissioning phases. Some of these additional mitigation measures will be relevant to specific vessel types but otherwise will apply for all marine traffic in the area.

231. For the construction phase there will be a need to restriction navigation and fishing activity (see **Chapter 14, Commercial Fisheries**) within the MDZ and the export cable corridor which will be achieved through implementation of Safety Zones of up to 500 m around all offshore works during construction.

232. For the operation and maintenance (including repowering) phase there will be a need to restrict navigation, anchoring and fishing activity within the MDZ and the export cable corridors. This will achieved by excluding any navigation within an "operational safety zone" of up to 500m of any offshore works or such other areas as may be determined following risk assessment or consultation with the MCA and RYA. However it is unlikely that it will be necessary to exclude all activity within the area such that:

- Navigation of commercial and passenger vessels should be possible within the MDZ where devices that provide at least 20 m UKC will be deployed as shown within **Figure 4-1** (**Volume II**);
- Navigation of recreational vessels should be possible within the MDZ except for all areas where floating devices are deployed (as shown within **Figure 4-1** (**Volume II**); and
- Within the export cable that lies outside the MDZ all navigation should be possible but all trawling/anchoring will be excluded within 200 m any cables once laid.

233. For the decommissioning phase there will be a need to restriction navigation and fishing activity (see **Chapter 14, Commercial Fisheries**) within the MDZ and the export cable corridor which will be achieved through implementation of Safety Zones of up to 500 m around all offshore works during construction.

Table 15-16 Summary of Potential Impacts on Shipping and Navigation Associated with the Development of the Project

Potential Impact	**Baseline Severity of Consequence**	**Baseline Frequency of Occurrence**	**Baseline Impact**	**Additional Mitigation Measures**	**Residual Impact (Risk)**
Construction Phase					
1. Potential impacts on commercial vessels (safe operations)	Moderate (C3)	Remote (F1)	(C3 x F1) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Only deploy devices that provide at least 20m UKC as shown within **Figure 4-1** (**Volume II**); ▪ Use of guard vessel(s) to monitor passing traffic; ▪ Implementation of Safety Zones; ▪ Temporary navigation aids as required by Trinity House; and ▪ Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known; ▪ Construction vessels to be marked in accordance with COLREGS; ▪ Check device surveys; and ▪ Exclusion of fishing within the MDZ (applicable to break out of device/device not at stated depth).	(C3 x F1) = **Low**
2. Potential impacts on commercial vessel routing	Minor (C2)	Remote (F1)	(C2 x F1) = Low	As above	(C2 x F1) = **Low**
3(a). Potential impacts on Passenger Vessels (safe operations)	Moderate (C3)	Unlikely (F2)	(C3 x F2) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ;	(C3 x F1) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Only deploy devices that provide at least 20 m UKC as shown within **Figure 4-1** (**Volume II**); ▪ Redesign the Northern Boundary; ▪ Use of guard vessel(s) to monitor passing traffic; ▪ Implementation of Safety Zones; ▪ Temporary navigation aids as required by Trinity House; ▪ Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known; ▪ Construction vessels to be marked in accordance with COLREGS; ▪ Appropriate spacing of devices; and ▪ Exclusion of fishing within the MDZ (applicable to break out of device/device not at stated depth).	
3(b). Contact: Passenger Vessels with mid-water devices (<8m UKC)	Moderate (C3)	Possible (F3)	(C3 x F3) = **ALARP**	▪ Restrict navigation through the Morlais Zone; ▪ Continues monitoring by Marine Co-ordination Centre; ▪ Devices >20m to be deployed along northern boundary; ▪ Re-design northern boundary; ▪ Check device surveys; ▪ Implementation of Safety Zones; ▪ Guard vessel to monitor passing traffic; ▪ Construction vessels to be marked in accordance with COLREGS; and	(C3 x F2) = **Low Risk**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Temporary navigation aids as required by Trinity House.	
3(c). Collision Passenger Vessel ICW Passenger Vessel	Major (C4)	Unlikely (F2)	(C4 x F2) = **ALARP**	▪ Continuous monitoring by Marine Co-ordination Centre; ▪ Re-design northern boundary; ▪ Guard vessels to monitor passing traffic; ▪ Construction vessels to be marked in accordance with COLREGS; and ▪ Temporary navigation aids as required by Trinity House.	(C4 x F1) = **ALARP**
4. Potential impacts on passenger vessel routing	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	As above	(C2 x F3) = **Low**
5. Potential impact on fishing vessels	Moderate(C3)	Possible (F3)	(C3 x F3) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Ensure appropriate alignment and spacing of devices; ▪ Ensure regular programme of device condition surveys; ▪ Use of Guard vessel(s) to monitor passing traffic;	(C2 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Enhanced cable protection; ▪ Implementation of Safety Zones; ▪ Temporary navigation aids as required by Trinity House; ▪ Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known; and ▪ Construction vessels to be marked in accordance with COLREGS.	
5 (b) Contact Fishing Vessel with Mid-Water Device <8 below CD	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Ensure appropriate alignment and spacing of devices; and ▪ Check device surveys.	C2 x F3 = **Low**
5 (c) Snagging / Obstruction Fishing Vessel	Minor (C2)	Frequent (F5)	(C2 x C5) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Ensure appropriate alignment and spacing of devices; and ▪ Check device surveys.	C2 x F3 = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
5 (d) Grounding Fishing Vessel	Minor (C2)	Likely (F4)	(C2 x F4) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Ensure appropriate alignment and spacing of devices; and ▪ Check device surveys.	(C2 x F3) = **Low**
6(a). Potential impact on recreational craft	Moderate (C3)	Possible (F3)	(C3 x F3) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Ensure appropriate alignment and spacing of devices; ▪ Ensure regular programme of device condition surveys; ▪ Use of guard vessel(s) to monitor passing traffic; ▪ Establish no anchoring areas; ▪ Enhanced cable protection; ▪ Implementation of Safety Zones; ▪ Temporary navigation aids as required by Trinity House; ▪ Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known;	(C3 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Construction vessels to be marked in accordance with COLREGS; and ▪ Exclusion of fishing within the MDZ (applicable to break out of device/device not at stated depth).	
6(b). Grounding Recreational Vessel	Moderate (C3)	Frequent (F5)	(C3 x F5) = **Significant** (Unacceptable in the absence of additional mitigation).	▪ Devices >8m below CD to be deployed along the eastern boundary. ▪	(C3 x F3) =ALARP
7. Potential impact on Other vessels	Moderate (C3)	Likely (F4)	(C3 x F4) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Use of guard vessel(s) to monitor passing traffic; ▪ Temporary navigation aids as required by Trinity House; and ▪ Construction vessels to be marked in accordance with COLREGS	(C2 x F3) = **Low**
8. Potential impact on emergency response operations	Minor (C2)	Unlikely (F2)	(C2 x F2) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Ensure appropriate alignment and spacing of devices; ▪ Ensure regular programme of device condition surveys;	(C2 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Use of guard vessel(s) to monitor passing traffic; ▪ Implementation of Safety Zones; ▪ Temporary navigation aids as required by Trinity House; ▪ Construction vessels to be marked in accordance with COLREGS; and ▪ Marine pollution contingency planning.	
8 (b) Contact SAR Vessel with Surface or Mid-Water Device (<8m below CD).	Minor (C2)	Likely (F4)	(C2 x F4) = **ALARP**	▪ Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Check Device Surveys; Appropriate spacing of devices. Local Promulgation; Creation of Emergency Response Cooperation Plan (ERCOP).	(C2 x F2) = **Low**
9. Subsea Infrastructure – impact on all receptors	Minor (C2)	Possible (F3)	(C2 x F3) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Ensure appropriate alignment and spacing of devices; ▪ Ensure regular programme of device condition surveys;	(C2 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Use of guard vessel(s) to monitor passing traffic; ▪ Implementation of Safety Zones; ▪ Temporary navigation aids as required by Trinity House; ▪ Construction vessels to be marked in accordance with COLREGS; and ▪ cable protection by burial (where possible), rock bags, burial, mattresses or split pipe.	
Operational Phase					
1. Potential impacts on commercial vessels (safe operations)	Moderate (C3)	Remote (F1)	(C3 x F1) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Check device surveys; ▪ Only deploy devices that provide at least 20 m UKC as shown within **Figure 4-1** (**Volume II**); and ▪ Use of guard vessel(s) to monitor passing traffic.	(C3 x F1) = **Low**
2. Potential impacts on commercial vessel routing	Minor (C2)	(Likely) F)	(C2 x F4) = Low	As above	(C2 x F1) = **Low**
3(a). Potential impacts on Passenger Vessels (safe operations)	Moderate (C3)	Unlikely (F2)	(C3 x F2) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Check device surveys; ▪ Only deploy devices that provide at least 20 m UKC as shown within **Figure 4-1** (**Volume II**);	(C3 x F1) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Redesign Northern Boundary; and ▪ Use of Guard vessel(s) to monitor passing traffic;	
3(b). Potential impact on passenger vessels: Contact: Passenger Vessels with mid-water devices (<8m UKC)	Moderate (C3)	Possible (F4)	(C3 x F4) = **ALARP**	As above	(C3 x F2) = **Low**
3(c). Collision Passenger Vessel ICW Passenger Vessel	Major (C4)	Remote (F2)	(C4 x F2) = **ALARP**	As above	(C4 x F1) = **ALARP**
4(a). Potential impacts on passenger vessel routing	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	As above	(C2 x F3) = **Low**
5. Potential impacts on fishing vessels	Minor (C2)	Possible (F3)	(C2 x F3) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Ensure appropriate alignment and spacing of devices; and ▪ Check device surveys.	(C2 x F1) = **Low**
5 (b) Contact Fishing Vessel with Mid-Water Device <8 below CD	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary;	C2 x F3 = Low

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Ensure appropriate alignment and spacing of devices; and ▪ Check device surveys.	
Snagging / Obstruction Fishing Vessel	Minor (C2)	Frequent(F5)	(C2 x F5) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Ensure appropriate alignment and spacing of devices; and ▪ Check device surveys.	C2 x F3 = **Low**
6(a). Potential impacts on recreational craft	Minor (C2)	Possible (F3)	(C2 x F3) = **Low**	▪ Restrict navigation throughout the MDZ; ▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Check device surveys; ▪ Ensure appropriate alignment and spacing of devices; and ▪ Establish no anchoring areas.	(C4 x F2) = **Low**
6(b). Grounding Recreational Vessel	Minor (C3)	Frequent (F5)	(C3 x F5) = **Significant** (Unacceptable in absence of additional mitigation)	▪ Devices >8m below CD to be deployed along the eastern boundary. ▪	(C3 x F3) = **ALARP**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
6 (c) Contact Recreational Vessel with Surface Device	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	▪ Restrict navigation throughout the MDZ; ▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ ; ▪ Check device surveys; and ▪ Ensure appropriate alignment and spacing of devices; and ▪ Establish no anchoring areas.	(C2 x F3) = **Low**
6 (d) Contact Recreational Vessel with Mid-Water Device (<8m below CD)	Minor (C2)	Likely (F5)	(C2 x F5) = **ALARP**	▪ Restrict navigation throughout the MDZ; ▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Check device surveys; and ▪ Ensure appropriate alignment and spacing of devices; and ▪ Establish no anchoring areas.	(C2 x F3) = **Low**
7. Potential Impacts on other vessels	Minor (C2)	Likely (F3)	(C2 x F3) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; and ▪ Construction vessels to be marked in accordance with COLREGS.	(C3 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
7 (b) Contact Other Vessels with Mid-Water Device (<8m below CD).	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	As Above	C2 x F3) = Low
8.(a) Potential impacts on emergency response operations	Minor (C2)	Unlikely (F2)	(C2 x F2) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; and ▪ Check device surveys.	(C2 x F2) = **Low**
8 (b) Contact SAR Vessel with Mid-Water Device (<8m below CD).	Minor(C2)	Likely (F4)	(C2 x F4) = **ALARP**	▪ Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; ▪ Devices >8m below CD to be deployed along eastern boundary; ▪ Check Device Surveys; ▪ Appropriate spacing of devices. ▪ Local Promulgation; ▪ Creation of Emergency Response Cooperation Plan (ERCOP).	(C2 x F2) = **Low**
9. (a) Subsea Infrastructure – potential impacts on all receptors	Minor (C2)	Unlikely (F2)	(C2 x F2) = **Low**	As above	(C2 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
9 (b) Snagging / Obstruction Fishing Vessel	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	As above	(C2 x F3) = **Low**
Decommissioning Phase					
	It is likely that decommissioning of individual structures will be the responsibility of the individual developers, as overseen by Mentor Môn. Decommissioning of the site comprises the complete removal of all infrastructure associated with the tidal energy project. Offshore decommissioning methodologies would vary considerably between devices but would be expected to be similar to the construction phase in reverse. As the methodologies for decommissioning are expected to be similar to construction it can be assumed that the same impacts arise and can be applied to the decommissioning phase. It should be noted that this is a highly precautionary assessment as it is likely that the impacts from decommissioning will be less than those from construction.				
Cumulative Impacts					
C1. Impact from increased vessel activity	Minor (C2)	Unlikely (F2)		▪ Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; ▪ Devices >8m below CD to be deployed along eastern boundary; ▪ Check Device Surveys; ▪ Appropriate spacing of devices. ▪ Local Promulgation; ▪ Creation of Emergency Response Cooperation Plan (ERCOP).	(C2 x F2) = **Low**
C2. Impact on vessel routing	Minor (C2)	Unlikely (F2)		As above	(C2 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
C3. Impact from subsea cables	Minor (C2)	Unlikely (F2)		As above	(C2 x F2) = **Low**

15.8. REFERENCES

Anatec, 2017. Summer Maritime Traffic Survey: South Stack, Anglesey. Prepared by Anatec Limited on behalf of Xodus and Morlais. 6th October 2017. Ref: A3955-MOR-TS-1.

Anatec, 2019. Winter Maritime Traffic Survey: South Stack, Anglesey. Prepared by Anatec Limited on behalf of Menter Mon. 26th April 2019. Ref: A4353-MM-TS-1.

Anatec, 2014c. Preliminary Hazard Analysis. Perpetuus Tidal Energy Centre. Ref.: A3192-RHDHV-PHA-00.

DECC, 2005, updated 2013. Guidance on the Assessment of the Impact of Offshore Wind Farms: Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms. London: DECC. DTI/Pub 8145/0.5k/12/05/NP. URN 05/1948.

DECC, 2011a. National Policy Statement for Renewable Energy Infrastructure (EN-3). ISBN 9780108510793.

DECC, 2011b. Standard Marking Schedule for Offshore Installations. London: Department of Energy & Climate Change.

HSE & MCA, 2017. Regulatory expectations on moorings for floating wind and marine devices, August 2017.

IALA, 2013. O-139 The Marking of Man-Made Offshore Structures. Edition 2. Saint Germain en Laye, France: International Association of Marine Aids to Navigation and Lighthouse Authorities.

IMO, 2002. Guidelines for Formal Safety Assessment (FSA) for use in the IMO Rule-Making Process. MSC/Circ.1023/MEPC/Circ392. London: International Maritime Association.

Marico Marine (2017). West Anglesey Demonstration Zone Marine Traffic Survey Report. 4th May 2017. Report Number: 17UK1318. Issue: 02

MAIB (2017). Maritime Incident Data (Maritime Accident Investigation Branch (MAIB) 1997-2017;

MCA, 2008a. Marine Guidance Notice 543 (MGN 543) (M+F) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response.

MCA, 2008b. Marine Guidance Notice 372 (M+F). Offshore Renewable Energy Installations (OREIs) – Guidance to Mariners Operating in the Vicinity of UK OREIs. Southampton: Maritime and Coastguard Agency.

Planning Inspectorate, 2018. Advice Note Nine: Using the Rochdale Envelope. July 2018. Version 3.

RYA, 2009, updated 2010. UK Coastal Atlas of Recreational Boating. Southampton: RYA.

RYA, 2013. The RYA's Position on Offshore Renewable Energy Developments: Paper 3 – Tidal Energy. Southampton: RYA.

UK Admiralty, 2014. Admiralty Sailing Directions – West Coast of England and Wales Pilot, NP37, 19th Edition, 2014.

UK Admiralty, 1970. UK Admiralty Charts: 1970, 1413.

Morlais Project
Environmental Statement

Chapter 16: Marine Infrastructures and Other Users

Volume I

Applicant: Menter Môn Morlais Limited Document Reference: PB5034-ES-016 Chapter 16: Marine Infrastructures and Other Users Author: MarineSpace			
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GLOSSARY OF ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
AfL	Area for Lease
ALARP	As Low As Reasonably Practicable
BT	British Telecommunications
DECC	Department of Energy and Climate Change
EIA	Environment Impact Assessment
ES	Environmental Statement
ESCA	European Subsea Cables Association
ICPC	International Cable Protection Committee
GBS	Gravity Base Structure
HRA	Habitats Regulation Assessment
HDD	Horizontal Directional Drilling
JLDP	Joint Local Development Plan
MCAA	Marine and Coastal Access Act
MCZ	Marine Conservation Zone
MCT	Marine Current Turbines
MPS	Marine Policy Statement
MOD	Ministry of Defence
MATZ	Military Aerodrome Traffic Zone
MDZ	Morlais Demonstration Zone
NPS	National Policy Statement
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
PEXA	Practice and Exercise Area
RAF	Royal Air Force
ROV	Remotely Operated Vehicle
SO	Scoping Opinion
SR	Scoping Report
SoS	Secretary of State
TAN	Technical Advice Notes
TEC	Tidal Energy Converter
UKHO	United Kingdom Hydrographic Office
UXO	Unexploded Ordinance
WNMP	Welsh National Marine Plan

GLOSSARY OF TERMINOLOGY

Unexploded Ordnance	Explosive weapons (bombs, shells, grenades, land mines, naval mines, cluster munition, etc.) that did not explode when they were employed and still pose a risk of detonation
Aggregate dredging	The dredging of sand or gravel from the marine environment for use in construction and civil engineering projects

16. MARINE INFRASTRUCTURE AND OTHER USERS

16.1. INTRODUCTION

1. Menter Môn Morlais Limited (Menter Môn) proposes the development of 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ). The development of the Morlais Project (the Project) will support the development of renewable energy technology objectives of the Anglesey and Gwynedd Joint Local Development Plan (JLDP), providing a consented tidal technology commercial demonstration zone which supports installation, testing and commercial demonstrations of tidal energy devices. The Project will also provide opportunities for the local communities via direct employment and support of the local supply chain (see **Chapter 25, Socioeconomics, Tourism and Recreation**).

2. The Project will include permanent communal infrastructure for tidal technology developers which provides a shared route to a local grid connection via nine export cable tails, an onshore Landfall Substation, and an onshore electrical cable route to a grid connection via a Switchgear Building and Grid Connection Substation.

3. The purpose of this chapter is to provide an assessment of possible impacts which may arise through the development of the project on marine infrastructure and other seabed users. This chapter describes the baseline environment, identifies potential impacts which may arise during the construction, operation and maintenance (O&M), repowering and decommissioning phases of the project and their related receptors. An impact assessment and associated results are presented, and where applicable proposes mitigation measures.

4. The Project will install multiple technology types within the MDZ, and so the consent application is based on a Project Design Envelope (also known as the Rochdale Envelope), determined through knowledge of existing technology and the direction of future developments. Hence, the potential effects on Marine Infrastructure and Other Users have been assessed conservatively using realistic 'worst case' scenarios for the Project.

5. This chapter has been prepared by MarineSpace Ltd on behalf of Menter Môn.

16.2. POLICY, LEGISLATION AND GUIDANCE

16.2.1. Overview

6. A full overview of the relevant policy and legislative context for the Project is provided in **Chapter 2, Policy and Legislation**.

7. The Project is seeking consent for a Transport and Works Act Order from the Welsh Government and a Marine Licence from NRW. Due to its size (240 MW), The Project is representative of a Nationally Significant Infrastructure Project (NSIP). Guidance that is relevant to assessing impacts on marine infrastructure and other users from NSIPs are set out within Overarching National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to marine infrastructure and other users include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and

- NPS for Renewable Energy Infrastructure (EN-3), July 2011;

8. Details of specific policies within EN-1 and EN-3 used to inform this assessment are provided in **Table 16-1** below. The specific assessment requirements for marine infrastructure and other users are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 16-1 NPS EN-1 and EN-3 Assessment Requirements Relevant to Marine Infrastructure and Other Users

NPS Requirement	NPS Reference	ES Reference
'… the applicant should undertake an assessment of the potential effect of the proposed development on such existing or permitted infrastructure or activities. The assessment should be undertaken for all stages of the lifespan of the proposed wind farm in accordance with the appropriate policy for offshore wind farm EIAs."	EN-3, Paragraph 2.6.179	The potential impacts of the Project are assessed in **Section 16.6**.
"Applicants should establish stakeholder engagement with interested parties in the offshore sector in the development phase (of the proposed OWF[1]), with an aim to resolve as many issues as possible prior to the submission of an application. Such stakeholder engagement should continue throughout the life of the development."	EN-3, Paragraph 2.6.180	Consultation undertaken for the Project and to inform this chapter is detailed in **Section 16.3**
"Where a wind farm potentially affects other offshore infrastructure or activity, a pragmatic approach should be employed by the Secretary of State (SoS). The SoS should expect the applicant to minimise negative impacts and reduce risks to as low as reasonably practicable;"	EN-3 Paragraph 2.6.183	Mitigation measures are proposed **Section 16.6** for each identified impact.
"The SoS should be satisfied that site selection and site design of the OWF has been made with a view to avoiding or minimising disruption or economic loss or any adverse effects on safety to other offshore industries;"	EN-3, Paragraph 2.6.184	The site selection process is detailed in **Chapter 3, Site Selection**.
"The SoS should not consent applications, which pose unacceptable risks to safety after mitigation measures have been considered"	EN-3, Paragraph 2.6.184	The residual impacts, following the implementation of mitigation measures are presented in **Section 16.7**, **Table 16-9**.
"Where schemes have been carefully designed and the necessary consultation has been undertaken at an early stage, mitigation measures may be found that can negate or reduce effects on other offshore infrastructure or operations to a level sufficient to enable the SoS to grant consent."	EN-3, Paragraph 2.6.186	Consultation undertaken to inform this chapter is presented in **Section 16.3** and mitigation measures are proposed throughout **Section 16.6**.

[1] Although EN-3 predominantly references OWF developments, relevant policies are listed here as they are also relevant to a tidal energy development of this scale.

9. Other industry standard guidance relevant to this chapter includes:

- International Cable Protection Committee (ICPC) recommendations, October 2017; and
- European Subsea Cables Association (ESCA) recommendations.

10. In addition to the above, the following relevant legislation has also been considered within this chapter:

- Convention on the International Regulations for Preventing Collisions at Sea 1972;
- The Marine and Coastal Access Act 2009; and
- The Merchant Shipping and Fishing Vessels (Control of Noise at Work) Regulations 2007.

16.2.2. Welsh National Marine Plan (WNMP)

11. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the WNMP. The Plan is being developed in accordance with the Marine and Coastal Access Act (MCAA) 2009, the Marine Policy Statement (MPS) and the Maritime Spatial Planning Directive, a draft version has been issued for consultation (discussed further in **Chapter 2, Policy and Legislation**).

12. **Table 16-1** presents relevant policies of the draft WNMP of relevance to the Project.

Table 16-2 Draft WNMP Policies Relevant to Infrastructure and Other Users

Policy Description	Reference	ES Reference
Draft WNMP		
Proposals that consider opportunities for coexistence with other compatible sectors are encouraged in order to optimise the value and use of the marine area and marine natural resources	ECON_02: Coexistence	Cumulative effects are assessed in **Section 16.6.7** and in **Chapter 26, Cumulative and In-combination**
Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01: Cumulative effects	

16.2.3. Planning Policy Wales

13. Planning policy for Wales is set out in the document Planning Policy Wales (Welsh Government, 2016). The planning policy document outlines the Welsh Government's approach to facilitating the delivery of the aims set out in Energy Wales: A Low Carbon Transition (Welsh Government, 2012b), as well as UK wide and European renewable energy targets, including obligations under the Renewable Energy Directive (2009/28/EEC).

14. The following Planning Policy Technical Advice Notes (TAN) have been reviewed within this chapter of the Morlais Environmental Impact Assessment (EIA):

- TAN 5: Nature Conservation and Planning; and
- TAN 8: Planning for Renewable Energy.

16.2.4. The Well Being of Future Generations (Wales) Act 2015

15. The Wellbeing of Future Generations (Wales) Act 2015 is used to improve the social, economic, environmental and cultural well-being of Wales. The Wellbeing of Future Generations (Wales) Act 2015 places a statutory duty on public bodies in relation to sustainable development, based on seven well-being goals (see **Chapter 2, Policy and Legislation**).

16. Climate change is integral to the wellbeing goals, which recognise that the case for action on climate change is clear and fundamental to future prosperity and the future resilience of communities (**Table 16-3**). The Wellbeing of Future Generations (Wales) Act 2015 provides a mechanism for public bodies to set targets and report progress against indicators. Through its well-being objectives, the Wellbeing of Future Generations (Wales) Act 2015 sets a clear agenda for sustainable development.

Table 16-3 Well-Being Goals and Adherence by the Project

Well-being Goal	Description	How is this addressed by the Project
A prosperous Wales	An innovative, productive and low carbon society which recognises the limits of the global environment and therefore uses resources efficiently and proportionately (including acting on climate change); and which develops a skilled and well-educated population in an economy which generates wealth and provides employment opportunities, allowing people to take advantage of the wealth generated through securing decent work.	If built, the Project would have a design life of approximately 35 years, after which it may be either decommissioned or repowered (subject to separate consenting). During its operation the project would contribute to reaching global, European and national targets on CO_2 reduction and renewable energy production. It is estimated that the Morlais project could produce enough electricity each year to power the equivalent of 188,000 houses. Further information on tidal energy is provided in **Chapter 1, Introduction**.
A resilient Wales	A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).	The Morlais ES details the considerations of the project on the baseline environment for a number of key receptors. A habitats regulations assessment (HRA) has been compiled to determine whether the Project has the potential to have an adverse effect on the integrity and features of a Natura 2000 site. Where appropriate, mitigation measures are provided to ensure that no residual significant impacts are caused by the Project. The technical chapters (**Chapters 7** to **26**) outline any legislation which is specific to the relevant receptors.

Well-being Goal	Description	How is this addressed by the Project
		The Information to Support the HRA is provided in **Document MOR/RHDHV/DOC/0067.**
A globally responsible Wales.	A nation which, when doing anything to improve the economic, social, environmental and cultural well-being of Wales, takes account of whether doing such a thing may make a positive contribution to global well-being.	The Project seeks to provide a platform for commercial tidal energy device development, the first of this scale in the world. Evidencing the projects importance, the development phase of the project has been supported by the European Regional Development Fund.

16.2.5. Regional Plans

16.2.5.1. Anglesey and Gwynedd Joint Local Development Plan (JLDP)

17. Development of the Project will support those objectives of the 2017 Anglesey and Gwynedd JLDP, aimed at promoting the development of renewable or low carbon energy technologies. The project will prioritise maximising opportunities for local communities directly via employment and indirectly via the establishment of a local supply chain.

18. Of the policies contained in the JLDP, those presented in **Table 16-4** below are considered to be of relevance to the proposed development.

Table 16-4 Relevant Policies of the Anglesey and Gwynedd JLDP

Policy	Description	Where considered within the ES
Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	Proposals for renewable and low carbon energy technologies, other than wind or solar, which contribute a low carbon future will be permitted, provided that the proposal conforms to certain criteria	**Chapters 7 to 27** present the assessments of impacts from the Project on all receptors

16.2.1. Industry Guidance

19. Industry guidance on the generic requirements, including spatial and temporal scales, for infrastructure and other marine users studies associated with tidal array developments is provided in several documents (some of which are specifically written for offshore wind farms but are also of relevance here):

- General advice on assessing potential impacts of and mitigation for human activities on Marine Conservation Zone (MCZ) features, using existing regulation and legislation' (JNCC & Natural England, 2011); and
- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects' (Cefas, 2011).

16.3. CONSULTATION

20. **Table 16-5** presents the relevant consultees responses on offshore infrastructure and other marine users.

Table 16-5 Consultation Responses

Consultee	Date/Document	Comment	Response
IACC 2017	2018 Scoping	The Applicant's SR indicates that the following topics can be scoped out: - MOD Operations - Aviation Whilst general aviation may be scoped out, the potential for impact on MOD operations, described as limited in nature during onshore infrastructure construction and no offshore impacts in the SO, remains a potential and should be fully considered in the ES.	MOD operations are considered with **Section 16.5.1.3** of this chapter.
NRW	2018 Scoping	We currently have no comments to make on this topic, but coordinates (lat & long co-ordinates for offshore and easting & northing for onshore) should be provided of the locations of the tidal array and cable route (inc sub-station etc) as the project is refined and develops.	Project coordinates are provided in **Chapter 4, Project Description**.

16.4. METHODOLOGY

16.4.1. Study Area

21. The marine infrastructure and other users study area encompasses the MDZ and Export Cable Corridor (ECC) and a wider region reflecting the potential for the Project and associated engineering works to widely affect other users. The extent of the study area is shown in **Figure 16-1** (**Volume II**) and consists of the offshore region between Bardsey Island at the southern extent and Prestatyn as the eastern extent.

16.4.2. Data Sources – Desk Study

22. A comprehensive review of available information was conducted to support the regional characterisation. The resources from which detail was extracted include, but were not limited to:

- Wales Marine Planning Portal;
- Consultation responses (see **Table 16-5**);
- The Crown Estate conflict check data; and
- Deep Green Holyhead Deep Project Phase I (0.5 MW) Environmental Statement (ES) (Minesto, 2018)

16.4.3. Data Sources – Site-Specific Surveys and Reports

23. Project-specific marine traffic surveys were undertaken as part of this EIA. The data and assessment related to these surveys are presented in **Chapter 15, Shipping and Navigation**.

16.4.4. Impact Assessment Methodology

24. **Chapter 5, EIA Methodology** outlines the full EIA Methodology which is used to assess the impacts to infrastructure and other marine users in this chapter.

25. The impact assessment considers the potential for impacts during the construction, operation and maintenance, and decommissioning phases of the Project.

26. Impacts are classified as follows:

- Direct impacts: these may arise from impacts associated with the construction, operation and maintenance, or decommissioning of the Project;
- Indirect impacts: these may be experienced by a receptor that is removed (e.g. in space or time) from the direct impact;
- Inter-relationships between impacts; or
- Cumulative impacts: these may occur as a result of the project in conjunction with other existing or planned projects within the study area for each receptor.

27. For each effect, the assessment identifies receptors within the study area that are sensitive to that effect and implements a systematic approach to understand the impact pathways and the level of impacts on given receptors. The process considers the following:

- The sensitivity of a receptor to the effect;
- The probability that an effect-receptor interaction will occur;
- The magnitude of the effect;
- The determination and (where possible) qualification of the level of impact on a receptor, considering the probability that the effect-receptor interaction will occur, the spatial and temporal extents of the interaction and the significance of the resulting impact; and
- The level of certainty at all stages.

28. By combining the magnitude of the impact and the sensitivity of the receptor in a matrix (see **Table 16-6**), the final significance of the impact (prior to the implementation of mitigation measures) can be obtained.

Table 16-6 Impact Assessment Matrix

		Negative Magnitude				**Beneficial Magnitude**			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

16.5. EXISTING ENVIRONMENT

29. The characterisation of the existing environment has been undertaken using data sources listed in the **Section 16.4** above.

16.5.1. Regional Context

16.5.1.1. Renewable Energy Developments

30. Approximately 1 km to the west of the MDZ sits the Deep Green Holyhead Deep Project site, owned by Minesto UK Ltd. In June 2014, the project was granted an Agreement for Lease (AfL) by The Crown Estate for a 10 MW installation, a subsequent EIA was delivered for the project in 2016 and a Marine Licence was awarded by Natural Resources Wales (NRW) in April 2017. The Deep Green Holyhead Deep project is planned to be completed in phases, with a single 0.5 MW device deployed in summer 2018. Minesto's ambition is to install further Deep Green devices and gradually expand the site to a commercial demonstration array of up to 80 MW installed capacity (Minesto, 2019).

31. An EIA Scoping Report for an up to 80MW capacity project was submitted to NRW and the Marine Management Organisation (MMO) in February 2017 and a formal scoping opinion (SO) issued by NRW in April 2017.

32. 11.4 km north-east of the MDZ is the consented Anglesey Skerries Tidal Array project. An ES for the project was submitted in 2011 and all relevant consents were granted in February 2013. In March 2016, Atlantis Resources Corporation (who acquired the development rights for this site after acquiring Marine Current Turbines (MCT) from Siemens in April 2015) announced that the agreements for lease would be relinquished. Ownership of the site has since been returned to The Crown Estate (TETHYS, 2019).

33. There are no offshore wind farms in the immediate vicinity of the MDZ. The closest operational sites are Rhyl Flats (66 km to the north east), North Hoyle (82 km to the north east), Gwynt y Môr (67.5 km to the north east) and Burbo Bank (120 km to the north). In 2017, Ørsted completed construction on an extension to the Burbo Bank site. In 2018, The Crown Estate began work on a plan level Habitats Regulation Assessment (HRA) for offshore wind farm extensions, within which Gwynt y Môr was included.

34. The offshore wind farms in the region of MDZ, including the proposed extension to Gwynt y Môr are shown in **Figure 16-1** (**Volume II**).

35. There are no wave energy sites in the study area (Crown Estate, 2019).

16.5.1.2. Cables and Pipelines

36. There are two active telecommunication cables to the south of MDZ. The closest of these is the 'CeltixConnect' fibre optic cable stretching from Holy Island to Dublin, Ireland. It passes within approximately 200 m to the southwest of the MDZ. The cable is owned and operated by AquaComms and has been in service since 2012 (Kingfisher, 2019).

37. The second cable, the 'Emerald Bridges Fibres' fibre optic cable, is 700 m to the southwest of the MDZ and stretches from Holy Island to Clonshaugh in Ireland. The cable is owned and operated by Zayo Group and ESB Telecoms and has been in service since 2012 (Kingfisher, 2019).

38. Exiting Holyhead harbour are three out of service British Telecommunications (BT) cables, that have been out of service since 1984 (Minesto, 2016). These cables will not be impacted by activities associated with MDZ.

39. There are no active or inactive hydrocarbon pipelines in the vicinity of the MDZ (**Figure 16-1, Volume II**) (Welsh Government, 2019).

16.5.1.3. Military Activity

40. During the scoping exercise it was identified that Royal Air Force (RAF) Valley is the only Ministry of Defence (MOD) owned site on Anglesey (RHDHV, 2018). The site is located approximately 10 km to the southeast of MDZ, to the north of Rhosniegr. RAF Valley is a training base for advanced fast jets for RAF and for Royal Navy Pilots. RAF Valley was also formerly the operational base for a number of Sea King helicopters which provided a search and rescue role for the Irish Sea, Snowdonia and the wider North Wales area.

41. **Figure 16-1** (**Volume II**) shows that the MDZ is approximately 200 m to west of a Military Aerodrome Traffic Zone (MATZ) at its closest point. Due to the close proximity there may be potential for some overlap in the south east corner of the area.

42. The whole of Anglesey, the Llyn Peninsula and Snowdonia are covered by a regular military low flying area where mitigation may be necessary to resolve concerns. These concerns and any appropriate mitigation would need to be discussed through consultation with the MOD and RAF Valley (RHDHV, 2018). A further military practice and exercise area (PEXA) is located 12 km to the south of the MDZ.

43. There are no known naval exercise or live firing areas within or adjacent to the MDZ (RHDHV, 2015).

16.5.1.4. Unexploded Ordnance (UXO)

44. There are a number of areas within the Irish Sea that may present a risk of Unexploded Ordnance (UXO). The MDZ is not located within any known minefields or dumping grounds; however, there is a potential risk that munitions from minefield areas could have migrated into the MDZ over time.

45. The MDZ is located in an area with the potential for munitions to be present as a result of artillery range activities along the coast of Anglesey.

46. As a result, there may be limited potential for the presence of UXO in the MDZ from historical military practice exercises and training as well as legacy from two world wars. Whilst no UXO's were identified during the benthic survey photography, a number of anomalies were identified in the geophysical data review carried out to inform the offshore archaeology assessment (see **Chapter 13, Offshore Archaeology and Cultural Heritage**). Pre-construction studies on the potential presence of UXO would be carried out once the final positioning of arrays and wider infrastructure are known, and prior to deployment.

16.5.1.5. Oil and Gas Infrastructure

47. The offshore area around the MDZ is largely undeveloped in terms of oil and gas developments and there are currently no oil and gas installations within 60 km of the MDZ. Block 109/17 sits immediately to the north of the MDZ and was offered as part of the 30th round; however, neither this block nor any others in its vicinity were awarded to operators in the 30th Licensing Round.

48. The closest existing oil and gas infrastructure to the MDZ is the P2292 well, located 61 km away. The Conwy Oil Field (74 km north east), Douglas Oil Field (77 km north east), Hamilton Gas Field (83 km north east) and Hamilton North Gas Field within Liverpool Bay (87 km north east), are the other closest infrastructure as shown in **Figure 16-1** (**Volume II**).

16.5.1.6. Aggregate Dredging

49. There are no marine aggregate extraction activities within the immediate vicinity of the MDZ (Crown Estate, 2019). Within the wider region in the eastern Irish Sea there are currently two operational licence areas and one exploration and option area. The closest licenced aggregate extraction area is Area 457 in Liverpool Bay which is approximately 77 km north east of the MDZ.

16.5.1.7. Disposal Sites

50. The western edge of the MDZ partially overlaps the open Holyhead Deep disposal site, IS040. The disposal site is used for the disposal of dredged material, averaging approximately 85,000 tonnes of material disposed each year. The IS040 disposal site is 13 km in length and 4.4 km in width and covers an area of 57.5 km². The MDZ overlaps with approximately 0.06 km² of the disposal site.

51. The ES for the Deep Green Holyhead Deep Project (Minesto, 2016) reports that in the past, seven companies used Holyhead Deep disposal site, however since 2009 only one company has utilised it; Stena Line Ports Limited. Materials disposed of within ISO40 include both capital dredge spoil and maintenance dredge spoil. The disposal of capital dredge spoil is infrequent, but generally consist of large quantities (exceeding 100,000 tonnes in three out of five events) (Minesto, 2016). Maintenance dredge spoil is disposed of more frequently in lower quantities and has never exceeded 100,000 tonnes in a single year. Maintenance disposal spoil primarily results from maintenance dredging around Holyhead Harbour which occurs at a maximum frequency once every two years (Potter, 2014).

52. The MDZ also partially overlaps with two closed disposal sites, Holyhead South (IS041), and Holyhead East (IS042) (Welsh Government, 2019).

16.6. IMPACT ASSESSMENT

53. This assessment covers all impacts identified during scoping, and any further potential impacts that have been highlighted as the EIA has progressed. The methodology for the assessment is summarised in **Section 16.4.4** and provided in full in **Chapter 5, EIA Methodology**.

16.6.1. Overview of Potential Impacts

54. Based on the baseline information described in **Section 16.5.1**, the list below indicates the other sea users that could be impacted by the proposed Project. Cumulative and in-combination impacts are discussed in **Section 16.6.7**:

- Interaction with Military Aerodrome Traffic Zone (construction, operation and maintenance and decommissioning);
- Inadvertent interaction with UXO (construction and decommissioning); and
- Interaction with active telecommunication cables (construction, operation and maintenance and decommissioning).

55. The potential impacts due to the presence of the two closed disposal sites (with regards to disturbance of potentially contaminated sediments) has been assessed in **Chapter 8, Marine Water and Sediment Quality and Chapter 9, Benthic and Intertidal Ecology**.

56. Impacts on the following receptors were scoped out of the marine infrastructure and other sea users assessment:

- Impacts on the Deep Green Holyhead Deep project site. Despite being located only 1.2 km from the MDZ the construction, installation and operation of the MDZ will not directly impact the Deep Green Holyhead Deep project. Consideration of potential cumulative impacts are addressed in **Section 16.6.7**;
- Impacts on the Skerries Anglesey Tidal Array, due to it being located 11.4 km from the MDZ;
- Impacts on MoD Practice and Exercise Areas, due to the closest being located 12 km from the MDZ;
- Impacts on oil and gas infrastructure due to the closest being located over 74 km from the MDZ; and
- Impacts on dredging sites, due to the closes being located over 77 km from the MDZ;
- Impacts on offshore wind projects, due to the closest being located over 60 km from the MDZ.

16.6.2. Embedded Mitigation

57. The following assessment provides a summary of all impacts identified during scoping study and those which have been noted as the EIA has progressed. These impacts are not relevant to all stages of the project, and thus impacts have been assessed within the stage of the project at which they will occur (construction, operation and decommissioning). Further, these impacts are comprised of both direct and indirect impacts.

58. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process (see **Chapter 4, Project Description** for further details). A range of different information sources has been considered

as part of embedding mitigation into the design of the project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

16.6.3. Worst Case Parameters

59. For many of the offshore EIA topics (**Chapter 9, Benthic and Intertidal Ecology**; **Chapter 11, Fish and Shellfish ecology** etc), a key consideration in terms of worst-case parameters used in the impact assessment relate to the footprint (m^2) of temporary seabed disturbance during construction works and then permanent habitat loss via project infrastructure.

60. For marine infrastructure and other users, these values are less important in the context of impact assessments, with the focus more on the scale/number/type of devices and associated infrastructure. Full details of the proposed project infrastructure are provided in **Chapter 4, Project Description** with an overview below.

61. The installation of project infrastructure, including anchor systems for Tidal Energy Converter (TEC) devices, seabed mounted devices, hubs and cables/cable protection, will all result in permanent habitat loss. Based on information provided in **Chapter 4, Project Description**, the values presented in **Table 16-7** have been calculated to define the worst-case parameters for permanent habitat loss via project infrastructure. The majority of these effects will only occur in the operational phase. Of note is the value of 7,400 m^2 related to the trench for up to nine cables at landfall, which will only be undertaken if Horizontal Directional Drilling (HDD) (which is the preferred method) is not possible/viable. Without detailed geotechnical analysis it is not currently possible to state if HDD is possible, and consequently, if trenching, and subsequent backfill of the trench(es) will be necessary. If trenching is necessary, this would represent a temporary disturbance on intertidal habitats. However, to ensure a precautionary approach is built into the assessment, it has been concluded that trenching/surface-laying of the landfall cables would lead to permanent habitat loss, thus this value is included below.

62. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50 % of the tenants will undertake repowering, i.e. for 50 % of the tenants, their infrastructure will be removed and replaced (potentially with different infrastructure by a different tenant). For the other 50 % of tenants, their infrastructure will remain over the lifetime of the project.

63. In terms of impact assessment parameters, the repowering process has, therefore, been defined as per below:

- Additional permanent habitat loss (over and above that via initial construction phase), due to placement of re-installed (repowered) foundations/TECs in different areas to where originally installed.

Table 16-7 Summary of worse-case scenario: permanent habitat loss via project infrastructure (including repowering)

Project Component	Worse Case (240 MW)	Unit	Notes
Main operational phase			
Gravity Base Structures (GBS)	74,790	m^2	Max value across entire project. Based on anchor mooring systems for floating devices. Includes hubs.
Swept Area of Catenary Cables	2,055,000	m^2	Based on: 30 devices having swept area of 9,500 m^2 (large floating devices (Orbital, Magallanes) 140 devices having swept area of 7,500 m^2 floating devices (Tocardo UFS, Aquantis) & hubs 240 devices having swept area of 3,000 m^2 small floating devices (Instream, SME PLATO)
Export Cable Footprint (cables; protection systems; rock bags)	11,745	m^2	Up to 40.5 km of export cables (with split-pipe protection/shells and rock bags)
Array Cable Footprint (cables; protection system; rock bagss)	30,040	m^2	Up to 204.5 km of array cables (with split-pipe protection/shells and rock bags)
Cable tails	120	m^2	Based on 9 x tails of 620 m length
Trench for 9 x landfall cables	7,400	m^2	740 m long trench x 10 m width in intertidal region
Footprint of Navigation Marker Buoys	540	m^2	3 m diameter square gravity anchor (9 m^2) per anchor x 60 anchors/buoys
Footprint of ADCP moorings	280	m^2	7 m^2 per ADCP mooring x 40 units
Footprint of seabed mounted environmental monitoring units	112	m^2	14 m^2 per env monitoring unit x 8 units
Footprint of mooring for floating environmental monitoring units	45	m^2	9 m^2 per mooring x 5 units
Permanent habitat loss (initial operational phase: 2,180,072 m^2 (2.18 km^2)			
Repowering Phase			
New tenant infrastructure in 50 % of berths	52,415	m^2	Total footprint of tenant infrastructure = 104,830 m^2 (GBS foundations = 74,790 m^2; array cables = 30,040 m^2): Footprint via repowering = 50 % of this value (52,415 m^2).
Permanent habitat loss (repowering of 50 % of berths): 52,415 m^2			
Permanent Habitat Loss: Total of 2,232,487 m^2 (2.23 km^2)			

64. In terms of actual device types/numbers, a maximum number of up to 620 devices could be installed at the full 240 MW capacity. These would comprise a combination of seabed mounted devices, mid-water devices and also floating (surface) devices with submerged rotors.

65. Indicative project layouts illustrating the configuration of these different device types are provided in **Chapter 4, Project Description** and demonstrate the potential for interaction between project infrastructure and other marine infrastructure and users. The worst-case layouts of tidal devices with respect to visual impact and navigation are presented in **Chapter 24, Seascape, Landscape and Visual Impact Assessment** and **Chapter 15, Shipping and Navigation** respectively.

66. The construction of offshore works (for installation of tidal devices and associated cabling and infrastructure) would be phased over a period of up to 10 years. Indicative installation periods are presented below:

- Up to 15 days per device (total = 4,306 days);
- Up to 15 days per hub (total = 1,800 days);
- Up to 1.5 days for each inter-array cable (total = 1,110 days);
- Up to 20 days for each offshore export cable (total = 180 days);
- Up to 12 days for cable protection works on each export cable (total = 108 days);
- Up to 20 days for installation of all nine (9) export cable tails (total = 20 days); and
- Up to six (6) months for HDD works at landfall.

16.6.4. Potential Impacts During Construction

16.6.4.1. Construction Impact 1: Disruption of Ongoing Ministry of Defence (MoD) Activities

67. RAF Valley is located 10 km to the south east of the MDZ, with the corresponding Military Aerodrome Traffic Zone (MATZ) located approximately 200 m from the MDZ at its closest point. As shown in **Figure 16-1** (**Volume II**), a large part of Anglesey and the surrounding offshore region is covered by an area previously identified a regularly used low flying zone.

68. Due to the MDZ being located outside of the MATZ, the magnitude of effect is assessed as Very Low, whilst due to the national importance of MOD activities the sensitivity is assessed as High. As a result, the effect is assessed as **minor.**

16.6.4.1.1. Mitigation

69. As part of the project embedded mitigation (**Chapter 4, Project Description**), ongoing engagement with the MoD RAF will be undertaken at all times during the construction phase. This will be via formal issue of Notices to Airmen (NoTAM's) prior to any major works that are judged to potentially impact aviation activities, such as those involving vessel-mounted cranes and also be ensuring that regular updates are also provided via construction phase bulletins.

16.6.4.1.2. Residual Impact

70. With successful implementation of mitigation measures, the impact will be reduced to **negligible.**

16.6.4.2. Construction Impact 2: Interaction with UXO

71. There is potential for construction activities to expose and disturb UXO. Such activities include vessel anchoring / placement of jack-up feet, ground preparation and placement of device foundation structures, electrical hubs, cables and monitoring equipment.

72. Whilst the MDZ is not located within any known minefields or disposal areas there may be potential for the presence of UXO in the MDZ from historical military practice exercises and training and as a legacy from two World Wars.

73. Without suitable mitigation being applied, due to the medium sensitivity and high magnitude of this potential effect, a **major adverse** impact could arise.

16.6.4.2.1. Mitigation

74. It will be necessary to undertake detailed risk assessment works in the development site and export cable corridor once the final positions of the infrastructure are known, in order to identify potential UXO and establish the requirements for any pre-construction survey of specific locations. Dependent on the nature of identified UXO, further investigations and/or detonations may be required, further to which a certificate would be provided to the contractor to determine that the risks associated with site investigation are reduced to As Low As Reasonably Practicable (ALARP).

75. Any proposed pre-construction marine geophysical surveys would be designed to have the potential capability to detect UXO in sufficient detail across the development site and export cable corridor. Given the moderate risk for encountering UXO in the offshore site, it is considered that the most prudent method of managing the risk to construction would be to undertake a high-resolution total field magnetometer or gradiometer survey of the specific works areas, with survey line spacing as small as 2m, and a sensor elevation not exceeding 5m (and ideally as low as 2m). Remotely operated vehicle (ROV) inspection would then be recommended to confirm whether identified targets were UXO related.

76. It may also be necessary to undertake micro-siting of infrastructure to avoid potential UXO, depending upon the results of detailed investigation.

77. In addition, it would be prudent to ensure that all construction staff have an awareness of the UXO hazard through contractors' induction processes. This will ensure that appropriate action is taken in the event that a suspect item is discovered.

78. Other risk mitigation will depend on the detail and nature of any planned works.

16.6.4.2.2. Residual Impact

79. Assuming successful implementation of the mitigation measures detailed above, any impact via interaction with UXO will be reduced to **negligible**.

16.6.4.3. Construction Impact 3: Interaction with Active Telecommunication Cables

80. The CeltixConnect cable is located approximately 200 m to the southwest of the MDZ. There is a potential impact from the deployment of anchors associated with installation barges operating near the edge of the MDZ. If anchor blocks need to be temporarily located outside the MDZ boundary then this may lead to the risk of anchor blocks being laid close to/on the CelticConnext cable, resulting in damage to this live asset.

81. Without mitigation, the magnitude of this effect is judged to be high, which when combined with the very high sensitivity of this receptor would result in a **major** impact.

16.6.4.3.1. Mitigation

82. To mitigate any risk of damage to this live cable a 500 m safety buffer will be implemented around the CeltixConnect cable during all construction works. The position of this live cable will be communicated to all installation vessels and the Project will consult with the asset owner directly.

16.6.4.3.2. Residual Impact

83. With successful implementation of appropriate mitigation measures, the significance of this impact will be reduced to **negligible.**

16.6.5. Potential Impacts During Operation

16.6.5.1. Operational Impact 1: Disruption of Ongoing Ministry of Defence (MOD) activities

84. In the operational phase there is very limited scope for impact on existing MoD/RAF activities within the MATZ. The highest structure in the MDZ will be up to eight surface-piercing electrical hubs that may be as high as 18m above LAT. A **negligible** impact is predicted.

16.6.5.1.1. Mitigation

85. As part of the project embedded mitigation (**Chapter 4, Project Description**), all project infrastructure will be communicated to the United Kingdom Hydrographic Office (UKHO) and updated on relevant Admiralty Charts.

16.6.5.1.2. Residual Impact

86. Through the above detailed mitigation measures, the potential residual impact of disruption to ongoing MoD activities is predicted as **negligible**.

16.6.5.2. Operational Impact 2: Interaction with Active Telecommunication Cables

87. The activity during this phase would be much reduced. Only maintenance and/or repowering works taking place in the development site would have any potential to impact the receptor. As a result potential impacts remain no more significant than in the main construction phase. The greatest potential sea bed scour effect in relation to interaction with active telecommunication cables will be associated with changes in the flow regimes around the foundations of devices as the flow bifurcates around the obstruction provided by each foundation. Where the sea bed

is comprised of bare bedrock or where this is covered with boulders, cobbles or gravels there is unlikely to be any change in suspended sediment concentrations. Given the nature of the sea bed morphology in the south east of the MDZ nearest the active telecommunication cables, comprising mostly of exposed bedrock, the potential for adverse effects of this nature is extremely limited.

88. A negligible magnitude of effect and low sensitivity of receptor results in a **negligible** impact**.**

16.6.5.2.1. Mitigation

89. None required.

16.6.5.2.2. Residual impact

90. A negligible impact has been predicted above and it is assessed here that no mitigation will be required and therefore the residual impact would be the same as above and is predicted to be **negligible**.

16.6.6. Potential Impacts During Decommissioning

91. At the end of the intended project lifetime of 37 years, the project will be decommissioned or re-powered. The worst-case scenario for assessment includes:

- Cables could be re-used, preserved in situ or removed. Removal is considered as the worst-case scenario for Infrastructure and Other Marine Users;
- Cable protection material will be left in situ on the sea bed, assuming that it causes no unacceptable impacts or hazards;
- Gravity base foundations (including gravity anchors) may be left in situ with piles cut to an acceptable level;
- All other components of the tidal devices (i.e. TECs, superstructure and support structure) will be removed;
- Any electrical hubs will be removed; and
- Navigation buoys and site monitoring equipment and their foundations / moorings will be removed for re-use.

92. For those activities involving the removal of assets, the types of effects would be analogous to those identified for the construction phase.

16.6.6.1. Decommissioning Impact 1: Disruption of Ongoing Ministry of Defence (MOD) Activities

93. During the decommissioning phase of The Project it is expected that impacts similar to those assessed above (**Section 16.6.4.1**) for the construction phase are predicted to arise. The magnitude of these effects may be lower due to the shorter expected timeframe of decommissioning works compared to installation.

94. As to the MDZ is located outside of the MATZ, and the Project will have been visible to the MOD throughout construction and operation, the magnitude of effect is assessed as Very Low. Due

to the national importance of MOD activities the sensitivity is assessed as High. As a result, the effect is assessed as **minor.**

16.6.6.1.1. Mitigation

95. As part of the project embedded mitigation (**Chapter 4, Project Description**), ongoing stakeholder engagement with the MOD during decommissioning, as per the construction phase.

16.6.6.1.2. Residual Impact

96. With successful implementation of mitigation measures, the impact will be reduced to **negligible.**

16.6.6.2. Decommissioning Impact 2: Interaction with UXO

97. As with construction impacts, this is dependent upon the requirement for contact with the seabed. It is expected that during normal operations any activity would be limited to the areas around installed infrastructure; these locations would be areas where there was no risk (through placement of foundations and cables in areas with no known UXO) or where UXO had been dealt with during construction, however it is noted that there is potential for movement of UXO over time due to tidal processes. Therefore, there may be potential for decommissioning activities to expose and disturb UXO, although the overall risk during decommissioning would be lower than for construction.

16.6.6.2.1. Mitigation

98. Mitigation measures will be the same as those discussed for the construction phase, within **Section 16.6.4.2.1**, with the exception of micro siting the cable. Any vessel involved with the decommissioning phase would need to be equipped to sufficiently detect UXO across the development site and export cable corridor.

16.6.6.2.2. Residual Impact

99. With the above mitigation measures adopted during the decommissioning phase it is assessed here that there would be a **negligible** residual impact from interaction with UXO on infrastructure and other marine user receptors as a result of the decommissioning phase of The Project.

16.6.6.3. Decommissioning Impact 3: Interaction with Active Telecommunication Cables

100. As with the construction impacts, the CeltixConnect and Emerald Bridge cables are located greater than 500 m from the southwest of the MDZ. There is a potential impact from the deployment of anchors associated with barges operating near the edge of the MDZ. In these areas, such anchor blocks may need to be temporarily located outside the MDZ boundary. This may lead to the risk of anchor blocks being laid close to the nearest cable (CelticConnext cable), resulting in damage to this live asset.

101. Without mitigation, the magnitude of this effect is judged to be high, which when combined with the very high sensitivity of this receptor would result in a **major** impact.

16.6.6.3.1. Mitigation

102. To mitigate any risk of damage to this live cable a 500 m safety buffer will be implemented around the CeltixConnect cable during all decommissioning works. The position of this live cable will be communicated to all installation vessels and the Project will consult with the asset owner directly.

16.6.6.3.2. Residual Impact

103. With successful implementation of appropriate mitigation measures, the significance of this impact will be reduced to **negligible.**

16.6.7. Cumulative Impacts

104. Following a review of information currently available in the public domain, it can be identified that there is a potential for cumulative or in-combination impacts with the Deep Green Holyhead Deep Phase I and subsequently Phase II tidal projects, which neighbours the MDZ to the west.

105. It is likely that the MDZ and Minesto projects will be operational simultaneously. As the Area for Lease (AfL) for both projects overlap with the current licenced area of the Holyhead Deep IS040 disposal site there may be cumulative impacts with the two projects. The EIA for the Deep Green Holyhead Deep Project Phase I (Minesto, 2016) states that disposal site ISO40 has infrequent use across the area and identifies that the disposal site boundary is likely to be re-designated, and possibly reduced in size by 50 %. Minesto (2016) suggest that if ISO40 is reduced in size the operational phases of the two projects will not affect activities at, and users of, the disposal site.

106. It is possible that during construction of these two projects, the presence of increased vessel activity in the area could result in some minor interference to vessels going to and from the disposal site, however the mitigation proposed in **Chapter 15, Shipping and Navigation** will manage vessel activity to ensure impacts are not significant.

16.6.8. Inter-Relationships

107. **Table 16-8** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 16-8 Inter-Topic Relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Marine Water and Sediment Quality	Chapter 8	Section 16.6.1	Both chapters consider the potential effects of the project on the marine disposal areas.
Benthic and Intertidal Ecology	Chapter 9	Section 16.6.1 and 16.6.3	Both chapters consider the potential effects of the project on the marine disposal areas and temporary habitat loss.
Shipping and Navigation	Chapter 15	Section 16.6.7	Both chapters consider the potential cumulative effects of this project and the Minesto project on sea users.

108. Alongside the other users considered for the purposes of this chapter a number of other users have been considered separately, which are reported on in **Chapter 14, Commercial Fisheries, Chapter 15, Shipping and Navigation, Chapter 23, Traffic and Transport** and **Chapter 25, Socio-economics, Tourism and Recreation.**

16.6.9. Interactions

109. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 16-9**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 16-9 Potential Interaction Between Impacts

Potential interaction between impacts			
Construction/ Decommissioning	Impact 1: Disruption of ongoing MOD activities	Impact 2: Interaction with UXO	Impact 3: Interaction with active telecom. cables
Impact 1: Disruption of ongoing MOD activities	-	Yes	No
Impact 2: Interaction with UXO	Yes	-	No
Impact 3: Interaction with active telecom. cables	No	No	-
Operation	Impact 1: Disruption of ongoing MOD activities	Impact 2: Interaction with UXO	Impact 3: Interaction with active telecom. cables
Impact 1: Disruption of ongoing MOD activities	-	Yes	No
Impact 2: Interaction with UXO	Yes	-	No
Impact 3: Interaction with active telecom. cables	No	No	-

16.7. SUMMARY

110. Whilst the MDZ is in close proximity to the CeltixConnect active telecommunications cable, modelling (as discussed and presented in **Chapter 7, Metocean Conditions and Coastal Processes**), demonstrates that only very minor changes are expected, even under the worst-case scenarios, to scour and sediment plumes in the vicinity of the active telecommunications cable. However, to prevent any potential for interaction with the cables a proposed 500 m safety buffer will be implemented.

111. Given the location of the MDZ, there is potential to expose and disturb UXO. Mitigation will be put in place to reduce the risk from UXO encountered.

112. To date there has been no consultation response from the MOD and therefore it has not been possible to assign a significance to potential impacts upon ongoing military activities. However, the assessment highlights that due to the MDZ being located outside of the MATZ any potential for impact during all phases of the MDZ project are likely to negligible.

113. The assessment is summarised in **Table 16-10**.

Table 16-10 Summary of Potential Impacts Identified

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase						
Impact 1: Disruption of ongoing MOD activities	MOD	High	Very Low	Minor	On-going stakeholder engagement. Plotting MDZ on Admiralty charts.	Negligible
Impact 2: Interaction with UXO	Sea Users (crew / vessels), environmental receptors	N/A	N/A	Potential to disturb and expose UXO	Risk assessment and potential survey required to identify location of potential UXO. If UXO present, infrastructure could be micro-sited or UXO cleared. Contractors to be made aware of potential risks.	Minor
Impact 3: Interaction with active telecommunication cables	CeltixConnect Subsea cable	High	Very low	Minor	Implementation of 500 m safety buffer around active subsea cable. The position of this live cable will be communicated to all installation vessels and the Project will consult with the asset owner directly.	Negligible
Operational Phase (including repowering)						
Impact 1: Disruption of on-going Ministry of Defence (MOD) activities	MOD	High	Very Low	Minor	Ongoing stakeholder engagement.	Negligible
Impact 2: Interaction with active telecommunication cables	CeltixConnect Subsea cable	High	Very low	Minor	None required.	Negligible
Decommissioning Phase						
Impact 1: Disruption of on-going Ministry of Defence (MOD) activities	MOD	High	Very Low	Minor	Ongoing stakeholder engagement.	Negligible

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Impact 2: Interaction with UXO	Sea Users (crew / vessels), environmental receptors	N/A	N/A	Potential to disturb and expose UXO	As per construction	Minor
Impact 3: Interaction with active telecommunication cables	CeltixConnect Subsea cable	High	Very low	Minor	Implementation of 500 m safety buffer around active subsea cable. The position of this live cable will be communicated to all decommissioning vessels and the Project will consult with the asset owner directly.	Negligible

16.8. REFERENCES

Crown Estate, 2019. Maps and GIS data [On-line]. Available from https://www.thecrownestate.co.uk/en-gb/resources/maps-and-gis-data/. Accessed March 2019.

Kingfisher, 2019. KIS-ORCA Interactive Map [On-line]. Available from http://www.kis-orca.eu/map Accessed March 2019.

Minesto, 2016. Deep Green Holyhead Deep Project Phase I (0.5 MW) Environmental Statement. Available from: https://minesto.com/sites/default/files/documents/l100194-s14-eias-001-a01_es_compressed.pdf. Access March 2019.

Minesto, 2019. Holyhead Deep – the world's first low-flow tidal stream project [On-line]. Available from: https://minesto.com/projects/holyhead-deep. Accessed April 2019..

Potter, D. (2014). A multi-disciplinary investigation of the fate of disposed dredge spoil at Holyhead Deep, Anglesey.A thesis submitted in partial fulfilment of the requirements of the Degree of MSc in Applied Marine Geoscience. Bangor University.

Royal Haskoning DHV (RHDHV). Morlais Tidal Demonstration Array Scoping Report. Reference PB2735/R/304464/Edin

TETHYS, 2019. Anglesey Skerries Tidal Stream Array [On-line]. Available from https://tethys.pnnl.gov/annex-iv-sites/anglesey-skerries-tidal-stream-array. Accessed March 2019.

Welsh Government, 2019. Wales Marine Planning Portal [On-line]. Available from: http://lle.gov.wales/apps/marineportal/#lat=52.5145&lon=-3.9111&z=8&layers=231. Accessed March 2019

Xodus (2014). Deep Green Project EIA: Coordination Holyhead Deep disposal site: characterisation and assessment of capacity to accommodate Minesto AfL. Document number L-100194-S06-REPT-001.

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Morlais Project
Environmental Statement

Chapter 17: Water Resources and Flood Risk

Volume I

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-017

Chapter 17: Water Resources and Flood Risk

Author: Royal HaskoningDHV

Morlais Document No.: MOR/RHDHV/DOC/0032	Status: Final	Version No: F3.0	Date: July 2019

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GLOSSARY OF ABBREVIATIONS

AONB	Area of Outstanding Natural Beauty
CIA	Cumulative Impact Assessment
CIRIA	Construction Industry Research and Information Association
CMS	Construction Method Statement
DCLG	Department for Communities and Local Government
DCWW	Dŵr Cymru – Welsh Water
DMRB	Design Manual for Roads and Bridges
EA	Environment Agency
EC	European Commission
EIA	Environmental Impact Assessment
ES	Environmental Statement
EU	European Union
FCA	Flood Consequence Assessment
FWMA	Flood and Water Management Act
GEP	Good Ecological Potential
GES	Good Ecological Status
GPP	Guidance for Pollution Prevention
HDD	Horizontal Directional Drilling
IoACC	Isle of Anglesey County Council
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authorities
LNR	Local Nature Reserve
NRW	Natural Resources Wales
PFRA	Preliminary Flood Risk Assessment
PWS	Private Water Supplies
RBD	River Basin District
RBMP	River Basin Management Plan
RIGS	Regionally Important Geological Site
SAC	Special Area of Conservation
SFCA	Strategic Flood Consequence Assessment
SNCI	Site of Nature Conservation Interest
SPA	Special Protection Area
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage System
TAN	Technical Advice Note
WFD	Water Framework Directive

GLOSSARY OF TERMINOLOGY

Aquifer	A body of permeable rock which can contain or transmit groundwater
Catchment	An area where water is collected by the natural landscape, eventually flowing to a river, lake, ocean or groundwater system
Devensian	The most recent Pleistocene glaciation in Britain
Erosion	The process of eroding or being eroded by wind, water or other natural agents
Groundwater	Water held underground in the soil or in pores and crevices in rock
Pelite	A sediment or sedimentary rock composed of very fine clay or mud
Psammite	A sedimentary rock, or sandstone
Sedimentation	The process of particles settling to the bottom of a body of water
Standing water	A pool of water of any size that does not flow
Surface water	Water that collects on the surface of the ground
Watercourse	A natural or artificial channel through which water flows

17. WATER RESOURCES AND FLOOD RISK

17.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) considers the potential impacts of the Morlais Project (the Project) on water resources and flood risk. An overview of the existing baseline for the proposed landfall and onshore development area is provided, followed by an assessment of the potential impacts and associated mitigation for the construction, operation and decommissioning of the Project. Cumulative impacts with other proposed projects are also considered in **Section 17.6.7**.

2. This chapter has been prepared by Royal HaskoningDHV in accordance with the relevant legislation and policies, adhering to the methodology for Environmental Impact Assessment (EIA) and Cumulative Impact Assessment (CIA) as discussed in **Section 17.4**.

3. Due to the close association between water resources and flood risk, ground conditions and onshore ecology, this chapter should be read in conjunction with **Chapter 18, Ground Conditions and Contamination** and **Chapter 19, Onshore Ecology**.

4. Additional information to support the assessment of impacts on water resources and flood risk is provided separately in the following appendices:

- **Appendix 17.1** (**Volume III**): Flood Consequence Assessment (FCA); and
- **Appendix 8.1** (**Volume III**): Water Framework Directive (WFD) Compliance Assessment.

17.2. POLICY, LEGISLATION AND GUIDANCE

5. There are a number of pieces of legislation, policy and guidance applicable to water resources and flood risk. The following sections provide detail on key pieces of international and UK legislation, policy and guidance. Further detail is provided in **Chapter 2, Policy and Legislation**.

17.2.1. Legislation and Policy (International)

17.2.1.1. Water Framework Directive (2000/60/EC)

6. The Water Framework Directive (WFD) (Council Directive 2000/60/EC establishing a framework for community action in the field of water policy) requires that all European Union (EU) Member States must prevent deterioration and protect and enhance the status of aquatic ecosystems. This means that EU Member States must ensure that new schemes do not adversely impact upon the status of aquatic ecosystems, and that historical modifications that are already impacting it need to be addressed.

7. Unlike the EU Birds and Habitats Directives (European Commission (EC) Directive on the Conservation of Wild Birds (2009/147/EC) and EC Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC), respectively), which apply only to designated sites, the WFD applies to all water bodies (rivers, lakes, estuaries, coastal waters and groundwater) including those that are man-made.

17.2.2. Legislation and Policy (National)

17.2.2.1. Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

8. The WFD is transposed into national law by means of the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. The Regulations provide for the implementation of the WFD, from designation of all surface waters (rivers, lakes, estuarine waters, coastal waters and ground waters) as water bodies, and set objectives for the achievement of Good Ecological Status (GES) or Good Ecological Potential (GEP).

17.2.2.2. Water Framework Directive (Standards and Classifications) Directions (England and Wales) 2015

9. The standards used to determine the ecological or chemical status of a water body are provided in the WFD (Standards and Classification) Directions (England and Wales) 2015. This includes the thresholds for determining the status of the biological, hydromorphological, physico-chemical and chemical status of surface water bodies, and the quantitative and chemical status of groundwater bodies.

17.2.2.3. Flood Water Management Act 2010

10. The Flood and Water Management Act (FWMA) aims to improve both flood risk management and the way we manage our water resources by creating clearer roles and responsibilities. This includes a lead role for local authorities in managing local flood risk (from surface water, ground water and ordinary watercourses) and a strategic overview role of all flood risk for Natural Resources Wales (NRW). The FWMA provides opportunities for a comprehensive, risk-based approach on land use planning and flood risk management by local authorities and other key partners.

17.2.2.4. National Policy Statements

11. Although this Project is not seeking a Development Consent Order (DCO), its size (up to 240 MW) means it is of equivalent scale and magnitude as a Nationally Significant Infrastructure Project (NSIP). Guidance that is relevant to assessing impacts on water resources and flood risk for NSIPs are set out within National Policy Statements (NPS) which are the principal decision-making documents for NSIPs.

12. The assessment of potential impacts within this chapter has therefore been undertaken with specific reference to the relevant National Policy Statements (NPS). The specific assessment requirements for water resources and flood risk in the NPS are detailed in the overarching statement for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a) as stated in **Table 17-1** below.

Table 17-1 NPS Assessment Requirements Relevant to Water Resources and Flood Risk

NPS Requirement	**NPS Reference**	**ES Reference**
Applications for energy projects of 1 hectare or greater in Flood Zone 1 in England or Zone A in Wales and all proposals for energy projects located in Flood Zones 2 and 3 in England or Zones B and C in Wales should be accompanied by a flood risk assessment (FRA). An FRA will also be required where an energy project less than 1 hectare may be subject to sources of flooding other than rivers and the sea (for example surface water), or where the EA, Internal Drainage Board or other body have indicated that there may be drainage problems. This should identify and assess the risks of all forms of flooding to and from the project and demonstrate how these flood risks will be managed, taking climate change into account.	NPS EN-1 Para 5.7.4	A flood risk assessment has been undertaken and is provided in **Appendix 17.1** (**Volume III**)
Applicants for projects which may be affected by, or may add to, flood risk should arrange pre-application discussions with the EA, and, where relevant, other bodies such as Internal Drainage Boards, sewerage undertakers, navigation authorities, highways authorities and reservoir owners and operators. Such discussions should identify the likelihood and possible extent and nature of the flood risk, help scope the FRA, and identify the information that will be required by the IPC to reach a decision on the application when it is submitted. The IPC should advise applicants to undertake these steps where they appear necessary, but have not yet been addressed.	NPS EN-1 Para 5.7.7	See **Section 17.3** and **Chapter 6, Consultation**.
In determining an application for development consent, the IPC should be satisfied that where relevant: ▪ The application is supported by an appropriate FRA; ▪ The Sequential Test has been applied as part of site selection; ▪ A sequential approach has been applied at the site level to minimise risk by directing the most vulnerable uses to areas of lowest flood risk; ▪ The proposal is in line with any relevant national and local flood risk management strategy; ▪ Priority has been given to the use of sustainable drainage systems (SuDs) (as required in the next paragraph on National Standards); and ▪ In flood risk areas the project is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed over the lifetime of the development.	NPS EN-1 Para 5.7.9	The impact assessment is presented in **Section 17.6,** a flood risk assessment is provided in **Appendix 17.1** (**Volume III**) and mitigation measures are outlined in **Section 17.6.2**, including development of a surface water drainage system
Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent.	NPS EN-1 Para 5.15.12	See **Section 17.5** for details of the existing environment

NPS Requirement	NPS Reference	ES Reference
The ES should in particular describe: ▪ The existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing discharges, proposed new discharges and proposed changes to discharges; ▪ Existing water resources affected by the proposed project and the impacts of the proposed project on water resources, noting any relevant existing abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates (including any impact on or use of mains supplies and reference to Catchment Abstraction Management Strategies); ▪ Existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics; and ▪ Any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive and source protection zones (SPZs) around potable groundwater abstractions.	NPS EN-1 Para 5.15.3	See **Section 17.5** for details of the existing environment
The IPC should satisfy itself that a proposal has regard to the River Basin Management Plans and meets the requirements of the Water Framework Directive (including Article 4.7) and its daughter directives, including those on priority substances and groundwater. The specific objectives for particular river basins are set out in River Basin Management Plans. The IPC should also consider the interactions of the proposed project with other plans such as Water Resources Management Plans and Shoreline/Estuary Management Plans.	NPS EN-1 Para 5.15.6	A Water Framework Directive Compliance Assessment is provided in **Appendix 8.1** (**Volume III**)
The IPC should consider whether mitigation measures are needed over and above any which may form part of the project application. A construction management plan may help codify mitigation at that stage.	NPS EN-1 Para 5.15.8	Mitigation measures are outlined in **Section 17.6.2**
The risk of impacts on the water environment can be reduced through careful design to facilitate adherence to good pollution control practice. For example, designated areas for storage and unloading, with appropriate drainage facilities, should be clearly marked.	NPS EN-1 Para 5.15.9	Mitigation measures are outlined in **Section 17.6.2**
The impact on local water resources can be minimised through planning and design for the efficient use of water, including water recycling.	NPS EN-1 Para 5.15.10	Mitigation measures are outlined in **Section 17.6.2**

17.2.2.5. Planning Policy Wales 2016

13. The planning policy for Wales is set out in the document Planning Policy Wales (Welsh Government, 2016). The planning policy document outlines the Welsh Government’s approach to facilitating the delivery of the aims set out in Energy Wales: A Low Carbon Transition (Welsh Government, 2012b), as well as UK wide and European renewable energy targets, including obligations under the Renewable Energy Directive (2009/28/EC).

14. This policy recognises the risk of an increase in the frequency and severity of rainfall events and the increased risk of flooding as a result of this, and sea level rise caused by climate change. During development design, account should be taken of shoreline management plans and measures such as managed realignment. In addition, development should reduce, and must not increase, flood risk arising from river and/or coastal flooding on and off the development site itself. Priority is placed on the protection of the undeveloped floodplain from development and the prevention of cumulative effects of incremental development.

15. The policy stipulates that built development in areas of flood plain that are currently unobstructed should be limited to essential transport and utilities infrastructure. This should be designed and constructed to remain operational at times of flood and should result in no net loss of floodplain storage, should not impeded water flows and not increase flood risk elsewhere.

17.2.3. Legislation and Policy (Regional)

17.2.3.1. Western Wales River Basin Management Plan 2015-2021 Summary

16. The River Basin Management Plan (RBMP) is a strategic document that sets out the objectives that have been set for implementation of the WFD at a regional (River Basin District (RBD)) level. The purpose of a RBMP is to provide a framework for protecting and enhancing the benefits provided by the water environment. To achieve this, and because water and land resources are closely linked, it also informs decisions on land-use planning.

17. The current Western Wales RBMP was published by the Welsh Government and NRW in December 2015. This document sets out the current state of the water environment according to WFD parameters, pressures affecting the water environment, environmental objectives for protecting and improving the waters, programme of measures to improve the water environment and deliver WFD objectives, actions needed to achieve the objectives, progress since the 2009 RBMP, and also informs decisions on land-use planning as water and land resources are closely linked.

17.2.3.2. Preliminary Flood Risk Assessment

18. The Project is located within the Western Wales RBD, for which a Preliminary Flood Risk Assessment (PFRA) was produced by NRW in December 2018, providing an update to the first PFRA produced in 2011. For the second cycle of the Flood Risk Regulations, the focus in Wales is on bringing information about the risk and management of flooding from main rivers, reservoirs, the sea and surface water together in one place. This involves working collaboratively across the Welsh Government, NRW, the Welsh Local Government Association and Lead Local Flood Authorities (LLFAs) to produce the PFRA as an output.

19. The PFRA assesses and identifies those areas within Wales that are most at risk of flooding from any source through assessing past flooding affecting Wales from 2011 onwards and potential adverse consequences of future flooding. It was then used to inform the Anglesey Local Flood Risk Management Strategy (**Section 17.2.4.1**).

17.2.4. Local Planning Policy

17.2.4.1. Anglesey Local Flood Risk Management Strategy (2013)

20. The Isle of Anglesey County Council (IoACC) is the LLFA for Anglesey and produced the Anglesey Local Flood Risk Management Strategy (LFRMS) in February 2013. At present there is no more recent version publicly available, therefore for the purposes of this report the 2013 LFRMS will be used, although it should be noted that this refers to the Environment Agency (EA) due to its publication date. All mentions of the EA are to be replaced by NRW which has taken on all responsibilities previously held by the EA in relation to flood and coastal erosion risk management in Wales.

21. The LFRMS highlights steps that need to be taken to improve knowledge of flood risk on the island and work better with organisations and the public towards reducing those risks whilst aiming to balance the needs to communities, the economy and the environment. This is done by pulling together available information on flooding in Anglesey to facilitate ease of access, and subsequently identify authorities and organisations involved and their part in reducing the risk of flooding. Strategic objectives are then outlined for managing flood risk and measures that could be implemented to achieve them.

22. Managing local flood risk in Anglesey is the responsibility of IoACC as an LLFA. Other Risk Management Authorities in the area that have legal responsibilities for the management of flood risk include: NRW, Dŵr Cymru – Welsh Water (DCWW) and North and Mid-Wales Trunk Road Agent.

17.2.4.2. Anglesey Area of Outstanding Natural Beauty Management Plan 2015-2020

23. The Isle of Anglesey Area of Outstanding Natural Beauty (AONB) Management Plan 2015-2020 was produced through collaboration of NRW and IoACC. It determines what actions are required to ensure that the special qualities of the AONB are conserved and enhanced for future generations; including water quality and accessible land and water.

24. The importance of water to the Isle of Anglesey is considered in terms of providing clean drinking water in the fenlands and reedbeds on Anglesey, and through the water catchments, rivers, streams, marshes, bogs and fens which help to regulate surface water flow and drainage of the land to reduce flooding at high rainfall and sustain surface water levels during droughts.

25. Policies NE 2.1, NE 2.2 and NE 2.3 of the AONB Management Plan relate to Soil, Air and Water and require community involvement in protecting soils and water from pollution with monitoring and promotion of water efficiency measures. All policies are translated into an action plan which was produced following public and stakeholder consultation.

26. **Table 17-2** outlines national and regional policies directly relevant to Water Resources and Flood Risk.

Table 17-2 National and Regional Policy Requirements Relevant to Water Resources and Flood Risk

Policy Description	Reference	ES Reference
MPS		
Developments and other activities at the coast and at sea can have adverse effects on transitional waters, coastal waters and marine waters. During the construction, operation and decommissioning phases of developments, there can be increased demand for water, discharges to water and adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants into the water environment and the likelihood of transmission of invasive non-native species, for example through construction equipment, and their impacts on ecological water quality need to be considered.	2.6.4.1	Potential impacts to the water environment, including direst disturbance to water bodies, accidental release of contaminants and changes to surface water run off are assessed in **Section 17.7.3**.
Climate change is likely to mean that the UK will experience hotter, drier summers and warmer, wetter winters. There is a likelihood of increased drought, heatwaves, changes in seasonal precipitation and the intensity of weather events such as rainfall leading to flooding.	2.6.7.1	Flood risk and the impact of climate change is assessed in **Section 17.7.3.4** and within the separate FCA (**Appendix 17.1 Volume III**).
Understanding the impacts and effects of climate change is key to maintaining a healthy environment. This will influence how we use and value our coasts and seas both now and in the future. Adaptation, including in the marine environment, is necessary to deal with the potential impacts of these changes which are already in train. Sea level rises, increased flooding and coastal erosion will lead to increased vulnerability for development and significant change along parts of the UK coast.	2.6.7.3	As above
Adapting to the impacts of climate change will also be a priority for terrestrial planning on the coast. Marine planning will need to be compatible with these impacts. This will include ensuring inappropriate types of development are not permitted in those areas most vulnerable to coastal change, or to flooding from coastal waters, while also improving resilience of existing developments to long term climate change.	2.6.7.4	As above
Marine planning will provide an important tool for meeting the long term challenges posed by climate change. To aid planning decisions in taking account of the impacts of climate change, UK Administrations produced a set of UK climate change projections and will be undertaking a UK Climate Change Risk Assessment by 2012 (to be updated every 5 years). The UK has also established the Marine Climate Change Impacts Partnership (MCCIP) which can provide advice to marine plan authorities.	2.6.7.5	As above
Coastal change and coastal flooding are likely to be exacerbated by climate change, with implications for activities and development on the coast. These risks are a major consideration in ensuring that proposed new developments are resilient to climate change over their lifetime.	2.6.8.1	As above

Policy Description	Reference	ES Reference
Draft WNMP		
Resilience to climate change: Proposals should demonstrate that they have considered the impacts of climate change and have incorporated appropriate adaption measures, taking into account Climate Change Risk Assessments for Wales.	SOC_11	As above
Resilience to coastal change and flooding: Proposals should demonstrate how they are resilient to coastal change and flooding over their lifetime.	SOC_08	As above
Cumulative effects Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01	Cumulative effects are assessed in **Section 17.7.6**, and in **Chapter 26, Cumulative and In-combination**.
Planning Policy Wales		
Climate change is likely to increase the risk of flooding as a result of sea-level rises, increased storminess and more intense rainfall. Flooding as a hazard involves the consideration of the potential consequences of flooding, as well as the likelihood of an event occurring. Planning authorities should adopt a precautionary approach of positive avoidance of development in areas of flooding from the sea or from rivers. Surface water flooding will affect choice of location and the layout and design of schemes and these factors should be considered at an early stage in formulating development proposals.	6.6.22	Flood risk and the impact of climate change is assessed in **Section 17.7.3.4** and within the separate FCA (**Appendix 17.1 Volume III**).
The continued construction of hard engineered flood defences to protect development in areas of floodplain is not sustainable. Government resources for flood and coastal defences are directed at protecting existing developments and are not available to provide defences in anticipation of future development. Account should be taken of shoreline management plans and measures such as managed realignment, the creation of washlands and flood plain restoration as alternatives to engineered flood defences.	6.6.23	The Project is not proposing to construct hard flood defences, or affect existing flood defences.
Development should reduce, and must not increase, flood risk arising from river and/or coastal flooding on and off the development site itself. The priority should be to protect the undeveloped or unobstructed floodplain from development and to prevent the cumulative effects of incremental development.	6.6.25	Flood risk is assessed in **Section 17.7.3.4** and within the separate FCA (**Appendix 17.1 Volume III**).
Planning authorities should be aware of the risk of surface water flooding, usually caused by heavy rainfall, and ensure developments are designed and planned to minimise potential impacts. Development should not cause additional run-off, which can be achieved by controlling surface water as near to the source as possible by the use of SuDS. Care	6.6.27	Surface water run-off is assessed in **Sections 17.7.3.4** and **17.7.4.1** and mitigation including a drainage strategy is proposed.

Policy Description	Reference	ES Reference
should be taken in places of shallow groundwater or where flooding is caused by combined surface and groundwater processes. In such situations direct infiltration SuDs may not be appropriate. Consultation with drainage bodies and NRW should be undertaken and relevant evidence and information drawn from Area Statements taken into account.		
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
Proposals should incorporate water conservation measures where practicable, including Sustainable Urban Drainage Systems (SUDS). All proposals should implement flood minimisation or mitigation measures where possible, to reduce surface water run-off and minimise its contribution to flood risk elsewhere.	Policy PCYFF 6: Water Conservation	Surface water run-off is assessed in **Sections 17.7.3.4** and **17.7.4.1** and mitigation including a drainage strategy is proposed.
1. All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced; 3. That the proposal is mitigated to ensure that there aren't any significant unacceptable effects on sensitive uses located nearby; 4. Where appropriate, that the proposal does not have a significant unacceptable effect on the quality and supply of water;	Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	The impact assessment and proposed mitigation are provided in **Section 17.7**. A summary is provided in **Table 17-23**.
Proposals for the following types of new non-residential development will be permitted on sites within the CChMA predicted as being at risk from coastal change during the second indicative policy epoch (2026 – 2055), subject to a compliant Flood Consequence Assessment or a Stability Assessment.	Policy ARNA 1: Coastal Change Management Area (CChMA)	A FCA is included in **Appendix 17.1, Volume III**.

17.3. CONSULTATION

27. Consultation undertaken throughout the pre-application phase has informed the approach taken and the information provided in this Chapter. A summary of the comments received from the Environmental Scoping Opinion of particular relevance to surface water and flood risk is provided in **Table 17-3** below.

Table 17-3 Consultation Responses

Consultee	Date / Document	Comment	Response
Planning Inspectorate	2018 Scoping Response	The EIA Regulations require an estimate, by type and quantity, of expected residues and emissions, where relevant. Specific reference should be made to water, air, soil and subsoil pollution, noise, vibration, light, heat, and radiation, where relevant. This information should be provided in a clear and consistent fashion and may be integrated into the relevant aspect assessments.	Impacts on water quality of surface features during construction is considered in **Sections 17.6.4.2**, **17.6.4.3** and **17.6.4.4**. Impacts during operation are considered in **Section 17.6.5.2**.

Consultee	Date / Document	Comment	Response
Planning Inspectorate	2018 Scoping Response	The Scoping Report has only considered potential impacts to water quality in the offshore area. Hydrological features are identified within the onshore scoping area, however the potential for the Proposed Works to impact on the water quality of such features is not considered. Given the limited detail currently available regarding the location of the onshore cable route, any potential impacts to water quality cannot be discounted and should be assessed in the ES. It is also noted that horizontal direction drilling ('HDD') may be used at the chosen landfall location. The ES should address potential risks to both groundwater resources and surface water bodies from HDD activities including leakage of drilling fluid. Any measures to be implemented in order to address such risks or impacts should be explained in the ES and it should be made clear how they will be secured.	Impacts on water quality of surface features during construction is considered in **Sections 17.6.4.2**, **17.6.4.3** and **17.6.4.4**. Impacts during operation are considered in **Section 17.6.5.2**.
Planning Inspectorate	2018 Scoping Response	Crossing of hydrological features: The ES should provide a schedule demonstrating the methods for each crossing and how any such methods have been factored into the assessment.	Heading has been given as a specific methodology for watercourse crossings for large watercourses that cannot be locally diverted. However, it is not anticipated that any water bodies that are too large to be diverted will be encountered. Therefore, heading is unlikely to be used, and open-cut trenching will be assumed as the worst case for the purposes of this assessment. The impact of these methods is assessed in **Section 17.6.4.1**.
Planning Inspectorate	2018 Scoping Response	Water feature survey: The Applicant should undertake a water feature survey along the cable route and around the proposed locations of the onshore structures and compounds. The likely significant effects on the quantity and quality of surface water and groundwater should be assessed.	An Extended Phase 1 Habitat Survey was carried out between September and November 2018, as discussed in **Chapter 19, Onshore Ecology**, which surveyed all water features along the cable route. This was used to inform the characterisation of the baseline environment

Consultee	Date / Document	Comment	Response
			presented in **Section 17.5**.
Planning Inspectorate	2018 Scoping Response	Flood risk: The Scoping Report describes the flood risk in the onshore scoping area. It is recommended that the ES contains figures clearly delineating the levels of flood risk across the site(s) for onshore works.	Flood risk is assessed in **Section 17.6.4.4** and in the Flood Consequence Assessment (FCA) in **Appendix 17.1**. **Volume III**
Planning Inspectorate	2018 Scoping Response	Flood risk: The ES should take into account not only the potential impacts of flood risk to the Proposed Works, but also whether the Proposed Works could increase flood risk elsewhere.	Flood risk is assessed in **Section 17.6.4.4**.
Planning Inspectorate	2018 Scoping Response	Flood risk: The assessment of flood risk should consider the impact of climate change upon flood levels and surface water run-off. The Applicant should make efforts to discuss and agree the appropriate extreme sea levels and climate change allowances with NRW.	Flood risk is assessed in **Section 17.6.4.4**.
Planning Inspectorate	2018 Scoping Response	Water Framework Directive: The consideration of potential impacts to Water Framework Directive waterbodies is welcomed, although the Scoping Report has not identified the existing water body status for the Caernarfon Bay North coastal water body within which the application site is located. The Applicant should demonstrate that the Proposed Works would not affect waterbody status and is advised to follow the WFD assessment framework set out in NRW's response (see **Appendix 1** of this Scoping Opinion).	Water Framework Directive (WFD) issues are considered separately in the WFD Compliance Assessment (**Appendix 8.1 Volume III**).
NRW (for PINS)	2018 Scoping Response	The demonstration zone is located at its nearest point, 0.5km (0.27 nautical miles) from the west coast of Holy Island Anglesey and falls within the Caernarfon Bay North WFD coastal water body which currently has an overall Good status, with a Good chemical status and a good ecological status. We advise that a Preliminary WFD Assessment report is prepared by the applicant in support of the application and, where required, a detailed WFD Compliance Assessment Report be undertaken. We welcome further discussion relating to WFD compliance assessment. We advise that WFD should be considered at an early stage in project planning and included in preapplication discussions to ensure avoidance, mitigation and/or improvement	Compliance with the Water Framework Directive is assessed in **Appendix 8.1 Volume III** WFD Compliance Assessment. The WFD Compliance Assessment follows the method suggested by NRW.

Consultee	Date / Document	Comment	Response
		measures are built in to the project where appropriate to minimise costs for the applicant and to provide the best environmental outcome. The Directive does not specify the format or process to follow for WFD assessments. This allows a flexible and proportionate approach to be undertaken. To aid in the decision-making process, it is recommended that the appraisal of an activity or project is conducted in 3 stages: • Screening: exclude any activities that do not need to go through the scoping or detailed assessment stages • Scoping – identify the quality elements that are potentially at risk from the proposed activity and need further detailed assessment • Detailed assessment – consider the potential impacts of an activity on bodies of surface and ground water, identify ways to avoid or minimise impacts, and identify if an activity may prevent the water body achieving good status or cause deterioration. In the event that an activity may prevent the water body achieving good status or cause deterioration then it may be allowed to proceed if it meets the requirements of Article 4.7. The WFD assessment must consider: • all activities carried out; and, • each stage of the activity, for example construction, operation, maintenance and decommissioning • The WFD compliance assessment process needs to also consider the zone of influence of the project in its entirety and any WFD waterbodies that fall within it, not just where there are direct impacts. • Consideration should be given to whether the potential impacts are short term effects (< 6 years) or will cause a non-temporary/permanent change (e.g. direct habitat loss alteration to sediment transport pathways, interference with migratory fish pathways etc). If the impacts are considered a non-temporary/permanent effect on the biological, chemical or hydro morphological elements of the WFD water body in question then the impact must be carried forward for consideration in the WFD compliance assessment process.	

Consultee	Date / Document	Comment	Response
NRW (for PINS)	2018 Scoping Response	Please see attached OGN 72 for further consideration. This is NRW's internal guidance document on assessing activities and projects for compliance with the Water Framework Directive. It is worth highlighting that these documents are intended for internal NRW use and therefore some of the links may not work and some content may not be relevant externally.	The OGN 72 has been consulted during the preparation of **Appendix 8.1 Volume III** WFD Compliance Assessment.
NRW (for PINS)	2018 Scoping Response	Please note that since 1st January 2018 the exemption for abstraction of groundwater and dewatering for engineering and quarrying has been removed. An abstraction licence will be required for these activities if there is an intention to abstract over 20m^3/day. Further detail can be obtained from our Water Resources Permitting team (0300 065 3000).	Permitting requirements will be considered as part of post-consent discussions.
NRW (for PINS)	2018 Scoping Response	We are aware that there are a number of private water supplies (PWS) located on the Isle of Anglesey; the local authority Environmental Health Officers will have a register of these. The works have the potential to impact small drinking water supplies such as PWS and we therefore recommend that the local authority is contacted for further advice. The potential impact on small drinking water supplies should be assessed, where significant effects are likely.	Potential impacts on groundwater resources are considered in **Sections 17.6.4.3**, **17.6.5.1** and **17.6.5.2**. The location of private water supplies known to the local authority is discussed in **Section 17.5.4**.
NRW (for PINS)	2018 Scoping Response	Requirements of a Water Feature Survey The applicant must undertake a preliminary site assessment, which should include the following: • Identification of all water features both surface and groundwater (ponds, springs, ditches, culverts etc.) within a 300 metres radius of the site. • Use made of any of these water features. This should include the construction details of wells and boreholes and details of the lithology into which they are installed; • An indication of the flow regime in the spring or surface water feature, for example whether or not the water feature flows throughout the year or dries up during summer months; • Accessibility to the spring/well; • This information should identified on a suitably scaled map (i.e. 1:10,000), tabulated and submitted to Natural Resources Wales. It would be useful for the developer to photograph each of the identified water features during the survey.	An Extended Phase 1 Habitat Survey was carried out between September and November 2018, as discussed in **Chapter 19, Onshore Ecology**, which surveyed all water features along the cable route. This was used to inform the characterisation of the baseline environment presented in **Section 17.5**.

Consultee	Date / Document	Comment	Response
NRW (for PINS)	2018 Scoping Response	Based on the results of the survey the applicant must assess the likely impacts from the development on both quantity and quality of the surface water and groundwater. This should take into consideration both the preferred methods of construction and the assumed hydrogeology in the vicinity of the development.	Potential impacts on groundwater resources are considered in **Sections 17.6.4.3**, **17.6.5.1** and **17.6.5.2**.
NRW (for PINS)	2018 Scoping Response	We may require identified groundwater features to be monitored during the proposed workings and would therefore recommend that the survey be undertaken as soon as possible to enable the developer to carry out suitable baseline monitoring prior to the commencement of workings at the site	Potential impacts on groundwater resources are considered in **Sections 17.6.4.3**, **17.6.5.1** and **17.6.5.2**.
NRW (for PINS)	2018 Scoping Response	With regard to flood risk associated with the landfall and cable route we are generally satisfied with the content of the EIA scoping report in that flood risk will be considered further as part of the ES (see **section 7.3.1.4**). We would advise that the flood maps referred to in footnote 34 show current day risks and do not include any allowances for climate change. Climate change allowances (75 years) would be in line with CL-03-16 (http://gov.wales/topics/planning/policy/policy clarificationletters/2016/cl-03-16-climatechange-allowances-for-planning-purposes/?lang=en).	Flood risk is assessed in **Section 17.6.4.4** and the separate FCA (**Appendix 17.1 Volume III**).
NRW (for PINS)	2018 Scoping Response	Extreme sea levels can be obtained for this coastline for a range of probability flood events including that of climate change allowances. These extreme sea levels would allow for surge conditions but not wave action. To obtain the levels a request may be made to our data distribution team.	Flood risk is assessed in **Section 17.6.4.4** and the separate FCA (**Appendix 17.1 Volume III**).
NRW	2018 Scoping Response	The ES should make reference to any main rivers within the route and directly downstream of the reservoirs referred to. These can be viewed on the NRW Flood Risk Maps (referred to in footnote 34 of the Scoping Report) using “detailed view” to see main river layer. Activities in, over, under or within 8m of a main river may be subject to a Flood Risk Activity Permit under the Environmental Permitting Regulations. These permits are determined by NRW.	None of the works are within 8m of a main river. Permitting requirements will be considered as part of post-consent discussions.
Isle of Anglesey County Council	2017 Scoping Response	Suggest consideration is given to addressing flood risk associated with onshore works. Area A has the least onshore flood risk.	Flood risk is assessed in **Section 17.6.4.4** and the separate FCA (**Appendix 17.1 Volume III**).

17.4. METHODOLOGY

17.4.1. Study Area

28. The study area for water resources and flood risk has been identified on the basis of surface hydrological catchments. Catchments have been included in the study area if they contain or are hydrologically connected to (i.e. upstream of downstream), the proposed works area (**Figure 17-1, Volume II**). The works area includes the onshore infrastructure comprising landfall, landfall substation at Ty-Mawr (hereafter referred to as landfall substation), onshore cable corridor, switchgear building at Parc Cybi (hereafter referred to as switchgear building) and grid connection substation at Orthios (hereafter referred to as grid connection substation). as well as the associated temporary works areas. The NRW WFD water body boundaries (including terrestrial components of transitional and coastal water bodies, which are not designated as separate river water bodies due to their small catchment area) are based on surface hydrological catchments and have therefore been used define surface water receptors.

17.4.2. Data Sources – Desk Study

29. The data sources that have been used to inform the water resources and flood risk baseline are listed in **Table 17-4**.

Table 17-4 Data Sources Features

Data	Year	Coverage	Confidence
Water Watch Wales Cycle 2 Rivers and waterbodies viewer	2019	Regional	High
Wales Water Body Objectives and Measures	2019	Regional	High
British Geological Survey Geoindex	2019	Nationwide	High
Lle Geo-Portal for Wales	2019	Regional	High
Natural Resources Wales' Flood Risk Map Viewer	2019	Regional	High
Water Watch Wales Reason for Not Achieving Good Status information	2019	Regional	High

17.4.3. Impact Assessment Methodology

30. **Chapter 5, EIA Methodology** provides a summary of the general impact assessment method, and the following sections describe the methodology used to assess the potential impacts of the Project on water resources and flood risk in more detail. More detailed methodologies for the FCA and WFD compliance assessment can be found in **Appendix 17.1** (**Volume III**) and **Appendix 8.1** (**Volume III**) respectively.

31. Two key groups of impacts have been identified for the purpose of defining impact significance:

32. Water resources: these are potential effects of the Project on the physical (including hydrology and geomorphology), biological or chemical character of surface waters or groundwater, potentially impacting on secondary receptors such as wetlands or abstractions, and WFD water body status; and

33. Flood risk: these are the potential impacts of the Project on site drainage, conveyance and surface water flooding.

34. Whilst there are clear links between the two impact groups, the assessment of receptor sensitivity and the magnitude of effect may differ. These definitions have been developed with reference to best-practice guidance for the assessment of environmental impacts on water receptors provided by the Department of Transport (2015) and Highways Agency (2008).

17.4.3.1. Sensitivity

35. Receptor sensitivity has been defined with reference to the adaptability, tolerance, recoverability and value of individual receptors. **Table 17-5** provides the criteria for appraisal of the value and sensitivity for identified water resources and flood risk receptors based on professional judgement.

Table 17-5 Definitions of the Different Sensitivity Levels for Water Resources and Flood Risk Receptors

Sensitivity	Definition
High	Receptor has **very limited** capacity to tolerate changes to hydrology, geomorphology, and water quality or flood risk. *Water resources* • Controlled waters with an unmodified, naturally diverse hydrological regime, a naturally diverse geomorphology with no barriers to the operation of natural processes, and good water quality. • Supports habitats or species that are highly sensitive to changes in surface hydrology, geomorphology or water quality. • Supports Principal Aquifer with public water supply abstractions by provision of recharge. • Site is within Inner or Outer Source Protection Zones. *Flood risk* • Highly Vulnerable Land Use, as defined by Technical Advice Note 15 for the Planning Policy Wales (2004). • Land with more than 100 residential properties (after Highways Agency, 2008).
Medium	Receptor has **limited** capacity to tolerate changes to hydrology, geomorphology, and water quality or flood risk. *Water resources* • Controlled waters with hydrology that sustains natural variations, geomorphology that sustains natural processes, and water quality that is not contaminated to the extent that habitat quality is constrained. • Supports or contributes to habitats or species that are sensitive to changes in surface hydrology, geomorphology and/or water quality. • Supports Secondary A or Secondary B Aquifer with water supply abstractions. • Site is within a Catchment Source Protection Zone. *Flood risk* • More Vulnerable Land Use, as defined by Technical Advice Note 15 for the Planning Policy Wales (2004). • Land with between 1 and 100 residential properties or more than 10 industrial premises (after Highways Agency, 2008).

Sensitivity	Definition
Low	Receptor has **moderate** capacity to tolerate changes to hydrology, geomorphology, and water quality or flood risk. *Water resources* • Controlled waters with hydrology that supports limited natural variations, geomorphology that supports limited natural processes and water quality that may constrain some ecological communities. • Supports or contributes to habitats that are not sensitive to changes in surface hydrology, geomorphology or water quality. • Supports Secondary A or Secondary B Aquifer without abstractions. *Flood risk* • Less Vulnerable Land Use, as defined by Technical Advice Note 15 for the Planning Policy Wales (2004). • Land with 10 or fewer industrial properties (after Highways Agency, 2008).
Negligible	Receptor is **generally** tolerant of changes to hydrology, geomorphology, and water quality or flood risk. *Water resources* • Controlled waters with hydrology that does not support natural variations, geomorphology that does not support natural processes and water quality that constrains ecological communities. • Aquatic or water-dependent habitats and/or species are tolerant to changes in hydrology, geomorphology or water quality. • Non-productive strata that does not support groundwater resources. *Flood risk* • Water Compatible Land Use, as defined by Technical Advice Note 15 for the Planning Policy Wales (2004). • Land with limited constraints and a low probability of flooding of residential and industrial properties (after Highways Agency, 2008).

17.4.3.2. Value

36. It should be noted that high value and high sensitivity are not necessarily linked with respect to a particular impact. A receptor could be of high value but have a low sensitivity to an effect. It is therefore important not to inflate the significance of an impact due to the value of the receptor. Instead, the value can be used as a modifier for the sensitivity assigned to the receptor. Definitions for the value of surface waters are provided in **Table 17-6**.

Table 17-6 Definitions of the Value Levels for Water Resources and Flood Risk Receptors

Value	Definition
High	Receptor is an **internationally or nationally important** resource with limited potential for offsetting / compensation. *Water resources*

Value	Definition
	• Supports or contributes to designated habitats or species of international or national importance (e.g. Special Area of Conservation (SAC), Special Protection Area (SPA), and Site of Special Scientific Interest (SSSI)). • Licensed potable abstractions (surface water and groundwater). *Flood risk* • Nationally significant infrastructure. • Internationally or nationally designated planning policy areas.
Medium	Receptor is a **regionally important** resource with limited potential for offsetting / compensation. *Water resources* • Supports or contributes to habitats or species of UK regional value (Site of Nature Conservation Interest (SNCI), Regionally Important Geological Site (RIGS)). • Licensed non-potable abstractions and unlicensed potable abstractions (surface water and groundwater). *Flood risk* • Locally significant infrastructure. • Local planning policy designated sites.
Low	Receptor is a **locally important** resource. *Water resources* • Supports or contributes to habitats or species of local value (e.g. Local Nature Reserve (LNR)). • Unlicensed non-potable abstractions (surface water and groundwater). *Flood risk* • Drainage that does not discharge to Critical Drainage Areas.
Negligible	Receptor is not considered to be an important resource. *Water resources* • Does not support or contribute to habitats or species of particular importance. • No abstractions (surface water and groundwater). *Flood risk* • No significant infrastructure.

17.4.3.3. Magnitude

37. Receptor magnitude has been defined with reference to the spatial extent, duration, frequency and severity of the effect. Impact magnitude is defined in **Table 17-7**.

Table 17-7 Definitions of the Magnitude Levels for Water Resources and Flood Risk Receptors

Value	Definition
High	Fundamental, permanent / irreversible changes, over the whole receptor, and / or fundamental alteration to key characteristics or features of the particular receptors character or distinctiveness. *Water resources* • Permanent changes to geomorphology and/or hydrology that prevent natural processes operating. • Permanent and/or wide scale effects on water quality or availability. • Permanent loss or long-term (>5 years) degradation of a water supply source resulting in prosecution. • Permanent or wide scale degradation of habitat quality. *Flood risk* • Permanent or major change to existing flood risk. • Reduction in on-site flood risk by raising ground level in conjunction with provision of compensation storage. • Increase in off-site flood risk due to raising ground levels without provision of compensation storage. • Failure to meet either sequential or exception test (if applicable).
Medium	Considerable, permanent / irreversible changes, over the majority of the receptor, and / or discernible alteration to key characteristics or features of the particular receptors character or distinctiveness. *Water resources* • Medium-term (1-5 years) effects on water quality or availability. • Medium-term (1-5 years) degradation of a water supply source, possibly resulting in prosecution. • Habitat change over the medium-term (1-5 years). *Flood risk* • Medium-term (1-5 years) or moderate change to existing flood risk. • Possible failure of sequential or exception test (if applicable). • Reduction in off-site flood risk within the local area due to the provision of a managed drainage system.
Low	Discernible, temporary (throughout project duration) change, over a minority of the receptor, and / or limited but discernible alteration to key characteristics or features of the particular receptors character or distinctiveness. *Water resources* • Short-term (<1 year) or local effects on water quality or availability. • Short-term (<1 year) degradation of a water supply source. • Habitat change over the short-term. *Flood risk* • Short-term (<1 year), temporary or minor change to existing flood risk. • Localised increase in on-site or off-site flood risk due to increase in impermeable area. • Passing of sequential and exception test.
Negligible	Discernible, temporary (for part of the project duration) change, or barely discernible change for any length of time, over a small area of the receptor, and/or slight alteration to key characteristics or features of the particular receptors character or distinctiveness. *Water resources* • Intermittent impact on local water quality or availability.

Value	Definition
	• Intermittent or no degradation of a water supply source. • Very slight local changes to habitat that have no observable impact on dependent receptors. *Flood risk* • Intermittent or very minor change to existing flood risk. • Highly localised increase in on-site or off-site flood risk due to increase in impermeable area.

17.4.3.4. Impact Significance

38. The potential significance of an impact is a function of the sensitivity and value of the receptor and the magnitude of the effect (noting that value and sensitivity are not necessarily linked, as detailed in **Section 17.4.3.2**).

39. The significance is derived using an impact significance matrix, as shown in **Table 17-8**. Definitions of each level of significance are provided in **Table 17-9**.

40. Assessment of impact significance is qualitative and reliant on professional experience, interpretation and judgement. The matrix should therefore be viewed as a framework to aid understanding of how a judgement has been reached, rather than as a prescriptive, formulaic tool. Note that impacts may be adverse or beneficial.

41. Effects that result in major or moderate impacts are considered to be 'significant' in EIA terms. Adverse significant impacts may require mitigation; beneficial significant impacts could contribute to the case in favour of the project.

Table 17-8 Impact Significance Matrix

		Negative Magnitude				Beneficial Magnitude			
		High	**Medium**	**Low**	**Negligible**	**Negligible**	**Low**	**Medium**	**High**
Sensitivity	**High**	*Major*	*Major*	*Moderate*	*Minor*	*Minor*	*Moderate*	*Major*	*Major*
	Medium	*Major*	*Moderate*	*Minor*	*Minor*	*Minor*	*Minor*	*Moderate*	*Major*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*	*Negligible*	*Minor*	*Minor*	*Moderate*
	Negligible	*Minor*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Minor*

Table 17-9 Impact Significance Definitions

Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.

Significance	Definition
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision making process.
Negligible	No discernible change in receptor condition.
No change	No impact, therefore no change in receptor condition.

42. Following initial assessment, if the impact does not require additional mitigation (or none is possible) the residual impact will remain the same. If, however, additional mitigation is proposed there will be an assessment of the post-mitigation residual impact.

17.4.4. Cumulative Impact Assessment

43. **Chapter 5, EIA Methodology** provides a general methodology with regards to the Cumulative Impact Assessment (CIA). The potential for cumulative effects has been considered for the construction, operation and decommissioning of the onshore development area with other onshore projects.

44. Cumulative impacts are considered where the onshore development area has the potential to overlap with similar impacts arising from:

- Recent development, either built or under construction (which is not considered as part of the baseline);
- Approved development, awaiting implantation; and
- Proposals awaiting determination within the planning process with design information in the public domain.

45. The CIA involves consideration of whether impacts on a receptor can occur on a cumulative basis between the Project and other activities, projects and plans for which sufficient information regarding location and scale exist.

17.5. EXISTING ENVIRONMENT

This section covers the freshwater surface water bodies and groundwater and does not consider coastal water bodies. However, information is provided on coastal water bodies for context as the surface watercourses within the study area drain into these. Marine water and sediment quality are discussed in **Chapter 8, Marine Water and Sediment Quality**.

17.5.1. Surface Water Drainage

46. The preferred option for the onshore cable route is for it to be excavated into the local road network where possible. This road network crosses or runs adjacent to a number of un-named ordinary watercourses comprising small, spring-fed drains and streams which are the responsibility of the local authority as the LLFA.

47. Fourteen surface water features have been identified as potentially being crossed or interacted with by the Project. These are shown in **Figure 17-1 (Volume II)** and listed in **Table 17-10** below:

Table 17-10 Surface water features located within the works area

Water Feature Number	Grid Reference	Description
1	SH21788163	Stream at landfall running adjacent to the road and over the cliff within HDD footprint.
2	SH22098057	Drain passing under the road near Ty-Mawr.
3	SH23698060 - SH23428001	Stream running adjacent to Porth Dafarch Road from Valley of the Rocks towards Porth Dafarch Beach, crossing under the road at SH23458019. Interacts with onshore cable corridor.
4	SH24518077	Area of spring-fed marshy ground with drains adjacent to Holyhead Leisure Centre interacts with onshore cable corridor; however, this may now be diverted to avoid this.
5	SH24828092	Drains to the northeast of the football ground at Holyhead Leisure Centre, crossed by the onshore cable corridor.
6	SH24888096	
7	SH25058102 - SH25158102	Drainage pond between roundabouts on Parc Cybi Road and B4545 may interact with the onshore cable corridor.
8	SH25208098	Drain adjacent to Parc Cybi Road between Tyddyn-pioden and the road interacts with onshore cable corridor.
9	SH25728091 - SH25878083	Drain adjacent to A55 leading to the pond, may interact with Horizontal Directional Drilling (HDD) area for grid connection substation.
10	SH25938078	SuDS pond adjacent to A55 road may interact with HDD area for grid connection substation.
11	SH26208077	Drain running adjacent to the A55 road on the northern side, potential overlap with HDD area.
12	SH26218065	Drain crossing under A55 within woodland towards Aluminium works may interact with HDD area for grid connection substation.
13	SH26598048	Second drain crossing beneath the A55 may interact with HDD area for grid connection substation.
14	SH27078045	Drain running adjacent to bridge that passes over A55 may interact with HDD area for grid connection substation.

48. The surface drainage features are not included within the catchments of any river water bodies under the WFD, because their catchment areas are too small to be considered as a water body in their own right. However, the terrestrial catchments are considered to be part of the transitional or coastal water bodies into which they drain.

49. The landfall is located in an area of the coastal fringe which drains into the sea, therefore two WFD coastal water bodies are considered as shown in **Figure 17-2** (**Volume II**):

50. Caernarfon Bay North (GB621010380000) which has an area of 135.19 km^2, stretching from where the Menai Strait enters St. George's Channel, round Anglesey to the area just north of Holyhead.

51. At the Project's eastern edge it is in close proximity to the Holyhead Strait (GB681010450000), which has an area of 7.29 km^2 and receives drainage from any ordinary watercourses present in that area.

52. Impacts on coastal waters bodies are discussed in **Chapter 8, Marine Water and Sediment Quality** and are not discussed further in this chapter. Further information on WFD compliance is provided in the separate WFD Compliance Assessment (**Appendix 8.1**).

17.5.2. Water Quality

53. As the surface water features within the onshore development area comprise small streams and drainage ditches and are ordinary watercourses, there is no available data relating to their water quality.

54. Data presented in the NRW Cycle 2 Rivers and water bodies WFD Data Download spreadsheet (accessed March 2019), indicate that water quality in the Caernarfon Bay North coastal water body is good, and that in the Holyhead Strait coastal water body is moderate.

17.5.3. Flood Risk

55. The NRW Development Advice Map shows that the onshore development area is located within Zone A, apart from four small areas on the foreshore at landfall which are within Zone C2 and are without significant flood defence infrastructure. There are no records of historical flooding from rivers, the sea, groundwater or surface water. The coastal frontage at landfall includes four areas classified as being low risk (i.e. between 1 in 1,000 (0.1 %) and 1 in 100 (1 %) chance of flooding from the sea each year. Further north, there are two areas classified as being at high risk (i.e. greater than 1 in 30 (30 %) chance of flooding each year.

56. The Isle of Anglesey Strategic Flood Consequence Assessment (SFCA) states that groundwater is not considered to be a significant source of flooding, and the Western Wales RBD PFRA states that groundwater flood events in Wales are rare.

57. The onshore cable corridor intersects areas classified as low (between 1 in 1000 (0.1 %) and 1 in 100 (1 %) chance), medium (between 1 in 100 (1 %) and 1 in 30 (30 %) chance) and high (greater than 1 in 30 (30 %) chance) risk of flooding from surface water. Areas of medium risk include an area to the east of Ty-Mawr Farm and along the road at Dafarch North.

58. The NRW Development Advice Map shows that the grid connection points are located entirely within Zone A with both the Parc Cybi and Orthios grid connection points intersecting an area of low (i.e. between 1 in 1,000 (0.1%) and 1 in 100 (1%) chance) of flooding from surface water each year. There is no risk of flooding from other sources.

59. A more detailed description of the baseline flood risk in the onshore development area is provided in the FCA (**Appendix 17.1 Volume III**).

17.5.4. Groundwater

60. The proposed Project is underlain by the Ynys Mon Secondary B Aquifer (GB41002G204400) spanning both the bedrock and superficial drift. The bedrock is made up of the South Stack psammite and pelite formation and the New Harbour Group schist and psammite group. The superficial deposit consists of Devensian till and small areas of glaciofluvial Devensian sand and gravel deposits.

61. The aquifer throughout the majority of Holy Island is of high vulnerability except for where the Project makes landfall where it is medium vulnerability. The quantitative status of the groundwater throughout northern Wales including Anglesey is good; however, the chemical status over most of Anglesey including Holy Island is poor. This has been attributed to the chemical dependent surface water body status through a source of probably diffuse pollution from mining and quarrying via abandoned mines.

62. There are no Source Protection Zones (SPZ) in the onshore development area, suggesting that the groundwater is not abstracted for public water supply, therefore reducing its likelihood to be sensitive to change. There are Private Water Supplies (PWS) within the area as shown in **Figure 17-3** (**Volume II**). However, none are present within 250 m of the onshore development area for which impacts are assessed for groundwater.

17.5.5. Designated Sites

63. The landfall is located within the Holy Island Coast SSSI, the Holy Island Coast SAC and Holy Island Coast SPA which all follow the coast of Holy Island around its western extent. The Holyhead Strait and Caernarfon Bay North water bodies are covered by the Anglesey Terns Marine SPA. The Holyhead Strait contains the Beddmanarch-Cymyran SSSI, and the Caernarfon Bay North is covered by the North Anglesey Marine candidate SAC:

64. Anglesey Terns Marine SPA is classified due to its population of breeding Arctic terns (*Sterna paradisae*), common terns (*Sterna hirundo*), roseate terns (*Sterna dougllii*) and sandwich tern (*Sterna sandvicensis*) the populations of which should all be stable or increasing.

65. Beddmanarch-Cymyran SSSI comprises shallow waters with areas of mud flats, saltmarsh and sandflats with large areas of seagrass lying between the Holy Island and mainland Anglesey. These support a wide range of wintering water-birds.

66. North Anglesey Marine candidate SAC stretches from the north coast of the Isle of Anglesey into the Irish Sea and has been identified as an area of importance for the harbour porpoise (*Phocoena phocoena*), as well as incorporating a range of other habitats.

67. Glannau Ynys Gybi / Holy Island Coast SAC includes a variety of Annex I habitats that are the reason for designation: vegetated sea cliffs of the Atlantic (and Baltic) Coasts comprising maritime heath with spotted rock rose *Tuberaria guttata* and extensive cliff-crevice and grassland communities. It is also the most important site in North Wales for European dry heaths.

68. Glannau Ynys Gybi / Holy Island Coast SPA supports a resident population of chough *Pyrrhocorax pyrrhocorax* which depends on diverse mix of habitats.

69. Glannau Ynys Gybi / Holy Island Coast SSSI is a component of the SAC and SPA and is designated for a variety of vascular plants (heathland and maritime species), birds (seabirds, peregrine, chough and heathland species), invertebrates and geology.

70. None of the designations listed above contain relevant features likely to be impacted by the Project, particularly when their size is considered in relation to the small scale of the works associated with the Project.

71. There are no terrestrial designations that are directly crossed by onshore infrastructure that are relevant to surface water features. However, the Tre Wilmot SSSI lies approximately 350 m away at its closest point. This is designated for its large area of acidic heath, lowland heath and associated heathland vegetation communities. The lower-lying areas support relevant features including wet heath or peatland communities with species such as crossleaved heath *Erica tetralix*, purple moor-grass *Molinia caerulea* and creeping willow *Salix repens*. However, this is not hydrologically connected to the works area, and water receptors are therefore unlikely to be impacted. Further information regarding designated sites can be found in **Chapter 19, Onshore Ecology.**

17.5.6. Sensitivity and Value of Receptors

72. As described in **Section 17.5.1**, the surface water receptors are made up of a series of small spring-fed drainage channels and streams. The value and sensitivity of each watercourse as described in **Table 17-10** is given below in **Table 17-11**. Any parts of the surface water network that are not included in Ordnance Survey datasets are considered to be part of the nearest downstream watercourse. The sensitivity of each surface water receptor has been defined based on the geomorphological (i.e. physical habitat), hydrological and water quality characteristics described in **Section 17.5.1**. The value has been defined with reference to the ecological value of the receptors and any connected habitats, including the presence of designated sites (see **Section 17.5.5**).

73. Three of the surface water features identified in **Section 17.5.1** appear to drain south or south-east into the Caernarfon Bay coastal water body with the remaining springs and drains appearing to remain as surface or ground water in the form of ponds and sinks. In many cases they appear to have been culverted or straightened next to or under roads or around residential properties and field boundaries in places; but are natural over the remainder of their courses. They are unlikely to encounter any sources of contamination due to the small, rural nature of their catchments and are not within a SPZ.

Table 17-11 Sensitivity and Value of Receptors

Water Feature Number	Sensitivity	Justification of Sensitivity	Value	Justification of Value
1	Medium	Appears to be a small low-energy watercourse which drains over the cliff to the beach at landfall.	High	Runs through an area of marshy grassland and drains into coastal area making up a SSSI, SPA and SAC.
2	Negligible	Low-energy watercourse with limited geomorphological variation and heavily overgrown.	Negligible	Does not contribute to habitats or species of particular interest.
3	Medium	Small watercourse which appears unmodified.	High	Runs through an area of marshy grassland and drains into coastal area making up a SSSI, SPA and SAC.
4	Low	Area of marshy grassland containing undefined drains.	Low	Marshy grassland constitutes a habitat of interest and local value.

Water Feature Number	Sensitivity	Justification of Sensitivity	Value	Justification of Value
5	Low	Low-energy modified drain adjacent to scrub and amenity grassland.	Negligible	Does not appear to drain into or contribute to any protected area and does not contribute to habitats or species of particular interest.
6	Low	Low-energy modified drain adjacent to scrub and amenity grassland.	Negligible	Does not appear to drain into or contribute to any protected area and does not contribute to habitats or species of particular interest.
7	Negligible	Heavily modified waterbody that appears to have been created as a result of road construction.	Negligible	Does not appear to show connectivity to other surface water bodies and does not contribute to habitats or species of particular interest.
8	Negligible	Low-energy modified drain adjacent to scrub and amenity grassland.	Negligible	Does not appear to show connectivity to other surface water bodies and does not contribute to habitats or species of particular interest.
9	Negligible	Low-energy modified drain adjacent to scrub and amenity grassland.	Negligible	Does not appear to show connectivity to other surface water bodies and does not contribute to habitats or species of particular interest.
10	Low	Pond with limited ecological value located within an area of scrub and semi-improved grassland.	Low	Not located in a protected area and does not contribute to local value.
11	Negligible	Low-energy modified drain adjacent to aluminium works running through scrub.	Negligible	Does not appear to show connectivity to other surface water bodies and does not contribute to habitats or species of particular interest.
12	Negligible	Low-energy modified drain adjacent to scrub and amenity grassland.	Negligible	Does not appear to show connectivity to other surface water bodies and does not contribute to habitats or species of particular interest.
13	Negligible	Low-energy modified drain adjacent to scrub and amenity grassland.	Negligible	Does not appear to show connectivity to other surface water bodies and does not contribute to habitats or species of particular interest.
14	Negligible	Low-energy modified drain adjacent to scrub and amenity grassland.	Negligible	Does not appear to show connectivity to other surface water bodies and does not contribute to habitats or species of particular interest.

Water Feature Number	Sensitivity	Justification of Sensitivity	Value	Justification of Value
Ynys Mon Secondary B Aquifer	Medium	As discussed in **Section 17.5.4**, this water body has a poor chemical status and is therefore considered to have medium sensitivity.	Low	It is designated as a Secondary B aquifer, and there is a lack of SPZ within 2 km of the project area.

17.6. IMPACT ASSESSMENT

17.6.1. Overview of Potential Impacts

74. Following the methodology presented in **Section 17.4.3** above, the impacts associated with the water resource receptors described in **Section 17.5** have been assessed and are presented in this section. Where measures over and above the embedded mitigation described in **Section 17.6.2** are required to avoid, reduce, remedy/compensate or enhance the adverse impacts of the Project, this information has been provided.

75. The nature of the surface water drainage system consisting of small water bodies, drainage systems and standing water which drain into coastal water bodies means that they do not have defined catchment areas. The methodology for crossing the watercourses is likely to be the same for all surface waterbodies, therefore the impact assessment will be similar throughout. Therefore, for ease and simplicity of assessment these have been separated into groups according to type of water feature and also sensitivity and value as described in **Table 17-12** below. Groundwater has been assessed separately.

Table 17-12 Grouping of Water Features

Receptor	Water features included	Description/Justification	Sensitivity	Value
Natural streams	1, 3	Small, natural watercourses which are relatively unmodified and drain over the cliff into designated sites.	Medium	High
Modified watercourses	2, 5, 6, 7, 8, 9, 11, 12, 13, 14	Small drains running along field boundaries, adjacent to roads, or through fields which appear overgrown and may only hold water on a seasonal basis. Do not contribute to designated sites.	Negligible	Negligible
Area of marshy grassland containing undefined drains.	4	Appears to be semi-natural, running through marshy grassland, increasing its value.	Low	Low
Standing water	10	Pond with limited ecological value located within an area of scrub and semi-improved grassland. May be part of SuDS for the road.	Low	Low

17.6.2. Mitigation

76. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process. A full account of embedded mitigation measures is contained in **Chapter 4, Project Description**. Where embedded mitigation measures have been developed into the design of the Project with specific regard to water resources and flood risk, these are described in **Table 17-13**. Additional mitigation measures are also included to follow best practice and policy requirements. These mitigation measures are described in **Table 17-14**.

Table 17-13 Embedded Mitigation Measures for Water Resources and Flood Risk

Parameter	Mitigation Measures Embedded into the Project Design
General	
Foul Drainage	Foul drainage (e.g. from construction welfare facilities) will be collected through a mains connection to an existing mains sewer (if a suitable connection is available) or collected in a septic tank located within the development boundary and transported off site for disposal at a licensed facility. The specific approach will be determined during detailed design with consideration of the availability of mains connections and the number of working hours for site attendees.
Landfall Substation, Switchgear Building and Grid Connection Substation (operational phase)	
Foul Drainage	Foul drainage at the landfall substation, switchgear building and grid connection substation will be collected through a mains connection to the existing local authority sewer system (if a suitable connection is available) or collected in a septic tank located within the onshore development area and transported off site for disposal at a licensed facility.

Table 17-14 Additional Mitigation through Best Practice and Policy for Water Resources and Flood Risk

Parameter	Mitigation Measures through Best Practice and Policy
General	
Sediment Management	A Construction Method Statement (CMS) and Code of Construction Practice (CoCP) (**Document MOR/RHDHV/DOC/0076, Outline Code of Construction Practice**) will be developed for the construction activities and will adhere to construction industry good practice guidance as detailed in the Construction Industry Research and Information Association (CIRIA)'s 'Control of water pollution from construction sites: Guidance for consultants and contractors (C532)' (2001). In addition, Guidance for Pollution Prevention (GPPs) from NRW, Scottish Environment Protection Agency and the Northern Ireland Environment Agency; specifically, GPP5 should be adhered to. Specific measures to control sediment supply that will be captured within the CMS include: • Subsoil exposure will be minimised, and strips of undisturbed vegetation will be retained on the edge of the working area where possible; • On-site retention of sediment will be maximised by routing all drainage through the site drainage system; • The drainage system will include measures to intercept sediment runoff at source. Suitable filters will be used to remove sediment from any water discharged into the surface drainage network; • Additional measures will be included in parts of the working area that are in proximity to surface drainage channels; and • Soil and sediment accumulation on road surfaces will be minimised as reasonably practicable by cleaning the wheels of vehicles leaving site and, where required, clearance of the road surface. Traffic movement would be restricted to minimise the potential for surface disturbance.

Parameter	Mitigation Measures through Best Practice and Policy
General	
Surface Drainage	Following construction and engineering design work, a surface water drainage system will be developed as part of a Sustainable Drainage System (SuDS). The detail of this is included in **Document MOR/RHDHV/DOC/0076, Outline Code of Construction Practice**. This will involve collecting run off from roads and buildings at the landfall substation, switchgear building and grid connection substation and using oil interceptors and bund pumps to discharge the water with all contaminants removed. The drainage system will also be designed to manage any residual risks to groundwater flooding, where appropriate (e.g. by conveying groundwater at the surface away from key infrastructure and into the on-site drainage network). Generally, the aim will be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable: i) into the ground (infiltration); ii) to a surface water body; iii) to a surface water sewer, highway drain or another drainage system; or iv) to a combined sewer.

77. Any further mitigation measures suggested within this chapter are therefore considered to be additional to this mitigation.

17.6.3. Worst Case Scenario

78. This section identifies the realistic worst-case parameters associated with the Project. This includes all onshore infrastructure including the grid connection infrastructure that the Project will require for ultimate connection to national electricity grid.

79. **Table 17-15** identifies those realistic worst-case parameters of the onshore infrastructure that are relevant to potential impacts on water resources and flood risk during construction, operation and decommissioning phases of the Project. Please refer to **Chapter 4, Project Description** for more detail regarding specific activities, and their durations, which fall within the construction phase.

Table 17-15 Realistic Worst Case Scenarios

Impact	Parameter	Notes
Construction		
Impacts related to the landfall (HDD option)	▪ Up to nine cable tails at landfall. ▪ Up to nine separate drills; each up to 550 m long, nominally 450 mm diameter. ▪ Separation of 10 m between HDD entry points. ▪ Separation of 20 m between HDD exit points. ▪ Total drill cuttings volume could be up to 900 m^3 (total amount for all 9 drills). ▪ Temporary works area up to 120 m x 70 m (total area for HDD rig, site office and equipment plus laydown area).	Landfall to be achieved via HDD unless this method is not feasible. No beach access required.
Impacts related to the landfall (trenched option)	▪ Up to nine cable tails at landfall.	Worst-case scenario if HDD is not feasible.

Impact	Parameter	Notes
	▪ Up to nine separate shallow trenches (slots within the cliff face), each between 480 m and 740 m long. ▪ Individual trench widths of up to 600 mm. Or a single trench with all nine cables laid within it of approximately 10 m width and 0.5 m to 1.2 m deep ▪ Duct or split pipe over 370 m to 550 m of each cable, up to 350 mm external diameter. ▪ Total material removed could be up to 8,880 m^3; however, the majority would be replaced to backfill the trench after the ducts / cables were installed. ▪ Temporary works area up to 100 m x 50 m (for site office and equipment plus laydown area).	
Transition pits	There will be one transition pit, up to 15 m x 85 m x 1.5 m deep, equating to a footprint of 1,275 m^2, excavated volume 1,912.5 m^3 in addition to trenching excavation or HDD cutting volumes. The final volume is subject to confirmation of geology and drill geometry.	
Landfall substation and associated buildings	▪ A fenced site compound with hardstanding which would house a grid transformer and connection terminations within an area approximately 80 m by 80 m. Within this would be three separate buildings of approximately 62 m by 22.5 m by 7 m high, the second will be 28 m by 10 m by 7 m high and the third 8 m by 8 m by 7 m. The estimated total footprint of the landfall substation compound is 6,400 m^2. ▪ The two buildings will include a control building for housing switch gear, and a welfare area which would be likely to consist of a site office and welfare facilities including an area of hardstanding for parking. ▪ In addition, a temporary construction compound and laydown area will also be created, estimated up to 50 m x 100 m, or equivalent area.	Hard standing will be in the form of hard core or tarmac surfaces on or adjacent to access roads within the substation, pertaining to the 5 m to 7 m wide perimeter access road. Outdoor areas within the compound will have a layer of crushed rock or gravel approximately 80 mm to 150 mm thick.
Impacts related to the onshore cable corridor	▪ The onshore cable route would feature up to two 132 kV cable circuits. Each	Trenching will be undertaken using a large excavator to dig up

Impact	Parameter	Notes
	circuit would consist of three power cables plus a fibre optic cable. This results in up to six power cables and two fibre optic cables in total. ▪ Up to 8.1 km total route length with the cable trenched into the local road network as much as practicable. ▪ Up to 110 mm diameter cable for each circuit (up to six in total). ▪ The cables will be laid within ducts, in trenches up to 1.5 m wide by 1.7 m deep. Joint bays will be required every 200 m to 900m along the cable route. Each joint bay will be up to 15 m by 3 m by 1.5 m in size and will be constructed with a concrete base and timber frame. Provision will be made for an earth link box of 1.5 m by 1.5 m within proximity to each joint bay. Up to 20 joint bays may be required. ▪ Approximately 20 m by 7 m of hardstanding will be required around each joint bay to provide enough space for the cable pulling works. ▪ Up to 30 m working width will be required for plant access, lay down of equipment, top soil, spoil and trench shoring. ▪ HDD will be used to install the cable under the A55 road and the railway line requiring approximately 150 m drill length. Up to two crossings each involving six drills will be possible, with two site areas prepared for each HDD crossing.	the ground along the route, with a rock breaker being required along some sections.
Impacts related to the switchgear building	▪ Infrastructure consisting of a 33 kV switchboard room and metering room within building up to 9.4 m by 5 m by 4 m. ▪ To be located northeast of the existing substation with a footprint of 38 m^2.	
Impacts relating to the grid connection substation	▪ Grid connection substation compound will be 104 m by 62 m by 9 m, containing up to seven battery containers, three substation buildings, a static synchronous compensator (STATCOM)	

Impact	Parameter	Notes
	building and external air cooled reactors and cooling units. ▪ Overall footprint of 6,448 m^2.	
Operation		
Impacts related to the landfall substation	▪ A fenced site compound with hardstanding which would house a grid transformer and connection terminations within an area approximately 80 m by 80 m. Within this would be three separate buildings of approximately 62 m by 22.5 m by 7 m high, the second will be 28 m by 10 m by 7 m high and the third 8 m by 8 m by 7 m. The estimated total footprint of the landfall substation compound is 6,400 m^2. There will be hard standing 5 m to 7 m wide from the South Stack Road or Lon Isallt road to any outdoor equipment compound or the plant access, and outdoor areas other than hard standing comprising crushed rock or gravel to approximately 80-150 mm thick.	
Impacts related to the onshore cable corridor	▪ Joint pits will be required every 200-900m along the cable route with approximately 20m x 7m of hardstanding required around each one.	
Impacts related to the switchgear building and grid connection substation	▪ Operational footprints of 38 m^2 and 6,448 m^2 respectively.	
Decommissioning		
Although contractual details have not been finalised, decommissioning of individual devices and arrays is likely to be the responsibility of the individual tenants. However, Menter Môn holds ultimate responsibility and the decommissioning of general infrastructure will be the responsibility of Menter Môn. At this stage, decommissioning of onshore electrical infrastructure is expected to consist primarily of removal of the landfall substation, switchgear building and grid connection substation. Offshore decommissioning methodologies would vary considerably between devices but would be expected to be similar to the construction phase in reverse. For the purpose of this ES, it is assumed that cables are required to be removed as this represents the worst-case scenario in terms of impacts.		

17.6.4. Potential Impacts During Construction

80. Four potential impacts on water resources and flood risk receptors resulting from the construction stage have been identified. These are:

- Direct disturbance of surface water bodies;
- Increased sediment supply;

- Accidental release of contaminants; and
- Changes to surface water runoff and flood risk.

81. Where the onshore works encounter a surface water body, a trenched crossing technique is likely to constitute the worst-case scenario in terms of impacts to surface water bodies. In terms of impacts to groundwater resulting from crossing of surface water bodies, the worst-case scenario is likely to be a trenchless technique such as HDD (or equivalent) which will cause maximum below-ground disturbance. These impacts are discussed in detail in the subsequent sub-sections.

17.6.4.1. Construction Impact 1: Direct Disturbance of Surface Water Bodies

82. Fourteen water features have been identified as being crossed by, or interacting with, the onshore development area, as shown on **Figure 17-1** (**Volume II**) and listed in **Table 17-10**. There is therefore the potential to directly alter the geomorphology, hydrology and any physical habitat value associated with these water features. Throughout the onshore cable corridor, it is assumed that when watercourses are encountered, the trench would be diverted off the road into an adjacent field or verge to allow watercourses to be crossed using a trenched technique. This process would involve using temporary dams (composed of sand bags, straw bales and ditching clay, or another suitable technique) installed upstream and downstream of the crossing point. The cable trench would then be excavated in the area of dry river bed between the dams, with flow maintained through the use of a temporary pump or flume. This technique represents the worst-case scenario in terms of impact to surface water bodies, and it is expected that in the event that any alternative method of crossing is used, it would result in a lesser impact.

83. The installation of the cable trench using the trenching method described above will directly disturb the bed and banks of the affected watercourses and could potentially result in geomorphological instability (e.g. due to enhanced scour and increased sediment supply) and the direct loss of natural geomorphological features (and associated physical habitat niches), both where the trench is located and a short distance up and downstream. However, this would be a temporary impact provided that the bed and banks are reinstated to their original level, position, planform and profile.

84. The presence of temporary dams could potentially result in reduced flow and sediment conveyance (particularly of coarse sediment), create upstream impoundment and affect patterns of erosion and sedimentation. Changes to flow conditions could also result in a reduction in the dissolved oxygen concentrations supported in the watercourses upstream of the impoundment. These activities could therefore reduce the physical habitat value of the watercourse for aquatic plants, invertebrates and fish species. The temporary dams could also act as a barrier to the movement of aquatic organisms. However, these impacts are considered to be temporary (i.e. confined to the duration of construction) and would be reversed once the temporary impounding structures were removed (i.e. as a result of natural bed scour and sediment transport processes, which would remobilise any accumulations of unconsolidated fine sediments once the normal flow regime has been reinstated).

85. In the event that trenching is used at landfall, rather than HDD; there is a small drainage channel (Watercourse 1) which travels over the cliff within the trenching area which may be vulnerable to disturbance. However, it is expected that due to its location on the southern edge of the site

boundary it will not be disturbed and that cables, where laid, will avoid the watercourse. Therefore, there is unlikely to be any mechanisms for direct disturbance.

86. The impacts on each receptor resulting from the direct disturbance are summarised in **Table 17-16**.

17.6.4.1.1. Mitigation

87. The following additional measures would be applied to reduce the impacts associated with the trenched crossing of the unnamed watercourses which will potentially be affected:

- To ensure that there are no adverse impacts resulting from the installation of temporary dams, Mentor Môn will seek (in so far as practicable) to minimise the amount of time that temporary dams are in place, flumes or pumps would be adequately sized to maintain flows downstream of the obstruction whilst minimising upstream impoundment and scour protection would be used to protect the bed downstream of the dam from higher energy flows at the outlet of the flumes or pumps. Furthermore, a fish rescue (if necessary) would be undertaken in the area between the temporary dams prior to dewatering;

- Cable ducts would typically be installed 2 m below the bed of the watercourses (sufficient to account for climate-related changes in fluvial flows and erosion). This would be dependent upon local geology and geomorphological risks (e.g. bed scour and channel instability) and avoid exposure during periods of higher energy flow where the bed could be mobilised;

- Vegetation would not be removed from the banks unless necessary to undertake the works; any vegetation removal would be restricted to the smallest practicable footprint; and

- Where possible, localised improvements to the geomorphology and in-channel habitats will be considered where the watercourse is crossed using open cut techniques. This will include sympathetic reinstatement of banks (e.g. by replacing re-sectioned banks with more natural profiles that are typical of the natural geomorphology of the watercourse). Note that any improvements would be restricted to within the works area of the proposed Project.

17.6.4.1.2. Residual Impact

88. Following the implementation of these additional mitigation measures, the potential for impacts associated with the trenched crossing of the natural streams as detailed in **Table 17-16**, would be reduced to a negligible magnitude. The residual impact resulting from the direct disturbance of surface water bodies would therefore be minor adverse for natural streams and negligible for the drains in the marshy grassland.

89. There are no impacts on groundwater associated with direct disturbance to surface water bodies.

Table 17-16 Impacts Resulting from the Direct Disturbance of Surface Water Bodies

Receptor	Sensitivity	Value	Assessment	Magnitude prior to mitigation	Significance prior to mitigation	Magnitude following mitigation	Residual impact
Natural streams	Medium	High	As these streams are of higher value due to their natural and apparently unmodified form, the potential for impact associated with a trenched crossing is slightly higher. However, any changes are considered to be temporary and reversible once structures have been removed and bed and banks have been reinstated. In addition, for watercourse 1 which occurs at landfall, it is expected that HDD processes will avoid this watercourse completely.	Low	Minor adverse	Negligible	Minor adverse
Modified watercourses	Negligible	Negligible	Due to the nature of these watercourse as heavily overgrown or negligible value, heavily modified watercourses, they are unlikely to be negatively affected. Works will be temporary and reversible once structures have been removed and banks reinstated therefore no impact is predicted.	No impact	-	-	-
Area of marshy grassland containing undefined drains.	Low	Low	As this watercourse includes an area of marshy grassland, it is possible it may experience a slightly higher impact. Works will be temporary and reversible and may be diverted to avoid this area of habitat.	Low	Minor adverse	Negligible	Negligible
Standing water	Low	Low	This water body lies within an area considered for HDD, therefore will not experience any direct disturbance if this methodology goes ahead. It is likely to be bypassed by the onshore cables.	No impact	-	-	-
Ynys Mon groundwater body	Medium	Low	There are no mechanisms for groundwater to be impacted by the direct disturbance of surface water bodies.	No impact	-	-	-

17.6.4.2. Construction Impact 2: Increased Sediment Supply

90. Construction activities in the onshore development area will involve earthworks and create areas of bare ground by removing surface vegetation cover and excavating the cable trench, although in areas where the onshore cable route is trenched into the road (intended to be the majority of the route) this is likely to be limited. These construction activities could increase the potential for the erosion of soil particulates, resulting in an increase in the supply of fine sediment (e.g. clays, silts and fine sands) to surface watercourses through surface runoff and the erosion of exposed soils.

91. Increased sediment supply could affect the geomorphology of watercourses by increasing turbidity in the water column and encouraging enhanced deposition of fine sediment on the bed of the channel. Furthermore, increased sediment loads could potentially smother existing bed habitats, reduce light penetration and reduce dissolved oxygen concentration, adversely affecting stream biota (e.g. macrophytes, aquatic invertebrates and fish) and adversely affecting the quality of in-channel habitats. Site preparation, ground excavations and other construction activities which have the potential to increase sediment supply will take place across the onshore development area.

92. The impacts on each receptor resulting from increased sedimentation are discussed in **Table 17-17**.

17.6.4.2.1. Mitigation

93. The Project will include a range of mitigation measures to reduce the potential for an increase in the supply of fine sediment will be included in the Code of Construction Practice (CoCP) (**Document MOR/RHDHV/DOC/0076, Outline Code of Construction Practice**) to prevent the release of sediment into surface watercourses. This will adhere to construction industry good practice guidance as detailed in the Construction Industry Research and Information Association (CIRIA)'s 'Control of water pollution from construction sites: Guidance for consultants and contractors (C532)' (2001).

- The area of open ground (including exposed topsoil and subsoil) at any one time will be minimised by confining onshore cable installation activities to defined work fronts that will be operative for a short period only;
- Topsoil will be stored and reinstated;
- Strips of undisturbed vegetation will be retained on the edge of the working area where possible;
- Where surface vegetation has been removed, it will be reseeded to prevent future runoff (excluding arable crops);
- Hardstanding will be used in mobilisation areas;
- On-site retention of sediment will be maximised by routing all drainage through the site drainage system;
- The drainage system will include measures to intercept sediment runoff at source. Suitable filters will be used to remove sediment from any water discharged into the surface drainage network;

- Additional measures will be included in parts of the working area that are in proximity to surface drainage channels; and
- Soil and sediment accumulation on road surfaces will be minimised as reasonably practicable by cleaning the wheels of vehicles leaving site and, where required, clearance of the road surface. Traffic movement would be restricted to minimise the potential for surface disturbance.

17.6.4.2.2. Residual Impact

94. The additional mitigation measures will reduce sediment supply to watercourses from the working area and are an important and integral part of best practice construction methodology to help ensure that sediment supply is not increased. The magnitude of the impact is therefore predicted to reduce to negligible in the surface water network and catchments of the two coastal waterbodies. The residual impact resulting from changes to sediment supply would therefore be minor adverse for natural streams and negligible for other affected watercourses (**Table 17-17**).

95. There are no anticipated impacts on groundwater.

Table 17-17 Impacts Resulting from Increased Sediment Supply

Receptor	Sensitivity	Value	Assessment	Magnitude prior to mitigation	Significance prior to mitigation	Magnitude following mitigation	Residual impact
Natural streams	Medium	High	As these streams are of higher value due to their natural and relatively unmodified form, the potential for impact associated with an increase in sedimentation is slightly higher as their capacity to hold sediment is low due to their small size. However, the current methodology involving trenching into the road will require a sequenced construction method. This will mean a limited amount of bare ground is exposed at any one time, and impacts will be temporary with working areas being restored following installation of the cable trench.	Medium	Moderate adverse	Negligible	Minor adverse
Modified watercourses	Negligible	Negligible	Due to the nature of these water bodies as heavily overgrown or negligible value, heavily modified watercourses, they are unlikely to be adversely affected. In some cases, it does not appear that they flow or are connected to other watercourses.	Medium	Negligible	Negligible	Negligible
Area of marshy grassland containing undefined drains.	Low	Low	As this water body includes an area of marshy grassland, it is possible it may experience a slightly higher impact. Works will be temporary and reversible and may be diverted to avoid this area of habitat.	Medium	Minor adverse	Negligible	Negligible
Standing water	Low	Low	With the current methodology, it is unclear what the impacts are likely to be for this water body. However, it lies within an area considered for HDD, and therefore will not experience any direct disturbance if this HDD is used.	No impact	-	-	-
Ynys Mon groundwater body	Medium	Low	There are no mechanisms for groundwater to be impacted by increased sedimentation.	No impact	-	-	-

17.6.4.3. Construction Impact 3: Accidental Release of Contaminants

96. There is the potential for the accidental release of lubricants, fuels and oils from construction machinery through spillage, leakage and in-wash from vehicle storage areas after rainfall and direct release from construction machinery working in and adjacent to surface watercourses. There is also the potential for accidental release of foul waters (from welfare facilities) and construction materials (including concrete and inert drilling fluids) into the surface waters and connected groundwaters during construction.

97. If a significant leakage or spillage occurs, there is the potential for adverse impacts upon water quality if contaminants enter the surface drainage network or percolate into groundwater. These water quality impacts have the potential to adversely affect ecology (particularly fish and macroinvertebrates; see **Chapter 19, Onshore Ecology**) if pollutant concentrations are sufficiently high.

98. Construction activities which disturb the ground will include excavation for trenching throughout the onshore cable route, HDD due to take place beneath the A55 road and adjacent railway line and any other uses of HDD; for example, if it is decided to use this method to cross watercourses or other roads. These activities could potentially introduce contaminants into the underlying groundwater bodies (particularly shallow aquifers) and could therefore adversely affect the quality of the underlying groundwater (including the secondary B aquifer) and could potentially impact upon any licensed and unlicensed abstractions within it.

99. The scale of the potential impact upon a surface catchment or body of groundwater is likely to be proportional to the area of each catchment that would be affected during construction (i.e. the total footprint of construction activities). The impacts on each receptor resulting from the accidental release of contaminants are shown in **Table 17-18** below.

17.6.4.3.1. Mitigation

100. Specific measures relating to pollution prevention will be captured within a CoCP (**Document MOR/RHDHV/DOC/0076, Outline Code of Construction Practice**). These measures will help to mitigate the accidental release of contaminants by preventing the immediate discharge of contaminated water from the onshore cable corridor into the surface drainage network:

- Concrete and cement mixing and washing areas will be situated at least 10 m away from the nearest watercourse. These will incorporate settlement and recirculation systems to allow water to be re-used. All washing out of equipment will be undertaken in a contained area, and all water will be collected for off-site disposal;
- All fuels, oils, lubricants and other chemicals will be stored in an impermeable bund with at least 110 % of the stored capacity. Damaged containers will be removed from site. All refuelling will take place in a dedicated impermeable area, using a bunded bowser. The refuelling and fuel storage area will be located at least 10 m from the nearest watercourse. Biodegradable oils will be used where possible; and
- Spill kits will be available on site at all times. Sand bags or stop logs will also be available for deployment on the outlets from the site drainage system in case of emergency spillages.

101. Furthermore, the potential for impacts associated with the accidental release of fuels, oils, lubricants, construction materials, foul waters and other contaminants will be reduced by the following additional measures:

- Buffer strips of vegetation will be retained adjacent to the watercourses, where possible, to intercept surface runoff and any dissolved or particulate contaminants associated with it; and

- Cable installation activities will be designed to ensure that they will not affect groundwater in any significant manner. The majority of excavations will be shallow (approximately 1.7 m deep), except for instances where HDD (or a similar method) is used. Details of where this will occur is to be confirmed.

102. As there are no impacts on groundwater quality, there are not anticipated to be any impacts on private water abstractions. However, any abstractions within the onshore cable corridor will be verified with the landowners prior to construction, and suitable mitigation measures employed at that point to ensure no adverse effects on water supplies occur.

17.6.4.3.2. Residual Impact

103. Following the implementation of these additional mitigation measures, the potential for accidental release of contaminants from construction activities is reduced to an effect of negligible magnitude within the surface watercourses and groundwater body. The residual impact resulting from the accidental release of fuels, oils, lubricants, foul waters and construction materials would therefore be minor adverse for natural streams and the Ynys Mon groundwater body and negligible for other watercourses (**Table 17-18**).

Table 17-18 Impacts Resulting from Accidental Release of Contaminants

Receptor	Sensitivity	Value	Assessment	Magnitude prior to mitigation	Significance prior to mitigation	Magnitude following mitigation	Residual impact
Natural streams	Medium	High	As these streams are of high value and flow into designated areas, they have a higher potential to experience a high impact due to the sensitivity of the areas they drain into. Where open cut crossing techniques are used to traverse water bodies, there is a direct route for contaminants released during construction to easily enter the surface drainage system. However, the proposed sequential method of construction will mean that a limited area of disturbed ground will be created at any one time, with the method of trenching into the road reducing the potential for sedimentation and runoff.	Medium	Moderate adverse	Negligible	Minor adverse
Modified watercourses	Negligible	Negligible	Due to the nature of these watercourses as heavily overgrown or negligible value, heavily modified waterbodies, they are unlikely to be adversely affected. Works will be temporary and reversible once structures have been removed and banks reinstated therefore no impact is predicted.	Medium	Negligible	Negligible	Negligible
Area of marshy grassland containing undefined drains.	Low	Low	As this waterbody includes an area of marshy grassland, it is possible it may experience a slightly higher impact. Works will be temporary and reversible and may be diverted to avoid this area of habitat.	Medium	Minor adverse	Negligible	Negligible
Standing water	Low	Low	With the current methodology, it is unclear what the impacts are likely to be for this waterbody. However, it lies within an area considered for HDD, and therefore will not experience any direct disturbance if HDD is used.	No impact	-	-	-

Receptor	Sensitivity	Value	Assessment	Magnitude prior to mitigation	Significance prior to mitigation	Magnitude following mitigation	Residual impact
Ynys Mon groundwater body	Medium	Low	The Ynys Mon Secondary Aquifer covers 623.22 km^2 in total, incorporating a large proportion of the Isle of Anglesey. Two areas of HDD are currently scheduled to take place: at landfall, and where the cable route crosses the A55 road and railway line; however, these are spatially limited, meaning that any adverse impacts are likely to be spatially limited too. Any impacts are likely to be spatially constrained and unlikely to affect water supplies, including private abstractions (shown on **Figure 17-3, Volume II**) of which none are located within 250 m of the onshore infrastructure.	Medium	Moderate adverse	Negligible	Minor adverse

17.6.4.4. Construction Impact 4: Changes to Surface Water Runoff and Flood Risk

104. The initial site preparation and construction activities associated with the proposed onshore development area have the potential to alter surface water flows and drainage patterns by:

- Altering existing flow paths and changing the distribution of surface drainage across development sites and along the onshore cable route;
- Reducing infiltration and increasing surface runoff as a result of soil compaction by construction vehicles;
- De-watering the cable trench and removal of the water through infiltration or discharge into the surface drainage network;
- Increasing the proportion of impermeable surfaces in a catchment and therefore reducing infiltration. The development of surface infrastructure also has the potential to change surface flows and infiltration rates as a result of changes to land use (i.e. by increasing the proportion of impermeable surfaces in a drainage catchment) and alter site runoff characteristics;
- Temporary changes to surface water flows as a result of the trenched crossing of any watercourses, particularly if the capacity of any pumps, flumes and temporary watercourse crossings is exceeded; and
- Changes to subsurface flow patterns resulting from changes to infiltration rates, surface flows and the installation of impermeable subsurface infrastructure.

105. It is important to note that the changes to surface water runoff and flood risk assessed in detail for each catchment below are expected to be relatively localised and would not be sufficient to cause a major accident or disaster.

106. The project design includes embedded mitigation measures to control surface water runoff during the construction phase, including the creation of drainage channels to intercept water from the cable trench and onshore cable corridor, as described in more detail in **Section 17.6.2**. These measures will help to control the release of surface waters from the onshore development activities and prevent changes to surface runoff and flood risk. With embedded mitigation measures in place, the magnitude of effect is considered to be low.

107. The impacts on each receptor resulting from increased surface water runoff are summarised in **Table 17-19**.

17.6.4.4.1. Mitigation

108. NRW Development Advice Map contained within Technical Advice Note (TAN) 15 advises that for development in Zone A the justification test is not applicable and surface water requirements apply.

109. Changes in surface water runoff as a result of the increase in impermeable area from the landfall substation, switchgear building and grid connection substation will be attenuated and discharged at a controlled rate, in consultation with the LLFA (IoACC) and NRW. The controlled runoff rate will be equivalent to the greenfield runoff rate.

110. As surface water requirements apply, it is recommended that the development includes embedded mitigation measures (**Section 17.6.2**). Additional measures to be included are, but not limited to, the following:

- Development of a drainage strategy including use of swales to allow for drainage of excess surface water from the site;
- Use of permeable surfacing where applicable;
- Use of flood-resilient building materials e.g. concrete floors and walling; and
- Raised electrical infrastructure to prevent flooding of critical infrastructure during a surface water flood event.

111. The drainage strategy will be developed according to the principles of the SuDS discharge hierarchy. Generally, the aim will be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

- Into the ground (infiltration);
- To a surface water body;
- To a surface water sewer, highway drain or another drainage system; or
- To a combined sewer.

17.6.4.4.2. Residual Impact

112. Following the implementation of these additional mitigation measures, the potential for increased surface runoff and flood risk is reduced to an effect of negligible magnitude for modified watercourses and minor adverse for natural streams and the Ynys Mon groundwater body (**Table 17-19**).

Table 17-19 Impacts Resulting from Increased Surface Water Runoff and Flood Risk

Receptor	Sensitivity	Value	Assessment	Magnitude prior to mitigation	Significance prior to mitigation	Magnitude following mitigation	Residual impact
Natural streams	Medium	High	There is no risk of flooding from rivers in the works area. The onshore development area intercepts Watercourse 1 and 2, as shown in **Figure 17-1, Volume II**, in an area of high risk i.e. greater than 1 in 30 chance of flooding from surface water every year.	Low	Minor adverse	Negligible	Minor adverse
Modified watercourses	Negligible	Negligible	The onshore development area (including onshore cable corridor, landfall substation, switchgear building and grid connection substation) will be altered at this point to avoid the marshy habitat this encompasses.	Medium	Negligible	Negligible	Negligible
Standing water	Low	Low	These water features are not located in areas of surface water flood risk, and are in Zone A.	No impact	-	-	-
Ynys Mon groundwater body	Medium	Low	The majority of the landfall substation, switchgear building and grid connection substation areas show limited potential for groundwater flooding to occur, regions of potential for groundwater flooding to occur to facilities below ground level, and potential for groundwater flooding to occur at the surface. However, groundwater flooding is rare in Wales according to the Western Wales RBD PFRA.	Low	Minor adverse	Negligible	Minor adverse

17.6.5. Potential Impacts During Operation

113. Two potential impacts on water resources and flood risk receptors resulting from the operational stage have been identified:

- Changes to surface water runoff, groundwater flows and flood risk; and
- Supply of fine sediment and other contaminants.

114. These impacts are discussed in detail in the subsequent subsections.

17.6.5.1. Operational Impact 1: Changes to Surface Water Runoff, Groundwater Flows and Flood Risk

115. The permanent above-ground infrastructure, including the landfall substation, switchgear building and grid connection substation and any new, permanent access tracks will result in permanent changes to land use. In most cases, the change in use from existing greenfield agricultural land use is likely to create a permanent increase in impermeable area. Although permeable surface treatments will be used where possible, jointing pits along the onshore cable route and the substations are expected to comprise impermeable surfaces, with associated infrastructure such as roads also comprising impermeable surfaces.

116. An increase in the proportion of impermeable surfaces in a sub-catchment will result in a corresponding decrease in local infiltration and an increase in surface runoff. Furthermore, the presence of the buried cable ducting along the onshore cable route will introduce an impermeable barrier that has the potential to impact upon subsurface flow routes and change the distribution of groundwater by changing subsurface flow patterns and forcing water to move upwards (i.e. towards the surface) or downwards (away from the surface).

117. There is therefore potential for changes in surface water runoff resulting from the increase in impermeable areas and changes to subsurface flows. These could be sufficient to impact upon the hydrology of the surface water system.

118. As well as impacts on geomorphology and in-channel habitats, changes to surface drainage patterns could also increase flood risk to third party land and property, especially if the discharge of any drainage is not sufficiently controlled. Furthermore, watercourse crossing locations have the potential to increase flood risk elsewhere should they not be reinstated to pre-construction channel capacities (i.e. any reductions in channel capacity could increase local flood risk).

119. As detailed in **Section 17.6.2**, the project will include embedded mitigation measures to reduce the potential for impact. This includes limiting discharge from the landfall substation, switchgear building and grid connection substation to the greenfield runoff rate.

120. The impacts on each receptor resulting from increased surface water runoff, altered subsurface flows and changes to flood risk are summarised in **Table 17-20**.

17.6.5.1.1. Mitigation

121. As surface water requirements apply, it is recommended that the development includes embedded mitigation measures. Additional measures should include, but not be limited to, the following:

- Development of a drainage strategy including use of swales to allow for drainage of excess surface water from the site;
- Use of permeable surfacing where applicable;
- Use of flood-resilient building materials e.g. concrete floors and walling; and
- Raised electrical infrastructure to prevent flooding of critical infrastructure during a surface water flood event.

122. The drainage strategy will be developed according to the principles of the SuDS discharge hierarchy (see **Section 17.7.3.4**). Generally, the aim will be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable.

17.6.5.1.2. Residual Impact

The residual impact resulting from any changes in surface water runoff, groundwater flows and flood risk will be minor adverse or negligible (**Table 17-20**).

Table 17-20 Impacts Resulting from Changes to Surface Water Runoff, Groundwater Flows and Flood Risk During Operation

Receptor	Sensitivity	Value	Assessment	Magnitude prior to mitigation	Significance prior to mitigation	Magnitude following mitigation	Residual impact
Natural streams	Medium	High	Within the landfall area and the vicinity of the landfall substation there will be an increase in the proportion of impermeable land, however due to the elevated position of the landfall area, this will not be at risk of flooding. In addition, with mitigation measures implemented including a drainage strategy, there will be no impact on the overall surface water runoff and flood risk during operation.	Low	Minor adverse	Negligible	Minor adverse
Modified watercourses	Negligible	Negligible	Throughout the onshore cable corridor, switchgear building and grid connection substation locations; the Project is located in Zone A. As the onshore cable route is being trenched into the road where possible, once operational the Project will not lead to any overall increase in impermeable ground.	Low	Negligible	Negligible	Negligible
Area of marshy grassland containing undefined drains.	Low	Low	Throughout the onshore cable corridor, switchgear building and grid connection substation locations; the Project is located in Zone A. As the onshore cable route is being trenched into the road where possible, once operational the Project will not lead to any overall increase in impermeable ground.	Medium	Minor adverse	Negligible	Negligible
Standing water	Low	Low	These water features are not located in areas of surface water flood risk, and are in Zone A.	No impact	-	-	-
Ynys Mon groundwater body	Medium	Low	The majority of the landfall, landfall substation, switchgear building and grid connection substation locations have limited potential for groundwater flooding to occur, regions of potential for groundwater flooding to occur to facilities below ground level, and potential for groundwater flooding to occur at the surface. However, groundwater flooding is rare in Wales according to the Western Wales RBD PFRA. In addition, as the onshore cable route is only being buried to the shallow depth of	Low	Minor adverse	Negligible	Minor adverse

Receptor	Sensitivity	Value	Assessment	Magnitude prior to mitigation	Significance prior to mitigation	Magnitude following mitigation	Residual impact
			1.7 m, its impacts will be localised and small scale in the context of the overall groundwater body. Any HDD works will have a short term impact on groundwater and will not result in a long term effect on groundwater flows.				

17.6.5.2. Operational Impact 2: Supply of Fine Sediment and Other Contaminants

123. The operation of the proposed Project, including planned and unplanned maintenance at the landfall substation, switchgear building and grid connection substation and along the onshore cable corridor, could result in the supply of fine sediment, fuels, oils and lubricants from the road network and other impermeable surfaces. This could potentially affect the geomorphology and water quality in the surface drainage network.

124. There is potential for an increase in sediment supply to surface waters during operation via mechanisms such as enhanced surface runoff from the permanent above-ground development (**Section 17.6.5.1**), which could impact upon the geomorphology and surface water quality of the river water bodies, and consequently impact upon aquatic ecology. Furthermore, there is potential for the supply of contaminants to surface waters during operation through surface runoff or accidental spillage or leakage of fuel oils or lubricants from vehicles during operational activities, which could impact upon surface water quality and that of connected groundwaters. This could have subsequent impacts upon aquatic ecology and the use of water resources for licensed and unlicensed abstractions. The impacts on each receptor resulting from the accidental release of contaminants are shown in **Table 17-21** below.

17.6.5.2.1. Mitigation

125. The following measures will be employed to prevent the release of contaminants during operation:

- All fuels, oils, lubricants and other chemicals will be stored in an impermeable bund with at least 110 % of the stored capacity;
- All refuelling will take place in a dedicated impermeable area, using a bunded bowser;
- The refuelling and fuel storage area will be located at least 10 m from the nearest watercourse;
- Biodegradable oils will be used where possible; and
- Damaged containers will be removed from site;
- Spill kits will be available on site at all times. Sand bags or stop logs will also be available for deployment on the outlets from the site drainage system in case of emergency.

126. The negligible impact along the onshore cable route means that there is no requirement to introduce further mitigation measures in any of the watercourses and their catchment areas, or to prevent the direct contamination of groundwater.

127. As there are no impacts on groundwater quality, there will be no impacts on private water abstractions; however, any abstractions within the onshore cable corridor will be verified with the landowners prior to construction, and suitable mitigation measures employed at that point to ensure no adverse effects on water supplies occur.

17.6.5.2.2. Residual Impact

128. The effect will remain negligible or minor adverse in all water features listed in **Table 17-10**, and the underlying groundwater. The residual impact resulting from the supply of sediment and contaminants during the operation of the project would therefore be minor adverse.

Table 17-21 Impacts Resulting from the Supply of Fine Sediment and Other Contaminants during Operation

Receptor	Sensitivity	Value	Assessment	Magnitude prior to mitigation	Significance prior to mitigation	Magnitude following mitigation	Residual impact
Natural streams	Medium	High	The landfall substation compound will be located within approximately 20 0m from stream 1, and therefore may lead to an increased run-off of sediment, and potentially contaminants, into the stream during rainfall events compared to current conditions. However, embedded mitigation measures including water treatment, permeable hard standing where possible and specified drainage systems will reduce this impact with the ultimate aim to maintain surface water flows at greenfield levels. Watercourse 2 is unlikely to experience adverse impacts as a result of the operation of the Project.	Low	Minor adverse	Negligible	Minor adverse
Modified watercourses	Negligible	Negligible	The majority of these watercourses are crossed by the onshore cable route. They do not appear to experience much flow, and most are not located in areas where the amount of impermeable ground is going to significantly increase. Mitigation associated with the landfall substation, switchgear building and grid connection substation include drainage systems and water treatment measures which will reduce the likelihood of impact associated with supply of sediment and contaminants.	Low	Negligible	Negligible	Negligible
Area of marshy grassland containing undefined drains.	Low	Low	This watercourse is unlikely to experience an increase in sediment and contaminant supply during operation due to its location some distance from the landfall substation, switchgear building and grid connection substation . Areas of hardstanding may increase the area of impermeable ground, but at the time of assessment there is no definite position for these.	No impact	-	-	-

Receptor	Sensitivity	Value	Assessment	Magnitude prior to mitigation	Significance prior to mitigation	Magnitude following mitigation	Residual impact
Standing water	Low	Low	This pond is located within the area identified for HDD for crossing under the A55 and the railway. As such it is already located adjacent to a source of run off and potential contaminants. Once the Project is operational, this water feature is likely to be separated from areas of hardstanding by the road itself and will experience negligible additional sediment and contaminant supply as a result of the Project. In addition, embedded mitigation measures including drainage systems at the landfall substation, switchgear building and grid connection substation will help to reduce the impact.	Low	Negligible	Negligible	No Impact
Ynys Mon groundwater body	Medium	Low	There is no requirement to undertake routine maintenance of the onshore cable route, and therefore no potential for groundwater contamination from plant along the onshore cable route (although it is possible that some planned and unplanned activities may be necessary through the operational life of the Project). The cable itself is only buried to 1.7 m depth across a narrow width and is therefore unlikely to impact on groundwater flows. Furthermore, the embedded mitigation measures described in **Section 17.6.2** will control the accidental release of foul drainage and surface water drainage (including potential contaminants from operational plant that could enter surface and groundwaters) from the operational Project.	Negligible	Minor adverse	Negligible	Minor adverse

17.6.6. Potential Impacts During Decommissioning

129. No decision has been made regarding the final decommissioning policy for the onshore infrastructure of the proposed Project as it is recognised that industry best practice, rules and legislation change over time.

130. However, the decommissioning of the Project is expected to consist primarily of removal of the landfall substation, switchgear building and grid connection substation. It is expected that the onshore cables will be removed and recycled, with the transition bays and cable ducts (where used) left in situ. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, for the purposes of a worst-case scenario, impacts no greater than those identified for the construction phase are expected for the decommissioning phase.

17.6.7. Cumulative Impacts

131. This section describes the CIA for water resources and flood risk, taking into consideration other plans, projects and activities. This has been undertaken as a two-stage process, with the first stage comprising assessing all the impacts from the previous sections for the potential to act cumulatively with other projects. This summary assessment is set out in **Table 17-22** below.

Table 17-22 Potential Cumulative Impacts

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Construction			
Impact 1: Direct disturbance of surface water bodies	Yes	Medium	Impacts to water bodies may be exacerbated by other projects
Impact 2: Increased sediment supply	Yes	Medium	Impacts to water bodies may be exacerbated by other projects
Impact 3: Accidental release of contaminants	Yes	Medium	Impacts to water bodies may be exacerbated by other projects
Impact 4: Disruption of groundwater levels and flows	Yes	Medium	Impacts to water bodies may be exacerbated by other projects
Impact 5: Changes surface water runoff and flood risk	Yes	Medium	Impacts to water bodies may be exacerbated by other projects
Operation			
Impact 1: Changes to Surface Water Runoff, Groundwater Flows and Flood Risk	Yes	Medium	Impacts to water bodies may be exacerbated by other projects
Impact 2: Supply of fine sediment and other contaminants	Yes	Medium	Impacts to water bodies may be exacerbated by other projects
Decommissioning			
Contractual details relating to decommissioning are yet to be finalised, however the ultimate responsibility for the decommissioning of the general onshore electrical infrastructure will lie with Menter Môn. At this stage, this is expected to consist primarily of removal of the landfall substation, switchgear building and grid connection substation.			

132. The second stage of the CIA is an assessment of whether there is spatial or temporal overlap between the extent of potential effects of the onshore development area, and the extent of potential effects of other projects scoped into the CIA on the same receptors. To identify whether this may happen, the potential nature and extent of effects arising from all projects scoped into the CIA have been identified and any overlaps between these and the effects identified above. Where there is an overlap, an assessment of the cumulative magnitude of effect is provided.

133. Projects taking place in the marine areas surrounding Holy Island and Anglesey have been scoped out due to the limited potential for impacts to act cumulatively between marine and terrestrial freshwater bodies. In addition, due to the small-scale nature of the onshore development area and its island location in respect of surface water bodies, those projects at a greater distance than 10 km away have also been scoped out. In addition, those projects relating to change of use of existing buildings or conversion of residential properties have been scoped out as there is no mechanism for them act impact cumulatively with the Project on the water environment.

134. **Table 17-23** summarises those projects which have been scoped into the CIA due to their temporal or spatial overlap with the potential effects arising from the project. The remainder of the section details the nature of cumulative impacts against all those receptors scoped in for cumulative assessment.

135. The assessment set out in **Table 17-23** demonstrates that there is no potential for cumulative impacts arising between the proposed onshore elements of the Project and other proposed onshore developments in the study area.

Table 17-23 Summary of Projects Considered for the CIA in Relation to the Water Resources and Flood Risk

Project	Status	Distance from Morlais Tidal Array Project (km)	Included in CIA	Rationale
Penrhos Coastal Park, Holy Island Resort	Planning permission granted, construction expected to be completed by 2021	< 1 km	No	Project components located adjacent to the Holy Island Resort proposed project area are being constructed on land that formed part of the demolished aluminium works and are therefore unlikely to increase the area of impermeable surface in this location. In addition, the Holy Island Resort includes areas of parkland and landscaping in addition to its 500 holiday cottages and leisure facilities which will assist with drainage. As such, no cumulative effects on onshore water resources and flood risk are anticipated as a result of the co-location of these two projects.
Industrial unit at Parc Cybi	Planning permission granted, construction status unknown	Overlaps with the project area at the HDD location for the proposed grid substation connection.	No	The small scale of the proposed new industrial unit, together with the extensive mitigation measures to prevent the supply of sediment and contaminants during construction mean that there are not considered to be any cumulative impacts associated with these two projects.
Roadking Parc Cybi	Planning permission granted, construction status unknown	0 km	No	This relates to the discharge of conditions including foul surface water and land drainage schemes associated with this development. Due to the provision of land drainage measures and the small scale of the project there are unlikely to be any cumulative effects with the Project.
Breakwater Country Park	Application validated and awaiting decision	Approx. 1.6 km	No	This application is for alterations and extensions to elements of Breakwater Country Park and the creation of a heritage play area and associated landscaping. Due to the distance from the works area and the limited surface water connectivity in this area, impacts are likely to be highly localised to each project, and therefore will not act cumulatively with each other.
Penrhos Industrial Estate	Planning permission validated, awaiting decision	<1 km (approx. 0.5 km)	No	The small-scale nature of the works on an existing industrial estate within which a drainage system will already exist means there are unlikely to be any cumulative impacts. In addition, the two projects are separated by the road and railway line, reducing connectivity of surface water flows between the two areas.
Holyhead Premier Inn	Operational	0 km	No	There are no major construction works associated with this project which could impact on water resources or flood risk to act cumulatively with the Project.
A5025 Highway	Consented, Construction Status unknown	2.5 km	No	This scheme is located across the Cymyran Strait, and although 2.5 km away at its closest location, the remainder of the works are located further away. There is no hydrological

Project	Status	Distance from Morlais Tidal Array Project (km)	Included in CIA	Rationale
				connectivity in terms of surface water systems and flood risk, therefore there is no mechanism for impact on the water environment.
Reclamation adjacent to Terminal 4 of the Port of Holyhead	Scoping report submitted 28/04/3017	2 km	No	No mechanism for this project to impact upon the water environment has been identified and therefore there is no potential for cumulative impacts to occur.

17.6.8. Inter-relationships

136. **Table 17-24** lists the inter-relationships between this chapter and other chapters within the ES.

Table 17-24 Inter-topic relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Ground Conditions and Contamination	Chapter 18, Ground Conditions and Contamination	**Section 17.5.4** (groundwater); **Section 17.6** (all impacts)	Both chapters consider the impacts on Groundwater resources and contamination with regard to aquifers and water supply.
Marine water and sediment quality	Chapter 8, Marine Water and Sediment Quality	**Section 17.5** (existing environment)	Both chapters consider the potential impacts of the project on water resources. Coastal water bodies are considered in this chapter only as a baseline and are not taken further.
Onshore Ecology	Chapter 19, Onshore Ecology	**Section 17.5.5** (designated sites) and **Section 17.5.6**	Both chapters consider the potential impacts on designated sites, which also influence the sensitivity and value of the water bodies.

17.6.9. Interactions

137. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within this chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity, the areas of interaction between impacts are presented in **Table 17-25**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 17-25 Potential Interactions between Impacts

Potential interaction between impacts				
Construction	1 Direct disturbance of surface water bodies	2 Increased sediment supply	3 Accidental release of contaminants	4 Changes to surface water runoff and flood risk
1 Direct disturbance of surface water bodies	-	Yes	Yes	Yes
2 Increased sediment supply	Yes	-	Yes	Yes
3 Accidental release of sediment	Yes	Yes	-	Yes
4 Changes to surface water runoff and flood risk	Yes	Yes	Yes	-
Operation	1 Changes to surface water runoff, groundwater flows and flood risk		2 Supply of fine sediment and contaminants	
1 Changes to surface water runoff, groundwater flows and flood risk	-		Yes	
2 Supply of fine sediment and contaminants	Yes		-	

17.7. SUMMARY

138. A summary of the findings of the ES for water resources and flood risk is presented in **Table 17-26**. In accordance with the assessment methodology, this table should only be used in conjunction with the additional narrative explanations provided in **Section 17.4.3**. This demonstrates that, post mitigation, all impacts have a maximum residual impact of minor adverse. There will therefore be no impacts resulting from the Project that are considered to be significant in EIA terms (i.e. moderate or major adverse).

Table 17-26 Potential Impacts Identified for Water Resources and Flood Risk

Potential Impact	Receptor	Sensitivity	Value	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction							
Impact 1: Direct disturbance of surface water bodies	Natural streams	Medium	High	Low	Minor adverse	Measures to minimise the impacts of temporary watercourse crossings, install infrastructure below the active bed of the channel, and reinstate bed and banks.	Minor adverse
	Modified watercourses	Negligible	Negligible	No impact	-		-
	Area of marshy grassland containing undefined drains	Low	Low	Low	Minor adverse		Negligible
	Standing water	Low	Low	No impact	-		-
	Ynys Mon groundwater body	Medium	Low	No impact	-		-
Impact 2: Increased sediment supply	Natural streams	Medium	High	Medium	Moderate adverse	Additional construction best practice measures to manage sediment and surface drainage, including Guidance for Pollution Prevention (GPPs) from NRW, Scottish Environment Protection Agency and the Northern Ireland Environment Agency; specifically GPP5.	Minor adverse
	Modified watercourses	Negligible	Negligible	Medium	Minor adverse		Negligible
	Area of marshy grassland containing undefined drains.	Low	Low	Medium	Minor adverse		Negligible
	Standing water	Low	Low	No impact	-		-
	Ynys Mon groundwater body	Medium	Low	No impact	-		-
Impact 3: Accidental release of contaminants	Natural streams	Medium	High	Medium	Minor adverse	A construction method statement will be produced in line with best practice guidance on pollution control measures.	Minor adverse
	Modified watercourses	Negligible	Negligible	Medium	Negligible		Negligible
	Area of marshy grassland containing undefined drains	Low	Low	Medium	Minor adverse		Negligible
	Standing water	Low	Low	No impact	-		-
	Ynys Mon groundwater body	Medium	Low	Medium	Moderate adverse		Minor adverse
Impact 4: Increased	Natural streams	Medium	High	Low	Minor adverse	Measures to minimise impact of temporary culverts, if	Minor adverse
	Modified watercourses	Negligible	Negligible	Medium	Negligible		Negligible

Potential Impact	Receptor	Sensitivity	Value	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
surface water runoff and flood risk	Area of marshy grassland containing undefined drains	Low	Low	Medium	Minor adverse	applicable, including the creation of drainage changes to manage construction drainage.	Negligible
	Standing water	Low	Low	No impact	-		-
	Ynys Mon groundwater body	Medium	Low	Low	Minor adverse		Minor adverse
Operation							
Impact 5: Changes to surface water runoff, groundwater flows and flood risk	Natural streams	Medium	High	Low	Minor adverse	A surface water drainage plan will be developed, particularly for the substation locations.	Minor adverse
	Modified watercourses	Negligible	Negligible	Low	Negligible		Negligible
	Area of marshy grassland containing undefined drains	Low	Low	Medium	Minor adverse		Negligible
	Standing water	Low	Low	No impact	-		-
	Ynys Mon groundwater body	Medium	Low	Low	Minor adverse		Minor adverse
Impact 6: Supply of fine sediment and other contaminants	Natural streams	Medium	High	Low	Minor adverse	Surface water drainage system will include oil interceptors and bund pumps.	Minor adverse
	Modified watercourses	Negligible	Negligible	Low	Negligible		Negligible
	Area of marshy grassland containing undefined drains	Low	Low	No impact	-		-
	Standing water	Low	Low	Low	Negligible		No Impact
	Ynys Mon groundwater body	Medium	Low	Low	Minor adverse		Minor adverse
Decommissioning							
Contractual details relating to decommissioning are yet to be finalised, however the ultimate responsibility for the decommissioning of the general onshore electrical infrastructure will lie with Menter Mon. At this stage, this is expected to consist primarily of removal of the landfall substation, switchgear building and grid connection substation.							

17.8. REFERENCES

British Geological Survey (undated), Geoindex online viewer [Online] Available: https://www.bgs.ac.uk/geoindex/ [Accessed 26/03/2019]

Construction Industry Research and Information Association (2001) Control of water pollution from construction sites: Guidance for consultants and contractors (C532).

European Commission (EC), (1992) Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC).

European Commission (EC), (2009) Directive on the Conservation of Wild Birds (2009/147/EC).

European Commission (EC), (2009) Renewable Energy Directive (2009/28/EC).

European Commission (EC), (2000) The Water Framework Directive (WFD) (Council Directive 2000/60/EC).

Flood and Water Management Act, (FWMA) (2010).

Highways Agency (2008) Design Manual for Roads and Bridges, Volume 11 Environmental Assessment, Section 2 Environmental Impact Assessment, Part 5 Assessment and management of environmental effects. HA205/08.

Isle of Anglesey County Council and Natural Resources Wales, (2015) Anglesey Area of Outstanding Natural Beauty Management Plan 2015-2020. Available online: https://www.anglesey.gov.uk/documents/Docs-en/Countryside/Anglesey-AONB-Management-Plan-2015-%E2%80%93-2020.pdf [Accessed 26/03/2019]

Isle of Anglesey County Council, (2013) Anglesey Local Flood Risk Management Strategy. Available online: https://www.anglesey.gov.uk/documents/Docs-en/Highways/Flooding/Anglesey-Local-Flood-Risk-Management-Strategy.pdf [Accessed 3/03/2019]

Natural Resources Wales, Flood Risk Map Viewer [Online] Available: https://maps.cyfoethnaturiolcymru.gov.uk/Html5Viewer/Index.html?configBase=https://maps.cyfoethnaturiolcymru.gov.uk/Geocortex/Essentials/REST/sites/Flood_Risk/viewers/Flood_Risk/virtualdirectory/Resources/Config/Default&layerTheme=0 [Accessed 27/03/2019]

Natural Resources Wales, (2016) Water Watch Wales Cycle 2 Rivers and Waterbodies Viewer [Online], Available: https://nrw.maps.arcgis.com/apps/webappviewer/index.html?id=2176397a06d64731af8b21fd69a143f6 [Accessed 26/03/2019]

Natural Resources Wales, (2018) Western Wales River Basin District Preliminary Flood Risk Assessment Report.

Natural Resources Wales, Scottish Environment Protection Agency and Northern Ireland Environment Agency (2018) Guidance for Pollution Prevention: Works and maintenance in or near water: GPP 5

The Water Framework Directive (Standards and Classification) Directions (England and Wales, (2015).

Water Environment (Water Framework Directive) (England and Wales) Regulations, (2017).

Welsh Government, (2012) Energy Wales: A Low Carbon Transition. Available online: https://gweddill.gov.wales/docs/desh/publications/120314energywalesen.pdf [Accessed 05/04/2019]

Welsh Government, (2016) Planning Policy Wales. Available online: https://gov.wales/sites/default/files/publications/2019-02/planning-policy-wales-edition-10.pdf [Accessed 26/03/2019]

Welsh Government, (2004) Planning Policy Wales Technical Advice Note 15: Development and Flood Risk. Available online: https://gov.wales/technical-advice-note-tan-15-development-and-flood-risk

Welsh Government and Natural Resources Wales, (2015) Western Wales River Basin Management Plan 2015 – 2021 Summary. Available online: https://cdn.naturalresources.wales/media/676165/wwrbdsummary.pdf?mode=pad&rnd=131596369400000000 [Accessed 26/03/2019]

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Morlais Project
Environmental Statement

Chapter 18: Ground Conditions and Contamination

Volume I

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-018

Chapter 18: Ground Conditions and Contamination

Author: Royal HaskoningDHV

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GLOSSARY OF ABBREVIATIONS

AONB	Area of Outstanding Natural Beauty
BGS	British Geological Survey
BGL	Below Ground Level
CIA	Cumulative Impact Assessment
CIRIA	Construction Industry Research and Information Association
CDM	Construction Design Management
CEMP	Construction Environmental Management Plan
CIA	Cumulative Impact Assessment
CMS	Construction Method Statement
CoCP	Code of Construction Practice
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EPA	Environmental Protection Act
ES	Environmental Statement
HDD	Horizontal Directional Drilling
HVDC	High Voltage Directional Current
IoACC	Isle of Anglesey County Council
IPC	Infrastructure Planning Commission
JLDP	Joint Local Development Plan
LNR	Local Nature Reserve
m	Metre
MMP	Material Management Plan
MPA	Mineral Planning Authority
NPS	National Policy Statement
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
O&M	Operations and Maintenance
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated biphenyl
PCOC	Potential Contaminant of Concern
PPE	Personal Protective Equipment
PPG	Pollution Prevention Guidance
PPMP	Pollution Prevention Management Plan
PRA	Preliminary Risk Assessment
PWS	Private Water Supplies
RIGS	Regionally Important Geological Site
RPE	Respiratory Protective Equipment
SAC	Special Area of Conservation

SgZs	Groundwater Safeguard Zones
SPA	Special Protection Area
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SVOC	Semi Volatile Organic Compound
SWMP	Site and Excavated Waste Management Plan
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VOC	Volatile Organic Compound
WCS	Worst Case Scenario
WFD	Water Framework Directive
WS	Wildlife Site

GLOSSARY OF TERMINOLOGY

Term	**Definition**
Code of Construction Practice (CoCP)	A document detailing the overarching principles of construction, contractor protocols, construction-related environmental management measures, pollution prevention measures, the selection of appropriate construction techniques and monitoring processes.

18. GROUND CONDITIONS AND CONTAMINATED LAND

18.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES), prepared by Royal HaskoningDHV, considers the potential impacts of the proposed Morlais Project (the Project) relating to ground conditions and contamination. The assessment focusses on the potential presence of contamination and pollutant linkages to sensitive receptors such as site workers, future users, geology, surface water and groundwater as a result of the construction, operation and decommissioning of the Project.

2. This chapter does not assess potential impacts on soil quality in the context of an agricultural resource or an ecosystem service; this is discussed separately in **Chapter 25, Socio-Economics, Tourism and Recreation**. Potential impacts to the groundwater and surface waters not relating to contamination are discussed in **Chapter 17, Water Resources and Flood Risk**.

3. The chapter provides an assessment of the potential impacts and associated mitigation for the construction, operation and decommissioning of the Project. The assessment also considers the cumulative impacts of the Project. The proposed methodology adhered to for the Environmental Impact Assessment (EIA) and Cumulative Impact Assessment (CIA) is discussed in **Section 18.4**.

4. Because of the close association between ground conditions, groundwater, surface water and ecology topics, this chapter should also be read in conjunction with the other related ES chapters (and their appendices and supporting documents). The relevant chapters are:

- **Chapter 7**, Metocean Conditions and Coastal Processes;
- **Chapter 8,** Marine Water and Sediment Quality;
- **Chapter 17**, Water Resources and Flood Risk;
- **Chapter 19**, Onshore Ecology; and
- **Chapter 25,** Socio-Economics, Tourism and Recreation.

18.2. LEGISLATION, GUIDANCE AND POLICY

5. The assessment within this section has been guided and informed by the following key relevant legislation, guidance and policy. Further detail on legislation and policy in relation to the wider Project is provided in **Chapter 2, Policy and Legislation**.

18.2.1. Legislation

6. The following UK legislation is considered the most relevant to ground conditions and contamination:

- The Environmental Permitting (England and Wales) Regulations (2010);
- The Water Resources Act 1991, as amended by the Water Act 2003;
- Environmental Protection Act (1990) Part 2A;

- Environment (Wales) Act 2016;
- The Water Environment (Water Framework Directive) (England and Wales) Regulations (2017);
- Environmental Damage (Prevention and Remediation) Regulations 2009 (SI 153); and
- HSE Construction (Design and Management CDM) Regulations (2015).

18.2.2. Guidance

7. The following UK guidance is considered the most relevant to ground conditions and contamination:

- Environment Agency and DEFRA Pollution Prevention for Businesses (2016);
- Environment Agency Model Procedures for the Management of Land Contamination, Contained Land Report 11 (CLR11);
- CIRIA Publication C532 Control of Water Pollution from Construction Sites (2011);
- CIRIA Publication C650 Environmental Good Practice on Site (2005);
- CIRIA Publication C503 Environmental Good Practices Working on Site (2000);
- CIRIA Publication C502 Environmental Good Practice on Site (2000);
- CIRIA Publication C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings (2007);
- DEFRA Construction Code of Practice for the Sustainable Use of Soil on Construction Sites (2009);
- British Standard BS10175 Investigation of Potentially Contaminated Sites; and
- British Standard BS5930 Code of Practice for Site Investigations.

18.2.3. Policy - National Policy Statements

8. Although this Project is not seeking a Development Consent Order (DCO), its size (up to 240 MW) means it is of equivalent scale and magnitude as a Nationally Significant Infrastructure Project (NSIP). Guidance that is relevant to assessing impacts on ground conditions and contamination for NSIPs are set out within National Policy Statements (NPS) which are the principal decision-making documents for NSIPs.

9. The assessment of potential impacts within this chapter has therefore been undertaken with specific reference to the relevant National Policy Statements (NPS). The specific assessment requirements for soils, geology and ground conditions in the NPS are detailed in the overarching statement for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a) as stated in **Table 18-1** below.

Table 18-1 NPS Assessment Requirements Relevant to Ground Conditions and Contamination

NPS Requirement	NPS Reference	ES Reference
EN-1 Overarching NPS for Energy		
'Where the development is subject to EIA [Environmental Impact Assessment] the applicant should ensure that the ES [Environmental Statement] clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the Infrastructure Planning Commission (IPC) consider thoroughly the potential effects of a proposed project'.	Section 5.3	Existing environment is discussed in **Section 18.5**. Impacts are set out in **Section 18.6**.

18.2.4. Planning Policy Wales

10. The planning policy for Wales is set out within the Planning Policy Wales (Welsh Government, 2018). The planning policy document outlines the Welsh Government's approach to facilitating the delivery of the aims set out in Energy Wales: A Low Carbon Transition (Welsh Government, 2012b), as well as UK wide and European renewable energy targets, including obligations under the Renewable Energy Directive (2009/28/EC).

11. The policy recognises the importance and need to protect and enhance areas of geodiversity within Wales, with planning authorities encouraged to conserve and enhance designated sites (e.g. SSSIs, UNESCO Global Geoparks). The policy also encourages, where possible, development on previously developed land but recognises the constraints that land contamination may pose on site selection for future developments without remediation, thus reducing the risks to human health.

18.2.5. Local Planning Policy

12. The onshore elements of the Project fall within the Isle of Anglesey County Council (IoACC) local authority boundary, policies relevant to ground conditions and geology are discussed below. A number of policies are inter-linked with **Chapter 17, Water Resources and Flood Risk** and **Chapter 19, Onshore Ecology**.

18.2.6. Joint Local Development Plan (Anglesey and Gwynedd)

13. **Table 18-2** below provides details on the policies of the Anglesey and Gwynedd Joint Local Development Plan (JLDP) which are relevant to ground conditions and geology.

Table 18-2 Relevant Local Planning Policies of the Joint Local Development Plan

Policy	Policy Purpose
Policy AND 3: Other Renewable Energy and Low Carbon Technologies	Proposals for renewable and low carbon energy technologies, other than wind or solar, which contribute a low carbon future will be permitted, provided that the proposal conforms to the following criteria… "*All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and*

Policy	Policy Purpose
	internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced'
Strategic Policy PS 19: Conserving and where appropriate enhancing the Natural Environment	The Councils will manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline, and proposals that have a significant adverse effect on them will be refused unless the need for and benefits of the development in that location clearly outweighs the value of the site or area and national policy protection for that site and area in question. When determining a planning application, consideration will need to be given to the following: 1. Safeguard the Plan area's habitats and species, geology, history, the coastline and landscapes; 2. Protect or where appropriate enhance sites of international, national, regional and local importance and, where appropriate, their settings in line with National Policy; 3. Have appropriate regard to the relative significance of international, national, regional or local designations in considering the weight to the attached to acknowledge interests, ensuring that any international or national responsibilities and obligations are fully met in accordance with National Policies.
Policy AMG 6: Protecting Sites of Regional or Local Significance	Proposals that are likely to cause direct or indirect significant harm to Local Nature Reserves (LNR), Wildlife Sites (WS) or Regionally Important Geological / Geomorphological Sites (RIGS) will be refused, unless it can be proven that there is an overriding social, environmental and/or economic need for the development, and that there is no other suitable site that would avoid having a detrimental impact on sites of local nature conservation value or local geological importance. When a development is granted, it will be necessary to ensure that there are appropriate mitigation measures in place. It will be possible to use planning conditions and/or obligations in order to safeguard the site's biodiversity and geological importance.

14. **Table 18-3** sets out national and regional policies of direct relevance to Ground Conditions and contamination.

Table 18-3 National and Regional Policy Requirements Relevant to Ground Conditions and Contamination

Policy Description	Reference	ES Reference
Planning Policy Wales		
Where land contamination issues arise, the planning authority will require evidence of a detailed investigation and risk assessment prior to the determination of the application to enable beneficial use of land, unless it can already be established that remedial measures can be employed.	6.9.19	A desk-based review of the potential for contamination within the project area has been conducted as part of the Preliminary Risk Assessment (**Appendix**

Policy Description	Reference	ES Reference
		18.1, Volume III) to inform the impact assessment. The impacts of the proposed Project are included within **Section 18.6**.
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
Planning permission will be refused where the proposed development would have an unacceptable adverse impact on: 7. The health, safety or amenity of occupiers of local residences, other land and property uses or characteristics of the locality due to increased activity, disturbance, vibration, noise, dust, fumes, litter, drainage, light pollution, or other forms of pollution or nuisance	Policy PCFF 2: Development Criteria	Potential construction impacts to human health are discussed in **Section 18.6.4.6.**
1. All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced; 3. That the proposal is mitigated to ensure that there aren't any significant unacceptable effects on sensitive uses located nearby; 4. Where appropriate, that the proposal does not have a significant unacceptable effect on the quality and supply of water;	Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	An impact assessment on geological designated sites is presented in **Section 18.6.4.1,** including any proposals for mitigation.

18.2.7. Anglesey Area of Outstanding Natural Beauty Management Plan 2015-2020

15. The Isle of Anglesey Area of Outstanding Natural Beauty (AONB) Management Plan 2015-2020 was produced through collaboration of Natural Resources Wales (NRW) and IoACC. It determines what actions are required to ensure that the special qualities of the AONB are conserved and enhanced for future generations.

16. Policies NE 2.1, NE 2.2 and NE 2.3 of the AONB Management Plan relate to Soil, Air and Water and require community involvement in protecting soils and water from pollution with monitoring and promotion of water efficiency measures. All policies are translated into an action plan produced following public and stakeholder consultation.

18.2.8. Impact Assessment Guidance

17. The assessment methodology used in this chapter follows the methodology set out in **Chapter 5, EIA Methodology**. There is no specific assessment guidance to reference in relation to this topic.

18.3. CONSULTATION

18. Consultation is key driver of the EIA and ES and is an ongoing process throughout the lifecycle of the Project, from the initial stages through to consent and post-consent.

19. **Table 18-4** provides a summary of the consultation responses that have been received as a response to the scoping reports relevant to ground conditions and contamination.

Table 18-4 Consultation Responses

Consultee	Date/Document	Comment	Response
NRW	2015 Scoping Comments	Identifying the key impact pathway/receptor combinations will help focus any additional evidence or data collection to most effectively inform the assessment of impacts within the EIA process. We would encourage engagement and with all relevant stakeholders to discuss the need for and scope of any additional data gathering before work commences.	Agreed, stakeholder consultation to define scope and data gaps will be important in determining the level of detail required for approval of ES. Additional consultation was undertaken with comments from the 2017 and 2018 scoping rounds included below in this table.
IoACC	2017 Scoping Comments	Works have the potential to impact small drinking water supplies (PWS); and Historic landfills within the area, potential for land contamination across the area during ground works.	A desk-based review of the potential for contamination within the project area has been conducted as part of the Preliminary Risk Assessment (**Appendix 18.1, Volume III**) to inform the impact assessment. The impacts of the proposed Project are included within **Section 18.6**.
IoACC	2017 Scoping Comments	Concern with ongoing issue associated with contamination in the former Anglesey Aluminium site.	A desk-based review of the potential for contamination within the Project area has been conducted as part of the Preliminary Risk Assessment (**Appendix 18.1, Volume III**) to inform the impact assessment. The impacts of the proposed Project are included within **Section 18.6**.
IoACC	2017 Scoping Comments	Potential land contamination should be considered if cables cross former Anglesey Aluminium land to Orthios site.	A desk-based review of the potential for contamination within the Project area has been conducted as part of the Preliminary Risk Assessment (**Appendix 18.1, Volume III**) to inform the impact assessment. The impacts of the proposed Project are included within **Section 18.6**.
Planning Inspectorate	2018 Scoping Comments	The Scoping Report anticipates that there would be no impacts on geological features due to the limited nature of the onshore development, and because all works would be expected to be located within surface soils (except the landfall installation	Noted. An assessment of the potential impacts to geology is included within **Section 18.6**.

Consultee	Date/Document	Comment	Response
		which would require either open trenching or horizontal directional drilling through rock). The Applicant therefore proposes to scope out impacts to geology features. However, Table 7-3 states that the significance of impacts in unknown (although predicted to be negligible). Part of Anglesey are designated as a UNESCO Geopark, although the extent of the designation has not been identified within the Scoping Report. It is acknowledged that the Applicant intends to lay the majority of the onshore cable within or adjacent to existing road infrastructure (Section 5.1.3), however, there is no detailed cable route at present and there is no definitive location for the onshore substation. There is also a need for short sections of cable route to cross unmade ground (Section 8.6.1.1 of Scoping Report). These points combine and accordingly, it would be premature to scope this matter out of the ES.	
Planning Inspectorate	2018 Scoping Comments	Preliminary Risk Assessment: the potential for land contamination in the onshore environment should be identified through a Preliminary Risk Assessment.	A Preliminary Risk Assessment for the Project has been completed and is included as **Appendix 18.1, Volume III**.
NRW (for PINS)	2018 Scoping Comments	There is the potential for works associated with the proposal to cause land contamination and the Applicant should be mindful of this. Once the landfall location has been finalised, we will need further information of the site setting regarding the potential for land contamination (a Preliminary Risk Assessment) and a water feature survey. The water feature survey should be carried out along all the cable routes and around any buildings, compounds and substations for the development.	A Preliminary Risk Assessment for the Project has been completed and is included as **Appendix 18.1, Volume III**. An assessment of the water environment is included in **Chapter 17, Water Resources and Flood Risk**.
NRW (for PINS)	2018 Scoping Comments	Requirement for a Preliminary Risk Assessment: Follow the risk management framework provided in CLR11 ‘Model Procedures for the	A Preliminary Risk Assessment for the Project has been completed and is included as **Appendix 18.1, Volume III.**

Consultee	Date/Document	Comment	Response
		Management of Land Contamination' when dealing with land affected by contamination (EA, 2004). Refer to the Environment Agency 'Guiding Principles for Land Contamination' (which has been adopted by NRW) for the type of information required in order to assess risks to controlled waters from the Site (EA, 2010). The local authority can advise on risk to other receptors, e.g. human health.	
IoACC	2018 Scoping Comments	Several RIGS sites are either captured or in close proximity to the onshore scoping area and impacts upon them should be mitigated.	An assessment of the potential impacts to geology is included within **Section 18.6**.
IoACC	2018 Scoping Comments	Potential for land contamination should be considered if the cables are directed across the former Anglesey Aluminium land to the Orthios site for connection to the grid (paragraph 8.2.2).	A desk-based review of the potential for contamination within the Project area has been conducted as part of the Preliminary Risk Assessment (**Appendix 18.1, Volume III**) to inform the impact assessment. The impacts of the proposed Project are included within **Section 18.6**.
IoACC PINS & NRW	2018 Scoping Comments	The Scoping Report (at 7.3.1.1) refers to parts of Holy Island/Anglesey being designated as a UNESCO Geopark. This is factually incorrect as the whole of the island benefits from the UNESCO designation and this should be reflected in the ES.	Acknowledged. A desk-based review of designated sites within the Project area, including the UNESCO geopark, has been completed as part of a Preliminary Risk Assessment (**Appendix 18.1, Volume III**).
IoACC Revised Scheme & NRW	2018 Scoping Comments	The report states that 'due to limited nature of the onshore development it is anticipated that there would be no impacts on the geology environment'. Whilst we agree with this statement in the main, it is necessary to point out that the onshore scoping area captures, or is in close proximity to, a number of RIGS sites. These are: Pen Las Rock RIGS, Penrhofeilw; South Stack Moor and South Stack RIGS, Holyhead; Porthdafarch RIGS, Holyhead; Rhosygader RIGS, Trearddur;	An assessment of the potential impacts to geology is included within **Section 18.6.**

Consultee	Date/Document	Comment	Response
		Porth y Post RIGS, Trearddur; Porth y Pwll, Trearddur; and Penrhos Drumlin RIGS, Holyhead. Any impacts on the RIGS sites in question must be adequately considered and mitigated where necessary.	
NRW	2018 Scoping Comments	The potential for the works to cause land contamination should be considered in the ES. Once the landfall location has been finalised, a Preliminary Risk Assessment for land contamination and a water feature survey should be undertaken. The water feature survey should be carried out along the onshore cable routes and around any buildings, compounds and substations for the development.	A Preliminary Risk Assessment is included as **Appendix 18.1, Volume III**. An Extended Phase 1 Habitat Survey was carried out between September and November 2018, as discussed in **Chapter 19, Onshore Ecology**, which surveyed all water features along the cable route, this was then used to inform the characterisation of the baseline water environment as discussed in **Chapter 17, Water Resources and Flood Risk**.
NRW	2018 Scoping Comments	The requirements for a preliminary risk assessment are: • Follow the risk management framework provided in CLR 11, model procedures for the management of land contamination, when dealing with land affected by contamination (EA, 2004). • Refer to the Environment Agency 'Guiding Principles for Land Contamination' (which has been adopted by NRW) for the type of information required in order to assess risks to controlled waters from the site (EA, 2018). The local authority can advise on risk to other receptors, e.g. human health.	A Preliminary Risk Assessment is included as **Appendix 18.1, Volume III**.
NRW	2018 Scoping Comments	As noted earlier in this scoping opinion, the onshore area covers, or is in close proximity to, a number of RIGS sites and impacts on the RIGS sites in question must be adequately considered and mitigated where necessary. As such, we disagree that onshore geology should be scoped out of the ES.	An assessment of the potential impacts to geology is included within **Section 18.6**.

20. Consultation phases are explained further in **Chapter 6, Consultation**.

18.4. METHODOLOGY

18.4.1. Study Area

21. The onshore infrastructure for the proposed Project will include the following elements:

- Landfall cable installation works;
- Landfall substation at Ty-Mawr (hereafter referred to as the landfall substation);
- Onshore cable route joint bays (along onshore cable route between landfall substation and grid substation);
- Onshore cable circuits installed between landfall and grid connection;
- A switchgear building at Parc Cybi (hereafter referred to as the switchgear building); and
- A grid connection substation at Orthios (hereafter referred to as the grid connection substation).

22. A full description of the above infrastructure is provided in **Chapter 4, Project Description**.

23. The study areas are defined by the distance over which impacts on ground conditions and contamination from the Project may occur and by the location of any receptors that might be affected by those potential impacts. This has been established by professional judgement supported by the Preliminary Risk Assessment (PRA) (**Appendix 18.1, Volume III**).

24. The proposed onshore development area, as outlined in **Chapter 4, Project Description**, is the largest area over which direct impacts could be experienced. At this stage, the direct impact study area includes an additional buffer of 1 km. However, contamination sources are only considered within a 250 m buffer of the proposed onshore development area, the risks associated with contamination sources at distances greater than 250 m are thought to decrease with increasing distance and so have not been assessed as part of the PRA.

18.4.2. Data Sources – Desk Study

25. The following data sources have been used to inform this ES:

- Morlais Project PRA (**Appendix 18.1, Volume III**);
- Envirocheck Report (Ref 196332764_1_1) comprising historical maps, environmental sensitivity data and regulatory records;
- British Geological Survey (BGS) online geology viewer;
- The Coal Authority interactive online viewer;
- UK Radon Website (Public Health England);
- Environmental data available on the data.gov.uk website (DEFRA); and
- Publicly available aerial imagery (Google Earth).

26. A site walkover was also undertaken.

18.4.3. Assessment of Ground Conditions

27. The assessment of ground conditions has followed a phased risk-based approach including consideration of potential sources, pathways and receptors to identify potential pollutant linkages that may result in unacceptable risks to receptors from ground contamination. For a risk to exist, all three elements (defined below) must be present.

- Source: A potentially polluting activity or existing ground contamination;
- Pathway: A route or means by which a receptor could be exposed to or affected by contamination; and
- Receptor: Something that could be adversely affected by contamination.

28. A PRA was undertaken to determine whether or not the Project poses potentially unacceptable risks to sensitive receptors.

29. The PRA is a desk-based study that forms the initial step in the assessment of potentially contaminated land. Within the PRA, risks are assessed qualitatively and are defined in terms of whether or not they are likely to be ‘unacceptable’. If a pollutant linkage is established, then a potentially ‘unacceptable’ risk exists. It may be possible to manage the risk through design measures, use of protective equipment or procedures during construction. The risk assessment is conservative, therefore, where the presence of contamination or a viable pathway is uncertain, it is assumed that a pollutant linkage exists until proved otherwise by further investigation.

18.4.4. Impact Assessment Methodology

30. The methodology adopted for the assessment of potential impacts follows the generic EIA methodology as presented in **Chapter 5, EIA Methodology** and is based on the following principles:

- The type of effect (long term, short term or intermittent; positive, negative or neutral);
- The probability of effect occurring;
- The sensitivity of the receptor (according to the criteria set out in **Table 18-5**); and
- The magnitude (severity) of the effect (according to the criteria set out in **Table 18-7**).

18.4.4.1. Sensitivity

31. The sensitivity of receptors is assessed according to the criteria set out in **Table 18-5** and is based on the capacity of receptors to tolerate change and whether or not increased risks would be acceptable within the scope of the prevailing legislation and guidelines. Note that human health is considered a high sensitivity receptor in all cases. The degree of change that is considered to be acceptable is dependent on the value of a receptor, which is discussed below.

Table 18-5 Definitions of Sensitivity Levels for Ground Conditions and Contamination

Criteria	Examples
High	**Human Health** Construction workers Site operatives

Criteria	Examples
Has very limited or no capacity to accommodate physical or chemical changes; or Is an international or nationally important resource.	General public (off-site)
	Controlled Waters Groundwater Source Protection Zone (SPZ) 1 / 2 (including unpublished abstraction wells). Surface Waters with Water Framework Directive 'High' status objective. Surface water or groundwater supporting internationally designated or nationally important conservation site (e.g. Special Areas of Conservation, Special Protection Area, Ramsar site / Site of Special Scientific Interest) or fishery.
Moderate Has limited capacity to accommodate physical or chemical changes or influences. Is a regionally important resource.	**Controlled Waters** Principal Aquifer (resource potential) Groundwater SPZ Total Catchment. Licenced groundwater / surface water abstractions. Surface waters with Water Framework Directive Status / Potential objective 'Good'. Surface water or groundwater supporting regionally important wildlife sites (Local Nature Reserve, Site of Nature Conservation Interest) or commercial aquaculture.
Low Has moderate capacity to accommodate physical or chemical changes. Is a locally important resource.	**Controlled Waters** Secondary A / Undifferentiated Aquifer (resource potential). Unlicensed water supplies. Surface waters with Water Framework Directive Status / Potential objective 'Moderate' / 'Poor'. Surface water or groundwater supporting locally important wildlife or amenity site.
Negligible Is generally tolerant of physical or chemical changes. Is of no significant resource value.	**Controlled Waters** Secondary B Aquifer / water-bearing Unproductive Strata (resource potential). Surface waters with Water Framework Directive Status / Potential objective 'Bad'.

18.4.4.2. Value

32. The sensitivity assessment takes into account how 'acceptable' changes to the availability or quality of a particular resource would be. This is dependent on the value of that resource which is assessed based on its strategic or geographic importance (**Table 18-6**).

Table 18-6 Definition of value of levels for ground conditions and contamination

Value	Definition
High	Is an international or nationally important resource
Medium	Is a regionally important resource
Low	Is a locally important resource
Negligible	Is of no significant resource value

33. It should be noted that high value and high sensitivity are not necessarily linked within a particular impact. A receptor could be of high value (e.g. Groundwater SPZ 1 areas) but have a low or negligible physical/ecological sensitivity to an effect.

18.4.4.3. Magnitude

34. Potential effects may be adverse, beneficial or neutral. The magnitude of an effect is assessed qualitatively, according to the criteria set out in **Table 18-7**. The following definitions apply to time periods used in the magnitude assessment:

- Long-term: >5 years;
- Medium-term: 1 to 5 years; and
- Short-term: <1 year.

35. For human health, magnitude reflects the likely increase or decrease in exposure risk for a receptor. For controlled waters, magnitude represents the likely effect that an activity would have on resource usability or value, at the receptor. Magnitude is therefore affected by the distance and connectivity between an impact source and the receptor.

Table 18-7 Magnitude of Effect Criteria and Examples

Criteria	Human Health Risk Proposed Development or activity is *likely* to result in:	Controlled Waters Physical, biological or chemical effects on groundwater or surface water *likely* to result in:
High Permanent or large-scale change affecting usability, risk or, value over a wide area, or certain to affect regulatory compliance.	Permanent or major change to existing risk of exposure (Adverse / Beneficial). Unacceptable risks to one or more receptors over the long-term or permanently (Adverse). Prosecution e.g. under health and safety legislation (Adverse). Remediation and *complete* source removal (Beneficial). Construction workers at risk due to lack of appropriate personal protective equipment (Adverse).	Permanent, long-term or wide scale effects on water quality or availability (Adverse / Beneficial). Permanent loss or long-term derogation of a water supply source of a water supply source resulting in prosecution (Adverse). Change in WFD water body status / potential or its ability to achieve WFD status objectives in the future (Adverse / Beneficial). Permanent habitat creation or complete loss (Adverse / Beneficial). Measurable habitat change that is sustainable / recoverable over the long-term (Adverse / Beneficial).
Moderate Moderate permanent or long-term reversible change affecting usability, value, or risk, over the medium-term or local area; possibly affecting regulatory compliance.	Medium-term or moderate change to existing risk of exposure (Adverse / Beneficial). Unacceptable risks to one or more receptors over the medium-term (Adverse). Serious concerns or opposition from statutory consultees (Adverse).	Medium-term or local scale effects on water quality or availability (Adverse / Beneficial). Medium-term derogation of a water supply source, possibly resulting in prosecution (Adverse). Observable habitat change that is sustainable / recoverable over the medium-term (Adverse / Beneficial). Temporary change in status / potential of a WFD waterbody or its ability to meet objectives (Adverse / Beneficial).
Low	Short-term temporary or minor change to existing risk of exposure (Adverse / Beneficial).	Short-term or very localised effects on water quality or availability. (Adverse / Beneficial).

Criteria	Human Health Risk Proposed Development or activity is *likely* to result in:	Controlled Waters Physical, biological or chemical effects on groundwater or surface water *likely* to result in:
Temporary change affecting usability, risk or value over the short-term or within the site boundary; measurable permanent change with minimal effect usability, risk or value; no effect on regulatory compliance.	Unacceptable risks to one or more receptors over the short-term (Adverse).	Short-term derogation of a water supply source (Adverse). Measurable permanent effects on a water supply source that do not impact on its operation (Adverse). Observable habitat change that is sustainable / recoverable over the short-term (Adverse / Beneficial). No change in status / potential of a WFD waterbody or its ability to meet objectives (Neutral).
Negligible Minor permanent or temporary change, indiscernible over the medium- to long-term short-term, with no effect on usability, risk or value.	Negligible change to existing risk of exposure. Activity is *unlikely* to result in unacceptable risks to receptors (Neutral).	Very minor or intermittent impact on local water quality or availability (Adverse / Beneficial). Usability of a water supply source will be unaffected (Neutral). Very slight local changes that have no observable impact on dependent receptors (Neutral). No change in status / potential of a WFD waterbody or its ability to meet objectives (Neutral).

18.4.4.4. Impact Significance

36. The impact significance assessment combines receptor sensitivity with effect magnitude, as shown in **Table 18-8**. Assessment of impact significance is qualitative and reliant on professional experience, interpretation and judgement. The matrix should therefore be viewed as a framework to aid understanding of how a judgement has been reached, rather than as a prescriptive, formulaic tool.

Table 18-8 Impact Significance Assessment

Magnitude	**Sensitivity**			
	High	**Moderate**	**Low**	**Negligible**
High	Major	Major	Moderate	Minor
Moderate	Major	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible

37. Following initial assessment, if the impact does not require additional mitigation (or none is possible) the residual impact will remain the same. If, however, additional mitigation is proposed there will be an assessment of the post-mitigation residual impact.

38. As with the definitions of magnitude and sensitivity, the matrix used for a topic is clearly defined by the assessor within the context of that assessment. The impact significance categories are divided as shown in **Table 18-9**.

Table 18-9 Impact Significance Definitions

Impact Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision-making process.
Negligible	No discernible change in receptor condition.
No Impact	No change, therefore no impact on receptor condition.

39. Note that for the purpose of the EIA, major and moderate impacts are deemed to be 'significant'. In addition, whilst minor impacts are not significant in their own right, it is important to distinguish these from other non-significant impacts as they may contribute to significant impacts cumulatively or through interactions.

18.4.5. Cumulative Impact Assessment

40. **Chapter 5, EIA Methodology** provides a general methodology with regards to the Cumulative Impact Assessment (CIA).

41. The CIA involves consideration of whether impacts on a receptor can occur on a cumulative basis between the Project and other activities, projects and plans for which sufficient information regarding location and scale exist.

42. The potential for cumulative effects has been considered for the construction, operation and decommissioning of the onshore development area cumulatively with other onshore projects.

43. The CIA is presented in **Section 18.6.7**.

18.4.6. Assumptions and Limitations

44. This assessment is based on a range of publicly available information and data from bodies such as NRW and Local Authorities. The direct assessments and judgements given in this report are limited by the finite data on which they are based. However, there is a level of uncertainty associated with extrapolation of site-specific data or non-site data to other locations within the study area, particularly where the study area is large as is the case of the Project.

18.5. EXISTING ENVIRONMENT

45. This section describes the existing environment in relation to ground conditions and contamination. It has been informed by the site walkover, review of published documents and the PRA. The baseline for the physical environment includes the following areas:

- Landfall and landfall substation – this includes landfall, transition pit, cabling laydown and access and landfall substation location. These components of the Project are located adjacent to Abraham's Bosom and South Stack Road.
- Onshore cable route, which is approximately 8.1 km in length, is the route by which the cable will take between landfall and the grid connection.
- Grid connection point – the grid connection point will be via the switchgear building at Parc Cybi and a 132 kV grid connection substation at Orthios.

18.5.1. Site Setting

46. The onshore study area is largely agricultural in nature, which represents potential for both diffuse and point sources of pollution to be present in relation to current agricultural activities. Settlements within or adjacent to the proposed onshore development include Kingsland town, developed areas also have the potential for historic sources of ground contamination.

47. The landfall for the Project is located within Abraham's Bosom on Holy Island, this area consists of an exposed rocky shore, backed by a hinterland of coastal heath and farmland. The landfall station is currently farmed land. From the landfall substation at Ty-Mawr, the onshore cable route mainly follows the minor road network to the A55 and Holyhead to Bangor railway line. The cable will be routed via trenching to a switchgear building at Parc Cybi and be subsequently routed via trenching, with a trenchless crossing under the A55 and rail line, to a substation at Orthios east of Holyhead (the site of the former Anglesey Aluminium Works).

18.5.2. Physical Environment

18.5.2.1. Geology

48. Information on the geological conditions within the study area has been collated from BGS datasets including 1: 50,000 scale geological mapping. The anticipated geological sequence for the landfall, landfall substation, onshore cable route, switchgear building, and grid connection substation as shown on the BGS online viewer, is outlined in **Table 18-10**.

Table 18-10 Geology

Stratum	Unit	Description
Superficial Deposits (units not present within all areas of the project boundary)	Till	Description not provided.
	Glaciofluvial Deposits	Sand and gravel.
	Alluvium	Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger desiccated surface zone may be present.

Stratum	Unit	Description
Bedrock	South Stack Formation – Psammite and Pelite	Grey to white turbiditic metasandstone and interbedded blue-grey silty mudstone.
	New Harbour Group	Chlorite-muscovite schist and phyllite, semipelite predominates with subsidiary psammite. Metabasaltic rock and calcsilicate rock locally. Abundant sheet like units of metamafic rock (amphibolite) occur locally.
	Dykes	Several dykes, comprised of gabbro, microgabbro and diorite are present along the proposed route of the site.

49. Holy Island is included within a UNESCO Geopark and there are several RIGS (largely related to Precambrian rock formations and glacial deposits) recorded within both the onshore development area or close proximity to it, details of the RIGS sites include:

- Pen Las Rock RIGS;
- South Stack Moor and South Stack RIGS;
- Porthdafarch RIGS;
- Rhosygader RIGS;
- Porth y Post RIGS;
- Porth y Pwll Trearddur RIGS; and
- Penrhos Drumlin RIGS.

50. Due to the designations given to both the island as a whole and individual areas, the geological sensitivity is considered to be **high**.

18.5.2.2. Hydrology and Surface Drainage

51. Information provided within the PRA indicates that the Project is located within the Crigyll Caradog surface water catchment area. 67 records of inland rivers were identified within the onshore development area, of these 52 are present at the ground surface and 15 are recorded as underground. The inland rivers identified as considered to be comprised of small streams and drainage ditches. There are three lakes recorded within the onshore development area. Within 250 m, there are 125 additional surface water features identified.

52. The coastal area surrounding the onshore development area, including the landfall location, are in an area designated as at risk of extreme flooding from rivers and sea without defences (Zone 2).

53. No surface water abstraction points were identified both within the onshore development area or within 1 km.

54. The sensitivity of hydrology within the onshore development area is considered to be **low**, this designation has been given due to the nature of surface water features both within and in close proximity to the onshore development area and the lack of surface water abstraction points.

55. The baseline hydrology is described in more detail in **Chapter 17, Water Resources and Flood Risk**.

18.5.2.3. Hydrogeology

56. The superficial Till deposits, which is the dominant superficial deposit within the onshore development area, are classified as a Secondary Undifferentiated Aquifer, this classification is given when it has not been possible to attribute either category A or B to a rock type.

57. The superficial Glaciofluvial and Alluvial deposits within the onshore development area are classified as Secondary A Aquifers, this type of aquifer is composed of permeable layers capable of supporting water supplies at a local rather than a strategic scale, and in some cases forming an important source to base flow to rivers.

58. The underlying New Harbour Group and South Stack Formation are classified as Secondary B Aquifers which are defined as comprising predominantly lower permeability strata which may in part have the ability to store and yield limited amounts of groundwater by virtue of localised features such as fissures, thin permeable horizons and weathering.

59. There are no groundwater abstraction points or SPZ recorded within the onshore development area or within 1 km.

60. Due to the Secondary A aquifer designation of the Glaciofluvial and Alluvial deposits, and Secondary Undifferentiated Aquifer of the Till deposits, the sensitivity of areas underlain by these deposits is considered to be **low**. With regards to the Secondary B designation of the underlying bedrock and the absence of a SPZ, the sensitivity is considered to be **negligible**.

18.5.2.4. Land Quality

61. The research undertaken to inform the PRA indicates that a large proportion of the Project is located in areas predominantly utilised for agricultural purposes. Historical OS maps for the landfall, landfall substation, onshore cable route, switchgear building, and grid connection substation areas show a limited number of individual properties recorded since the earliest available historical map (1888) and are probably associated with agricultural activities. There is the potential for both diffuse and point sources of pollution to be present in relation to historical and current agricultural activities within the landfall, landfall substation, onshore cable route, switchgear building, and grid connection substation areas, no other activities were identified that could give risk to land contamination within these areas.

62. The onshore cable route, switchgear building, and grid connection substation also cross/are located within close proximity to a number of potential sources of contamination. The potential sources are:

- A railway line Chester and Holyhead railway adjacent to the grid connection substation, recorded from 1888-1896 to the present day);

- A HGV fuel station (located adjacent to the onshore cable route, information provided in the production of the PRA does not indicate whether the fuel station is currently operational);
- Aluminium works (recorded adjacent to the railway line at the eastern end of the cable route near to the proposed grid connection substation, recorded from 1969 – 2014);
- Electricity substation (recorded adjacent to the onshore cable route from 1986 until present); and
- The A55 road (adjacent to the railway line, currently in use).

63. These potential sources of contamination may be associated with a wide range of contaminants including, but not limited to, herbicides, hydrocarbons, metals, polychlorinated biphenyl (PCBs), asbestos, volatile organic contaminants (VOCs) and semi-volatile organic contaminants (SVOCs).

64. The landfall and landfall substation and onshore cable route are located in areas where less than 1 % of properties are above the radon action level, as such no radon protection measures would be considered necessary within this section of the proposed development for new buildings, conversions or extensions to existing ones. The switchgear building, and grid connection substation are located within an area where more than 30 % of properties are above the radon action level, as such full radon protection measures would be necessary within this area of the proposed Project for new buildings, conversions or extensions to existing ones.

18.5.2.5. Human Health

65. The required onshore infrastructure comprises landfall works, onshore cable installation, landfall substation, switchgear building and grid connection substation. Haul and access roads will also be required during the construction period.

66. During construction of the onshore infrastructure, the critical human health receptors would be adults involved with construction activities, adjacent off-site residents, site users and adults engaged in other off-site commercial operations. Post-completion, the critical human health receptors will be site users and those engaged in future maintenance / construction activities and off-site commercial workers and residents.

67. On-site receptors could be exposed to contaminants of concern through dermal contact, ingestion and inhalation. Exposure to off-site receptors would be confined to ingestion and inhalation of fugitive dusts. The sensitivity of all these receptors is considered to be **high**.

18.5.3. Sensitive Land Use

68. The proposed Project is located within or in close proximity to the following designated areas:

- AONB – Ynys Mon / Anglesey;
- Environmentally Sensitive Areas – Ynys Mon / Anglesey;
- Special Areas of Conservation (SAC) – Gogless Môn Forol / North Anglesey Marine and Glannau Ynys Gybi / Holy Island Coast;

- Special Protection Areas (SPA) – Morwenoliaid Ynys Môn / Anglesey Terns and Glannau Ynys Gybi / Holy Island Coast;
- Site of Special Scientific Interest (SSSI) – Glannau Ynys Gybi / Holy Island Coast;
- Ancient Woodland – Name not supplied; and
- RIGS - Pen Las Rock, South Stack Moor and South Stack, Porthdafarch, Rhosygader, Porth y Post, Porth y Pwll Trearddur and Penrhos Drumlin.

69. Glannau Ynys Gybi / Holy Island Coast SAC includes a variety of Annex I habitats that are the reason for designation: vegetated sea cliffs and extensive cliff crevice and grassland communities. It is also the most important site in North Wales for European dry heaths.

70. Glannau Ynys Gybi / Holy Island Coast SPA supports a resident population of chough *Pyrrhocorax pyrrhocorax* which depends on a diverse mix of habitats.

71. Glannau Ynys Gybi / Holy Island Coast SSSI is a component of the SAC and SPA and is designated for a variety of vascular plants (heathland and maritime species), birds (seabirds, peregrine, chough and heathland species), invertebrates and geology.

72. Within 250 m of the proposed project boundary there are four records of Ancient Woodland (names not supplied in the available information) and on Site of Special Scientific Interest (Beddmanarch-Cymyran) which is designated as a SSSI as it supports a variety of coastal habitats. Further information regarding designated sites can be found in **Chapter 19, Onshore Ecology**.

18.6. IMPACT ASSESSMENT

18.6.1. Overview of Potential Impacts

73. This section details the impact assessment and proposed mitigation for the construction, operation and decommissioning phases of the Project, based upon the worst-case scenario with regards to receptor sensitivity and value (with embedded mitigation), and the magnitude of the potential impact (as detailed in **Section 18.4.4**).

18.6.2. Mitigation

74. All construction work has the potential to impact on land and water quality and human health, through spillages, mobilisation of sediment and contaminants by surface run-off or disturbance of contaminated ground. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process. Menter Môn has committed to a number of techniques and engineering designs/modifications as part of the Project (embedded mitigation through design), during the pre-application phase in order to avoid a number of impacts or reduce impacts as far as possible. A full account of embedded mitigation measures is contained in **Chapter 4, Project Description**.

75. Where embedded mitigation measures have been developed into the design of the Project with specific regard to ground conditions and contamination, these are described in **Table 18-11**.

76. Additional mitigation measures are also included to follow best practice and policy requirements. These mitigation measures are described in **Table 18-12**.

Table 18-11 Embedded Mitigation for Ground Conditions

Parameter	Mitigation Measure Embedded into the Project Design
Land quality	Avoidance of construction in areas of historic development, including all historic pits and areas of infilled land identified. Should any unanticipated contamination be encountered during the work, work should be halted and a written statement on how contamination will be dealt with should be agreed with the local authority.

Table 18-12 Additional Mitigation through Best Practice and Policy for Ground Conditions

Parameter	Mitigation Measure through Best Practice and Policy
Code of Construction Practice (CoCP)	Environmental best practice would include both the now revoked Environment Agency best practice guidelines (e.g. Pollution Prevention Guidance (PPG) PPG1, PPG5, PPG6 and PPG22) and current best practice guidelines.
Construction Design Management Regulation (CDM, 2015)	• All works/operations to be carried out by appropriately trained personnel; • Appropriate personal protective equipment (PPE) and working practices to be adopted by construction workers, including subcontractors, and health and safety measures would be undertaken to mitigate any short-term risk during construction; and • Development of CDM site specific risk assessment.
Construction Environmental Management Plan (CEMP) and Pollution Prevention and Management Plan (PPMP)	Adherence to a CEMP and PPMP, including Incident/Emergency Response Plans. Incident/Emergency Response Plan which will be drafted in advance of any construction works. The CEMP will provide a protocol under which the environmental risk mitigation and other specific remedial measures will be defined and executed.
CL:AIRE Industry Code of Practice for waste management	Adoption of a CL:AIRE Industry Code of Practice to manage excavated soils on site, thereby maximise sustainability and providing an audit trail to demonstrate the appropriate use of materials. A Material Management Plan (MMP) will be drafted in advance of any construction works. Validation of materials imported to site in line with pre-agreed assessment criteria to ensure that they are suitable for proposed end use. A Site and Excavated Waste Management Plan (SWMP) for the Project will be developed.
Environment Agency groundwater protection pollution prevention guidance (PPG)	Best practice guidance including the Environment Agency PPG notes and guidance from the Construction Industry Research and Information Association (CIRIA).
General best practice	Store oils and fuel within designated areas above ground in impervious storage bunds with a minimum of 110 % capacity to contain any leaks or spillages. Carry out regular inspections of oil and fuel storage areas. Restrict refuelling activities to designated areas were impermeable surfaces and drip trays are utilised. Have spill kit available for use on site always. All staff to have site inductions were appropriate use of chemical and fuels on site are discussed.

Parameter	Mitigation Measure through Best Practice and Policy
	A pollution prevention plan and incident response plan will be incorporated into the environmental management plan. This is to be agreed with NRW and follow industry best practice. Storage of hazardous materials will be done with due care and if adequate store locations cannot be identified within the site compound, these materials will be stored off-site in a secure location. A protocol for dealing with potentially contaminated materials will be utilised during the construction works.
Groundwater quality	A hydrogeological risk assessment to ensure the protection of groundwater where abstractions are present, this should include a detailed hydrogeological risk assessment of the effects of horizontal directional drilling (HDD). This assessment and the proposed methods used to avoid contamination should be agreed with NRW.

77. Any further mitigation measures suggested within this chapter are therefore considered to be additional to this mitigation.

18.6.3. Worst Case Scenario

78. **Chapter 4, Project Description** presents the parameters for the worst-case scenario with respect to impacts associated with the construction, operation and decommissioning of the onshore infrastructure for the Project. The key activities which could result in potential impacts and that are relevant to this chapter are summarised below:

- Impacts associated with HDD at the landfall;
- Impacts associated with trenching at the landfall and along the onshore cable corridor - trenching will be undertaken using a large excavator to dig up the ground along the route, with a rock breaker being required along some sections;
- Impacts associated with excavation of the transition pits using an excavator;
- Landfall substation and associated buildings requiring excavation of materials to form foundations; and
- Impacts associated with inland substation, switchgear building and grid connection substation requiring excavation of materials to form foundations, including the potential for piles.

18.6.4. Potential Impacts During Construction

18.6.4.1. Construction Impact 1: Impacts on Designated Geological Sites

79. The Island of Anglesey is a designated UNESCO Geopark, the Holy Island Coast is also a designated SSSI and there are several RIGS associated with glacial deposits and Precambrian rocks both within and in close proximity to the onshore development area. During construction, direct impacts to the designated geological sites may occur due to the intrusive nature of earthworks including trenching, HDD (at the landfall location) and piling (if required).

80. It is likely that trenching activities will predominantly be located within the superficial deposits, with some areas potentially impacting bedrock where superficial deposits are recorded as

absent, e.g. in some areas of the cable route. Bedrock will be impacted by areas where HDD or piling is required.

81. Impacts relating to offshore cable installation are assessed in **Chapter 7, Metocean Conditions and Coastal Processes**.

82. Due to the designation of the geology as a UNESCO Geopark within the onshore development area, it is considered to be of **high** sensitivity. The impacts are predicated to be of local spatial extent, of short-term duration (related to the working areas only) and of intermittent occurrence. The magnitude of effect is therefore considered to be **negligible**. The potential impact to designated geological sites is deemed to be **minor adverse**.

18.6.4.1.1. Mitigation

83. With the exception of landfall and HDD crossing points, excavation works are proposed to be conducted within the superficial deposits thus minimising the potential impacts to the designated geological sites. HDD is deemed necessary at a number of locations within the onshore development area, mitigation of the impacts to geology would involve limiting these activities where possible and/or avoiding particularly sensitive areas.

18.6.4.1.2. Residual Impact

84. The magnitude of effect remains **negligible** with the potential impact to designated geological sites remains as **minor adverse** which is not significant in EIA terms.

18.6.4.2. Construction Impact 2: Impacts on Groundwater Quality in the Superficial Secondary Aquifers During Earthwork Activities

85. Direct impacts to the Secondary A and Secondary Undifferentiated Aquifers (and by extension private water supplies, if present) within the superficial deposits may occur due to the intrusive nature of earthworks, trenching and piling (if required). The significance of the disturbance will be dependent on the depth of the aquifer unit in relation to the proposed depth of the excavation.

86. During construction, surface layers will be excavated, allowing increased infiltration of rainwater and surface run-off to the subsurface. This could potentially mobilise any residual contamination already present in overlying strata which could potentially migrate into the underlying shallow superficial aquifers. Excavation within areas previously identified as sources of potential contaminants of concern during the PRA, e.g. the former Anglesey Aluminium Works, are considered to be higher risk activities as the potential to disturb residual contamination is greater than in the large section of the proposed onshore development which crosses agricultural land where areas of significant contamination are not anticipated.

87. It is also anticipated that potentially polluting substances and activities could be introduced during the construction works.

88. The secondary aquifers which form part of the superficial deposits are considered to be of **low** sensitivity. Any potentially polluting incidents that occur during the construction phase are predicated to be of local spatial extent within each aquifer unit, of short-term duration (related to the working areas only), of intermittent occurrence and high reversibility. The magnitude of effect

is therefore considered to be **low**. The potential impact to the superficial secondary aquifers is deemed to be **minor adverse**.

18.6.4.2.1. Mitigation

89. As detailed in **Section 18.6.2**, mitigation measures through design include the avoidance of construction activities in areas of historical development (where possible), including all historic pits and area of infilled land that has previously been identified. In addition to these measures, cable installation activities will be designed to ensure that they will not impact groundwater in any significant manner through shallow excavations (approximately 1.7 m deep).

90. Where it is not possible to avoid areas of previous development, e.g. the grid connection point, the accidental release of contaminants will be mitigated through adherence to a CoCP (**Document MOR/RHDHV/DOC/0076, Outline Code of Construction Practice**), CEMP and PPMP, including Incident/Emergency Response Plans.

91. Should any unanticipated contamination be encountered during the work, work should be halted in the area of contamination and a written statement on how contamination will be dealt with should be agreed with the local authority.

18.6.4.2.2. Residual Impact

92. Following the implementation of these mitigation measures, the magnitude of effect is deemed to be **negligible**, the potential for earthworks activities to impact groundwater within the superficial deposits is considered to be of **negligible** significance which is not significant in EIA terms.

18.6.4.3. **Construction Impact 3: Impacts on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from HDD**

93. Direct impacts to the Secondary B Aquifers (and by extension private water supplies, if present) may occur from deep ground workings related to HDD operations for cable installation beneath surface infrastructure and watercourses. There is potential for drilling mud to leak along the drill path, or from the immediate area, which could cause contamination of groundwater. The volume of drilling fluid that could be released is dependent on a number of factors, including the size of the fracture, the permeability of the geological material, the viscosity of the drilling fluid, and the pressure of the hydraulic drilling system.

94. Due to the Project not being located within a SPZ and the absence of groundwater abstraction points, the sensitivity of the Secondary B Aquifers associated with the underlying bedrock is considered to be **negligible**.

95. The impacts of construction activities are predicted to be of local spatial extent (occurring only at trenchless crossing locations) and of intermittent occurrence. The magnitude of effect is therefore considered to be **negligible**.

96. The potential impact to the Secondary B Aquifers is deemed to be **negligible** significance.

18.6.4.3.1. Mitigation

97. Although the potential impact to the Secondary B Aquifers is deemed to be of **negligible** significance, where it is not possible to avoid areas of previous development, e.g. the grid connection point, best practice will be followed during constructions works, by adherence to the CoCP (**Document MOR/RHDHV/DOC/0076, Outline Code of Construction Practice**), a CEMP and a PPMP including an Incident/Emergency Response Plan. Adherence to these measures will reduce the potential impacts to the deeper groundwater should accidental release of contamination occur.

98. Should any unanticipated contamination be encountered during the work, work should be halted and a written statement on how contamination will be dealt with should be agreed with the local authority.

18.6.4.3.2. Residual Impact

99. The potential impact to the Secondary B Aquifers remains as **negligible** significance which is not significant in EIA terms.

18.6.4.4. Construction Impact 4: Impact on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from Piling

100. Direct impacts to the Secondary B Aquifers of the South Stack Formation and New Harbour Group (and by extension private water supplies, if present) may occur as a result of piling. Piling may be required to provide foundations for the landfall substation, switchgear building and grid connection substation. Piling has the potential to create preferential pathways through Till deposits allowing potential contamination of the underlying Secondary B Aquifers.

101. The PRA (**Appendix 18.1, Volume III**) shows that a large section of the onshore development area crosses agricultural land where areas of contamination are not anticipated. Piling activities, if required, are not anticipated to be undertaken within areas identified within the PRA as potential sources of contamination.

102. Due to the Project not being located within a SPZ and the absence of groundwater abstraction points both within the onshore development area and within 1 km, the sensitivity of the Secondary B Aquifers is considered to be **negligible**.

103. The impacts of construction activities are predicted to be of local spatial extent (occurring only at piling locations) and of intermittent occurrence. The magnitude of effect is therefore considered to be **negligible**.

104. The potential impact to the Secondary B Aquifers from piling activities is deemed to be of **negligible** significance.

18.6.4.4.1. Mitigation

105. Although the potential impact to the Secondary B Aquifers is deemed to be of **negligible** significance, where it is not possible to avoid areas of previous development, e.g. the grid connection point, best practice will be followed during constructions works, by adherence to the

CoCP (**Document MOR/RHDHV/DOC/0076, Outline Code of Construction Practice**), a CEMP and a PPMP including an Incident/Emergency Response Plan. Adherence to these measures will reduce the potential impacts to the deeper groundwater should accidental release of contamination occur.

106. If piling is required in areas previously identified as potential sources of contamination, additional mitigation measures may be required prior to piling activities commencing, this may include a ground investigation to identify areas of concern and/or remediation.

107. Should any unanticipated contamination be encountered during the work, work should be halted and a written statement on how contamination will be dealt with should be agreed with the local authority.

18.6.4.4.2. Residual Impact

108. The potential impact to the Secondary B Aquifers from piling activities is deemed to be of **negligible** significance which is not significant in EIA terms.

18.6.4.5. Construction Impact 5: Impact on Surface Waters from Contamination of Groundwaters and Subsequent Discharge

109. As discussed previously there is the potential for groundwater to become contaminated during the earthworks associated with construction. A large section of the onshore development area crosses agricultural land where areas of significant contamination are not anticipated. Within areas previously identified as potential sources of contamination, e.g. the former Anglesey Aluminium works, earthworks associated with construction have the potential to disturb pre-existing contamination.

110. Contamination within the groundwater could migrate laterally and potentially discharge into surface waters both within the onshore development area and the surrounding areas where there is a hydraulic connection. However, the presence of Alluvium, particularly in high risk areas, may significantly delay the potential migration of contaminants encountered or disturbed during excavations associated with the Project within the shallow groundwater. Piling has the potential to introduce new preferential pathways for contamination into the deeper Secondary B Aquifers of the bedrock.

111. It is considered that surface waters represent a **low** sensitivity receptor, this designation has been given due to the nature of surface water features both within and in close proximity to the project boundary and the lack of surface water abstraction points.

112. The effect is predicted to be of local spatial extent, of intermittent occurrence and high reversibility. The magnitude of effect is therefore, considered to be **low**.

113. The potential impact to surface waters is deemed to be **minor adverse**.

18.6.4.5.1. Mitigation

114. As detailed in **Section 18.6.2**, mitigation measures through design include the avoidance of construction activities in areas of historical development (where possible), including all historic

pits and area of infilled land that has previously been identified. Where it is not possible to avoid areas of previous development, e.g. the grid connection point, the accidental release of contaminants will be mitigated through adherence to a CoCP (**Document MOR/RHDHV/DOC/0076, Outline Code of Construction Practice**), CEMP and PPMP, including Incident/Emergency Response Plans. Adherence to these measures will reduce the potential impacts to the deeper groundwater should accidental release of contamination occur.

Should any unanticipated contamination be encountered during the work, work should be halted and a written statement on how contamination will be dealt with should be agreed with the local authority. **Figure 18-1** (**Volume II**) illustrates the known areas of contamination within the vicinity of the grid connection substation.

18.6.4.5.2. Residual Impact

115. It is anticipated that after adopting the outline mitigation measures, specifically the adherence to the Environment Agency pollution prevention guidance, the magnitude of effect is considered to be **negligible** and the potential impact would be **negligible** which is not significant in EIA terms.

18.6.4.6. Construction Impact 6: Impacts to Human Health

116. The excavation of the cable trench, earthworks and piling (if required) for the landfall substation, switchgear building and grid connection substation, movement and stockpiling of soils have the potential to mobilise existing ground contamination (where present), which could result in impacts on human health through dermal contact, inhalation and ingestion.

117. The PRA (**Appendix 18.1, Volume III**) showed that a large section of the onshore development area crosses agricultural land where areas of significant contamination are not anticipated. However, there are parts of the onshore development area that crosses potentially contaminated land including a railway and aluminium works.

118. Potential Contaminants of Concern (PCOC) could be present in the proposed onshore development area and represent a risk to construction workers, the public, and future site end-users if exposed during construction activities. Construction activities, particularly earthworks associated with the proposed Project could disturb and expose construction workers to localised made ground soils and potential soil and / or groundwater contamination associated with historical and current land uses within the study area. Construction activities could create pollutant linkages through ingestion, inhalation and direct dermal contact pathways.

119. In the event of exposing soils and stockpiling construction waste (including excavated materials), dust could be generated during dry and windy conditions. Under these conditions, construction workers and the general public, such as users of neighbouring sites and surrounding residents, could temporarily be exposed to contamination via the inhalation of potentially contaminated dusts.

120. The sensitivity of human health as a receptor (construction workers, site operatives and the general public (off-site)), is considered to be **high**.

121. The impacts are predicted to be of local spatial extent (localised to the work areas), of short-term duration, of intermittent occurrence and high reversibility (only occurring during the works).

122. The magnitude of effect is therefore considered to be **low**. The impact would therefore be considered to be **moderate adverse**.

18.6.4.6.1. Mitigation

123. Mitigation will consist of a Site and Excavated Waste Management Plan (SWMP), to ensure that any waste arising is closely monitored, and that waste prevention, re-use or recycling opportunities are maximised. The appropriate waste management route is confirmed following a waste hierarchy assessment. An outline waste assessment report is provided in **Appendix 18.2** (**Volume III**).

124. A written scheme (based on the Model Procedures for the Management of Land Contamination, CLR11) for the management of contamination of any land and groundwater would be submitted and approved by the local authority. The document will also provide procedures to follow in the event of encountering unexpected contamination and will include proposals to deal with any waste soils excavated during the works.

18.6.4.6.2. Residual Impact

125. Following the implementation of mitigation, the magnitude of effect is **negligible**, the residual impact is predicted to be **negligible** which is not significant in EIA terms.

126. Further discussion of human health can be found in **Chapter 25, Socio-economics, Tourism and Recreation**.

18.6.4.7. Construction Impact 7: Impacts on Controlled Waters as a Result of Construction Activities

127. There is a possibility that the hydraulic regime of the local area will be affected by the Project. Backfilling the cable trench with less compacted soil could potentially influence the groundwater regime by altering porosity and creating preferential groundwater flow paths.

128. Shallow groundwater within superficial deposits is considered to be of **low** sensitivity. The impacts are predicted to be of local spatial extent (localised to the work areas), of short-term duration, of intermittent occurrence and high reversibility (occurring only during the works). The magnitude of effect is therefore considered to be **low**.

129. Due to the **low** sensitivity of the receptor and the **low** magnitude of effect, the overall impact during the construction works is therefore considered to be of **minor adverse** significance.

18.6.4.7.1. Mitigation

130. Mitigation measures may be required in areas previously identified as potential sources, this may include a ground investigation to identify areas of concern, backfilling with a low permeability material in these areas and/or remediation.

18.6.4.7.2. Residual Impact

131. Following the implementation of mitigation, the magnitude of effect is considered to be **negligible**, the residual impact is predicted to be **negligible** which is not significant in EIA terms.

18.6.5. Potential Impacts During Operation

132. There are unlikely to be any significant additional impacts from the operation of the Project. Routine Operation and Maintenance (O&M) activities will follow standard procedures therefore minimising any potential impacts. Non-routine maintenance will be subject to robust and effective planning and risk assessment procedures.

18.6.6. Potential Impacts During Decommissioning

133. This section describes the potential impacts of the decommissioning of the onshore infrastructure with regards to impacts on ground conditions. Further details are provided in **Chapter 4, Project Description**.

134. In relation to the onshore cable, the programme for decommissioning is expected to include onshore cables remaining in situ where either buried beneath a road or verge. Where the cable has been laid on the surface, it will be removed. If any portion of the cable is to remain in situ, the ends will be terminated.

135. In relation to the landfall substation, switchgear building and grid connection substation, the programme for decommissioning is expected to be similar in duration to the construction phase. The detailed activities and methodology would be determined later within the project lifetime, but are expected to include:

- Dismantling and removal of outside electrical equipment from site located outside of the landfall substation, switchgear building and grid connection substation;
- Removal of cabling from site;
- Dismantling and removal of electrical equipment from within the onshore project substation/switchgear buildings;
- Removal of landfall substation, switchgear building, grid connection substation and minor services equipment;
- Demolition of the support buildings and removal of fencing;
- Landscaping and reinstatement of the site (including land drainage); and
- Removal of areas of hardstanding.

136. Whilst details regarding the decommissioning of the landfall substation, switchgear building and grid connection substation are currently unknown, considering the worst-case scenario which would be the removal and reinstatement of the current land use at the site, it is anticipated that the impacts would be similar or less than to those during construction.

137. The decommissioning methodology would need to be finalised nearer to the end of the lifetime of the Project to be in line with current guidance, policy and legislation at that point. Any such

methodology would be agreed with the relevant authorities and statutory consultees. The decommissioning works could be subject to a separate licencing and consenting approach.

18.6.7. Cumulative Impacts

138. This section describes the CIA for ground conditions and contamination, taking into consideration other plans, projects and activities. The assessment of cumulative impact has been undertaken as a two-stage process, with the first stage comprising an assessment of all the impacts from the previous sections for the potential to act cumulatively with other projects. This summary assessment is set out in **Table 18-13**.

Table 18-13 Potential cumulative impacts

Impact		**Potential for Cumulative Impact**	**Rationale**
Construction			
1	Impacts to coastline, including designated areas of outstanding beauty.	Yes	Impacts to interest features of designated sites may be exacerbated by other projects.
2	Contamination of secondary aquifers as a result of construction activities.	Yes	Impacts to secondary aquifers may be exacerbated by other projects.
3	Impacts on groundwater quality in secondary aquifers resulting from trenchless crossing technique (e.g. HDD) conduit construction and piling.	Yes	Impacts to secondary aquifers may be exacerbated by other projects.
4	Impacts on the quality and quantity of surface waters fed by groundwater during construction.	Yes	Impacts to surface waters may be exacerbated by other projects.
5	Impacts to human health, including construction workers and public during any excavations associated with construction.	No	The impacts will be confined to the work area.
6	Impacts on shallow groundwater due to changes to the hydraulic regime as a result of the construction works.	Yes	Impacts to groundwater may be exacerbated by other projects.
Operation			
As discussed previously, there are unlikely to be any significant cumulative impacts from the operation of the Project.			
Decommissioning			
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage.			

139. The second stage of the CIA is an assessment of whether there is a spatial or temporal overlap between the extent of potential effects of the onshore infrastructure and the potential effects of other projects scoped into the CIA upon the same receptors. To identify whether this may occur, the potential nature and extent of effects arising from all projects scoped into the CIA has been identified in **Table 18-14**. Where there is an overlap, an assessment of the cumulative magnitude of effect is provided.

Table 18-14 Project screening for CIA for Ground Conditions and Contaminated Land

Project	Online Reference	Current Status	Description	Distance (km)	Discussion	Potential for Cumulative Impact
Extensions to dwelling	FPL/2019/23	Consented 13/03/19, construction status unknown	Full application for the subdivision of existing dwelling into two dwellings together with alterations and extensions at Cefn Coch, Trearddur Bay. EIA not required	0	Due to the nature and scale of the project no cumulative effects on onshore ground conditions and contamination are considered likely.	No
Holyhead Premier Inn	MAO/2019/1	Operational	Minor amendments to scheme previously approved under planning permission 19C842E/1/TR/ECON so as to amend the plans of the approved scheme	0	No cumulative effects for onshore geology and ground conditions as project already operational.	No
Parc Cybi	FBL/2018/25	Application validated, awaiting decision	Erection of a building to be used as a builder's merchant with warehouse and sales floor areas (general use), construction of a new vehicular site access, storage yard, loading areas together with soft and hard landscaping areas at Parc Cybi	0	Overlapping proposed project boundaries may result in impacts of a direct and/or indirect nature on geology, controlled waters, human health and ground conditions.	Yes
Roadking Parc Cybi	19C842M/1/ECON	Consented, construction status unknown	Application to discharge conditions relating to planning permission 19C842M/1/ECON on land adjacent to Roadking, Parc Cybi, Holyhead.	0	Overlapping proposed project boundaries may result in impacts of a direct and/or indirect nature on geology ground conditions, however, due to incorporation of a CEMP and the nature of the development, there will be no cumulative impacts on geology and ground conditions.	No

Project	Online Reference	Current Status	Description	Distance (km)	Discussion	Potential for Cumulative Impact
Change of use to residential property	FPL/2018/58	Consented, construction status unknown	Full application for the change of use part of the existing garage into a self-contained annexe at Maes y Geiniog, Penrhos Feilw, Caergybi / Holyhead.	0.25	Due to the nature and scale of the development no cumulative effects on onshore ground conditions and contamination are considered likely.	No
Penrhos Coastal Park	RM/2018/6	Consented, construction status unknown	Reserved matters application including details of the appearance, landscaping, layout and scale for raised boardwalk footways within woodlands to provide locations for artworks, pond edge access and viewing decks, outdoor learning area, bird and squirrel feeding locations, bird watching hides, picnic area enhancement, interpretation and directional signage, cycle parking, vehicle access turning and parking, waste storage and collection bins on part of the publicly accessible area approved under outline planning permission 46C427K/TR/EIA/ECON at the Penrhos Coastal Park, Holyhead at Land and Lakes Penrhos Coastal Park Holyhead.	0.35	Due to the nature of the development no cumulative effects on onshore ground conditions and contamination are considered likely.	No
Amendments to construction at industrial unit	MAO/2018/1	Consented, construction status unknown	Minor amendments to scheme previously approved under planning permission 19C689P/1/VAR so as to amend the materials at Uned/Units 6 / 8, Parc Ddiwyddianol Penrhos Industrial Estate, Caergybi / Holyhead.	0.4	Due to proximity of the development to the Project there is the potential for cumulative impacts of a direct and/or indirect nature on geology, controlled waters and ground conditions.	Yes
Conversion of outbuilding	FPL/2018/55	Consented, construction status unknown	Full application for the conversion of outbuilding into a holiday accommodation together with the installation of a package treatment plant at Penrhyn Owen	0.4	Due to proximity of the development to the Project there is the potential for cumulative impacts of a direct and/or indirect nature	Yes

Project	Online Reference	Current Status	Description	Distance (km)	Discussion	Potential for Cumulative Impact
					on geology, controlled waters and ground conditions.	
Penrhos Industrial Estate	FPL/2019/55	Application validated: 06/03/2019	Full application for the erection of an industrial unit on land at Block D Stad Ddiwydiannol Penrhos Industrial Estate, Caergybi/Holyhead	0.5	Due to proximity of the development to the Project there is the potential for cumulative effects of a direct and/or indirect nature on geology, controlled waters and ground conditions.	Yes
Amendments to construction at industrial unit	19C779N/VAR	Consented, construction status unknown	Application under Section 73 for the variation of conditions (02) (non-food retail) and (12) (as approved drawings) of planning permission reference 19C779A and condition (01) (non-food retail) of planning application 19C779J (Erection of a A1 class retail) so as to allow the sale and display of convenience and comparison goods together with the formation of one unit in lieu of two units at Uned 1 ag Uned 2 / Unit 1 and Unit 2, Parc Busnes Penrhos Business Park, Caergybi / Holyhead.	0.6	Due to proximity of the development to the Project there is the potential for cumulative effects of a direct and/or indirect nature on geology, controlled waters and ground conditions.	Yes

18.6.7.1. Cumulative Impacts during Construction

140. A number of projects have been identified that could result in cumulative impacts; however, it is assumed that they will be constructed with relevant mitigation measures embedded within their design. These measures should prevent significant adverse impacts on ground conditions or contamination occurring as a result, therefore it is considered that there is no pathway for cumulative impacts.

18.6.7.2. Cumulative Impacts during Operation

141. There are unlikely to be any pathway cumulative impacts from the operation of the Project. Routine O&M activities will follow standard procedures therefore minimising any potential impacts.

18.6.7.3. Cumulative Impacts during Decommissioning

142. No decision has been made regarding the final decommissioning policy for the onshore infrastructure as it is recognised that industry best practice, rules and legislation change over time. However, the landfall substation, switchgear building, and grid connection substation will likely be removed and reused or recycled. It is expected that the onshore cables will be removed and recycled, with the transition bays and cable ducts (where used) left in-situ. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, impacts no greater than those identified for the construction phase are expected for the decommissioning phase.

18.6.8. Inter-relationships

143. **Table 18-15** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 18-15 Inter-topic relationships

Topic and description	Related chapter	Where addressed in this chapter	Rationale
Impacts to coastline, including designated geological sites.	Chapter 7, Metocean and Coastal Processes	Section 18.6.4 – 18.6.6	The Project could indirectly impact designated geological sites by affecting erosion and deposition processes.
Impacts to coastline, including designated geological sites.	Chapter 8, Marine Water and Sediment Quality	Section 18.6.4 – 18.6.6	The Project could indirectly impact designated geological sites by affecting erosion and deposition processes.

Topic and description	Related chapter	Where addressed in this chapter	Rationale
Impacts on quality and quantity of surface waters fed by groundwater during construction.	Chapter 17, Water Resources and Flood Risk	Section 18.6.4 – 18.6.6	Any Project-related impacts on the quality and quantity of surface waters could impact upon the hydraulically connected groundwaters.

18.6.8.1. Interactions

144. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst-case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 18-16**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 18-16 Potential interactions between impacts

Potential interaction between impacts							
Construction	**Impacts on Designated Geological Sites**	**Impacts on Groundwater Quality in the Superficial Secondary Aquifers During Earthwork Activities**	**Impacts on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from HDD**	**Impact on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from Piling**	**Impact on Surface Waters from Contamination of Groundwaters and Subsequent Discharge**	**Impacts to Human Health**	**Impacts on Controlled Waters as a Result of Construction Activities**
Impacts on Designated Geological Sites	-	No	No	No	No	No	No
Impacts on Groundwater Quality in the Superficial Secondary Aquifers During Earthwork Activities	No	-	Yes	Yes	Yes	No	Yes
Impacts on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from HDD	No	Yes	-	Yes	Yes	No	Yes

Potential interaction between impacts							
Construction	**Impacts on Designated Geological Sites**	**Impacts on Groundwater Quality in the Superficial Secondary Aquifers During Earthwork Activities**	**Impacts on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from HDD**	**Impact on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from Piling**	**Impact on Surface Waters from Contamination of Groundwaters and Subsequent Discharge**	**Impacts to Human Health**	**Impacts on Controlled Waters as a Result of Construction Activities**
Impact on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from Piling	No	Yes	Yes	-	Yes	No	Yes
Impact on Surface Waters from Contamination of Groundwaters and Subsequent Discharge	No	Yes	Yes	Yes	-	No	Yes
Impacts to Human Health	No	No	No	No	No	-	No
Impacts on Controlled Waters as a Result of Construction Activities	No	Yes	Yes	Yes	Yes	No	-
Operation							

Potential interaction between impacts							
Construction	**Impacts on Designated Geological Sites**	**Impacts on Groundwater Quality in the Superficial Secondary Aquifers During Earthwork Activities**	**Impacts on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from HDD**	**Impact on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from Piling**	**Impact on Surface Waters from Contamination of Groundwaters and Subsequent Discharge**	**Impacts to Human Health**	**Impacts on Controlled Waters as a Result of Construction Activities**
There are unlikely to be inter-topic effects from the operation of the Project. Routine Operation and Maintenance (O&M) activities will follow standard procedures therefore minimising any potential impacts. Non-routine maintenance will be subject to robust and effective planning and risk assessment procedures.							
Decommissioning							
It is anticipated that the decommissioning impacts will be similar in nature to those of construction.							

18.7. SUMMARY

145. The proposed development is located within an area which has a number of sensitive land uses including AONB, Environmentally Sensitive Areas, SSSI, SPA and SACs. In addition to these sensitive land uses, the whole of the Island of Anglesey is a designated UNESCO Geopark.

146. A summary of the findings of the ES for ground conditions and contamination is presented in **Table 18-17**. In accordance with the assessment methodology, this table should only be used in conjunction with the additional narrative explanations provided in **Section 18.4.4**. This demonstrates that provided mitigation measures (both embedded and additional) are in place to prevent impacts on receptors the project is anticipated to be **negligible** in relation to ground conditions and contamination.

Table 18-17 Potential Impacts Identified for Ground Conditions and Contamination

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction						
Impact 1: Impacts on designated geological sites	Geology	High	Low	Minor Adverse	N/A	N/A
Impact 2: Impacts on Groundwater Quality in the Superficial Secondary Aquifers During Earthwork Activities	Secondary A and Undifferentiated Aquifers	Low	Low	Negligible	N/A	N/A
Impact 3: Impacts on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from HDD	Secondary B Aquifers	Negligible	Negligible	Negligible	N/A	N/A
Impact 4: Impact on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from Piling	Secondary B Aquifers	Negligible	Negligible	Negligible	N/A	N/A
Impact 5: Impact on Surface Waters from Contamination of Groundwaters and Subsequent Discharge	Surface Waters	Low	Low	Minor	Adherence to the Environment Agency pollution prevention guidance.	Negligible
Impact 6: Impacts to Human Health	Humans	High	Low	Moderate Adverse	Appropriate personal protective equipment (PPE) and working practices to be adopted by construction workers, including subcontractors, and health and safety measures would be undertaken to mitigate any	Negligible

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
					short-term risk during construction.	
Impact 7: Impacts on Controlled Waters as a Result of Construction Activities	Controlled waters	Low	Low	Minor Adverse	Use of lower permeability material to backfill trenches in areas identified as being/in close proximity to potential sources.	Negligible

18.8. REFERENCES

British Geological Survey (undated). Geoindex online viewer [Online] Available: https://www.bgs.ac.uk/geoindex/ [Accessed March 2019].

British Standards Institute (2015). British Standard BS5930:2015 The Code of Practice for Site Investigations.

British Standards Institute (2017). British Standard BS10175:2011 + A2:2017 Investigation of Potentially Contaminated Sites.

CIRIA (2000). Publication C503: Environmental Good Practices – Working on Site.

CIRIA (2000). Publication C502: Environmental Good Practices on Site.

CIRIA (2001). Publication C532: Control of Water Pollution from Construction Sites.

CIRIA (2005). Publication C650: Environmental Good Practice on Site.

CIRIA (2015). Publication C665: Assessing Risks Posed by Hazardous Ground Gases to Buildings.

Coal Authority (undated). Interactive Map Viewer [Online] Available: http://mapapps2.bgs.ac.uk/coalauthority/home.html [Accessed March 2019].

Department of Energy and Climate Change (2011). Overarching National Policy Statement for Energy (EN-1).

Department for Environmental Food and Rural Affairs (2009). Construction Code of Practice for the Sustainable Use of Soils on Construction Sites.

Department for Environmental Food and Rural Affairs (2012). Environmental Protection Act 1990: Part 2A – Contaminated Land Statutory Guidance.

Environment Agency (2004). Model Procedures for the Management of Land Contamination (Contaminated Land Report 11).

Environment Agency and Department for Environmental Food and Rural Affairs (2016). Pollution Prevention for Businesses.

Health and Safety Executive (2015). Construction Design and Management (CDM) Regulations.

Ministry of Housing, Communities and Local Government (2019). National Planning Policy Framework.

Public Health England (undated). UK Maps of Radon [Online] Available: https://www.ukradon.org/information/ukmaps [Accessed March 2019].

Royal HaskoningDHV (2019). Morlais Tidal Energy Project, Preliminary Risk Assessment.

UK Parliament (2003). Water Resources Act 1991: Amended by the Water Act 2003.

UK Parliament (2009). Environmental Damage (Prevention and Remediation) Regulations (SI 153).

UK Parliament (2010). Environmental Permitting Regulations (SI 3538).

UK Parliament (2016). Environment (Wales) Act 2016.

UK Parliament (2017). The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

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Morlais Project
Environmental Statement

Chapter 19: Onshore Ecology

Volume I

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-019

Chapter 19: Onshore Ecology

Author: Royal HaskoningDHV

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GLOSSARY OF ABBREVIATIONS

AWS	Ancient Woodland Site
BAP	Biodiversity Action Plan
BCT	Bat Conservation Trust
CIA	Cumulative Impact Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CIRIA	Construction Industry Research and Information Association
CoCP	Code of Construction Practice
Cofnod	North Wales Environmental Information Service
CRoW	Countryside and Rights of Way Act 2000
Db	Decibel
DECC	Department for Environment and Climate Change
DMP	Dust Management Plan
EAP	Ecological Action Plan
EcIA	Ecological Impact Assessment
ECoW	Ecological Clerk of Works
eDNA	Environmental Deoxyribonucleic Acid
EAP	Ecological Action Plan
EcIA	Ecological Impact Assessment
ECoW	Ecological Clerk of Works
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EP1HS	Extended Phase 1 Habitat Survey
EPS	European Protected Species
ES	Environmental Statement
GCN	Great Crested Newt
GPP	Guidance for Pollution Prevention
Ha	Hectare
HDD	Horizontal Directional Drilling
HGV	Heavy Goods Vehicle
HRA	Habitats Regulation Assessment
HSI	Habitat Suitability Index
IAQM	Institute of Air Quality Management
ILE	Institution of Lighting Engineers
IoACC	Isle of Anglesey County Council
IPC	Infrastructure Planning Commission
IROPI	Imperative Reason of Overriding Public Interest
JLDP	Joint Local Development Plan
JNCC	Joint Nature Conservation Committee
KM	Kilometre
LBAP	Local Biodiversity Action Plan

LDP	Local Development Plan
LNR	Local Nature Reserves
LWS	Local Wildlife Site
M	metre
Mm	millimetre
MMO	Marine Management Organisation
MW	Mega Watt
NERC	Natural Environment and Rural Communities
NPS	National Policy Statements
NRW	Natural Resources Wales
OMH	Open Mosaic Habitat
PPG	Pollution Prevention Guidelines
PPS	Planning Policy Statements
PPW	Planning Policy Wales
PRoW	Public Rights of Way
pSPA	Potential Special Protection Areas
RIGS	Regionally Important Geological / Geomorphologic Site
RSPB	Royal Society of Protection of Birds
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TAN	Technical Advice Note
UK	United Kingdom
UKBAP	United Kingdom Biodiversity Action Plan
WADZ	West Anglesey Demonstration Zone
WCA	Wildlife and Countryside Act 1981
WS	Wildlife Site

GLOSSARY OF TERMINOLOGY

Cloddiau	Vegetated stone wall
Desk Study Area	The Onshore Development Area plus a 1 km buffer
GCN Study Area	The Onshore Development Area plus a 250 m buffer
Onshore Study Area	The Onshore Development Area plus a 50 m buffer
Sett	Resting place (den) for badgers
Survey Study Area	A much wider area than the Onshore Development Area which was originally surveyed in the early phase of project development. This encompasses the GCN and Onshore Study Areas and additional surrounding land (See **Appendix 19.1, Volume III** for details).

19. ONSHORE ECOLOGY

19.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) considers the potential impacts of the proposed Morlais Project (the Project) on onshore ecology. Potential impacts on terrestrial birds are considered within this chapter; however, marine and coastal birds are discussed in full in **Chapter 11, Offshore Ornithology**.

2. This chapter provides an overview of the existing baseline environment with respect to onshore ecology within a study area (see **Section 19.4.1**) around the Project's onshore infrastructure (**Figure 19.1, Volume II**). This chapter provides the findings from an Ecological Impact Assessment (EcIA) that has been undertaken of the potential impacts of construction, operation and decommissioning of the Project based on this baseline environment. This EcIA also considers transboundary impacts, and cumulative impacts of existing and proposed projects in respect of onshore ecology.

3. It should be noted that the Project also has the potential to impact on marine and coastal ecology including ornithology and marine mammals. The impacts associated with these receptors are covered in **Chapter 9, Benthic and Intertidal Ecology**, **Chapter 10, Fish and Shellfish Ecology**, **Chapter 11, Offshore Ornithology** and **Chapter 12, Marine Mammals**.

4. This chapter has been prepared by Royal HaskoningDHV, using information obtained from a suite of ecological field surveys that have been undertaken by BSG Ecology. The assessment follows guidance published by the Chartered Institute of Ecology and Environmental Management (CIEEM, 2018).

19.2. POLICY, LEGISLATION AND GUIDANCE

19.2.1. Legislation

5. There are a number of pieces of legislation applicable to onshore ecology. Further detail on legislation and policy in relation to the wider Project is provided in **Chapter 2, Policy and Legislation**. The following key pieces of International and UK legislation are relevant to this chapter (and are detailed within **Chapter 2, Policy and Legislation**):

- Habitats Directive - Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora;
- Birds Directive - Council Directive 2009/147/EC on the Conservation of Wild Birds;
- Wildlife and Countryside Act 1981 (as amended);
- The Conservation of Habitats and Species Regulations 2017;
- Natural Environment and Rural Communities (NERC) Act 2006;
- The Environment (Wales) Act 2016;
- The Commons Act 2006; and
- Countryside and Rights of Way Act 2000 (CRoW).

6. **Table 19-1** sets out national and regional policies relevant to onshore ecology.

Table 19-1 National and Regional Policy Requirements Relevant to Onshore Ecology

Policy Description	Reference	ES Reference
Planning Policy Wales		
The Environment (Wales) Act 2016 introduced an enhanced biodiversity and resilience of ecosystems duty (Section 6 Duty). This duty applies to public authorities in the exercise of their functions in relation to Wales and will help maximise contributions to achieving the well-being goals. The Nature Recovery Action Plan supports this legislative requirement to reverse the decline in biodiversity, address the underlying causes of biodiversity loss by putting nature at the heart of decision-making and increasing the resilience of ecosystems by taking specific action focused around the 6 objectives for habitats and species.	6.4.2	**Chapter 3, Site Selection and Consideration of Alternatives** discusses how the Project has avoided sensitive ecological features where possible. Opportunities for habitat enhancement is discussed in **Section 19.6.5**
A proactive approach towards facilitating the delivery of biodiversity and resilience outcomes should be taken by all those participating in the planning process. In particular, planning authorities must demonstrate that they have sought to fulfil the duties and requirements of Section 6 of the Environment Act by taking all reasonable steps to maintain and enhance biodiversity in the exercise of their functions.	6.4.8	As above
The presence of a species protected under European or UK legislation, or under Section 7 of the Environment (Wales) Act 2016 is a material consideration when a planning authority is considering a development proposal which, if carried out, would be likely to result in disturbance or harm to the species or its habitat and to ensure that the range and population of the species is sustained. Planning authorities should advise anyone submitting a planning application that they must conform with any statutory species protection provisions affecting the site, and potentially the surrounding area, concerned. An ecological survey to confirm whether a protected species is present and an assessment of the likely impact of the development on a protected species may be required in order to inform the development management process. It is considered best practice that screening to determine the presence of protected species should be carried out by a competent ecologist on the basis of data provided by the relevant Local Environmental Record Centre.	6.4.22	Impacts to European designated sites are considered within the **Information to Support HRA (Document MOR/RHDHV/DOC/0067)** and **Chapter 11, Offshore Ornithology**. Impacts to SSSIs are considered within **Section 19.6.5** of this chapter. Habitats and species of principal importance are discussed in **Sections 19.5 and 19.6**
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
1. All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced; 3. That the proposal is mitigated to ensure that there aren't any significant unacceptable effects on sensitive uses located nearby;	Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	The impact assessment for construction, operation and decommissioning of the Project, including proposed mitigation measures can be found in **Section 19.6**.

Policy Description	Reference	ES Reference
The Councils will manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline, and proposals that have a significant adverse effect on them will be refused unless the need for and benefits of the development in that location clearly outweighs the value of the site or area and national policy protection for that site and area in question.	Strategic Policy PS 19: Conserving and Where Appropriate Enhancing the Natural Environment	As above.
In considering a proposal on the coast, including the Heritage Coast, there will be a need to ensure that the proposal conforms to certain criteria	Policy AMG 4: Coastal Protection	Impacts to the Heritage Coast are considered in **Chapter 20, Onshore Archaeology** and **Chapter 24, SLVIA**.
Proposals must protect and, where appropriate, enhance biodiversity that has been identified as being important to the local area	Policy AMG 5: LOCAL Biodiversity Conservation	Compensation or enhancement of habitat is proposed where work is carried out within a site of European importance (**Section 19.6.5.1**)
Proposals that are likely to cause direct or indirect significant harm to Local Nature Reserves (LNR), Wildlife Sites (WS) 1 or regionally important geological / geomorphologic sites (RIGS) must have overriding economic and social benefit and not cause unacceptable harm	Policy AMG 6: Protecting Sites of Regional or Local Significance	An assessment of potential impacts to locally designated sites is included in **Section 19.6.5**. Impacts to geological sites are assessed in **Chapter 18, Ground Conditions and Contamination**.

7. In addition, the following policy, legislation and guidance is also relevant to onshore ecology.

19.2.1.1. The Protection of Badgers Act 1992

8. The Protection of Badgers Act 1992 makes it an offence to wilfully kill, injure or take, or attempt to kill, injure or take a badger *Meles meles*; and to cruelly ill-treat a badger.

9. The Act also makes it an offence to intentionally or recklessly damage, destroy or obstruct a badger sett, or to disturb a badger whilst in a sett.

19.2.1.2. The Hedgerow Regulations 1997

10. The Regulations make it an offence to remove or destroy certain hedgerows without permission from the local planning authority and the local planning authority is the enforcement body for such offences.

19.2.2. Guidance

11. The impact assessment has been based upon the following guidance and standards:

- Chartered Institute of Ecology and Environmental Management (CIEEM) (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2018);
- British Standard 42020:2013 – Biodiversity. Code of Practice for planning and development (British Standard, 2013);
- Construction Industry Research and Information Association (CIRIA) C648 (2006) Control of water pollution from linear construction projects (CIRIA, 2006); and
- CIRIA Guidance note C692 Environmental Good Practice on Site Guide (3rd Edition) (CIRIA, 2016).

12. The following species-specific guidance and standards have been used during the assessment process. Natural England guidance is considered in lieu of a Welsh equivalent where appropriate:

- Biggs et al (2014) Analytical and methodological development for improved surveillance of the Great Crested Newt. Appendix 5. Technical Advice Note for field and laboratory sampling of great crested newt (Triturus cristatus) environmental DNA;
- Creswell et al (2004) An assessment of the efficiency of capture techniques and the value of different habitats for the great crested newt;
- Maddock (2011) UK Biodiversity Action Plan; Priority Habitat Descriptions;
- Natural England (2014) Otters: surveys and mitigation for development projects. Natural England Standing Advice;
- Natural England (2015a) Badgers: surveys and mitigation for development projects. Natural England Standing Advice;
- Natural England (2015b) Bats: surveys and mitigation for development projects. Natural England Standing Advice;
- Natural England (2015c) Great crested newts: surveys and mitigation for development projects. Natural England Standing Advice;
- Natural England (2015d) Invertebrates: surveys and mitigation for development projects. Natural England Standing Advice;
- Natural England (2015e) Reptiles: surveys and mitigation for development projects. Natural England Standing Advice;
- Natural England (2015f) Water voles: surveys and mitigation for development projects. Natural England Standing Advice;
- Oldham et al (2000) Evaluating the suitability of habitat for the Great Crested Newt (Triturus cristatus); and
- Williams (2013) How to collect a water sample to detect Great Crested Newt eDNA.
- Natural England and Forestry Commission (2018) Ancient woodland and veteran trees: protecting them from development. Natural England and Forestry Commission Standing Advice;

- British Standard 5837: 2012 – Trees in relation to design, demolition and construction (British Standard, 2012);
- Bat Conservation Trust and Institute of artificial Lighting Engineers (2018) Bats and Lighting in the UK;
- Dean et al. (2016) The Water Vole Mitigation Handbook (The Mammal Society Guidance Series);
- Edgar et al. (2010). Reptile Habitat Management Handbook;
- English Nature (2001) Great Crested Newt Mitigation Guidelines;
- Joint Nature Conservation Committee (JNCC) (2003) Herpetofauna Worker's Manual;
- Environment Agency (2006) Managing Japanese knotweed on development sites: the knotweed code of practice;
- Strachan and Moorhouse (2011) Water Vole Conservation Handbook, 3rd Edition; and
- GB Non-native Species Secretariat (2015) Species Information.

19.2.3. Policies and Plans

13. The policies and plans outlined below have also been reviewed for their relevance to onshore ecology.

19.2.3.1. Planning Policy Wales

14. The Welsh Government publishes Planning Policy Wales (PPW), which is amended periodically.

15. The Welsh Government's objectives for conserving and improving the natural environment are as follows:

- "*Promote the conservation of landscape and biodiversity, in particular the conservation of native wildlife and habitats;*
- *Ensure that action in Wales contributes to meeting international responsibilities and obligations for the natural environment;*
- *Ensure that statutorily designated sites are properly protected and managed;*
- *Safeguard protected species; and*
- *Promote the functions and benefits of soils, and in particular their function as a carbon store."*

16. There is a clear requirement within PPW for pre-planning consent consultation with Natural Resources Wales (NRW) where a planning application or proposal may be "*likely to have a significant effect on sites of more than local importance or on a designated area*' or would be '*likely to result in disturbance or harm to a protected species*."

17. PPW requires local planning authorities to "*have regard to the relative significance of international, national and local designations in considering the weight to be attached to nature conservation interests and should take care to avoid placing unnecessary constraints on development*." Statutory designations do not necessarily prohibit development taking place,

however, PPW states that development proposals "*must be carefully assessed for their effect*" on the interests for which the designation is made.

18. Species protected under European or UK legislation are identified as a material consideration when considering a development proposal where protected species are present and if the development would "*be likely to result in disturbance or harm to the species or its habitat*." The potential need for ecological survey and assessment of likely impact of a proposed development on a protected species to inform planning decisions is highlighted in paragraph 5.5.11 of PPW.

19. Trees, woodlands and hedgerows are identified as being of great importance and that local planning authorities should seek their protection where they have natural heritage value. Ancient and semi-natural woodlands are specifically highlighted as "*irreplaceable habitats of high biodiversity value which should be protected from development that would result in significant damage*." Consultation with NRW and/or the Forestry Commission is required if a site is recorded on the inventory of ancient woodland before authorising potentially damaging operations.

19.2.3.2. TAN-5: Nature Conservation and Planning (Wales only)

20. Technical Advice Note (TAN) 5 supplements PPW (**Section 19.2.3.1**) and provides advice about how the land use planning system in Wales "*should contribute to protecting and enhancing biodiversity and geological conservation*."

21. TAN5 has been reviewed to inform the approach to this chapter. The TAN provides guidance to local planning authorities on: "*the key principles of positive planning for nature conservation; nature conservation and Local Development Plans; nature conservation in development management procedures; development affecting protected internationally and nationally designated sites and habitats; and, development affecting protected and priority habitats and species*."

22. The TAN states that when deciding planning applications that may affect nature conservation, "*Local Authorities should:*

- *Contribute to the protection and improvement of the environment…seeking to avoid irreversible harmful effects on the natural environment;*
- *Ensure that appropriate weight is attached to designated sites of international, national and local importance;*
- *Protect wildlife and natural features in the wider environment, with appropriate weight attached to priority habitats and species in Biodiversity Action Plans (BAP);*
- *Ensure that all material considerations are taken into account and decisions are informed by adequate information about the potential effects of a development on nature conservation;*
- *Ensure that the range and population of protected species is sustained;*
- *Adopt a stepwise approach to avoid harm to nature conservation, minimise unavoidable harm by mitigation measures, offset residual harm by compensation measures and look for new opportunities to enhance nature conservation; where there may be significant*

harmful effects local planning authorities will need to be satisfied that any reasonable alternative sites that would result in less or no harm have been fully considered."

19.2.3.3. Renewable Energy Policy Wales

23. This Policy is discussed in **Chapter 2, Policy and Legislation**.

19.2.3.4. Natural Environment White Paper 2011 (as amended)

24. The paper was the first White Paper produced by the government in 20 years. The paper contains plans to reconnect nature, connect people and nature for better quality of life and capture and improve the value of nature.

19.2.3.5. A Green Future: Our 25 Year Plan to Improve the Environment 2018

25. The plan sets out ten goals and a range of high-level policies aimed at helping "*the natural world regain and retain good health*".

26. The key policies within the plan relevant for this chapter are:

- Embedding an environmental net gain principle for development, including housing and infrastructure;
- Focusing on woodland to maximise its many benefits; and
- Protecting and recovering nature (including improving biosecurity to protect and conserve nature).

19.2.3.6. National Policy Statements

27. The assessment of potential impacts upon terrestrial ecology has been made with specific reference to the relevant National Policy Statements (NPS). Those relevant to the project are:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC), 2011a):
- NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2011b); and
- NPS for Electricity Networks Infrastructure (EN-5) (DECC, 2011c).

28. The specific assessment requirements for terrestrial ecology, as detailed in the NPSs, are summarised in **Table 19-2**, together with an indication of the paragraph numbers of where within this ES chapter it has been addressed. Where any part of the NPS has not been followed within the assessment, an explanation as to why the requirement was not deemed relevant, or has been met in another manner, is provided.

Table 19-2 NPS Assessment Requirements

NPS Requirements	NPS Reference	ES Reference
EN-1 Overarching NPS for Energy		
'Where the development is subject to EIA [Environmental Impact Assessment] the applicant should ensure that the ES [Environmental Statement] clearly sets out any effects on	Section 5.3.3	Impacts to designated sites are discussed in

NPS Requirements	NPS Reference	ES Reference
internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the Infrastructure Planning Commission (IPC) consider thoroughly the potential effects of a proposed project.'		Impacts 1 and 2, **Section 19.6.5**
'The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests.'	Section 5.3.4	**Chapter 3, Site Selection and Consideration of Alternatives** discusses how the Project has avoided sensitive ecological features where possible. Opportunities for habitat enhancement is discussed in **Section 19.6.5**
'When considering the application, the IPC will have regard to the Government's biodiversity strategy as (sic) set out in 'Working with the grain of nature', which aims to halt or reverse declines in priority habitats and species; accept the importance of biodiversity to quality of life. The IPC will consider this in relation to the context of climate change. As a general principle, and subject to the specific policies below, development should aim to avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives (as set out in section 4.4 above); where significant harm cannot be avoided, then appropriate compensation measures should be sought. In taking decisions, the IPC should ensure that appropriate weight is attached to designated sites of international, national and local importance; protected species; habitats and other species of principal importance for the conservation of biodiversity; and to biodiversity and geological interests within the wider environment.'	Sections 5.3.5 – 5.3.8	**Sections 19.6.5 and 19.6.6** discuss the mitigation measures proposed to avoid significant harm to biodiversity interests. Geology is discussed in **Chapter 18, Ground Conditions and Contamination**
'The IPC will have the same regard to potential Special Protection Areas (pSPAs) and Ramsar sites as those sites identified through international conventions and European Directives.'	Section 5.3.9	Impacts to pSPAs and Ramsar sites are discussed in **Chapter 11, Offshore Ornithology**
'Many SSSIs are also designated as sites of international importance and will be protected accordingly. Those that are not, or those features of SSSIs not covered by an international designation, should be given a high degree of protection.'	Section 5.3.11	Impacts to SSSIs are discussed in Impact 2 in **Section 19.6.5**
'Where a proposed development on land within or outside an SSSI is likely to have an adverse effect on an SSSI (either individually or in combination with other developments), development consent should not normally be granted. Where an adverse effect, after mitigation, on the site's notified special interest features is likely, an exception should only be made where the benefits (including need) of the development at this site,	Section 5.3.11	Impacts to SSSIs are discussed in Impact 2 in **Section 19.6.5**

NPS Requirements	NPS Reference	ES Reference
clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest and any broader impacts on the national network of SSSIs.'		
'The IPC will have regard to sites of regional and local biodiversity and geological interest, which include Regionally Important Geological Sites, Local Nature Reserves and Local Sites when considering applications since they are recognised to have a fundamental role in meeting overall national biodiversity targets.'	Section 5.3.13	Impacts to regional and local sites are discussed in Impact 2 in **Section 19.6.5**. Geology is discussed in **Chapter 18, Ground Conditions and Contamination**
'Ancient woodland is a valuable biodiversity resource both for its diversity of species and for its longevity as woodland. Once lost it cannot be recreated. The IPC should not grant development consent for any development that would result in its loss or deterioration unless the benefits (including need) of the development, in that location outweigh the loss of the woodland habitat. Aged or 'veteran' trees found outside ancient woodland are also particularly valuable for biodiversity and their loss should be avoided. Where such trees would be affected by development proposals the applicant should set out proposals for their conservation or, where their loss is unavoidable, the reasons why.'	Section 5.3.14	Ancient woodlands have been avoided by the Project infrastructure. They are further discussed in **Section 19.6.5.2.1.**
The IPC will aim to maximise opportunities to build in beneficial biodiversity features when considering proposals as part of good design.	Section 5.3.15	Opportunities for habitat enhancement are discussed in **Section 19.6.5**
The IPC shall have regard to the protection of legally protected species and habitats and species of principal importance for nature conservation. 'The IPC shall refuse consent where harm to the habitats or species and their habitats would result, unless the benefits (including need) of the development outweigh that harm. In this context the IPC should give substantial weight to any such harm to the detriment of biodiversity features of national or regional importance which it considers may result from a proposed development.'	Sections 5.3.16 – 5.3.17	Habitats and species of principal importance are discussed in **Sections 19.5 and 19.6**
The applicant should include appropriate mitigation measures as an integral part of the proposed development and demonstrate that: ▪ During construction, they will seek to ensure that activities will be confined to the minimum areas required for the works; ▪ During construction and operation best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements; ▪ Habitats will, where practicable, be restored after construction works have finished; and	Section 5.3.18	These measures are embedded in the project design and are discussed in **Sections 19.6.3, 19.6.4 and 19.6.5.**

NPS Requirements	NPS Reference	ES Reference
▪ Opportunities will be taken to enhance existing habitats and, where practicable, to create new habitats of value within the site landscaping proposals.		
'The IPC will need to take account of what mitigation measures may have been agreed between the applicant and Natural England has granted or refused or intends to grant or refuse, any relevant licences, including protected species mitigation licences.'	Section 5.3.20	Mitigation is discussed in **Sections 19.6.3, 19.6.4, 19.6.5 and 19.6.6**
EN-3 NPS for Renewable Energy Infrastructure		
'Proposals for renewable energy infrastructure should demonstrate good design in respect of landscape and visual amenity, and in the design of the project to mitigate impacts such as noise and effects on ecology.'	Section 2.4.2	Landscape and visual amenity is discussed in **Chapter 24, Seascape, Landscape and Visual Impact Assessment**, noise is discussed in **Chapter 21, Noise and Vibration** and **Sections 19.5, 19.6.3 and 19.6.5** discuss how the design of the project has mitigated impacts on ecology
'Ecological monitoring is likely to be appropriate during the construction and operational phases to identify the actual impact so that, where appropriate, adverse effects can then be mitigated and to enable further useful information to be published relevant to future projects.'	Section 2.6.70	Proposals for ecological monitoring are discussed in **Sections 19.6.3, 19.6.4, 19.6.5** and **19.6.6**
'There may be some instances where it would be more harmful to the ecology of the site to remove elements of the development, such as the access tracks or underground cabling, than to retain them.'	Section 2.7.15	Decommissioning is discussed in **Chapter 4, Project Description** and **Section 19.6.8**

19.2.3.7. Anglesey and Gwynedd Joint Local Development Plan

29. **Table 19-3** below provides details on the policies of the Joint Local Development Plan (JLDP) which are relevant to onshore ecology.

30. Designated areas which these policies may refer to are shown on **Figure 19.2** (**Volume II**) and **Figure 19.3** (**Volume II**). A number of policies which primarily relate to the management of water resources, and which are inter-linked with onshore ecology are discussed in **Chapter 17, Water Resources and Flood Risk**.

Table 19-3 Relevant Local Planning Policies of the Joint Local Development Plan

Policy/Guidance	Policy/Guidance Purpose
Policy ISA 4: Safeguarding Existing Open Space	To protect open spaces as an invaluable amenity resource
Policy AND 3: Other Renewable Energy	Proposals for renewable and low carbon energy technologies, other than wind or solar, which contribute a low carbon future will be permitted, provided that the proposal conforms to the following criteria… "*All impacts on landscape character,*

Policy/Guidance	Policy/Guidance Purpose
and Low Carbon Technologies	*heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced*".
Strategic Policy PS 19: Conserving and where appropriate enhancing the Natural Environment	The Councils will manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline, and proposals that have a significant adverse effect on them will be refused unless the need for and benefits of the development in that location clearly outweighs the value of the site or area and national policy protection for that site and area in question. When determining a planning application, consideration will need to be given to the following: 1. Safeguard the Plan area's habitats and species, geology, history, the coastline and landscapes; 2. Protect or where appropriate enhance sites of international, national, regional and local importance and, where appropriate, their settings in line with National Policy; 3. Have appropriate regard to the relative significance of international, national or local designations in considering the weight to be attached to acknowledged interests, ensuring that any international or national responsibilities and obligations are fully met in accordance with National Policy; 4. Protect or enhance biodiversity within the Plan area and enhance and/or restore networks of natural habitats in accordance with the Local Biodiversity Action Plans and Policy AMG 5; 5. Protect or enhance biodiversity through networks of green/ blue infrastructure; 6. Safeguard internationally, nationally and locally protected species; 7. Protect, retain or enhance the local character and distinctiveness of the individual Landscape Character Areas (in line with Policy AMG 2) and Seascape Character Areas (in line with Policy AMG 4); 8. Protect, retain or enhance trees, hedgerows or woodland of visual, ecological, historic cultural or amenity value
Policy AMG 4: Coastal Protection	In considering a proposal on the coast, including the Heritage Coast, there will be a need to ensure that the proposal conforms to the following criteria: It does not cause unacceptable harm to: "…*the area's biodiversity interests (including European Protected Areas such as marine Special Areas of Conservation and Special Protected Areas) due to their location, scale, form, appearance, materials, noise, or emissions or due to an unacceptable increase in traffic…"*
Policy AMG 5: Local Biodiversity Conservation	Proposals must protect and, where appropriate, enhance biodiversity that has been identified as being important to the local area by: Avoiding significant harmful impacts through the sensitive location of development. Considering opportunities to create, improve and manage wildlife habitats and natural landscape including wildlife corridors, stepping stones, trees, hedges, woodlands and watercourses. A proposal affecting sites of local biodiversity importance will be refused unless they can conform with all of the following criteria: 1. That there are no other satisfactory alternative sites available for the development. 2. The need for the development outweighs the importance of the site for local nature conservation; 3. That appropriate mitigation or compensation measures are included as part of the proposal. Where necessary, an Ecological Assessment which highlights the relevant local biodiversity issues should be included with the planning application.

Policy/Guidance	Policy/Guidance Purpose
Policy AMG 6: Protecting Sites of Regional or Local Significance	Proposals that are likely to cause direct or indirect significant harm to Local Nature Reserves (LNR), Wildlife Sites (WS) or regionally important geological / geomorphologic sites (RIGS) will be refused, unless it can be proven that there is an overriding social, environmental and/or economic need for the development, and that there is no other suitable site that would avoid having a detrimental impact on sites of local nature conservation value or local geological importance. When a development is granted, it will be necessary to ensure that there are appropriate mitigation measures in place. It will be possible to use planning conditions and/or obligations in order to safeguard the site's biodiversity and geological importance.

19.2.3.8. Biodiversity Action Plan

31. At the Rio summit in 1992 world leaders pledged to fight against wildlife's extinction and strive to protect the variety of living nature on earth and the Convention on Biological Diversity was signed.

32. The UK generated the UK Biodiversity Action Plan (UKBAP) in response to this agreement. Local Biodiversity Action Plans (LBAP) were adopted at the county level to generate action on the ground and help meet UK targets.

33. Anglesey's LBAP was written to help secure partnership work between local people and organisations to ensure these local resources are valued and looked after in the future. The action plan set out work to help important habitats and species on Anglesey.

19.3. CONSULTATION

34. To inform the ES, Mentor Môn has undertaken a thorough pre-application consultation process, which has included the following key stages:

- Scoping Reports submitted to the Planning Inspectorate (Royal HaskoningDHV 2015, 2017, 2018); and
- Scoping Opinions (2015, 2017, 2018) received from the Planning Inspectorate (2018).

35. To aid the assessment of onshore ecology, comments on the scope of the ecological survey was provided by the Isle of Anglesey Council (IoACC) Ecological Advisor during pre-application consultation outlined in **Chapter 6, Consultation**. Full details of the ecological surveys that have been undertaken to inform this EcIA are provided in **Appendix 19.1** (**Volume III**).

36. NRW (Protected Species Officer and Development Planning Advisor) was contacted to discuss the strategy for survey and assessing impacts on great crested newt (GCN) on 11 June 2018. A copy of the Spatial Action Plan for GCNs in Anglesey was provided to BSG Ecology by NRW.

37. The Project is in the vicinity of important habitat for chough, a Schedule 1 species and feature of a number of designated sites in the area. Information on chough nesting sites was obtained from Adrienne Stratford (of the Cross and Stratford Chough Project) on 27 January 2019. The Royal Society for the Protection of Birds (RSPB) provided chough information and data including records of foraging birds from transect surveys of land parcels within and close to the South

Stack RSPB reserve. Further information and figures showing locations of chough nest and roost sites and feeding areas/records are included in **Confidential Appendix 19.2** (**Volume III**).

38. Full details of the project consultation process to date is presented within **Chapter 6, Consultation**.

39. A summary of the consultation carried out at key stages throughout the Project, of particular relevance to onshore ecology, is presented in **Table 19-4**.

Table 19-4 Consultation Responses

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
NRW	Scoping Opinion (2015)	The Habitats Regulations Assessment (HRA) is a two stage process, the first stage being a ‘Test of Likely Significant Effect’ to establish whether the proposals are likely to result in significant effects on any European sites (and Ramsar sites). If this establishes that significant effects are likely, or there is uncertainty whether significant effects are likely to result, then an appropriate assessment of the effects of the activity in view of the conservation objectives of the site(s) is required. The HRA also needs to consider in-combination effects of the proposed Project with other projects.	Noted, the HRA Screening document and information to inform an Appropriate Assessment are presented in **Document MOR/RHDHV/DOC/0067, Information to Support HRA**
NRW	Scoping Opinion (2015)	The process of the consideration of development proposals likely to affect European Sites (and Ramsar sites) takes into account the conservation objectives of the site(s) concerned. It is undertaken by the Competent Authority, which in the case of the Marine Licence is NRW’s Marine Licensing Team and is an additional requirement to EIA. However, the information contained within the ES may be of relevance and be used in the HRA. We therefore recommend that the ES includes ‘Information to inform the Habitats Regulations Assessment (HRA)’. Competent Authorities may only permit proposals that will adversely affect the integrity of European Sites (and Ramsar sites) if there are no alternative solutions, there are Imperative Reasons of Overriding Public Interest (IROPI) for the development and compensatory measures have been secured	Noted, the HRA Screening document and information to inform an Appropriate Assessment are presented in **Document MOR/RHDHV/DOC/0067, Information to Support HRA**
NRW	Scoping Opinion (2015)	Without prejudice to the HRA or consenting process, a package of measures that would avoid or mitigate the effects of the proposed scheme and avoid adverse effects on the integrity of the European Sites (and Ramsar Sites), would appear challenging to achieve in this case. If this is the case it may be necessary to consider the scheme under Regulation 62 of the Habitats Regulations, where the possibility of alternatives to the Project that would not give rise to adverse effects on the integrity of the European Sites are considered.	Noted, the HRA Screening document and information to inform an Appropriate Assessment are presented in **Document MOR/RHDHV/DOC/0067, Information to Support HRA**
NRW	Scoping Opinion (2015)	It is difficult to determine from the information provided in the scoping report the potential impacts and the significance of potential impacts, for protected sites. The EIA should concentrate on impacts both direct and indirect on marine and coastal sites and those adjacent to the cable route and any land-based infrastructure.	Designated sites are considered in **Section 19.6.5**.

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
NRW	Scoping Opinion (2015)	Certain species listed under Schedule 5 of the Wildlife and Countryside Act 1981 (WCA, 1981), as amended by the Countryside and Rights of Way Act 2000 (CRoW, 2000) are legally protected from 'reckless or intentional disturbance. In addition, certain species listed in Annex IV(a) of the Habitats Directive and whose natural range includes any area in Great Britain are legally protected under the Conservation of Habitats and Species Regulations 2010 (as amended) (the 'Habitats Regulations') (*this was updated in 2017*) and Offshore Marine Conservation (Natural Habitats &c) Regulations 2010 (Offshore Marine Regulations). The Regulations prohibit the deliberate capture, injury, killing or disturbance of any wild animal of an EPS. The ES must consider the impact of the project on species protected under UK and European legislation, including those which are features of protected sites. Further information on protected species of particular relevance to the WADZ and guidance on the requirements of legislation can be found in NRW's 'Natural heritage checklist for the demonstration zone' and NRW Advisory's 'Advice on scoping an Environmental Impact Assessment for marine renewable energy developments'.	Protected species are considered in **Section 19.6.5**.
NRW	Scoping Opinion (2015)	If the EIA identifies the presence of European or nationally protected species appropriate mitigation and/or compensation and reasonable avoidance measures must be proposed to ensure the Favourable Conservation Status of the species is maintained where necessary.	Mitigation is detailed in **Section 19.6.5**.
NRW	Scoping Opinion (2015)	Menter Môn may also wish to consider whether an EPS Licence under the Conservation of Habitats and Species Regulations 2010 (*this was updated in 2017*) will be required, as it is an offence to deliberately disturb capture, injure or kill or damage or destroy a breeding site or resting place of EPS. Further details on the EPS can be found in Annex 2 of this document. The need for EPS licence(s) should be determined as part of the EIA process	EPS are discussed in **Section 19.6.5**.
NRW	Scoping Opinion (2015)	SSSI, which are nationally important sites, notified under the Wildlife and Countryside Act,1981,(WCA) as amended by the Countryside and Rights of Way Act,2000 (CRoW), which could be impacted by the project and therefore should be included in the ES include: ▪ Rhosneigr Reefs Site of SSSI; ▪ Beddmanarach and the Cymyran SSSI; ▪ Glannau Rhoscolyn SSSI; and ▪ Ynys Feurig SSSI	Impacts to SSSI are discussed in **Section 19.6.5**.
NRW	Scoping Opinion (2015)	The EIA should take into consideration any potential impacts of onshore development associated with the Morlais Demo zone. The EIA should include appropriate ecological surveys to assess the likely impact of the scheme on protected sites and/or species.	Baseline ecological surveys have been undertaken and impacts to onshore ecology

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
			are discussed in **Section 19.6**.
NRW	Scoping Opinion (2015)	The proposed development is approximately 950m away from the boundary of the Beddmanarch Cymryan SSSI. The EIA should give full consideration to the potential impacts the scheme may have on this designated site.	Beddmanarch Cymryan SSSI is considered in **Section 19.6.5**.
NRW	Scoping Opinion (2015)	There is a record of otter and great crested newts in the vicinity of the proposed development. Otters and great crested newts are protected under the WCA,1981 (as amended) and the Conservation of Habitats and Species Regulations (2010). The EIA should assess the scheme's potential impact on the maintenance of the otter population at a favourable conservation status.	Otter and GCN are considered in **Section 19.6.5**.
NRW	Scoping Opinion (2015)	EIA baseline characterisation strategy points: We agree with the proposal to gather existing and new data. We note that a large amount of relevant material has been gathered from recent survey work for other proposals/ cases in the area (particularly Lateral Power and Land and Lakes), if available would be useful to inform the baseline characterisation.	Site-specific surveys were commissioned, and baseline characterisation is undertaken in **Section 19.5**
NRW	Scoping Opinion (2015)	We have been made aware that common lizards are present in the area, although not EPS, reptiles have partial protection under the WCA, 1981, and should be covered in the EIA.	Common lizards are discussed in **Section 19.5.2.2**.
IoACC	Scoping Opinion (2017)	▪ Local Wildlife sites not included; ▪ Not statutory but are a feature in current LDP process and referred to in planning cases; ▪ Advise proportional consideration in EIA: ▪ Local Wildlife Sites ▪ Protected species, incl. Cofnod (North Wales Environmental Information Service) ▪ Survey detail (certain species/groups) and clarity on preferred routes. ▪ Suggests appropriate workshop meeting for relevant council staff and stakeholders. See Appendix 1 for further detail.	LWS have been considered in **Section 19.5 and 19.6.5**.
IoACC	Scoping Opinion (2017)	▪ Anglesey Terns SPA was not included in Scoping Report, should be considered as part of subsequent planning application, along with other identified sites ▪ Extra attention given to ornithological receptors, further advise for ES detailed in Appendix 3 ▪ Section on habitat/species connectivity in order to prevent habitat fragmentation and indirect impacts upon receptors, habitats and designated sites. ▪ Scoping area B poses least disruption (largely urban and small area of designated sites)	Connectivity is considered in **Section 19.6.5**.

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
IoACC	Scoping Opinion (2017)	▪ Reference local wildlife sites ▪ Badgers present in the area, ecology reports in relation to Parc Cybi development ▪ Impacts on ancient woodland (Penrhos Coastal Park)	These features are all discussed in **Section 19.5** and considered in **Section 19.6.5**.
IoACC	Scoping Opinion (2017)	▪ Consider impact on protected species and demonstrate will not impact on Favourable Conservation Status of European and Nationally protected species ▪ Propose and deliver appropriate mitigation /compensation schemes to ensure favourable conservation status. ▪ Be aware that the development may only proceed under derogation licence should surveys confirm presence of species that are protected	Impacts to protected species are assessment in **Section 19.6.5**.
IoACC	Scoping Opinion (2017)	All works at the site must be carried out in accordance with GPP5 and PPG6: 'Works in, near or over watercourses' and 'Working at construction and demolition sites'	Works will be undertaken in accordance with GPP5 and PPG6.
IoACC	Scoping Opinion (2017)	Welcomes HRA assessment and applicant should liaise with statutory and other consultees as part of this screening process.	The HRA is presented in **Document MOR/RHDHV/DOC/0067, Information to Support HRA.**
Planning Inspectorate	Scoping Opinion (2018)	In some circumstances it will be appropriate for information to be kept confidential. In particular, this may relate to information about the presence and locations of rare or sensitive species such as badgers, rare birds and plants where disturbance, damage, persecution or commercial exploitation may result from publication of the information. Where documents are intended to remain confidential the Applicant should provide these as separate paper and electronic documents with their confidential nature clearly indicated in the title and watermarked as such on each page. The information should not be incorporated within other documents that are intended for publication or which the Welsh Ministers would be required to disclose under the Environmental Information Regulations 2014.	Badger data is provided in **Confidential Appendix 19.3**. Chough data is provided in **Confidential Appendix 19.2.**
Planning Inspectorate	Scoping Opinion (2018)	Study areas: It is recommended that the Applicant makes efforts to agree the relevant study areas with NRW and that they are appropriate to ensure any likely significant effects are identified in the ES.	Surveys have been agreed with NRW and IoACC (see **Section 19.3**).

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
Planning Inspectorate	Scoping Opinion (2018)	Habitats Regulations: The Applicant should note that the Habitat Regulations referred to in the Scoping Report were consolidated and replaced in 2017.	Information on HRA is presented in **Document MOR/RHDHV/DOC/0067, Information to Support HRA.**
Planning Inspectorate	Scoping Opinion (2018)	Designated Sites: There are number of errors in the Table 8-1 including incorrectly named designated sites and features. The Applicant should ensure that any such errors are omitted from information in the ES. There are a greater number of designated sites listed in Table 8-1 of the Scoping Report than shown on Figure 8-1. The ES should include figures identifying the location of all designated sites discussed in the text and also identify the distance of the designated sites from the Proposed Works	Terrestrial Ecology designated sites are discussed in **Section 19.5.1** and assessed in **Section 19.6.5**.
Planning Inspectorate	Scoping Opinion (2018)	Potential Impacts: It is unclear how habitat loss will affect some designated sites located far away from the Proposed Works e.g. Dee Estuary SAC. This should be clarified in the ES.	Terrestrial Ecology designated sites are discussed in **Section 19.5.1** and assessed in **Section 19.6.5**.
Planning Inspectorate	Scoping Opinion (2018)	Potential Impacts: The potential impacts are duplicated in Table 8-2, although do not always correlate with the potential impacts identified in Table 8-1 (e.g. effects of lighting are noted in Table 8-1 but not Table 8-2). Where relevant the Applicant should ensure consistency between information presented in the ES.	Potential Impacts are discussed in **Section 19.6**
Planning Inspectorate	Scoping Opinion (2018)	Potential Impacts: Tables 8-1 and 8-2 of the Scoping Report identify a number of potential impacts for which it is assumed modelling could be required e.g. noise impacts, collision risk, electro-magnetic field ('EMF'). The Scoping Report does not explain the intended approach to predicting these potential impacts. The ES should provide details of any models used, the input parameters and any assumptions made in the models. Any guidance used to inform the assessment should be detailed within the ES. This comment also applies to the Benthic Ecology and Terrestrial and Coastal Ecology aspects.	No models have been used for the assessment of impacts to terrestrial ecology. Noise is discussed in **Chapter 21, Noise and Vibration.** Collision Risk and EMF is discussed in **Chapter 10, Fish and Shellfish Ecology, Chapter 11, Offshore Ornithology and Chapter 12, Marine Mammals** Impacts to benthic ecology are covered

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
			in **Chapter 9, Benthic and Intertidal Ecology**
Planning Inspectorate	Scoping Opinion (2018)	Ancient Woodland: Isle of Anglesey County Council's (IoACC) comment in Table 11-1 of the Scoping Report is noted, along with the need to consider ancient woodland at and around Penrhos Coastal Park. The Applicant's response indicates intent to consider ancient woodland in the assessment, however there is no further reference to ancient woodland in the Scoping Report. The potential impacts to ancient woodland should be assessed within the ES.	Ancient woodland is assessed in **Section 19.5.1 and 19.6.5**.
Planning Inspectorate	Scoping Opinion (2018)	Barn owls: NRW's comments in Table 11-1 of Appendix A1 of the Scoping Report, identify potential impacts on barn owls, however this species has not been identified as a relevant species for assessment in the baseline of the Scoping Report. The potential impacts on barn owls should be assessed in the ES.	Barn owls are discussed in in **Sections 19.5.2 and 19.6.5**.
Planning Inspectorate	Scoping Opinion (2018)	Focus on the ecology on Holy Island: The Scoping Report has focused on the ecology on Holy Island only. It is noted that one grid connection option is located in Valley, which is not on Holy Island. The ES should encompass the entire application site and the study area for the assessment should be defined according to the relevant receptors that may experience impacts by the Proposed Works.	All onshore works will now be on Holy Island and Valley is no longer considered. See **Sections 19.5 and19.6**
Planning Inspectorate	Scoping Opinion (2018)	Designated sites on Holy Island: Only designated sites on Holy Island have been considered in terms of terrestrial ecology. In addition to the comments above, consideration should be given to sites outside of Holy Island that have mobile species.	All onshore works will be on Holy Island. Study areas are discussed in **Section 19.4.1**.
Planning Inspectorate	Scoping Opinion (2018)	"The impact on coastal SACs and SSSIs in terms of changes to sediment processes and receptor food resource would be assessed in the EIA and specific impacts on SAC and SSSI interest features would be addressed separately": This statement is not understood. The ES should assess all potential impacts to designated sites.	Impacts to designated sites relevant to onshore ecology are considered in **Section 19.6.5**. See also **Chapter 10, Fish and Shellfish Ecology, Chapter 11, Offshore Ornithology and 12, Marine Mammals** for further impacts to designated sites.

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
Planning Inspectorate	Scoping Opinion (2018)	Surveys: The Scoping Report does not identify what site specific surveys would be undertaken. It is recommended that the scope of the surveys is discussed and agreed with relevant consultees including NRW.	Consultation regarding the surveys is discussed in **Section 19.3**
Planning Inspectorate	Scoping Opinion (2018)	Lighting: The Scoping Report identifies the potential presence of species which could be affected by artificial lighting e.g. bats. The ES should assess the potential impacts of onshore lighting including temporary lighting during construction and any permanent lighting at the substation where significant effects are likely.	Lighting is discussed in **Section 19.6.5** and **19.6.6**.
Planning Inspectorate	Scoping Opinion (2018)	Protected Species: The Applicant should demonstrate that the favourable conservation status of protected species would be maintained.	Impacts to protected species are discussed in **Section 19.6.5**.
Planning Inspectorate	Scoping Opinion (2018)	Impacts to ecological receptors: The results of the noise and vibration assessment should be used to inform the assessment of impacts on ecological receptors.	Noise and vibration is considered in **Chapter 21, Noise and Vibration**, and discussed in **Section 19.6.5**.
NRW (for PINS)	Scoping Opinion (2018)	Certain species listed under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) are legally protected from 'reckless or intentional disturbance' Species listed in Annex IV(a) of the Habitats Directive, and whose natural range includes any area in Great Britain, are legally protected under the Habitats Regulations (above) and the Conservation of Offshore Marine Habitats and Species Regulations 2017. The Regulations prohibit the deliberate capture, injury, killing or disturbance of any 'European Protected Species (EPS)'. An EPS licence may be required for activities depending on the significance of any disturbance; this should be determined as part of the EIA process and documented in the ES.	EPS relevant to onshore ecology are considered in **Section 19.6.5**. Other EPS are discussed in **Chapter 10, Fish and Shellfish Ecology and Chapter 12, Marine Mammals**
NRW (for PINS)	Scoping Opinion (2018)	In our previous EIA scoping responses to Anglesey County Council and NRW's Marine Licensing Team we stated that we agreed with the designated sites, species and receptors identified within section 7 of the scoping report (table 8.1 in current EIA scoping report) to be included within the EIA and HRA. We noted that the Anglesey Terns SPA was not included within the scoping report and should be considered as part of any subsequent ES. Table 8.1 has since been changed and now contains numerous errors. We strongly advise that these are rectified prior to the submission of any ES.	Designated sites are considered in **Section 19.5.1** and **Section 19.6.5**.

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
NRW (for PINS)	Scoping Opinion (2018)	A number of the designated sites included in table 8.1 (and throughout the report) are incorrectly named and there are several examples of duplication, possibly stemming from the fact that some sites have both a Welsh and an English name. Where sites are duplicated, such as is the case for Llyn Dinam SAC, Glannau Ynys Gybi/Holy Island Coast SPA, Glannau Rhoscolyn/Rhoscolyn Coast SSSI and Porth Diana SSSI to name a few, differing (conflicting) levels of potential impacts are often reported.	Designated sites are considered in **Section 19.5.1** and **Section 19.6.5**.
NRW (for PINS)	Scoping Opinion (2018)	The entries under the 'features' column of table 8.1 are inconsistent and often incorrect. We advise that the column is carefully checked, and the features communicated in a consistent format that is easy for the reader to understand.	This has been corrected. Designated sites and their features are considered in **Section 19.5.1 and 19.6.5**
NRW (for PINS)	Scoping Opinion (2018)	In table 8.1 the statement provided regarding drainage in Llyn Padrig SSSI is incorrect; the water table has been artificially lowered across the whole site and there is clear evidence of this in the surrounding fields.	This site is no longer within the study area. In addition, no impacts are anticipated to this site and it is not considered further
NRW (for PINS)	Scoping Opinion (2018)	Impacts to terrestrial ecological protected sites (table 8.2) are dismissed as being minimal on the grounds of being localised. We note, however, that the cable landfall will cross the Glannau Ynys Gybi / Holy Island Coast SAC, SPA and SSSI and therefore impacts have the potential to be significant in the areas affected.	The Glannau Ynys Gybi / Holy Island Coast SAC, SPA and SSSI is considered in **Section 19.6.5**.
NRW (for PINS)	Scoping Opinion (2018)	The proposed scoping area overlaps with the Glannau Ynys Gybi / Holy Island SPA. We advise that sufficient information should be provided on the impacts on breeding and nonbreeding chough, a qualifying feature of the SPA. The ES should propose and deliver appropriate mitigation to ensure that the works do not have adverse effects on the site integrity of the Glannau Ynys Gybi / Holy Island SPA. The ES should assess the likely impacts from disturbance and/or loss of chough foraging areas (both within and beyond site boundaries) and, where required, detail proposed mitigation measures.	Chough are discussed in **Section 19.5 and 19.6.5**.
IACC 2018	Scoping Opinion (2018)	Adequate information on the S7 species and habitats (as listed under the 2016 Act) should be included for consideration.	Section 7 species and habitats are assessed in **Section 19.6.5**.
IACC 2018	Scoping Opinion (2018)	There should be a clear commitment to undertake survey for species.	Surveys have been undertaken and discussed in **Section 19.4.3 and 19.5**

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
IACC (2017)	Scoping Opinion (2018)	Badgers are known to be present in the area and ecology reports in relation to the development of Parc Cybi for example may provide useful information.	Badger data has been provided in **Confidential Appendix 19.3** (**Volume III**).
IACC (2017)	Scoping Opinion (2018)	Consideration should be given to any impacts on ancient woodland present at and around Penrhos Coastal Park (paragraph 7.3.4).	Ancient woodland is discussed in **Section 19.5.1** and **Section 19.6.5**.
IACC 2017 revised scheme	Scoping Opinion (2018)	In Chapter 8 (Biological Environment), Figure 8-1 which depicts Designations around Holy Island and the wider Anglesey area, the figure does not include local Wildlife Sites. These are now protected under Joint Local Development Plan (JLDP) Policy AMG6. As such, these sites should be added to the figure.	Local Wildlife Sites are included under non-statutory sites in **Section 19.6.5**.and shown on **Figure 19.2** (**Volume II**)
IACC 2017 revised scheme	Scoping Opinion (2018)	In paragraph 8.1.1.1 (Onshore), this paragraph is mainly about HRA, with no mention of the SSSI or Local Wildlife Sites. It is suggested that the applicant considers changing title or adding reference to these designations.	SSSI and LWS are assessed in **Section 19.6.5**.
IACC 2017 revised scheme	Scoping Opinion (2018)	In paragraph 8.6 (Terrestrial and Coastal Ecology), on page 106 specifically, the third from last paragraph states ‘Impacts to EPS species and species protected under the Wildlife and Countryside Act (1981) will be fully considered within the EIA.’ This commitment is duly noted.	These species are assessed in **Section 19.6.5**.
IACC 2017 revised scheme	Scoping Opinion (2018)	In the final paragraph of page 106, it is stated that ‘…a full review of impacts on terrestrial designated habitats suggested by NRW will be undertaken for the EIA and HRA…’. We query whether this refers to habitats within protected sites only. It continues ‘…however, for this scoping survey, only designated sites on Holy Island have been considered in terms of terrestrial ecology.’ It is unclear whether this included Local Wildlife Sites, and why other areas have not been considered. We are concerned that, where relevant, there will be clear coverage of habitats listed under S7 of the Environment Wales Act 2016. The reasoning behind this is that there should be a means to ensure that adequate information on the S7 species and habitats as listed under the Act is included for consideration, in view of the duty to seek to conserve and enhance biodiversity under S6 of this recent Act.	S7 habitats and species are discussed in **Section 19.6.5**.
IACC 2017 revised scheme	Scoping Opinion (2018)	On page 107, the final paragraph of 8.6.1.1 (following the list of various species) states ‘The EIA will consider sensitive flora and fauna in further detail once preferred infrastructure options have been refined.’ We query whether this refers to the species listed on p107. As noted above, the means of covering S7 species and habitats is required, whether on protected sites or not.	S7 habitats and species are discussed in **Section 19.6.5**.

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
IACC 2017 revised scheme	Scoping Opinion (2018)	Table 8-10 refers to potential impacts on certain species. We would advise that there are potential direct impacts on some species which can be mitigated for with appropriate methodology.	Impacts to species are discussed in **Section 19.6.5**.
IACC 2017 revised scheme	Scoping Opinion (2018)	In paragraph 8.6.2 (EIA Baseline Characterisation) it states that to inform the EIA baseline, data is to be gathered on terrestrial and coastal habitats through site survey and review of data including Cofnod records. It also states (2nd bullet) that information on UK and local priority species, and EPS 'would be needed' and it is proposed to gather this through literature reviews and phase one habitat surveys. There should be a clear commitment here to undertake survey for species to establish details of presence, particularly for EPS for example, and also for reptiles.	Surveys have been undertaken and are discussed in **Section 19.4.3 and 19.5**
NRW	Scoping Opinion (2018)	Figure 8-1 which depicts designations around Holy Island and the wider Anglesey area needs to be updated. It does not include Anglesey terns SPA, North Anglesey Marine cSAC, or local Wildlife Sites. Local Wildlife Sites are now protected under Joint Local Development Plan (JLDP) Policy AMG6. These sites should be added to the figure and assessed in the ES.	Sites designated for terrestrial ecology (including LWS) are discussed in **Section 19.5.1 and 19.6.5.** Anglesey terns SPA is discussed in **Chapter 11, Offshore Ornithology**. North Anglesey cSAC is discussed in **Chapter 9, Benthic and Intertidal Ecology**
NRW	Scoping Opinion (2018)	Paragraph 8.1.1.1 (Onshore) is mainly about HRA designations, with no mention of the SSSI or Local Wildlife Sites. The title to this section should be changed or reference to these other designations should be included.	SSSI and LWS are considered in **Section 19.6.5**.
NRW	Scoping Opinion (2018)	A number of the designated sites included in table 8.1 (and throughout the report) are incorrectly named and there are several examples of duplication, possibly stemming from the fact that some sites have both a Welsh and an English name. Where sites are duplicated, such as is the case for Llyn Dinam SAC, Glannau Ynys Gybi/Holy Island Coast SPA, Glannau Rhoscolyn/Rhoscolyn Coast SSSI and Porth Diana SSSI, differing (conflicting) levels of potential impacts are often reported. This must be corrected in the ES.	Sites designated for terrestrial ecology are discussed in **Section 19.5.1 and 19.6.5.**
NRW	Scoping Opinion (2018)	The entries under the 'features' column of table 8.1 are inconsistent and often incorrect. This column should be carefully checked, and in the ES the features should be communicated in a consistent format that is easy for the reader to understand.	Sites designated for terrestrial ecology are discussed in **Section 19.5.1 and 19.6.5.**

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
NRW	Scoping Opinion (2018)	Certain species listed under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) are legally protected from ‘reckless or intentional disturbance’ Species listed in Annex IV(a) of the Habitats Directive, and whose natural range includes any area in Great Britain, are legally protected under the Habitats Regulations and the Conservation of Offshore Marine Habitats and Species Regulations 2017. The Regulations prohibit the deliberate capture, injury, killing or disturbance of any ‘European Protected Species (EPS)’. An EPS licence may be required for activities depending on the significance of any disturbance; this should be determined as part of the EIA process and documented in the ES. In reference to paragraph 5.1, it should be noted that NRW is the authority that determines EPS licences in welsh waters, not the MMO.	Protected species are discussed in **Section 19.5.2 and 19.6.5.**
NRW	Scoping Opinion (2018)	Section 8.6.1.1 states that the proposed scoping area overlaps with the Holy Island SAC and SSSI but fails to mention the Glannau Ynys Gybi / Holy Island SPA. This omission should be rectified in the ES.	Sites designated for terrestrial ecology are discussed in **Section 19.5.1 and 19.6.5.**
NRW	Scoping Opinion (2018)	According to the EIA scoping report the landfall and substation will be mainly situated in areas of agricultural land of limited interest (section 8.6.1.1). This may be true for the substation, however, without seeing location maps this statement cannot be confirmed. It should be noted that agricultural land can provide valuable feeding ground for chough and the landfall will have to cross the Glannau Ynys Gybi / Holy Island SAC / SPA and SSSI.	Sites designated for terrestrial ecology are discussed in **Section 19.5.1 and 19.6.5.**
NRW	Scoping Opinion (2018)	Section 8.6.1.2 states that “The central areas of Holy Island are largely rural pastoral land and coastal grassland, with upland areas of heath around Holyhead Mountain. These areas would be expected to be of low to moderate importance to terrestrial ecology receptors”. As these are areas of SAC heathland and SPA habitat the assessment of ‘low to moderate importance’ may need to be reconsidered.	Habitats and designated sites are discussed in **Section 19.5.2 and 19.6.5**.
NRW	Scoping Opinion (2018)	There are various records of great crested newts, bats, otters and water voles within the scoping zone. The ES will need to consider the impact of the proposal on protected species and demonstrate that the proposal will not impact on the Favourable Conservation Status of European and nationally protected species.	Protected species are discussed in **Section 19.5.2 and 19.6.5**.
NRW	Scoping Opinion (2018)	In paragraph 8.6.2 (EIA Baseline Characterisation) it states that to inform the EIA baseline, data is to be gathered on terrestrial and coastal habitats through site survey and review of data including Cofnod records. It also states (2nd bullet) that information on UK and local priority species, and EPS ‘would be needed’ and it is proposed to gather this through literature reviews and phase one habitat surveys. We strongly recommend that surveys are undertaken to establish details of presence for EPS and reptiles.	Surveys have been undertaken and are discussed in **Section 19.4.3 and 19.5.**

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
NRW	Scoping Opinion (2018)	In consideration of the impacts of the proposed development on birds and animals (table 8.10) it is important that consideration is given to the seasonality of works e.g. certain elements of construction for example may be more disruptive or damaging if they were to occur during breeding periods or periods of hibernation etc. Attention will also be required to the issue of habitat and species connectivity in order to avoid habitat fragmentation and indirect impacts up sensitive receptors. In addition, the ES should consider any hydrological effects which could arise and impact receptors within hydrological connectivity of the proposed development.	Seasonality is considered in **Section 19.5 and 19.6.5**. Hydrological effects are considered in **Chapter 17, Water Resources and Flood Risk** and discussed in **Section 19.6.5**.
NRW	Scoping Opinion (2018)	If surveys conclude the presence of protected species, the ES must include appropriate mitigation and / or compensation schemes along with Reasonable Avoidance Measures, to ensure that the favourable conservation status of the species is maintained. Please be aware that the development may only proceed under derogation licence should surveys confirm presence of species that are protected.	Protected species are considered in **Section 19.5 and 19.6.5**.
NRW	Scoping Opinion (2018)	In the final paragraph of page 106, it is stated that '…a full review of impacts on terrestrial designated habitats suggested by NRW will be undertaken for the EIA and HRA…'. We query whether this refers to habitats within protected sites only. It continues '…however, for this scoping survey, only designated sites on Holy Island have been considered in terms of terrestrial ecology.' It is unclear whether this included Local Wildlife Sites, and why other areas have not been considered. In addition, the ES must include clear coverage of habitats listed under S7 of the Environment Wales Act 2016. On page 107, the final paragraph of 8.6.1.1 (following the list of various species) states 'The EIA will consider sensitive flora and fauna in further detail once preferred infrastructure options have been refined.' We query whether this refers to the species listed on p107. As noted above, Environment Act S7 species and habitats should be assessed in the ES, whether in protected sites or not.	Designated sites, including LWS are considered in **Section 19.5.1** and **19.6.5**. S7 habitats and species are considered in **Section 19.5.2** and **19.6.5**.

19.4. METHODOLOGY

19.4.1. Study Area

40. At the time the ecological field surveys were commissioned, a wide area (the 'Survey Study Area') was surveyed to capture desk and field data as there were a number of landfall locations and grid connection options being considered at that time. As discussed in **Chapter 3, Site Selection and Consideration of Alternatives**, the Onshore Development Area has since been further refined, taking into account a number of constraints including ecology and nature conservation designated sites.

41. The Project's Onshore Study Area, and in turn for this chapter, is the Onshore Development Area (**Figure 19.1, Volume II**) with appropriate buffers for different receptors depending on their sensitivities and habitat preferences, as detailed in **Table 19-5**. These study areas were determined by consultation with stakeholders (see **Section 19.3**) and professional judgement.

42. The Onshore Study Area takes in all areas within the Onshore Development Area, which includes:

- Landfall works Including transition pits / berths;
- Cable installation from landfall to the landfall substation at Ty-Mawr (hereafter referred to as the landfall substation);
- Cable installation from landfall substation to the grid connection substation at Orthios (hereafter referred to as the grid connection substation), including cable junction boxes, draw pits and one HDD crossing;
- Temporary road and right of way closures;
- Landfall substation;
- Switchgear building at Parc Cybi (hereafter referred to as the switchgear building);
- Grid connection substation;
- Temporary laydown and construction areas, including fencing / walls, and accommodation;
- Levelling works; and
- Parking areas (including electric vehicle charging points) and site access.

43. For most species and habitats, a 50 m wide buffer was applied around the Onshore Development Area (the "Onshore Study Area"). An additional 250 m buffer has also been applied to the Onshore Development Area to allow possible impacts on GCN *Triturus cristatus* to be considered; this area (the "GCN Study Area") is shown on **Figure 19.4** (**Volume II**). Statutory and non-statutory terrestrial designated sites within 2 km of the Onshore Development Area have also been considered.

44. The "Desk Study Area" incorporates the Onshore Development Area and an additional 1 km buffer. The original Desk Study Area was identified and subsequently surveyed prior to the finalisation of the Onshore Development Area. Therefore, the data obtained encompasses a

larger area and includes the multiple route options that were under consideration at that time. The findings of the desk study informed the decisions made to finalise the Onshore Development Area, avoiding sensitive ecological features where possible. Details on the original Desk Study Area are provided in **Appendix 19.1** (**Volume III**). This chapter discusses features within the 1 km buffer.

45. A full description of, and associated information for, the onshore infrastructure is provided in **Chapter 4, Project Description**.

Table 19-5 Study areas for different onshore ecology receptors used for the EcIA (desk study and field survey)

Data / survey	Study area
Desk study area	Within 1 km of the Onshore Development Area
Statutory designated sites	Within 2 km of the Onshore Development Area (**Figure 19.2, Volume II**).
Non-statutory designated sites, including LWS and Ancient Woodland Sites (AWS)	Within 2 km of the Onshore Development Area (**Figure 19.3, Volume II**).
UKHPI and Anglesey LBAP Habitats	Within 50 m of the Onshore Development Area (**Figure 19.5, Volume II**).
Protected and notable species survey (except great crested newts *Triturus cristatus*)	Within 50 m of the Onshore Development Area (**Figure 19.6a**, **19.6b**, **19.6c**, **19.6d**, **19.6e**, **19.6f 19.7**, **19.8, Volume II**).
Great crested newt survey	Within 250 m of the Onshore Development Area (**Figure 19.4, Volume II**).

19.4.2. Data Sources – Desk Study

46. A detailed desk study has been undertaken of the area within the Desk Study Area (**Appendix 19.1**). This has involved:

- A review of aerial photographs (Google Earth and Bing Maps, accessed during April and November 2018), and Google Street View imagery was used to help identify and accurately map habitats and to identify ponds within the GCN Study Area;
- A detailed review of 1:25000 Ordnance Survey Maps, to identify ponds and public rights of way within the GCN Study Area;
- The UK Government's MAGIC website (www.magic.gov.uk) has been used to identify statutory designated sites within 2 km of the Onshore Development Area; and
- Cofnod (the local biological record centre for North Wales) was contacted to supply data within 2 km of the Onshore Development Area on any protected/notable species records or non-statutory sites of conservation value, including Local Wildlife Sites (LWS) and ancient woodland sites (AWS). Data were supplied on 19 April 2018. Cofnod supplied further data on 19 July 2018 which extended coverage into the Trearddur Bay area as the route options were refined.

19.4.3. Data Sources – Site-Specific Surveys and Reports

47. A number of dedicated field surveys were commissioned to characterise the ecology of the Survey Study Area (**Appendix 19.1, Volume III**) and to ascertain presence of protected or other

notable species or habitats. The Survey Study Area was established and surveyed prior to the Onshore Development Area being finalised, and therefore encompasses a much greater area, when multiple route options were under considerations.

48. The findings of the field surveys informed the decisions made to finalise the Onshore Development Area, avoiding sensitive ecology features where possible. Details on the Survey Study Area are provided in **Appendix 19.1** (**Volume III**). This chapter discusses findings from the Survey Study Area within the Onshore Study Area and the GCN Study Area, both of which are encompassed within the Survey Study Area.

49. The field survey work was carried out over multiple visits between April and November 2018. Initial Phase 1 habitat survey work (not 'extended') was carried out in April and May. This was followed by more detailed survey of ponds for GCN, and Extended Phase 1 Habitat Survey (EP1HS) as the route became more refined and access to the various areas requiring survey was agreed. Methodologies of the surveys are detailed in the following sections.

19.4.3.1. Initial Phase 1 Habitat Survey

50. Principal Ecologist Guy Miller CEcol CIEEM and Ecologist Emily Moore Grad CIEEM undertook the initial field survey over four days in late April/early May 2018 (26-27 April, 30 April-1 May 2018). This was not considered to be an EP1HS.

51. The review of aerial photographs and mapping was used to inform the field survey and identify habitats which required ground truthing.

52. During the survey the proposed onshore cabling routes within the Survey Study Area were driven in a slow-moving car with regular stops to record vegetation in habitats in the adjacent land. Public rights of way (PRoW) were used to obtain vantage points and view adjacent habitats. The habitats were described using the Joint Nature Conservation Committee (JNCC) Phase 1 habitat survey methodology (JNCC, 2010).

53. Habitats within the Survey Study Area were subject to an initial assessment for their suitability for protected species, including reptiles and amphibians (including GCN), badger M*eles meles*, water vole *Arvicola amphibius*, otter *Lutra lutra* and bats. Potential nesting habitats for breeding birds (common and Schedule 1 species) were identified. Detailed searches for evidence of protected species were not carried out during the initial assessment due to access constraints.

54. The Survey Study Area was also searched for the presence of invasive non-native plants including, but not limited to, Japanese knotweed *Fallopia japonica*.

19.4.3.2. Habitat Suitability Index (HSI) Assessment for Great Crested Newt

55. Where possible, any ponds that were accessible or visible from PRoW (using binoculars) were visited or viewed during the initial Phase 1 habitat survey (**Section 19.4.3.1**), described and subject to a Habitat Suitability Index (HSI) assessment for GCN. This involved recording a variety of environmental and ecological characteristics (such as water quality, shade, presence of aquatic plants, fish and wildfowl) and using a model to calculate a score between 0 and 1; scores closer to 1 represent ponds of high suitability for GCN; scores below 0.5 and closer to 0

represent ponds of lower suitability for GCN. The method followed the approach described in Oldham *et al*. 2000.

56. During the scoping process, ponds over 250 m from the GCN Study Area were excluded from the assessment, ponds that are shown on OS 1:25,000 map but not found to be present were excluded, and ponds that are brackish were excluded. Following this process, 19 ponds are within the GCN Study Area (i.e. within 250 m of the Onshore Development Area), 13 of which were subject to HSI assessment.

19.4.3.3. eDNA Survey for Great Crested Newt

57. The results of the HSI assessment (**Section 19.4.3.2**) were used to determine which of the ponds within the Survey Study Area were assessed to be suitable for GCN (**Appendix 19.1, Volume III**).

58. In total, 19 ponds/waterbodies were identified during the GCN Study Area (from 1:25,000 OS maps and aerial photographs, Bing Maps and Google Earth) and initial Phase 1 habitat survey.

59. As agreed with IOACC, many of these ponds/waterbodies were subsequently scoped out of the assessment either due to: a) the distance from the Onshore Development Area (over 250 m), b) being no longer present, although they are shown on the OS 1:25,000 map, or c) a low HSI score (<0.5: poor suitability) or brackish nature. Some ponds were found to be dry during the survey. Where there was a lack of evidence of aquatic or wetland vegetation presence (which indicates that they hold water at certain times of year), they were also scoped out of the assessment.

60. The findings, following the review of the 13 HSI results in combination with the criteria outlined above, resulted in a total of 11 ponds being identified as requiring an Environmental Deoxyribonucleic Acid (eDNA) survey within the GCN Study Area. Samples from these ponds were collected in June 2018; however, ponds which were found to be dry were not sampled. The survey work was led by Ecologist Emily Moore GradCIEEM who holds a survey licence for GCN (Licence no. 2015-17866-CLS-CLS), with assistance from Ecologist Sophie Olejnik and Principal Ecologist Guy Miller, who also holds a survey licence for GCN (Licence no. 2015-18702-CLS-CLS). The industry protocol for collecting GCN eDNA was followed (Williams, 2013; Biggs et al., 2014). Water samples were sent to NatureMetrics for analysis; the results of the lab analysis were returned on 20 July 2018.

19.4.3.4. Extended Phase 1 Habitat Survey (EP1HS)

61. A more detailed Extended Phase 1 Habitat Survey (EP1HS) was carried out between September and November 2018, when full survey access had been arranged. The survey was carried out by Emily Moore, Guy Miller and Sophie Olejnik. The purpose of the survey was to carry out more detailed survey of vegetation, to confirm the assessment made during the initial Phase 1 Habitat survey where full access was not previously granted, and to carry out survey for evidence of use by protected species.

19.4.3.4.1. Badger Survey

62. During the EP1HS, searches for evidence of badger activity were carried out within the Onshore Study Area. Setts and other evidence of badger activity (such as latrines, tracks and evidence of feeding activity) were recorded. Any setts located were assessed for signs of activity and where possible were classified as a main sett, an annex sett or an outlier sett (Neal & Cheeseman, 1998).

63. Dense scrub vegetation affected the ability to search for badger setts in parts of the Onshore Study Area. The significance of this constraint is considered to be small and is discussed in more detail in **Confidential Appendix 19.3** (**Volume III**).

64. An embankment between the railway and the A55 dual carriageway, to the south of the former aluminium works, was not accessible and was therefore not surveyed; although, it was viewed at certain points from the aluminium works where possible to do so (where breaks in scrub allow views through the fence). The significance of this constraint is considered to be small; however, the possible presence of a badger sett in this area cannot be ruled out. Although HDD will be undertaken under the railway and A55, construction works may still take place within 30 m of this embankment and therefore if so, this area will be included in the pre-construction survey areas.

19.4.4. Impact Assessment Methodology

19.4.4.1. EcIA Methodology

65. General methods for EIA are discussed in **Chapter 5, EIA Methodology**. The EcIA methodology proposed in relation to onshore ecology is based on the Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal and Marine (CIEEM, 2018). These guidelines aim to predict the residual impacts on important ecological features affected, either directly or indirectly by a development, once all the appropriate mitigation has been implemented.

66. The approach to determining the significance of an impact follows a systematic process for all impacts. This involves identifying, qualifying and, where possible, quantifying the sensitivity, value and magnitude of all ecological receptors which have been scoped into this assessment. Using this information, a significance of each potential impact has been determined. Each of these steps is set out in the remainder of this section (**Section 19.4.4.2, Section 19.4.4.3**).

67. The EcIA has used professional judgement to ensure the assessed significance level is appropriate for each individual receptor, taking account of local values for biodiversity to avoid a subjective assessment wherever possible as per the CIEEM guidelines. As a result, the assessed significance level may not always be directly attributed to the guidance matrix detailed below.

19.4.4.1.1. Importance

68. The first stage of an EcIA is determining the 'importance' of ecological features or 'receptors'. CIEEM identifies the important ecological features as those key sites, habitats and species which have been identified by European, national and local governments and specialist organisations as a key focus for biodiversity conservation in the UK. These include:

- Statutory and non-statutory designated sites for nature conservation;
- Species occurring on national biodiversity lists;
- UK Habitats of Principal Importance; and
- Red listed, rare or legally protected species.

69. Importance is also qualified by the geographic context of an ecological receptor, i.e. a species which may be not recognised on a national biodiversity list may be locally in decline, and therefore its local importance is greater than its national importance.

70. For this EcIA, the guidelines outlined in **Table 19-6** will be followed to provide the relative importance of different ecological features.

Table 19-6 Definitions of importance levels for onshore ecology

Importance	Definition
High	▪ An internationally designated site or candidate site or an area which the statutory nature conservation organisation has determined meets the published selection criteria for such designation, irrespective of whether or not it has yet been notified; ▪ A nationally designated site or a discrete area, including ancient woodlands, which the statutory nature conservation organisation has determined meets the published selection criteria for national designation (e.g. SSSI selection guidelines) irrespective of whether or not it has yet been notified; ▪ A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat which are essential to maintain the viability of a larger whole; ▪ A viable area of a UK Habitat of Principal Importance or smaller areas of such habitat which are essential to maintain the viability of a larger whole; ▪ A European protected species listed in The Conservation of Habitats and Species Regulations 2017; or ▪ A regularly occurring, nationally significant population / number of any internationally important species.
Medium	▪ County Council / Unitary Authority designated sites and other sites which the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves selected on defined ecological criteria and Wildlife Trust sites; ▪ Viable areas of habitat identified in a Local Biodiversity Action Plan (LBAP); ▪ Semi-natural woodland greater than 0.5 hectares (ha) which is considered to be in 'good condition'; ▪ Any regularly occurring population of a nationally important species which is threatened or rare in the region; or

Importance	Definition
	▪ A regularly occurring, locally significant number of a species identified as important on a regional basis.
Low	▪ Semi-natural woodland greater than 0.25 ha which is considered to be in 'good condition' or greater than 0.5 ha in unfavourable condition; ▪ Network of inter-connected hedgerows including some species-rich hedgerows; ▪ Individual Important hedgerows or other ancient-countryside linear features; ▪ Viable areas of habitat identified in a sub-county (District / Borough) BAP; ▪ Any regularly occurring population of a nationally important species which is not threatened or rare in the region or county; ▪ Sites / features that are scarce within the District / Borough or which appreciably enrich the District / Borough habitat resource; or ▪ Other features identified as wildlife corridors or migration routes.
Negligible	▪ Features of value to the immediate area only e.g. within the site.

71. In addition to the features listed in **Table 19-6**, ecological features which play a key functional role in the landscape or are locally rare have been considered. The importance of such features has been determined by professional judgement.

72. CIEEM places the emphasis on using professional judgement when considering importance of ecological receptors, based on available guidance, information and expert advice (CIEEM, 2018). Different aspects of ecological importance should be taken into account, including designations, biodiversity value, potential value, secondary or supporting value, social value, economic value, legal protection and multi-functional features.

19.4.4.1.2. Magnitude

73. The magnitude of the impact is assessed according to:

- The extent of the area subject to a predicted impact;
- The duration the impact is expected to last prior to recovery or replacement of the resource or feature;
- Whether the impact is reversible, with recovery through natural or spontaneous regeneration, or through the implementation of mitigation measures or irreversible, when no recovery is possible within a reasonable timescale or there is no intention to reverse the impact; and
- The timing and frequency of the impact, i.e. conflicting with critical seasons or increasing impact through repetition.

74. **Table 19-7** summarises the definitions of magnitude that have been used for the onshore ecology receptors.

Table 19-7 Definitions of magnitude levels for onshore ecology

Magnitude	Definition
High	Major impacts on the feature / population, which would have a sufficient effect to alter the nature of the feature in the short to long term and affect its long-term viability. For example, more than 20 % habitat loss or damage.

Magnitude	Definition
Medium	Impacts that are detectable in short and long-term, but which should not alter the long-term viability of the feature / population. For example, between 10 – 20 % habitat loss or damage.
Low	Minor impacts, either of sufficiently small-scale or of short duration to cause no long-term harm to the feature / population. For example, less than 10 % habitat loss or damage.
Negligible / No impact	A potential impact that is not expected to affect the feature / population in any way, therefore no effects are predicted.

19.4.4.1.3. Duration

75. The definitions of duration used within this EcIA are dependent on the individual ecological receptor, and how sensitive it is to effects over different timescales. However, in general terms the following definitions have been used:

- **Short term**: effects which at most occur over a part of, or over a part of a key period of, a species' active season or a habitat's growing season, i.e. typically effects which occur over a matter of days or weeks;
- **Medium term**: effects which occur over the full duration of a species' active season or a habitat's growing season, i.e. typically effects which occur over a matter of months or one year; and
- **Long term**: effects which occur over the multiple active or growing seasons, i.e. typically effects which occur over more than one year.

76. Where deviations from these definitions are used within **Section 19.6**, this is explained within the text.

19.4.4.1.4. Impact Significance

77. Following the identification of receptor importance and magnitude of the effect, it is possible to determine the significance of the impact.

78. Ecologically significant impacts are defined as:

79. "*…impacts on structure and function of defined sites, habitats or ecosystems and the conservation status of habitats and species (including extent, abundance and distribution)*" (CIEEM, 2018).

80. Impacts are unlikely to be significant where features of low importance are subject to small scale or short-term effects. If an impact is found not to be significant at the level at which the resource or feature has been valued, it may be significant at a more local level.

81. CIEEM recommend that the following factors are taken into account when determining significance for selected ecological receptors (**Section 19.4.4.2** and **19.4.4.3**).

19.4.4.2. Designated/Defined Sites and Ecosystems

- **Designated sites**: is the Project and associated activities likely to undermine the site's conservation objectives, or positively or negatively affect the conservation status of species or habitats for which the site is designated, or may it have positive or negative effects on the condition of the site or its interest/qualifying features?

- **Ecosystems**: is the Project likely to result in a change in ecosystem structure and function?

19.4.4.3. Habitats and Species

- **Habitats**: conservation status is determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area.
- **Species:** conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area (CIEEM, 2018).

82. Following the identification of receptor importance and magnitude of effect, the significance of the impact has been considered using the matrix presented in **Table 19-8** below and knowledge of the ecological features affected.

83. The assessment of potential impacts has been undertaken assuming implementation of embedded mitigation and commitments for the project. Residual impacts include any additional mitigation measures required. An assessment of residual impacts is then made, after assuming implementation of additional mitigation measures where required, i.e. the significance of the effects that are predicted to remain after the implementation of all committed mitigation measures.

Table 19-8 Impact significance matrix

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

84. The impact significance categories are defined as shown in **Table 19-9**.

Table 19-9 Impact significance definitions

Impact Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision making process.
Negligible	No discernible change in receptor condition.
No change	No impact, therefore no change in receptor condition.

85. Note that for the purposes of the EIA, major and moderate impacts are deemed to be significant. In addition, whilst minor impacts are not significant in their own right, it is important to distinguish these from other non-significant impacts as they may contribute to significant impacts cumulatively or through interactions.

86. Embedded mitigation has been referred to and included in the initial assessment of impact. If the impact does not require mitigation (or none is possible) the residual impact remains the same. However, if mitigation is required, an assessment of the post-mitigation residual impact is provided.

19.4.4.3.1. Cumulative Impact Assessment

87. For an introduction to the methodology used for the Cumulative Impact Assessment (CIA), please refer to **Chapter 5, EIA Methodology**. This chapter includes those cumulative impacts that are specific to onshore ecology.

88. The key consideration used in relation to linear developments such as the onshore infrastructure is whether there is spatial or temporal overlap of effects from projects on the same receptors. Therefore, for habitats and non-mobile species, unless there is a spatial overlap there is no pathway for cumulative impact between spatially separated projects. There is however a potential for a cumulative impact upon the overall habitat resource at a regional or national level. Where potential regional or national level impacts are identified and considered to be relevant they are highlighted in the CIA.

89. For mobile species there is only a pathway for cumulative impact if there is spatial overlap of potential receptor ranges in addition to temporal overlap with the activity or its resultant impact i.e. where developments follow on from one another before the species has recovered from displacement or other impact. In addition, whilst it is assumed that any consented development would be subject to mitigation and management measures which would reduce impacts to non-significant unless there were exceptional circumstances, it is accepted that such projects may contribute to a wider cumulative impact.

90. Finally, in cases where the Project has negligible or no impact on a receptor (through for example avoidance of impact through routeing or construction methodology) it is considered that there is no pathway for a cumulative impact.

19.4.4.3.2. Habitats Regulations Assessment

91. Information to support an HRA is presented in **Document MOR/RHDHV/DOC/0067, Information to Support HRA**. The HRA assesses whether or not the Project is likely to give rise to a likely significant effect upon a European site (SPA, SAC or Ramsar sites), either alone or in combination with other projects.

92. This chapter refers to and draws on the HRA when discussing potential impacts upon ecological receptors which are European sites or are associated with European sites. With regards to terrestrial ecology features, the HRA considers chough from the Glannau Ynys Gybi / Holy Island Coast SPA and the Vegetated sea cliffs of the Atlantic (and Baltic) Coasts feature from the Glannau Ynys Gybi / Holy Island Coast SAC.

19.5. EXISTING ENVIRONMENT

19.5.1. Designated Sites

19.5.1.1. Statutory Nature Conservation Designated Sites

93. Statutory designated sites, such as SPAs, Ramsar sites, SACs and SSSIs, protect areas of national and international importance and therefore are considered to be of high conservational value.

94. There is one SAC/SPA and two SSSIs within 2 km of the Onshore Development Area, and areas covered by the designations are afforded multiple levels of protection. These are summarised within **Table 19-10** below and shown on **Figure 19.2** (**Volume II**). Due to the site selection process, Porth Diana SSSI is no longer within 2 km of the Onshore Development Area and there is no pathway for impact with this site. This site is therefore not considered further.

Table 19-10 Statutory Designated Sites within 2 km of the Desk Study Area

Site name	Designation	Distance from Onshore Development Area	Description[1]
Glannau Ynys Gybi / Holy Island Coast	Special Protection Area (SPA)	Within the footprint of the landfall works within the Onshore Development Area.	Sea cliffs with cliff top grassland, offshore stacks and islets and maritime heath. The SPA supports a resident population of chough *Pyrrhocorax pyrrhocorax*, which depends on the diverse mix of habitats and their low intensity agricultural management. <u>Qualifying species:</u> Chough *Pyrrhocorax pyrrhocorax*, 18 pairs representing at least 5.3% of the breeding population and at least 2.6 % of the wintering population in Great Britain.
	Special Area of Conservation (SAC)	Within the footprint of the landfall works within the Onshore Development Area.	<u>Annex I habitats that are a primary reason for selection of this site:</u> Vegetated sea cliffs of the Atlantic (and Baltic) Coasts: maritime heath with spotted rock rose *Tuberaria guttata* and extensive cliff-crevice and grassland communities. European dry heaths: the most important site in North Wales for maritime dry heaths. The main NVC types are H7 *Calluna vulgaris* – *Scilla verna* heath and H8 *Calluna vulgaris* – *Ulex gallii* heath Small areas of wet

[1] *Information source: jncc.defra.gov.uk and https://naturalresources.wales (SPA and SAC citations)*

Site name	Designation	Distance from Onshore Development Area	Description[1]
			heath; grassland, heath, bracken and bramble scrub zonation. The heath is an important locus for spotted rock-rose *Tuberaria guttata*. <u>Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site</u> Northern Atlantic wet heaths with *Erica tetralix.*
	Site of Special Scientific Interest (SSSI) (and component of Glannau Ynys Gybi / Holy Island Coast SPA/SAC)	Within the footprint of the landfall works within the Onshore Development Area.	Heathland, maritime grassland, coastal cliffs and ledges, a variety of vascular plants (heathland and maritime species), birds (seabirds, peregrine, chough and heathland species), invertebrates and geology.
Tre Wilmot	SSSI (and component of Glannau Ynys Gybi / Holy Island Coast SPA/SAC)	36 m	Lowland heath and rocky ridges with intervening depressions with a range of heathland vegetation communities, including wet heath and peatland communities, and small open water areas.
Beddmanarch-Cymyran	SSSI	59 m	Supports a variety of coastal habitats including sandbank, mudflat, saltmarsh, dune heath. Important for overwintering and breeding birds and saltmarsh plant species and eel grass.

95. The site description (as detailed in the Core Management Plan, Countryside Council for Wales (CCW), 2008) relevant to terrestrial ecology for the Glannau Ynys Gybi (South Stack) area of the Glannau Ynys Gybi / Holy Island Coast SAC which overlaps with the Project is detailed in **Box 19.1**.

Box 19.1 Site Description of terrestrial ecology features for Glannau Ynys Gybi (South Stack) area of the Glannau Ynys Gybi / Holy Island Coast SAC (CCW, 2008)

This site is of special interest for its geological and biological features, including heathland and maritime grassland communities, coastal cliffs and ledges, its assemblages of vascular plants and birds, invertebrates and its solid geology. The site lies on the north west corner of Holy Island and includes the most westerly point on Anglesey. Holyhead lies immediately to the east.

An extensive area of dry lowland heath of heather *Calluna vulgaris* and western gorse *Ulex gallii* covers the flanks of Holyhead Mountain. Scree along the western edge of the mountain supports a more diverse bilberry *Vaccinium myrtillus* subcommunity of this heather/ western gorse heath. Around the coastal margins heather /western gorse heath of the spring squill *Scilla verna* subcommunity grades into heather *Calluna vulgaris* /spring squill *Scilla verna* maritime heath. In wetter areas cross-leaved heath *Erica tetralix*, bogmoss *Sphagnum compactum* and deergrass *Scirpus cespitosus* dominate cross-leaved heath Erica tetralix wet heathland.

On rocky ledges and at the top of the cliffs the vegetation comprises the thrift *Armeria maritima* - common mouseear *Cerastium diffusum* maritime therophyte community. This generally forms rather sparse open turf with much bare ground; associated species include buckshorn plantain *Plantago coronopus* and kidney vetch *Anthyllis vulneraria*. On deeper soils above the cliffs is the cocksfoot *Dactylis glomerata* subcommunity of the red fescue - *Festuca rubra* Yorkshire fog *Holcus lanatus* grassland. These areas are characterised by a very thick sward with associated Spring squill, wild carrot *Daucus carota* and sorrel *Rumex acetosella*.

The cliffs support important seabird colonies; guillemots, razorbills and puffins combine to create one of the largest colonies of breeding auks in North Wales. Fulmar and kittiwake also nest on these cliffs together with peregrine and chough, the latter using the heathland and adjacent areas extensively for feeding. Within the heathland stonechat, skylark, linnet and whitethroat all breed regularly.

The site supports a good range of invertebrates including the silver studded blue *Plebejus argu*s. Marsh fritillary *Eurodryas aurinia* has been recorded here in the past.

19.5.1.2. Non-Statutory Nature Conservation Designated Sites

96. There are five non-statutory Local Wildlife Sites (LWS) and ten Ancient Woodland Sites (AWS) within the Desk Study Area. The Onshore Development Area also borders South Stack Cliffs RSPB reserve, and marginally overlaps its boundary where the temporary construction buffer extends past the road where the cables will be laid. One AWS is located within the onshore development area, one is adjacent to the boundary and one is located 25 m away. Breakwater Country Park is located 1,270m to the north of the landfall. The location, designation and summary description for each site are described in **Table 19-11**. The location of these Sites is shown in **Figure 19.3** (**Volume II**), which also shows one further LWS that lies just outside the Desk Study Area.

97. These non-statutory designated sites are of local ecological importance and have protection from development under Joint Local Development Plan (JLDP) Policy AMG6. As such they are considered to be of medium value.

Table 19-11 Non-Statutory Designated Sites

Local Wildlife Site / Ancient Woodland Site	Grid reference	Distance from Onshore Development Area	Description
Cors Tre Wilmot LWS	SH222816	7.35 m	Valley wetland with herb rich, rush dominated fen meadows. With reedbed, purple moor-grass and bog vegetation.
Arfordir Bwth Corwgl – Bae Trearddur LWS	SH242794	721.2 m	Rocky coast with grassland and heath.
Rhostir Mynydd Celyn LWS	SH237813	358.9 m	Enclosed pastures and low rock outcrops, grassland and dry and wet heath.

Local Wildlife Site / Ancient Woodland Site	Grid reference	Distance from Onshore Development Area	Description
Chwarel Morglawdd, Caergybi LWS	SH227832	807.8 m	Disused quarry, heathland.
Cors Pont Hwfa LWS	SH238822	1202.7 m	Reedbed, fen vegetation and marshy grassland.
South Stack Cliffs RSPB Reserve	SH216819	Within the footprint of the Onshore Development Area	Heathland, farmland, sea cliffs, chough and breeding guillemots, razorbill and puffin
Breakwater Country Park	SH229835	1,270 m	Heathland, barn owl, peregrine falcon, quarry
AWS: 26037	SH273805	25 m	Ancient Semi Natural Woodland.
AWS: 26041	SH270809	93.8 m	Ancient Semi Natural Woodland.
AWS: 26042	SH272811	54.6 m	Ancient Semi Natural Woodland.
AWS: 26043	SH268813	492.3 m	Ancient Semi Natural Woodland.
AWS: 26044	SH267815	683.2 m	Ancient Semi Natural Woodland.
AWS: 26066	SH270804	0 m	Restored Ancient Woodland Site.
AWS: 26067	SH274806	79.1 m	Restored Ancient Woodland Site.
AWS: 43665	SH272805	0 m	Plantation on Ancient Woodland Site.
AWS: 43667	SH268812	0 m	Plantation on Ancient Woodland Site.
AWS: 43668	SH274810	295.1 m	Plantation on Ancient Woodland Site.

98. As part of embedded mitigation within the design phase, all LWS have been avoided. Given the distance and geographical separation from the Onshore Development Area, direct or indirect impacts on LWS are not anticipated from the development. As such, there will be no impact on LWS.

99. Impacts to the RSPB reserve, Country Park and AWS are considered in **Section 19.6.3 and 19.6.5.**

19.5.2. Protected Habitats and Species

19.5.2.1. Habitats

100. Habitats which fall within the boundaries of the designated sites are discussed within **Section 19.5.1** above. The HRA Screening and information to inform an Appropriate Assessment is presented in **Document MOR/RHDHV/DOC/0067, Information to Support HRA.**

101. The Onshore Study Area incorporates a wide range of habitats. Habitats recorded during the EP1HS are shown on **Figure 19.6** (**Volume II**) and described below.

19.5.2.1.1. Grassland

102. A variety of grassland types are present within the Onshore Study Area.

103. Unimproved grassland is uncommon and generally limited to small patches of maritime grassland on steeper slopes and along the top of cliffs in the west part of Holy Island (Abraham's Bosom, where landfall will take place) and at the top of the small cliffs to the south of the road between South Stack and Trearddur Bay. This unimproved grassland has the character of maritime grassland, supporting cock's-foot *Dactylis glomerata*, Yorkshire fog *Holcus lanatus* and red fescue *Festuca rubra*, with occasional sorrel *Rumex acetosa*, bladder campion *Silene vulgaris*, spring squill *Scilla verna*, primrose *Primula vulgaris*, common scurvy grass *Cochlearia officinalis*, and wild carrot *Daucus carota*.

104. The majority of grassland within the Onshore Study Area is either grazed species-poor semi-improved grassland or improved grassland. Many of the fields are improved, supporting a high proportion of perennial rye grass *Lolium perenne* and few other species.

105. The low-input short-sward semi-improved pasture fields provide suitable foraging habitat for chough. Some of these fields in the western part of the Onshore Study Area are managed by the RSPB to provide habitat for chough, which nests in the Holy Island SPA, immediately adjacent to the Onshore Development Area. Chough are discussed in **Section 19.5.2.2.7**.

106. Marshy grassland is a common feature on Holy Island, with damper ground supporting abundant growth of soft rush *Juncus effusus*, with occasional cuckooflower *Cardamine pratensis*, tufted hair-grass *Deschampsia caespitosa* and purple moor-grass *Molinia caerulea*. The onshore cable corridor passes through an area of marshy grassland south west of the leisure centre.

107. Small patches of dry open grassland occur in the land surrounding the former aluminium works, forming part of a mosaic of scrub, carr woodland and grassland in this area.

108. Amenity grassland is also occasionally present within the Onshore Study Area, mainly in the form of campsites, lawns and managed recreational areas (e.g. sports pitches).

19.5.2.1.2. Heathland

109. Extensive areas of heathland are present in the western part of Holy Island, these occur primarily within the Glannau Ynys Gybi / Holy Island Coast SSSI/SAC and Tre Wilmot SSSI. Heathland habitat has been avoided by the Onshore Development Area. Small areas of coastal heath occur on the various small headlands between South Stack and Trearddur Bay, in amongst areas of maritime grassland.

110. These areas of heathland are dominated by heather *Calluna vulgaris* and western gorse *Ulex gallii* with occasional cross-leaved heath *Erica tetralix*, bilberry *Vaccinium myrtillus*, purple moor-grass, spring squill, and deer grass *Trichophorum cespitosum*.

19.5.2.1.3. Scrub

111. Patches of dense and scattered scrub vegetation are common features within the landscape. In the western part of Holy Island, the scrub is interspersed with areas of pasture, often where low rocky outcrops occur. These patches of scrub are typically dominated by gorse, with patches of bracken *Pteridium aquilinum* and bramble *Rubus fruticosus agg*. Scrub habitat mosaic borders much of the road that the Onshore Cable Route will be located within in the west of the Onshore Development Area, between landfall and the leisure centre (TN 1). Scrub is also present within the Grid Connection Substation location. Heather does occur but is less frequent than on the SSSI heathland. Ground flora more typically characteristic of woodland, including bluebell Hyacinthoides non-scripta, wood sorrel *Oxalis acetosella*, primrose, honeysuckle *Lonicera periclymenum* and red campion *Silene dioica*, occurs occasionally in the more sheltered areas, typically between rocky outcrops, under a low canopy formed by gorse.

19.5.2.1.4. Cliff Vegetation

112. The sea cliffs around South Stack and the Range in the western part of Holy Island support a diverse vegetation community including thrift *Armeria maritima*, primrose, sea beat, sea squill, common scurvy grass, bladder campion, kidney vetch *Anthyllis vulneraria*, buck's-horn plantain *Plantago coronopus*, western gorse, and blackthorn *Prunus spinosa* scrub.

113. A number of nationally rare plant species are known to occur on these cliffs (NRW, 2018), as described in the Glannau Ynys Gybi / Holy Island Coast SSSI citation, including South Stack fleawort *Tephroseris integrifolia* sp. *maritima*, spotted rock rose *Tuberaria guttata* and rock sea lavender *Limonium britannicum* sp. *celticum* and also various bryophytes and ferns. Exposed rock is frequent on the cliffs.

19.5.2.1.5. Wetland Vegetation

114. Wetland vegetation is present in several parts of the Onshore Study Area. In the western part of Holy Island is Cors Tre Wilmot, a LWS, which is an extensive valley wetland with herb-rich, rush dominated fen meadows, with areas of reedbed, purple moor-grass and bog vegetation. This area has been avoided by the Onshore Development Area.

115. An area of reedbed and fen vegetation is present to the north and west of Holyhead Leisure Centre, shown on **Figure 19.5** (**Volume II**) as swamp and marshy grassland habitat (TN1). The Onshore Development Area has been widened around this section of route to allow for micro-siting to avoid this area if possible, however the Onshore Cable Route may potentially pass through this wetland vegetation. It supports damp grassland tussocks, soft rush, sedge *Carex* sp., common reed *Phragmites australis*, cuckooflower, horsetail *Equisetum* sp., great willowherb *Epilobium hirsutum* and patches of willow *Salix* sp. and bramble scrub. This area is shown on **Figure 19.5** (**Volume II**).

19.5.2.1.6. Ponds/Waterbodies

116. There are 45 ponds/waterbodies on Holy Island, 19 of which were within the GCN Study Area. These range from small reservoirs in the western part of Holy Island, to field ponds in pasture, heathland pools, a balancing pond by the new Roadking Truckstop at Parc Cybi, and the woodland ponds in Penrhos Coastal Park.

117. Many of the ponds support vegetation. This varies considerably between ponds, frequently occurring species include yellow flag, common reed, floating sweet-grass *Glyceria fluitans*, soft rush, marsh marigold *Caltha palustris*, fool's water cress, and great willowherb.

19.5.2.1.7. Woodland

118. Woodland habitats occur infrequently on Holy Island. The most extensive area of woodland occurs on either side of the A5 in the vicinity of the Grid Connection Substation, between the former aluminium works and Penrhos Coastal Park. This area supports blocks of ancient woodland and plantation on ancient woodland, and also patches of secondary woodland. Sycamore *Acer pseudoplatanus* is the dominant tree species in the ancient woodland, with hazel *Corylus avellana* common in the understorey. Beech *Fagus sylvatica* and various conifers are also present. Ground flora includes a variety of typical woodland species including bluebell, ramsons *Allium ursinum*, dog's mercury *Mercurialis perennis*, primrose, pendulous sedge *Carex pendula*, and various ferns including male fern *Dryopteris filix-mas*, common polypody *Polypodium vulgare* and hart's tongue *Asplenium scolopendrium*, with patches of ivy *Hedera helix* and bramble. One AWS is located within the Onshore Development Area (**Table 19-11** and **Figure 19.3, Volume II**): a restored AWS within the HDD area for crossing the railway and A55. A plantation on AWS is located adjacent to the Grid Connection Substation.

119. Further blocks of mainly mixed woodland and scrub are present to the south of the A55, on the far side of the dual carriageway from the Grid Connection Substation. These woodland areas are mainly of relatively recent origin and include a mixture of broadleaved (sycamore, sweet chestnut *Castanea sativa*, silver birch, oak *Quercus* sp., willow *Salix* sp., cherry *Prunus* sp.) and coniferous species (*Pinus* sp. and *Picea* sp.), and extensive patches of hawthorn scrub, gorse and bramble scrub. Small pockets of semi-natural broadleaved woodland are present on the eastern side of the track between to corner of Lon Towyn Capel and the A55 including a small area of ancient woodland at TN2.

120. Broadleaved plantation woodland (sycamore and Scot's pine *Pinus sylvestris*), and small patches of willow and alder carr woodland are present in the land to the west of the Grid Connection Substation.

121. Away from these areas, woodland cover is generally very limited with occasional small copses of trees and shrubs close to properties or occurring within other habitat types.

19.5.2.1.8. Field Boundaries

122. The field boundaries on Holy Island vary. Many are formed by mortared stone walls (particularly adjacent to wider roads) and dry-stone walls. There are traditional vegetated stone walls/earth banks (cloddiau) within the Onshore Development Area (**Figure 19.5, Volume II**). These occur more frequently beside minor roads and internal field boundaries, mainly in the west part of Holy Island, including the footprint of the landfall. Post and wire/rail fences, natural banks and rocky outcrops, and occasionally hedgerows also form some of the field boundaries (**Figure 19.6, Volume II**).

123. Cloddiau can support a wide variety of plant species (such as primrose, red campion, wild carrot, Alexanders, yarrow *Achillea millefolium*, foxglove Di*gitalis purpurea,* scurvy grass, creeping

thistle *Cirsium arvense*, wood sage *Teucrium scorodonia*, bluebell, gorse, bracken and bramble). A number of Cloddiau are within the Onshore Development Area in the vicinity of the landfall area.

124. Hedgerows are classed as species poor and are both continuous and defunct in structure within the Onshore Study Area.

19.5.2.1.9. Urban/Built-Up Areas

125. The majority of the Onshore Cable Route will be located within the existing road network, which passes through rural settlements. The onshore cable route passes Holyhead Leisure Centre before Horizontal Directional Drilling (HDD) transports it under the railway and A55 to the former aluminium works where the Grid Connection Substation will be located.

126. There are several discrete areas of vegetation, or undeveloped fields, adjacent to the roads within the western part of Holyhead, including a small area of secondary woodland at TN3, and an area of derelict land and a former paddock with patches of woodland ground flora at TN4.

127. Landscaping, including drains with grass margins and banks planted with trees and scrub, occur around the business park currently being developed on either side of Parc Cybi, at the eastern edge of Holyhead, where the Switchgear Building will be located.

128. The former aluminium works at Penrhos, supports large industrial buildings and hard-standing (approximately 40 ha in area), set in grounds which include approximately 40 ha of habitats including grassland, scrub, woodland and wetland vegetation.

129. This site also supports a small area of open mosaic habitat (OMH). Approximately 1.0 ha of this habitat type is present to the south of the aluminium works buildings, which borders and slightly overlaps into the Onshore Study Area (**Figure 19.5, Volume II**). This area supports patches of marshy grassland with areas of bare ground, inundated areas and ditches. Species present include soft rush, silverweed *Potentilla anserina*, creeping cinquefoil *Potentilla reptans*, knapweed, a hawkbit sp. Leontodon, common centuary *Centaurium erythraea*, knapweed and common mouse-ear *Cerastium fontanum*.

130. There are no extensive areas of urban and built up areas in other parts of the Onshore Study Area. Very small plots (<0.25 ha) supporting waste ground or vacant plots are considered to have low ecological value and have been excluded from the assessment.

19.5.2.1.10. Habitats of Principal Importance

131. The Onshore Study Area supports small areas of various habitat types which are habitats of principal importance (see **Table 19-12** below and **Figure 19.5, Volume II**); these habitats are listed in response to Section 7 of the Environment (Wales) Act 2016.

132. The criteria set out in Maddock (2011) have been used to identify these habitat types, which are summarised in **Table 19-12** below, together with identification of potential impacts:

Table 19-12 Impacts to habitats of principal importance. * Habitats with a similar or corresponding category in the Anglesey BAP

Habitat of Principal Importance	Status and location within Onshore Study Area (See Figure 19.5, Volume II)	Potential impacts
Coastal saltmarsh	Coastal saltmarsh is present just to the south of the west end of the A55 bridge (forming part of the Beddmanarch-Cymyran SSSI); a small area of saltmarsh has also formed at the east (Valley) end of the lagoon between the A5 and A55 bridges (again also within the boundary of the SSSI). Further saltmarsh vegetation (also part of the SSSI) is present on the east side of Lon Towyn Capel (SH 261794) and to the east of private track that runs between to corner of Lon Towyn Capel and the A55 (at SH264797).	This habitat has been avoided and there is no pathway for impacts to this habitat.
Coastal vegetated shingle	This habitat is present on the shores of the Beddmanarch-Cymyran SSSI at either end of the A5 and A55 bridges (within the boundary of the SSSI).	This habitat has been avoided and there is no pathway for impacts to this habitat.
Eutrophic standing waters*	There are three reservoirs in the west part of Holy Island (referred to as ‘ponds’ 1, 2 and 3, elsewhere within the report). These have not been subject to detailed survey but may meet the criteria for inclusion within this habitat type.	These reservoirs have been avoided and there is no pathway for impacts to this habitat.
Hedgerows*	Few hedgerows are present in the west part of Holy Island. Those that are present are species poor and a number are defunct. NB: Although not included in the definition in Maddock (2011) cloddiau (vegetated walls) are included in the hedgerow section of the Anglesey Biodiversity Action Plan (these are considered below).	There is potential for disturbance for up to four species poor hedgerows at landfall. Along the cable route there is potential for disturbance of up to 14 species poor intact or defunct hedgerows. These hedgerows are considered to be of medium value.
Inland rock outcrops and scree habitats	Small inland rock outcrops occur in several areas across the island, occurring frequently on either side of Porthdafarch Road and on either side of Lon Isallt. These rocky areas typically occur in association with scrub and heathland.	This habitat has been avoided and there is no pathway for impacts to this habitat.
Intertidal mudflats	Extensive intertidal mudflats occur within Beddmanarch-Cymyran SSSI on either side of the A5 and A55 bridges.	This habitat has been avoided and there is no pathway for impacts to this habitat.
Lowland dry acid grassland	Small patches of this habitat type occur in association with more extensive areas of heathland; the majority of this habitat type in Holy Island is beyond the Onshore Study Area.	This habitat has been avoided and there is no pathway for impacts to this habitat.
Lowland fen*	The west and southern tip of Cors Tre Wilmot Local Wildlife Site, which includes fen vegetation, north of the Onshore Development Area at SH 22085 81824 and SH 21873 81133, respectively. There is also include some fen vegetation is present to the north and west of Holyhead Leisure Centre.	The LWS has been avoided and there will be no impact to this habitat. The Onshore Cable Route passes through the lowland fen habitat west of the

Habitat of Principal Importance	Status and location within Onshore Study Area (See Figure 19.5, Volume II)	Potential impacts
		Holyhead Leisure Centre. This habitat is considered to be of medium value.
Lowland heathland	Heathland occurs extensively in the Holy Island Coast SSSI and Tre Wilmot SSSI (both parts of the Holy Island Coast SAC). Away from the SSSI smaller patches of heathland/scrub vegetation are common features within the landscape interspersed with areas of pasture, frequently where low rocky outcrops occur.	This habitat is not within the Onshore Development Area and has been avoided. There is no pathway for impacts to this habitat.
Lowland meadows	This habitat type includes a wide range of lowland grasslands, including most forms of unimproved neutral grassland. The grassland habitats identified during the survey are not assessed to meet the habitat criteria set out in Maddock (2011), being either improved or semi-improved. (See also Maritime Cliff and Slopes for maritime grassland).	The grassland habitats within the footprint are considered to of low ecological value and not classed as Habitats of Principal importance.
Lowland mixed-deciduous woodland*	This habitat type occurs on either side of the A5 between the former aluminium works and Penrhos Coastal Park, where a combination of ancient woodland, plantation on ancient woodland, and also patches of secondary woodland occur. Several small pockets of semi-natural deciduous woodland are also present on either side (although primarily on the east side) of the private track that runs northwards between Lon Towyn Capel and the bridge over the A55. No other significant blocks of ancient woodland occur. Other blocks of woodland are present but appear to be more recently planted/secondary woodland and are therefore considered less likely to meet the Priority Habitat criteria in Maddock (2011).	Woodland within the Onshore Development Area will be avoided and fenced off as part of embedded mitigation therefore this habitat has been avoided and there is no pathway for impacts to this habitat.
Maritime cliff and slopes*	This habitat type is extensive on the sea cliffs around South Stack and the Range in the west part of the Study Area. All areas of higher cliff have been avoided, under a worst case scenario there will be temporary disturbance should the cables be trenched through this habitat at landfall. Areas of cliff top maritime grassland occur in several areas to the south of Lon Isallt between the Range and Trearddur.	The preference is for cables to be installed under the cliffs using HDD technology. Under this scenario, the cliff habitat and associated vegetation will be avoided and there will be **no impact** to maritime cliff and slope habitat. Under a worst case scenario. the cables will be trenched at landfall and installed in J-tubes up the cliff. This habitat is assessed to be of high value and is part of the SAC designation.
Open mosaic habitat on	This habitat type occurs in the land surrounding the former aluminium works.	The Onshore Cable Route utilises the corridor between

Habitat of Principal Importance	Status and location within Onshore Study Area (See Figure 19.5, Volume II)	Potential impacts
previously developed land (OMH)	This habitat type is present to the south of the aluminium works buildings, which is within the Onshore Development Area. Other patches of OMH are present nearby but these are outside the Onshore Development Area.	the south side of aluminium works and the railway line and there is potential for an impact on this habitat. This habitat is considered to be of low value as it is currently subject to scrub encroachment.
Ponds*	The pond priority habitat classification relates to ponds which support species and assemblages of conservation importance. Not all the ponds within the GCN Study Area are considered likely to meet these criteria set out in Maddock (2011). For guidance, if great crested newt was present the pond would meet the criteria. The results of the surveys for this species in 2018 were negative.	GCN were not found to be established in any pond habitat. Ponds have been avoided as part of the embedded mitigation and any which lie within the Onshore Development Area will be fenced off, therefore there is no pathway for impacts to this habitat.
Purple moor-grass and rush pastures*	The southern tip of Cors Tre Wilmot Local Wildlife Site includes purple moor grass vegetation	This habitat has been avoided and there is no pathway for impacts to this habitat.
Reedbed* (marked as swamp on the Phase 1 habitat survey plan)	The southern tip of Cors Tre Wilmot Local Wildlife Site includes reedbed (swamp) vegetation. An area of wetland vegetation, which primarily includes swamp (reedbed), is present to the north and west of Holyhead Leisure Centre (at SH 245808). Areas of swamp and marshy grassland occur in the habitats to the north of the former aluminium works at (SH 26267 81343) and just to between the A5 and Penrhos Beach Road (at SH 26040 81537). Small patches of reedbed and swamp also occur adjacent to Lon Towyn Capel and at the corner of Lon Isallt and Parc Isallt in Trearddur Bay	Cors Tre Wilmot LWS has been avoided and there is no pathway for impacts to this habitat here. The Onshore Cable Route passes through the lowland fen habitat west of the Holyhead Leisure Centre. This habitat is considered to be of medium value. All other areas of swamp and marshy grassland have been avoided and there is no pathway for impacts to this habitat.

* Habitats with a similar or corresponding category in the Anglesey Biodiversity Action Plan

19.5.2.2. Species

19.5.2.2.1. Great Crested Newt

133. There are 18 previous records of GCN from Holy Island. A cluster of records was provided by Cofnod for an area immediately to the west of Holyhead that includes several ponds (Ponds 7-12) and this area has been avoided. The Onshore Development Area does not fragment this habitat and, should GCN be present in these ponds, the Project will have no impact to them or the connective habitat between the ponds. These records are not considered further. A single record was provided from the vicinity of the golf course (from a location near to Pond 19). This is a historic record and is 384 m from the Onshore Development Area, outside the GCN Study Area. A number of records were also provided from the area around Valley on Anglesey; however, this area has also been avoided during route design.

134. Pond 19b was surveyed for GCN in 2007; however, none were recorded (Cofnod, pers. comm., 4 May 2018). No data relating to any other previous pond survey are held by Cofnod. It is therefore assumed that the remaining ponds within the Onshore Study Area have not previously been surveyed for GCN.

135. A scoping process was undertaken for HSI Assessment. Methodology for HSI is discussed in **Section 19.4.3**. A summary of the HSI assessment is provided in **Table 19-13** below, and more details are provided in **Appendix 19.1** (**Volume III**).

Table 19-13 Great crested newt HSI results summary (ponds within GCN Study Area).

HSI Category	Score	Pond	eDNA survey
Excellent	>0.8	N/A	N/A
Good	0.7-0.79	17, 18a, 19, 21,	Yes
Average	0.6-0.69	15b, 19a, 42	Yes
Below average	0.5-0.59	16a, 16b, 16c, 19b,	Yes
Poor	<0.5	3, 20,	No
Ponds within 250 m but scoped out of assessment	Scoped out (as agreed with IoACC)	Dry/Not present: 14, 15, 18b, 40, 41 Not a pond, part of a stream/watercourse: 16	No
Ponds beyond 250 m	Scoped out	All other ponds scoped out of the assessment.	N/A

136. While it's not possible to categorically state that ponds with a low HSI score will not support GCN, the HSI approach was designed to be proportionate to the level of risk, and this approach was agreed with IoACC. During the GCN surveys, suitable ponds within the GCN Study Area were surveyed using eDNA sampling, which is a reliable method for identifying presence. The relationship is not sufficiently strong, however, to allow estimations of the numbers of GCN in any particular pond. Given that the results for the ponds with higher HSI scores in proximity to the route were negative, it follows that those with low suitability (poor <0.5 HSI) are also unlikely to be used by GCN, although this is not 100 % accurate.

137. As agreed with IoACC, all ponds with HSI scores of 0.5 (classed as 'below average') and above were subject to eDNA survey during the GCN surveys (**Appendix 19.1, Volume III**). Eleven of these ponds were within 250 m of the Onshore Development Area. The results of the eDNA survey are summarised in **Table 19-14** below.

Table 19-14 Results of eDNA survey

Pond	Sample successfully tested (Y/N)	eDNA Survey result
15b	Y	Negative
16a	Y	Negative
16b	Y	Negative
16c	Y	Negative
17	Y	Negative
18a	Y	Negative

Pond	Sample successfully tested (Y/N)	eDNA Survey result
19	Y	Negative
19a	Y	Negative
19b	Y	Negative
21	Y	Negative
42	Y	Negative

138. The ponds that were sampled in the west part of the GCN Study Area are not near any previously identified GCN populations.

139. GCN are EPS, listed on Schedule 2 of the Conservation of Habitats and Species Regulations 2010 (as amended). They are subject to the provisions of Regulation 43 of those Regulations. All EPS are also protected under the Wildlife and Countryside Act 1981 (as amended) and listed on the Anglesey LBAP and Section 7 of the Environment Wales Act. As such, GCN are considered to be of high importance.

19.5.2.2.2. Otter

140. Twenty seven records of otter were provided by Cofnod within the Desk Study Area (as shown on **Figure 19.7, Volume II**). The majority of these records were from Anglesey. Five of these were from Holy Island and one is within the Onshore Study Area but outwith the boundary of the Onshore Development Area, at the south east extent of the old aluminium works.

141. The coastal areas provide extensive areas of habitat suitable for foraging and resting sites. There is limited habitat potential for otter across the Onshore Study Area and habitat fragmentation is not anticipated to occur. There are no freshwater watercourses at landfall to provide habitat for otters to clean their fur or shelter, and no other suitable watercourses within the Onshore Development Area. No signs of otter were recorded during the field surveys.

142. Otter are EPS, listed on Schedule 2 of the Conservation of Habitats and Species Regulations 2017 (as amended). They are subject to the provisions of Regulation 43 of those Regulations. All EPS are also protected under the Wildlife and Countryside Act 1981 (as amended) and listed on the Anglesey LBAP. They are also listed on section 7 of the Environment Wales Act 2016. As such, otter are considered to be of high importance.

19.5.2.2.3. Bats

143. Numerous (133) bat records were provided by Cofnod for the Desk Study Area (**Figure 19-8, Volume II**). These include common pipistrelle *Pipistrellus pipistrellus* (the majority of records), soprano pipistrelle *Pipistrellus pygmaeus*, Daubenton's bat *Myotis daubentonii*, whiskered/Brandt's bat *Myotis mystacinus/brandtii*, Natterer's bat *Myotis nattereri*, Leisler’s *Nyctalus leisleri*, noctule *Nyctalus noctula*, Nathusius' pipistrelle *Pipistrellus nathusii*, and brown long-eared bat *Plecotus auritus*. A historic record from 2012 for at least one single common pipistrelle roost has been recorded in the Onshore Study Area close to landfall within the 50 m buffer at buildings at Ty’n Nant, 27 m west of the Onshore Development Area. No other known roosts are present within the Onshore Study Area.

144. The majority of bat records are associated with houses within Holyhead and in residential properties around South Stack. Records were also provided from the woodland area around Penrhos Park; few records were provided from other areas.

145. There is little woodland on Holy Island; however, since the island is exposed with little woodland, much of the Onshore Study Area does not offer extensive areas of optimal habitat for bats. There are, however, localised patches of good foraging habitat (dense scrub, ponds, ditches and wet grassland around waterbodies). The woodland habitat that is present is likely to offer suitable foraging habitat for bats. Hedgerows in the Onshore Study Area are recorded as species poor and often defunct, offering limited foraging suitability for bats.

146. Given the lack of woodland in the Onshore Study Area, buildings are considered likely to offer the main opportunities for roosting bats. There are no significant bridge structures which may provide roost habitat and no buildings will be removed during the construction works. It is possible that suitable tree roosts occur in the small areas of woodland that do exist, such as the woodland areas around Penrhos Country Park, which extend into the Onshore Study Area in the vicinity of the Grid Connection Substation.

147. Bats have protection under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) and as a EPS under Schedule 2 of the Conservation of Habitats and Species Regulations 2017 (as amended) and Section 7 of the Environment Wales Act 2016. Some species of bats are UK BAP priority species and Anglesey LBAP species.

148. The bat species recorded to be using the onshore site for foraging and commuting purposes are considered to have medium ecological value. The habitat within the Onshore Development Area is of low importance for roosting bats.

19.5.2.2.4. Red Squirrel

149. Three records of red squirrel *Sciurus vulgaris* were provided by Cofnod (as shown on **Figure 19.7, Volume II**) from dates between 2010 and 2017. Three are from the Penrhos Coastal Park area, which supports a mixture of ancient and plantation woodland. None are within the Onshore Study Area.

150. The woodland within and close to Penrhos Coastal Park, and some of the nearby woodland on the south side of the A55, offer suitable habitat for this species. The lack of woodland cover or ecological connectivity elsewhere means that the majority of the Onshore Study Area is unlikely to be suitable for red squirrel.

151. Red squirrels have protection under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) and is listed on Section 7 of the Environment Wales Act 2017. Red squirrel is also a UK BAP priority species and Anglesey LBAP species. Overall, red squirrels are considered to be of high value.

19.5.2.2.5. Water Vole

152. A total of 113 records of water vole were provided by Cofnod for the Desk Study Area. The majority of these are from ditches to the south and east of Valley, outwith the Onshore Study Area. Four of these records were on Holy Island, one of which was within the Onshore Study

Area, from a ditch with within the former aluminium works. A small cluster of records was provided from a ditch to the west of Holyhead as shown on **Figure 19.7** (**Volume II**).

153. During the EP1HS, no ditches were recorded in the Onshore Study Area that could provide suitable habitat for this species. No field signs were recorded during the EP1HS.

154. Water vole is protected under the Wildlife and Countryside Act 1981 (as amended). This makes it an offence to kill, injure or take any water vole, damage, destroy or obstruct access to any place of shelter or protection that the animals are using, or disturb voles while they are using such a place. Water vole is listed as a Species of Principal Importance under the provisions of the NERC Act 2006 in England and under the provisions of the Environment (Wales) Act 2016. Water voles and water vole habitat is considered overall to be of medium ecological value.

19.5.2.2.6. Badger

155. Badgers are Protected by the Protection of Badger Act 1992 and due to the sensitivity of this species and their risk to persecution, the location of badger setts are confidential. Details on the baseline environment from the desk study and EP1HS are provided in **Confidential Appendix 19.3** (**Volume III**) and shown on **Confidential Figure A19.3.1** (**Volume III**).

19.5.2.2.7. Birds

156. Habitats suitable for nesting birds (both common species and Schedule 1 species) occur throughout the Onshore Study Area including the sea cliffs, heathland, scrub, wetland areas, and woodland. The estuarine habitats between Holy Island and the Anglesey mainland are also important for passage and wintering birds.

157. The cliffs support a variety of cliff nesting sea birds, such as herring gull *Larus argentatus*, fulmar *Fulmarus glacialis*, kittiwake *Rissa tridactyla*, razorbill *Alca torda*, guillemot *Uria aalge*, puffin *Fratercula artica*, kestrel *Falco tinnunculus* and peregrine falcon *Falco peregrinus*. Seabirds are assessed in **Chapter 11, Offshore Ornithology** and are not considered further here.

158. The cliff vegetation in the western part of the Onshore Study Area forms part of the SPA for chough. Chough nest in caves in the cliffs and forage on low-input short sward grassland at the top of the cliffs. The Onshore Study Area includes numerous suitable fields. Where these occur close to nest sites, they are potentially important during the breeding season for foraging adults and fledged juveniles; birds range more widely in the winter and use a wider range of foraging habitat. Chough records for the Study Area are included in **Confidential Appendix 19.2** (**Volume III**) and shown on **Figures A19.2.1** – **A19.2.6** (**Volume III**).

159. Peregrine falcon *Falco peregrinus* is resident in the Holy Island SPA and is a Schedule 1 listed breeding species protected under the Wildlife and Countryside Act 1981. Peregrine falcon is most commonly recorded in the coastal strip, particularly around nesting seabird colonies on the cliffs. Barn owl *Tyto alba* is also listed on Schedule 1 and known to be present on Holy Island. Peregrine and barn owl records for the Study Area, supplied during the desk study, are included in **Confidential Appendix 19.2** (**Volume III**) and shown on **Figures A19.2.7** – **A19.2.8** (**Volume III**).

160. The heathland and scrub areas support linnet *Linaria cannabina*, whitethroat *Sylvia communis*, skylark *Alauda arvensis*, and stonechat *Saxicola rubicola*. The small patches of wetland vegetation are used by other species such as sedge warbler *Acrocephalus schoenobaenus* and reed bunting *Emberiza schoeniclus*, and, where scrub occurs, grasshopper warbler *Locustella naevia*. Marshy grassland provides suitable nesting habitat for lapwing *Vanellus* and curlew *Numenius arquata*.

161. Other areas of trees, scrub and shrubs provide nesting habitat for a variety of common and widespread species of nesting birds such as blue tit *Cyanistes caeruleus*, great tit *Parus major*, long-tailed tit *Aegithalos caudatus*, wren *Troglodytes*, robin *Erithacus rubecula*, dunnock *Prunella modularis*, blackbird *Turdus merula*, song thrush *Turdus philomelos*, and chaffinch *Fringilla coelebs*. The buildings may also offer opportunities for nesting birds such as starling *Sturnus vulgaris* and house sparrow *Passer domesticus*.

162. All nesting birds are protected under Section 1 of the Wildlife and Countryside Act 1981 (as amended) which makes it an offence to intentionally kill, injure or take any wild bird or take, damage or destroy its nest whilst in use or being built, or take or destroy its eggs. In addition to this, for some rarer species (listed on Schedule 1 of the Act), it is an offence to disturb them whilst they are nest building or at or near a nest with eggs or young, or to disturb the dependent young of such a bird. Breeding birds and supporting habitat are considered to be of medium value. Due to their listing on Schedule 1 and/or association with internationally designated sites. chough, peregrine falcon and barn owl, and habitat which supports these species is considered to be of high value.

19.5.2.2.8. Reptiles

163. Records of three common reptile species (namely adder *Vipera berus*, common lizard *Lacerta vivipara* and slow worm *Anguis fragilis*) were provided by Cofnod. Numerous adder records were provided from the heathland habitats around South Stack, The Range and Tre Wilmot, in the western part of Holy Island. Common lizard and slow worm records were also provided for these areas, but also with a few records of both species occurring more widely across the Desk Study Area. Four records of common lizard are present within the Onshore Study Area, three in the vicinity of landfall (two of which are within the Onshore Development Area) and one in the vicinity of the Grid Connection Substation. Reptile records are shown on **Figure 19.9** (**Volume II**).

164. The heathland, scrub and grassland mosaic which occurs patchily across Holy Island provides a good habitat for reptiles and it is likely that these species occur more widely across the Onshore Study Area.

165. Reptiles have protection under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). All native reptiles are UK BAP priority species and listed on Section 7 of the Environment Wales Act (2016). Reptiles are considered to have medium ecological value.

19.5.2.2.9. Plants

166. A large number of plant records were provided by Cofnod. Records summarised below relate to species listed on Schedule 8 of the Wildlife & Countryside Act, 1981 (as amended) and those

listed in response to Section 7 of the Environment (Wales) Act 2016 (Species of Principal Importance).

167. Spatulate (South Stack) fleawort *Tephroseris integrifolia* ssp. *maritima* is endemic to Holy Island and occurs along the cliff top vegetation between South Stack and the Range. This plant is listed on Schedule 8 of the Wildlife and Countryside Act, 1981 (as amended). Records of this species are shown on **Figure 19.10** (**Volume II**). Some of these records are from the section of coastline around Abraham's Bosom, outwith the Onshore Development Area but in the general vicinity of the proposed landfall points.

168. Records of golden hair lichen *Teloschistes flavicans* were provided for Porth Dafarch, south of the Onshore Development Area. These locations are close to but outside of the Onshore Development Area. This lichen is also listed on Schedule 8 of the Wildlife and Countryside Act, 1981 (as amended).

169. Records of the following plant species, which are listed in response to Section 7 of the Environment (Wales) Act 2016 (Species of Principal Importance), were provided by Cofnod:

- Several records of pillwort *Pilularia globulifera* and three-lobed crowfoot *Ranunculus tripartitus* were provided from Tre Wilmot SSSI. There are no records of this species from the Onshore Development Area;
- Pale dog violet *Viola lactea* occurs in several locations on The Range, part of the Glannau Ynys Gybi/ Holy Island Coast SSSI. There are no records of this species from the Onshore Development Area; and
- A historical record (1988) of small-flowered catchfly *Silene gallica* was provided from Bodwarren Farm (SH217811), in the west part of the Study Area. This record is however stated as a casual record, likely to have been introduced with grass seed.

170. There are other notable plant species/Welsh Red Data book plants (BSBI, 2018) which occur within the Study Area, including:

- Spotted rock-rose *Tuberia guttata*, which has a restricted UK distribution and a strong hold locally, occurs in several locations from the heathland around South Stack and The Range, and three records from the patchy heathland and scrub to the south of Lon Isallt; and
- A leek *Allium ampeloprasum* occurs in three locations in a road verge/field boundary near Ty Mawr (South Stack). This is within the Onshore Development Area at landfall.

171. Records of these species are shown on **Figure 19.10** (**Volume II**).

172. These species are considered to be of medium value. Spatulate fleawort is considered to be of high ecological value as it is endemic to the area.

19.5.2.2.10. Invertebrates

173. Records of invertebrate species listed in response to Section 7 of the Environment (Wales) Act 2016 (Species of Principal Importance) provided by Cofnod included various butterflies (small pearl-bordered fritillary *Boloria selene*, silver studded blue *Plebejus argus*, wall *Lasiommata megera*, grayling *Hipparchia semele* and small heath *Coenonympha pamphilus*) and a very wide

range of moth species. These records are predominantly from the heathland areas around South Stack, the Range, Tre Wilmott (mainly from areas within the SSSIs) and also from the large area of grassland, scrub and woodland habitat immediately to the south of the former aluminium works on the south side of the A55, which, given the number of records provided, appears to have been regularly surveyed for moths.

174. The majority of high value invertebrate habitat detailed above has been avoided through the site selection process, however due to the range of invertebrates recorded on Holy Island, which are rare according to the Red Data Book, or nationally scarce, the assemblage of invertebrates within the Onshore Development Area are considered to be of medium ecological value. The habitat within the Onshore Development Area is considered to be of low ecological value for invertebrates.

19.5.2.2.11. Invasive Species

175. The invasive plant Japanese knotweed was recorded from four locations on Holy Island locations during the EP1HS, two of which are located within the Onshore Development Area, as shown in **Table 19-15** below and shown on **Figure 19-10** (**Volume II**). No other records of invasive non-native species have been made in the area. Japanese knotweed is listed under Schedule 9 Part I of the Wildlife and Countryside Act 1981 (as amended). Invasive non-native species are considered to be of medium importance.

Table 19-15 Japanese knotweed locations

Reference (Figure 19-10, Volume II)	Location	OS Grid reference	Description
a	141 m from the Onshore Development Area, (adjacent to reservoir access track. Just inside the Glannau Ynys Gybi / Holy Island Coast SSSI heathland.	SH 22021 82089	A large stand of Japanese knotweed near the base of a steep area of heathland, just inside the Glannau Ynys Gybi / Holy Island Coast SSSI
b	Within the Onshore Development Area, within a small enclosed field at Ty Mawr, South Stack Road.	SH 21702 81798	A few plants around the perimeter of the field.
c	Within the Onshore Development Area, in western part of survey area, near Penrhosfeilw.	SH 21945 80590	Small clump in the road verge; likely to be very close to working area.
d	600 m from the Onshore Development Area, in woodland approximately 50 m to the west of access track.	SH 26464 79931	A large clump at the base of a spoil mound.

19.6. IMPACT ASSESSMENT

19.6.1. Overview of Potential Impacts

176. Impacts from the development could arise from the following activities:

- Vegetation removal;
- Excavation of trenches;
- Storage of arisings;
- Storage of other materials;
- Creation of site compounds;
- HDD compounds and other above ground infrastructure;
- Temporary removal of field boundaries; and
- Creation of ditch crossing points.

177. At worst case, these potential impacts are anticipated to be greatest during construction and decommissioning activities, with less disturbance anticipated during the operational phase of the Project.

178. This work has the potential to give rise to impacts on habitats through:

- Direct permanent or temporary loss or fragmentation of habitat features;
- Temporary disturbance of habitats (such as light, dust, noise or pollution events);
- Spread of non-native invasive species; and
- Localised changes in hydrology.

179. The work also has potential to give rise to the mortality or disturbance to individuals of certain species.

180. Impact risk is considered below in **Section 19.6.5** and **Section 19.6.6** with respect to designated sites, habitats and protected species, with recommendations for mitigation or further pre-construction survey where appropriate and proportionate to do so.

19.6.2. Worst Case Scenario

181. Full project details are discussed in **Chapter 4, Project Description**. With regards to onshore ecology, the worst-case scenario is outlined below.

19.6.2.1. Landfall

182. Two options are being considered for landfall of the subsea cable and connection to the shoreside cable (**Table 19-16**). Option 1 is for HDD landfall and Option 2 is for trenched landfall.

Table 19-16 Landfall Options

Parameter	**Option 1 (HDD at landfall – preferred)**	**Option 2 (trenched landfall – worst case)**
Max number of cables	9	9
Max. length of each drill / trench	550 m	480m – 740 m
Drill / trench dimensions	Nominally 450 mm	Nine x individual trench widths up to 600mm, or single trench up to 10m width; 0.5 to 1.2m deep
Separation distances	10m between HDD entry points and 20m between HDD exit points	Individual trench widths of up to 600 mm. Or a single trench with all nine cables laid within it of approximately 10 m width and 0.5 to 1.2 m deep
Beach crossing method	Underground	Trench across foreshore using an excavator and rock cutter
Cliff crossing method	Underground	Up to nine shallow trenches would be created using a rock cutter and the cables would be 'surface laid' over the cliff using a split pipe or J-tube. Nominal 500mm separation between J-tube centres is proposed. Therefore, total width of grouped J-tubes c.30m (0.5m x 8 for spacing + 0.35m x 9 for tubes themselves).
Material removed	Up to 900m^3 (spoil reused in substation build)	Up to 8,880m^3 (majority of the material excavated will be replaced as backfill)
Temporary working corridor	Underground	30m
Temporary works area	Up to 120m x 70m	Up to 100m x 50m
Culvert	A precast concrete box culvert will be installed beneath the Ty-Mawr Access Road to allow the onshore ducts to pass through the landfall substation with minimal disruption to existing access	
Transition pits	There will be one transition pit, up to 15 m x 85 m x 1.5 m deep, equating to a footprint of 1,275 m^2, excavated volume 1,912.5 m^3 in addition to trenching excavation or HDD cutting volumes (Worst case 36 ducts).	Up to 9, each up to 15m x 3m x 1.5m deep (spoil material removed)
Transition pits (post construction)	All transition pits will be buried upon completion of the works and covered by a depth of approximately 200mm topsoil (recovered from excavated materials) and seeded with grass mix	

183. There are currently two HDD scenarios to installing the export and onshore cables that may be possible:

- Scenario 1: HDD boreholes, onshore cable ducts and infrastructure are installed and subsequently pull through export and onshore cables. This work would take place during the construction phase; or

- Scenario 2: HDD boreholes, onshore cable ducts and infrastructure are installed during the construction phase. Each developer will pull through their export and onshore cables and therefore these operations will be staggered during the service life of the facility.

184. Scenario 1 represents the worst case scenario for cumulative noise, visual and disturbance impacts and therefore is assessed as such in the assessments within this chapter,

19.6.2.2. Landfall Substation

185. The landfall substation will have capacity of 240 MW (**Table 19-17**). The landfall substation will be enclosed within a boundary fence/wall and where necessary include screening to minimise the effect of visual impact.

Table 19-17 Landfall Substation

Parameter	Value (outdoor plant)
Footprint	The design would consist of a fenced site compound of an area equivalent to 80 m by 80 m. Within this would be three separate buildings of approximately: the first to 62 m by 22.5 m by 7 m high (or equivalent area): the second to 28 m by 10 m by 7 m high (or equivalent area); and the third to 8 by 8 by 7 m high (or equivalent area). The third building will be wholly within an external transformer compound of approximately 28 m by 36 m by 7 m high (or equivalent area).
Peak height	7m
Temporary construction compound and laydown area	50m x 70m (or equivalent area)
Screening	Positioned within a recessive location in the landscape within a valley and uses the landform to help integrate the substation into the landscape. Some screening may be incorporated into final design (see ***Chapter 24, SLVIA***)
Surfaces	Hard standing will hard core or tarmac surfaces. Footpaths may be poured concrete. Outdoor areas within the compound; crushed rock or gravel.
Lighting	Minimum of 110 lux directed lighting around entrance and electrical plant. Only be turned on when needed, as well as equipped with motion sensors.

19.6.2.3. Onshore Cable Route

186. As much as possible, it is proposed that the Onshore Cable Route from landfall to Grid Connection Substation will be trenched into the local road network. As the worst case, there will be the possibility that the verge or field areas will be used to install the final cable route and pit transition areas required for cable section installation (**Table 19-18**). The proposed cable corridor follows South Stack Road, Porthdafarch Road and Mill Road towards the Switchgear Building. The cable will be trenched from the Switchgear Building to the Grid Connection Substation, with a section installed via Horizontal Directional Drilling (HDD) beneath the A55 and the Holyhead to Bangor rail line.

Table 19-18 Onshore Cable Route

Cable route parameter	Landfall Substation to Switchgear Building	Switchgear Building to Grid Connection Substation
Circuit	132kv	33kv
Number of cables	6 power cables plus 2 fibre optic cables (2 circuits)	

Cable route parameter	Landfall Substation to Switchgear Building	Switchgear Building to Grid Connection Substation
Trench depth	1620mm	1620mm
Trench width	1400mm	2000mm
Length	6675m	1420m
Joint bays (No.)	18	2
Joint bay chamber depth	1.65m	1.65m
Joint bay chamber width	2m	3m
Joint bay chamber length	12.5m	5m
Draw pits (to be fully reinstated following works) (No.)	35	7
Draw pit depth	1.65m	1.65m
Draw pit width	3m	5m
Draw pit length	8m	8m
Temporary works area	6m up to 30m width. Space for cable pulling of up to 20m by 7m around each joint box (hardstanding)	
HDD Crossing	The two transition pits (entry and exit pits) will be 80m x 15m x 1.5x deep.	

19.6.2.4. Switchgear Building

187. The infrastructure at Parc Cybi will consist of a 33kV switchboard room and metering room. The existing road will be used to access this location, during both construction and operation of the switch. Dimensions of the switchgear building are detailed in **Table 19-19**.

Table 19-19 Switchgear Building

Parameter	Value (outdoor plant)
Footprint	9.4m x 5m
Peak height	4m
Temporary construction area and laydown	None
Screening	Screening influence of existing buildings and vegetation, with potentially additional screening (see ***Chapter 24, SLVIA***)
Surfaces	Hard standing will hard core or tarmac surfaces.
Foundations	Concrete slab
Lighting	Minimum of 110 lux directed lighting around entrance and electrical plant. Only be turned on when needed, as well as equipped with motion sensors.

19.6.2.5. Grid Connection Substation

188. A separate substation will be required to achieve connection at the grid connection point. The location of the Grid Connection Substation will be the Orthios site, the location of the former Anglesey Aluminium works to the north east of Holy Island. This will require access under the A55 and railway, which will be crossed by HDD. Dimensions of the Grid Connection Substation are detailed in **Table 19-20**.

Table 19-20 Grid Connection Substation

Parameter	**Value (outdoor plant)**
Footprint	104m x 62m
Peak height	9m
Appearance	External plan equipment plus four buildings.
Temporary construction compound and laydown area	50m x 100m or equivalent area
Screening	Screening influence of existing buildings and vegetation. Further screening may be incorporated (see ***Chapter 24, SLVIA***)
Surfaces	Hard standing will hard core or tarmac surfaces. Outdoor areas within the compound; crushed rock or gravel.
Foundations	Concrete slab.
Lighting	Minimum of 110 lux directed lighting around entrance and electrical plant. Only be turned on when needed, as well as equipped with motion sensors.

19.6.3. Mitigation

189. Options for reducing or avoiding the significance of these impacts include:

- Localised micro-siting of the route within the Onshore Development Area to avoid habitat features;
- Localised reduction of the width of the Proposed Working Area where required to avoid features;
- Habitat protection and reinstatement following the construction phase; and
- Avoidance of harm to nesting birds and protected species though adopting specific working practices, including the timing of the work to avoid sensitive periods.

190. An overarching Ecological Action Plan (EAP), incorporating all necessary mitigation measures and management plans for habitats and species, will sit underneath the Construction Environmental Management Plan (CEMP) (**Document MOR/RHDHV/DOC/0073, Outline CEMP**) (**Section 19.6.4**). This will be submitted for review to NRW and IOACC for agreement prior to construction.

19.6.3.1. Embedded Mitigation

191. The Project has undergone an extensive site selection process which has involved incorporating ecological considerations into the identification of the proposed onshore inshore infrastructure locations. The site selection process is provided in full in **Chapter 3, Site Selection and Consideration of Alternatives**. The following section describes the ecological constraints which have fed into this site selection process and have as a consequence avoided potential impacts upon selected ecological receptors.

19.6.3.1.1. Designated Sites

192. Constraints mapping was undertaken for landfall, cable routing and grid connection. This constraints mapping exercise was used to determine the route options for the onshore

infrastructure for the Project. The following ecological receptors were considered and avoided where possible as part of the constraints mapping process:

- International designated sites for nature conservation (SAC, SPA, Ramsar sites);
- National designated site for nature conservation (SSSI, LWS, RSPB Reserve and Country Park); and
- Ancient woodland.

19.6.3.1.2. Route Refinement

193. The onshore infrastructure has undergone continuous refinement since the publication of the three Morlais Scoping Reports (Royal HaskoningDHV, 2015; Royal HaskoningDHV, 2017; Royal HaskoningDHV, 2018). Refinements have included consideration of more detailed ecological constraints. The following principles have been applied when refining the onshore infrastructure into that presented in **Chapter 4, Project Description**:

- Ancient woodland – following the Forestry Commission's Standing Advice on Ancient Woodland and Veteran Trees, a buffer of 15 m around all ancient woodlands will been used (Forestry Commission, 2014);
- Woodland – areas of woodland have been avoided where possible (including root protection zone of max radius of 15 m where possible) during the route selection process;
- Habitat – standing water bodies, watercourses, trees, and agricultural ditches have been avoided where possible; and
- Hedgerows and Cloddeau – the number of hedgerow and Cloddeau crossings has been minimised as far as possible, taking other fixed constraints into account. When crossing hedgerows, the width of the cable easement will be reduced to the running track and cable trenches only to minimise the amount of hedgerow removal. A root protection zone will also be included (max radius of 15 m where possible).

19.6.3.1.3. Engineering Design

194. Consideration is made to the use of HDD at the landfall location, which will avoid disturbance of the coastal fringe habitats. The use of HDD is not confirmed and may not be possible for other reasons, see **Chapter 4, Project Description** for further details).

19.6.3.1.4. Replanting

195. A commitment of intention has been made by the Project to reinstate any habitat that has been removed using native species of local provenance matching the existing habitats as soon as practicably possible, with consideration of additional species to enhance diversity as appropriate. The maximum size of the hedgerow gap created has been minimised within the project design as far as possible.

19.6.3.1.5. Seasonal Constraints

196. Any hedgerow and tree removal will be undertaken outside of the bird nesting season. As a guide, the bird nesting season is between February and August inclusive; dates vary by species

and can be affected by prevailing weather conditions. The majority of species do not start nesting until March and April.

197. Where possible, construction in reptile habitat will take place within the reptile active season (March to October inclusive).

19.6.4. Mitigation Measures through Best Practice and Policy

19.6.4.1. Standard Best Practice

198. A commitment is made for all construction, operation and decommissioning activities to follow standard best practice guidance, including:

- Guidance for Pollution Prevention GPP5: Works in, near or over watercourses;
- Pollution Prevention Guidelines PPG6: Working at construction and demolition sites;
- Construction Industry Research and Information Association (CIRIA) C648 (2006) Control of water pollution from linear construction projects; and
- CIRIA Guidance note C692 Environmental Good Practice on Site Guide (3rd Edition).

19.6.4.2. Ecological Action Plan

199. All mitigation measures proposed in relation to the impacts identified for each receptor below will be incorporated and detailed in an overarching EAP. Where mitigation or management plans are mentioned in the mitigation sections below, these will be incorporated into the EAP also.

200. The EAP will form part of the Code of Construction Practice (CoCP) and will cover the ecological requirements of the pre, during and post-construction stages of the project. The EAP will be a live document and will be updated throughout each of these phases. The EAP will take into account any planning obligations and conditions attached to the Project should consent be granted. The EAP will be submitted to and agreed with the IoACC, NRW and other stakeholders, where appropriate, based upon the final design option chosen. The EAP will include the principal requirements of mitigation, including:

- Pre-construction ecological surveys;
- Habitats directly affected by the Project;
- Method statements (where necessary);
- Licensing requirements (where necessary);
- Habitat re-instatement plan;
- Habitat creation and management plan (if necessary); and
- Overall strategy for delivery of the mitigation proposed in this EcIA; including
  - Programme for delivery of mitigation; and
  - Responsibilities attributed to the relevant parties to deliver the plan.

201. An Ecological Clerk of Works (ECoW) will audit the implementation of the EAP. This would be a desk-based and site-based role. It should be noted that the mitigation measures presented

below are based on the individual receptor, therefore in some cases there may be a conflict between the requirements of one receptor over another (or indeed with other priorities, e.g. tourism and recreation). The ECoW will have suitable expertise to develop and find pragmatic solutions to any potential conflicts in consultation with the relevant consultees.

19.6.5. Potential Impacts During Construction

19.6.5.1. Construction Impact 1: habitat loss and disturbance of features of Statutory Designated Nature Conservation Sites

202. This section considered impacts to statutory designated nature conservation sites. Sites designated for marine and coastal birds are considered within **Chapter 11, Offshore Ornithology**. Those considered for marine mammals are considered in **Chapter 12, Marine Mammals**. Those considered for marine or intertidal features are considered in **Chapter 9, Benthic and Intertidal Ecology**.

19.6.5.1.1. Glannau Ynys Gybi / Holy Island Coast SSSI/SPA/SAC and Tre Wilmot SSSI

203. Potential impacts of habitat loss and disturbance during construction on the SPA qualifying species chough are considered in **Section 19.6.5.11.2**. Overall, following mitigation that no construction works will take place within 500 m of an active chough nest during the breeding season, impacts to chough are not anticipated to be greater than **minor adverse** in significance.

204. Holy Island has hard rock acidic cliffs and supports important examples of coastal cliff heathland vegetation. Extensive areas of heathland are present in the western part of the island, these occur primarily within the Glannau Ynys Gybi / Holy Island Coast SSSI/SAC and Tre Wilmot SSSI. Small areas of coastal heath occur on the various small headlands between South Stack and Trearddur Bay, in amongst areas of maritime grassland. These areas of heathland are dominated by heather *Calluna vulgaris* and western gorse *Ulex gallii* with occasional cross-leaved heath *Erica tetralix*, bilberry *Vaccinium myrtillus*, purple moor-grass, spring squill, and deer grass *Trichophorum cespitosum*.

205. ‘Vegetated sea cliffs of the Atlantic and Baltic Coasts’ and ‘European dry heath’ are Annex 1 habitats that are both primary reasons for the site’s designation as a SAC. ‘Northern Atlantic wet heaths with *Erica tetralix’* is also an Annex 1 habitat qualifying feature. The SAC is the most important site in North Wales for maritime forms of European dry heath and RSPB have requested during consultation (Project Meeting Minutes, RSPB South Stack Reserve, 24/01/2018) that the Project avoids impact to the heath habitat entirely due to its importance for breeding / foraging chough. Following the site selection process to define the working footprint of the Project, neither wet or dry heath have been recorded during the EP1HS within the Onshore Development Area and are therefore absent from the locations where the landfall activities will be undertaken. As shown in **Figure 19.6** (**Volume II**) this area of the designated land is characterised by improved grassland and poor semi improved grassland, with a strip of unimproved neutral grassland (4,200 m^2) and maritime cliff and slope (9,850 m^2) adjacent to the bay where landfall will occur, which fall within the interests of the ‘Vegetated sea cliffs of the Atlantic and Baltic Coasts’ designated feature. Spotted rock rose is recorded at numerous locations around the coastline (**Figure 19.10, Volume II**), but this plant is associated with heath

habitat and no records coincide with the Onshore Development Area. Other notable plant species are discussed in **Section 19.6.5.13** below.

206. Conservation Objectives for the SAC include for the vegetated coastal cliffs to remain largely undisturbed and support the endemic South Stack fleawort and other notable plants. Also, that 70% of the site should be characterised by good quality lowland and coastal heath and that in some areas where there are rocky outcrops in heathland, the habitat should be favourable for the spotted rock rose which occurs in the thin crusts of soil with lichens and mosses and short grasses. Areas of herb rich neutral grassland may be maintained for their floristic, invertebrate and chough feeding value.

207. A water resources assessment has been undertaken and is presented in **Chapter 17, Water Resources and Flood Risk**. The assessment concluded no significant impacts. There is no hydrological connection to the protected sites in terms of surface water, and the excavations are shallow enough to have no significant impact on groundwater flow. As such, there is not anticipated to be any hydrological impacts which may affect the habitats, species or designated features of the designated sites.

208. Air quality impacts on designated ecological sites are considered in **Chapter 22, Air Quality**. Impacts on designated sites relating to construction phase dust and particulate matter emissions were considered. Risk of dust impacts to ecological receptors, including the designated sites, were assessed to be high during earthworks, low during construction activities and medium from trackout from Heavy Goods Vehicles (HGV) movements. With the implementation of the recommended mitigation measures, i.e. adherence to best practice dust minimisation and suppression methods as recommended by the Institute of Air Quality Management (IAQM), including creation of a Dust Management Plan (DMP), impacts to ecological receptors are considered to be not significant. There are not anticipated to be any significant impacts on designated sites associated with road traffic emissions due to the expected low number of vehicle movements in the construction, operational and decommissioning phases.

209. Noise and vibration assessments are undertaken in **Chapter 21, Noise and Vibration**, and are discussed in detail in **Section 19.6.5.11.2** below regarding impacts to the chough population at the SPA. Following mitigation, there is not anticipated to be a significant noise impact on any designated sites or their features.

210. The preferred option of transporting the cables ashore at landfall is to use HDD (see **Chapter 4, Project Description**). This will avoid any interaction with the intertidal environment, vegetated sea cliffs and coastal fringe habitat, utilising the grasslands set further back from the coast (**Figure 19.6, Volume II**). Entry and Exit pits will be set back a minimum 10 m from sensitive coastal habitats. Should HDD be used as the landfall methodology, the designated site and its qualifying features will be avoided entirely, as will the habitat and species for which it is afforded protection, and consequently there will be **no impact** on Holy Island SSSI, SPA, SAC.

211. Under a worst-case scenario where HDD at landfall is not possible for technical / engineering reasons, landfall activities will involve trenching the cabling through a narrow coastal strip of the Holy Island SSSI, SPA, SAC designation. This will involve disturbance and temporary habitat loss of up to 31,700 m^2 of the designated site, which covers an area of 43,600,000 m^2 – Therefore a disturbance of a total percentage of up to 0.07 % of the entire designated site. A

maximum 14050 m^2 (0.032 % of the entire designated site) of the Onshore Development Area is within the neutral grassland and maritime cliff and slope habitat which contributes to the 'Vegetated sea cliffs of the Atlantic and Baltic Coasts' feature. In reality, the percentage of this feature disturbed during construction activities is likely to be less, as the full footprint of the Onshore Development Area is unlikely to be required for construction. Up to nine trenches will be placed 0.5 m wide and 0.6 m apart, or a single trench of 10 m wide with a working area buffer of up to 30 m each side will be required, equalling a corridor of 70 m wide across the grassland habitat. J-tubes will be grouped in a corridor approximately 30 m wide down the cliffs with a construction footprint of 30 m either side, equalling 90 m corridor. This corridor equates to 5300 m^2 (0.012 % of the entire designated site) of which 1,400 m^2 is in the neutral grassland habitat and 1,770 m^2 is in the maritime cliff and slope habitat.

212. Temporary habitat loss will still occur within the designated site in this 70 m wide corridor in the grassland habitat and the temporary 30 m construction footprint either side of the J-tubes. including across vegetated cliff and slope habitat and neutral grassland, which falls within the Annex 1 feature. Some permanent habitat loss may occur on the cliff face where cables are pinned in shallow slots, in a corridor of up to 30m wide however, expected that they would removed upon decommissioning. This would be of medium magnitude on the designated site as it will be potentially affecting designated features, although the percentage area of this habitat is very small, and all important wet and dry heath habitat has been avoided. The impact of trenching (and possible pinning of cables) through the SAC/SPA/SSSI is considered to be **major adverse** in significance, however the majority of the disturbance will be temporary and the amount of potential permanent habitat loss on the cliff face would be 1,770 m^2 (0.004%) of the entire designated site and is considered to be *de minimis*, with no impact on the site integrity.

213. As no heath habitat is present within this location, there will be **no impact** to the wet heath or dry heath designated features.

214. Tre Wilmot SSSI is located north of the landfall and cable route and is also part of the Glannau Ynys Gybi / Holy Island Coast SAC / SPA. Tre Wilmot SSSI contains open water, peatland and wet heath habitat. This site has been avoided during the site selection process and furthermore there is no hydrological pathway between this site and the works associated with the construction of the proposed development. There is not anticipated to be any pathway for impacts to the Tre Wilmot SSSI and as such **no impact** is anticipated.

19.6.5.1.2. Beddmanarch-Cymryan SSSI

215. Beddmanarch-Cymryan SSSI is coastal, flanking the coastline of Holy Island and Anglesey. As a SSSI, it is considered to be of high value. It is located 59 m (at its closest point) from the Grid Connection Substation footprint. Direct impacts to the features of the SSSI have been avoided through the project design process, as the Grid Connection Substation will be constructed within the old aluminium works, therefore avoiding crossing this stretch of water and in turns its habitats for which is known to support, namely salt marsh vegetation and coastal dune heath, and intertidal mud and sand habitats.

216. Indirect impacts have potential to occur through uncontrolled pollution events during construction activities including spillages from construction vehicles or plant draining into the SSSI. As part of the embedded mitigation, pollution prevention best practice guidelines will be

adhered to throughout construction. As such, the construction of the Grid Connection Substation (and all other elements of the project) are not expected to affect to SSSI and the magnitude is assessed to be low. As such, the potential impact to the Beddmanarch-Cymryan SSSI is assessed to be **minor adverse**.

19.6.5.1.3. Mitigation

217. The following mitigation measures will be taken to reduce the potential impact to statutory designated nature conservation sites. Mitigation specific to chough is discussed in **Section 19.6.5.11**.

218. Should HDD not be possible, trenching is required, there will be temporary disturbance across the maritime cliff and slope habitat and neutral grassland and temporary pinning of cables on the cliff habitat. Temporary habitat lost or disturbed will be reinstated. This will be detailed in the EAP.

219. Turf removed within the SAC will be carefully managed to allow for reinstatement upon completion of the works. This will include the following measures:

- Stripped turfs will be stored at the edges of the construction corridor 'vegetation or turf side up' with adequate growing conditions e.g. water, light and temperature;
- Turves will not be stored on good quality habitat;
- Turves will be re-used in areas with similar vegetation and hydrology;
- Turves should be replaced as soon as possible after the initial cut, however can be stored up to two months under the right conditions during March/September (the growing season);
- Turf transfer will not be undertaken in periods of hot and dry conditions or sub-zero conditions to avoid desiccation or frost damage; and
- Turves will be monitored and watered during dry spells to ensure they remain viable and do not desiccate.

220. The turf management proposed will ensure that the trenched habitat within the SAC will recover quickly following completion of the works, and will be included within a habitat management plan, undertaken in consultation with the IoACC and NRW. The habitat creation and management plan will include:

- A defined area which will be subject to the plan;
- A plan for any pre-construction surveys;
- Details of suitable planting and ground preparation and planting methodology;
- Details of any post-creation monitoring surveys, reporting and reviewing required;
- A schedule/programme for delivery of the plan;
- Responsibilities attributed to the relevant parties to deliver the plan; including creation, maintenance and monitoring of the new habitat; and

- Consideration of the future of the new habitat following decommissioning of the Landfall Substation site.

221. This plan will be developed with the relevant stakeholders and should be complimentary to other proposed mitigation measures.

222. In addition, the following will also take place to minimise the impacts associated with the proposed development:

- Toolbox talks will be delivered to all construction personnel detailing the importance of the protection of the designated sites.
- A strict construction working footprint will be maintained;
- Temporary fencing will be installed to physically delineate the rest of the designated site from the construction footprint;
- Materials and plant will be stored within the construction footprint;
- Habitats affected within and outwith the designated site will be combined within the habitat reinstatement plan; and
- A habitat re-instatement plan will be implemented upon completion of the works.

223. Although long term impacts are considered to be *de minimis*, it is recognised that the project will involve (under the worst case) works within an SAC, a site protected under European Law. As such, as additional management, compensation habitat is also proposed for within the onshore site, or enhancement will take place at nearby adjacent cliff and slope habitat of poorer quality than that which is being temporarily lost.

224. The compensatory/enhancement habitat will aim to maintain the functionality of the small amount of cliff habitat that is temporarily lost. The area of compensatory/enhancement habitat will be as a minimum the same area of cliff habitat that is lost. Compensatory/enhancement habitat will be subject to a habitat creation and management plan, undertaken in consultation with the IoACC and NRW.

19.6.5.1.4. Residual Impacts

225. Following the implementation of mitigation including appropriate storage of turf and associated habitat reinstatement, the temporarily disturbed grassland habitats will recover quickly (one to three years). Vegetation on the cliff habitats, where storage of the temporarily disturbed habitat is unlikely, is expected to recover over a number of seasons (approximately five to ten years, Natural England, 2007) and will be monitored through post construction surveys with consultation with NRW of results. Longer term habitat loss will remain in the 30m wide corridor where the J-tubes are pinned to the cliff, until the removal of those tubes at the end of the Project. Therefore, the impact to the Glannau Ynys Gybi / Holy Island Coast SSSI/SPA/SAC is assessed to be reduced to **moderate adverse** in significance should the cables be trenched at landfall. Compensation or enhancement habitat is proposed in recognition of working in a site of European importance. If HDD technology is used, there will be **no impact** to the Glannau Ynys Gybi / Holy Island Coast SPA/SAC/SSSI. The assessed impacts at all other sites remain the same.

19.6.5.2. Construction Impact 2: Habitat loss and disturbance of features of Non-Statutory Designated Nature Conservation Sites

226. This section discusses impacts to non-statutory designated nature conservation sites. Sites designated for marine birds are considered within **Chapter 11, Offshore Ornithology**.

19.6.5.2.1. Ancient Woodlands

227. Following the Forestry Commission's guidance on assessing the impacts of development (Forestry Commission, 2014), the following potential effects on ancient woodland from development on adjacent land have been considered:

- Fragmentation and loss of ecological connections with surrounding woodland/ veteran trees and the wider natural landscape;
- Reduction in the area of other semi-natural habitats adjoining ancient woodland;
- Increased deposition of dust, particularly from quarries, resulting in physical and/or chemical effects;
- Impacts on local hydrology through drainage or water table levels changing;
- Change to the landscape context for ancient woods and veteran trees; and
- Change to light pollution at night (if development includes street lighting).

228. As detailed in embedded mitigation (**Section 19.6.3**), woodlands AWS 43665 and 26066 will be avoided during construction and protected by a 15 m fenced buffer. Potential effects arising from changes in local hydrology, dust emissions, noise, light levels, landscape context are discussed in **Chapter 17, Water Resources and Flood Risk**, **Chapter 21, Noise and Vibration**, **Chapter 22, Air Quality** and **Chapter 24, Seascape, Landscape and Visual Impact Assessment**.

229. Scrub and species poor hedgerow is present in the vicinity of the ancient woodlands, along with planted broadleaf and coniferous woodland, which may provide ecological linkage habitat. All woodland will be avoided and impacts to hedgerow and scrub will be limited in footprint and temporary in nature.

230. A water resources assessment has been undertaken and is presented in **Chapter 17, Water Resources and Flood Risk**. The assessment concluded no significant impacts throughout. There is no hydrological connection to the ancient woodlands in terms of surface water, and the excavations are shallow enough to have no significant impact on groundwater flow. As such, there is not anticipated to be any hydrological impacts which may affect the ancient woodlands.

231. Air quality impacts on designated ecological sites are considered in **Chapter 22, Air Quality**. Impacts on designated sites relating to construction phase dust and particulate matter emissions were considered. Risk of dust impacts to ecological receptors, including the designated sites, were assessed to be high during earthworks, low during construction activities and medium from trackout from HGV movements. With the implementation of the recommended mitigation measures, i.e. adherence to best practice dust minimisation and suppression methods as recommended by the IAQM, including creation of a DMP, impacts to ecological receptors are considered to be not significant. There are not anticipated to be any significant impacts on

designated sites associated with road traffic emissions due to the expected low number of vehicle movements in the construction, operational and decommissioning phases.

232. Noise and vibration assessments are undertaken in **Chapter 21, Noise and Vibration**, and are discussed in detail in **Section 19.6.5.11** below, regarding impacts to the chough population at the SPA. Following mitigation, there is not anticipated to be a significant noise impact on any designated sites or their features.

233. Ancient woodlands are considered to be of medium value. Given they will be avoided to mitigate against direct impacts, removal of other woodland will be avoided, and general pollution best practice measures will be followed throughout construction, and indirect impacts are not anticipated, the magnitude of effect is assessed to be **negligible** and the anticipated impact to ancient woodlands is assessed to be **negligible**.

19.6.5.2.2. South Stacks Cliffs RSPB Reserve

234. South Stacks Cliffs RSPB reserve is located adjacent to the Onshore Development Area at the landfall end. The boundary of the reserve extends up to the road where the cables are proposed to be constructed, and consequently the working buffer of the construction works overlaps into the reserve by 32,800 m^2 along the length of the road (**Figure 19-3, Volume II**). This includes overlap into the fields which are used by chough (See **Section 19.6.5.11.2** for details on chough). It is estimated that a working area of 30m width would suffice for installation in a single lane road and as a worst case this working width may overlap in to the reserve for a portion/all of the extend of the overlap. Due to the known sensitivity of the local botany, pre-construction surveys are proposed to inform the micro siting of the Onshore Cable Route to avoid sensitive/rare/protected plant species.

235. Indirect impacts have potential to temporarily arise during the construction phase from dust, noise, temporary lighting and changes in the local hydrology regime.

236. A water resources assessment has been undertaken and is presented in **Chapter 17, Water Resources and Flood Risk**. The assessment concluded no significant impacts throughout. There is no hydrological connection to the protected sites in terms of surface water, and the excavations are shallow enough to have no significant impact on groundwater flow. As such, there is not anticipated to be any hydrological impacts which may affect the habitats, species or features of the RSPB reserve.

237. Air quality impacts on designated ecological sites are considered in **Chapter 22, Air Quality**. Impacts on designated sites relating to construction phase dust and particulate matter emissions were considered. Risk of dust impacts to ecological receptors, including the designated sites, were assessed to be high during earthworks, low during construction activities and medium from trackout from HGV movements. With the implementation of the recommended mitigation measures, i.e. adherence to best practice dust minimisation and suppression methods as recommended by the IAQM, including creation of a DMP, impacts to ecological receptors are considered to be not significant. There are not anticipated to be any significant impacts on designated sites associated with road traffic emissions due to the expected low number of vehicle movements in the construction, operational and decommissioning phases.

238. Noise and vibration assessments are undertaken in **Chapter 21, Noise and Vibration**, and are discussed in detail in **Section 19.6.5.11** below, regarding impacts to the chough population at the SPA. Following mitigation, there is not anticipated to be a significant noise impact on any designated sites or their features.

239. No significant impacts have been identified within **Chapter 22, Air Quality**, **Chapter 21, Noise and Vibration** and **Chapter 17, Water Resources and Flood Risk**.

240. Indirect impacts may occur through temporary loss of foraging habitat of raptor species such as barn owl and peregrine falcon during construction. These are discussed in **Section 19.6.5.11** Impacts to Birds, under raptors. Overall a **minor adverse** impact is anticipated to barn owl and peregrine falcon during short term habitat loss.

241. Potential impacts of construction on chough, a species for which the reserve and adjacent areas are managed, are considered in **Section 19.6.5.11**. Overall, following mitigation, impacts to chough are assessed to be no greater than **minor adverse** in significance.

242. The RSPB reserve is considered to be of medium importance and magnitude of impact is considered to be low. A **minor adverse impact** to the RSPB reserve is anticipated.

19.6.5.2.3. Breakwater Country Park

243. Breakwater Country Park is located 1.27 km to the north of the Onshore Development Area and no direct impacts are anticipated due to the distance from the Onshore Development Area, however indirect impacts may occur through loss of foraging habitat of raptor species who breed in the park, such as barn owl and peregrine falcon. These are discussed in **Section 19.6.5.11**, under raptors. Overall a **minor adverse** impact is anticipated to barn owl and peregrine falcon during short term habitat loss.

19.6.5.2.4. Mitigation

244. The following mitigation measures will be taken to reduce the potential impact to Non-Statutory Nature Conservation Designated Sites:

- Pre-construction surveys are proposed to inform the micro siting of the Onshore Cable Route to avoid sensitive/rare/protected plant species;
- A habitats reinstatement plan will be implemented, including replacement of linkage habitat in the vicinity of the ancient woodlands;
- Toolbox talks will be delivered to all construction personnel detailing the importance of the protection of the designated sites;
- A strict construction working footprint will be maintained;
- Temporary fencing will be installed to physically delineate the rest of the designated site from the construction footprint;
- Materials and plant will be stored within the construction footprint;
- A habitat re-instatement plan will be implemented upon completion of the works.

- It is recommended that prior to construction, further detailed botanical survey work is undertaken to ensure the risk of impacts to spatulate (South Stack) fleawort, golden-hair lichen and spotted rock-rose (and other areas of botanically rich vegetation) can be avoided. Such survey work should be carried out in May or June when fleawort is in flower. This survey work will support the decision of where the Onshore Cable Route is micro-sited to, enabling the footprint of overlap into the RSPB reserve to be minimised; and
- Consultation with NRW and RSPB will be undertaken to agree the final micro-siting of the Onshore Cable Route.

19.6.5.2.5. Residual Impact

245. Following the instigation of mitigation, the impacts to non-statutory designated sites will be **negligible,** with a **minor adverse impact** anticipated should there be an overlap into the RSPB reserve.

19.6.5.3. Construction Impact 3: Habitat Loss

246. Permanent habitat and temporary loss in low ecology value habitat is identified in **Table 19-21** based upon the worst case parameters outlined in **Section 19.6.2**.

Table 19-21 Permanent and temporary habitat loss

Project component	Permanent habitat loss (m^2)	Temporary works area (m^2)
Landfall HDD (Option 1)	-	8,400
Landfall trench/surface laying option (Option 2)	Worst case cables on cliff face in j-tubes in corridor up to 30 m wide	16,500
Landfall Substation	6400	3,500
Onshore Cable Route (based on worst case of 30 m corridor, however realistically this will be less in much of the route)	-	243,000
Draw Pits (42)	1,120	-
HDD crossings	-	1,200
Joint Boxes (20)	25	2,800
Grid Connection Substation	6,448	5,000
Switchgear Building	38	-
Total Option 1	**15,231**	**263,900**
Total Option 2	**15,231 plus j-tubes on cliffs**	**272,000**

19.6.5.3.1. Grasslands

247. Impacts to maritime grassland unimproved neutral grassland are discussed in **Section 19.6.5.1** and are not repeated here.

248. 1,525,000 m^2 of grassland is located within the boundary of the Onshore Development Area. The majority of the works (1,510,000 m^2) will be undertaken in improved and poor semi improved grassland, including the works at landfall and along the Onshore Cable Route, where works will be micro-sited to low ecology value habitat wherever possible. Works at the Grid Connection Substation and Switchgear Building will be on existing areas of industry, poor semi improved grassland and scrub where possible. These habitats are of low ecological value and although habitat loss will be permanent it will not alter the function of the surrounding habitat and is assessed to be medium magnitude. The impact of permanent habitat loss of grassland habitat is therefore assessed to be **minor adverse** in significance. Temporary habitat loss of up to 272,000m^2 will occur to grassland habitat used as laydown areas around the two substation locations and Switchgear Building, and with the buffer zone either side of the Onshore Cable Route including joint boxes, draw pits and HDD, however it is anticipated that impacts will be short – medium term and this habitat will recover quickly. Temporary habitat loss of grassland is also considered to be **minor adverse** in significance.

19.6.5.3.2. Hedgerows and Trees

249. Woodland will be avoided through embedded mitigation (Section 19.6.3), however there remains potential for impacts to hedgerows and trees. Despite being species poor and often defunct, the hedgerows are considered to have a low level of ecological value locally as linking networks for a number of species and potentially local navigation features for bats and are considered to be of medium value. Much of the Onshore Development Area is exposed, and trees are limited. Disturbance of the hedgerows and trees may be avoided through micro-siting activities at landfall and throughout the Onshore Development Area, however as a worst-case scenario there is anticipated to be potential temporary impacts to small sections of up to 18 hedgerows, constituting an impact of medium magnitude. A root protection zone of max 15m radius will be used to protect trees and hedgerow wherever possible. No trees are anticipated to be removed during construction. The impact to hedgerows is considered to be **moderately adverse** in significance as a worst-case scenario.

19.6.5.3.3. Lowland Fen and Reedbed

250. At a number of locations along the onshore cable corridor, marshy grassland is present in fields adjacent to the road. It should be possible to using areas of wetland for lay down of plant and materials; however, as a worst-case scenario there may be trenching works within these pockets of wetland habitat.

251. An area of lowland fen and reedbed is located west of the leisure centre. The boundary of the onshore cable corridor has been widened at this location to enable an opportunity to microsite around this wetland area if possible. Under a worst-case scenario, if avoidance is not possible, there will be trenching works across this wetland area. The wetland habitat is considered to be of medium ecological value for its species diversity, provision of habitat for insects and breeding birds, and trenching through this habitat is anticipated to be of medium magnitude. If this area

of fen and reedbed cannot be avoided, there will be a **moderately adverse** impact to lowland fen and reedbed. If it is possible to microsite around this habitat onto the surrounding grassland of low ecological value, the impacts of the proposed development on this habitat is considered to be **negligible**.

19.6.5.3.4. Maritime Cliff and Slope:

252. Impacts to maritime cliff and slope include impacts across the SAC designated land. This is discussed in **Section 19.6.5.1** and are not repeated here.

19.6.5.3.5. Open Mosaic Habitat

253. Open mosaic habitat (OMH) is present in the vicinity of the Grid Connection Substation and may be subject to temporary or permanent habitat loss should (as a worst case), although the majority of the habitat is located outwith the Onshore Development Area. The habitat is currently being encroached by scrub habitat and is considered to be of low value. Disturbance of this habitat is considered to be low magnitude at a worst case, resulting in a **minor adverse** impact.

19.6.5.3.6. Cloddiau

254. In addition to the habitats of principal importance described above, Cloddiau and scrub (primarily gorse scrub in this area of Anglesey) are habitats referred to in the Anglesey BAP (Cloddiau is referred to in the section relating to ancient hedgerows).

255. Where the route runs in fields adjacent to existing roads and need to cross field boundaries, it is possible that Cloddiau will be affected. Cloddiau are considered to be of medium value.

256. A number of Cloddiau networks are present leading up to the south side of the road along the cable route immediately south of the landfall area. Under a worst case scenario, these features may be disturbed or removed for the cables to be installed. Three sections of Cloddiau are located within the area for landfall. Under a worst-case scenario, the cables will be trenched at landfall, requiring the removal of these features. This would constitute an impact of high magnitude on the Cloddiau features which may be removed, and as such, the impact to these three Cloddiau is anticipated to be long term **major adverse**. Mitigation for the removal of Cloddiau is described below.

257. If cables are installed by HDD, it is likely the cables will also extend under the two coastal Cloddiau and therefore impacts to these features will be avoided.

19.6.5.3.7. Mitigation

258. The following mitigation will be implemented to minimise the impact to Habitats of Principal Importance:

- Toolbox talks will be presented to all contractors to inform of the Habitats of Principle Importance present in the area. Microsite to avoid hedgerow, marshy grassland, fen and open mosaic habitat where possible;
- A strict construction working footprint will be maintained;

- Temporary fencing will be installed to physically delineate the rest of the habitats of principal importance from the construction footprint;
- Materials and plant will be stored within the construction footprint;
- Habitats affected within and outwith the designated site will be combined within the habitat reinstatement plan;
- A habitat re-instatement plan will be instigated upon completion of the works;
- Root protection areas will be fenced off during construction;
- Turf management (as described in Section 19.6.5.1.3) will be undertaken in area where Habitats of Principle Importance are present to allow for effective reinstatement upon completion of the works;
- A pre-construction assessment of all trees to be removed will be undertaken by a suitably qualified arboriculturist;
- Where hedgerows are disturbed, they will be replaced following completion of construction activities to the same quality or better, with native species of local provenance. The replanting plan will be detailed in the EAP;
- To mitigate impacts to the OMH at the aluminium works, habitat reinstatement will be undertaken upon completion of the construction phase. This would involve the reinstatement of excavated material in a way that would provide low nutrient substrate suitable for ephemeral vegetation. The replanting plan will be detailed in the EAP. Since this area is subject to scrub encroachment it is possible that some localised disturbance will be beneficial (to reduce scrub and maintain patches of open habitat); and
- If trenching is required at landfall through the designated land, further consultation will be undertaken with NRW and RSPB to determine full mitigation, methodology and to obtain any necessary consents.

259. To minimise impacts to Cloddiau, all Cloddiau to be left in situ will be clearly marked by a one metre buffer fence. A tool box talk will be presented by the ECoW to all construction personnel to ensure the importance of these features is understood.

260. Where Cloddiau cannot be avoided by going around or underneath, the walls will be carefully dismantled by an appropriately trained professional and stored within a marked fenced area during construction. As soon as possible upon completion of construction activities, the stone walls will be rebuilt in a traditional style, reusing the original materials. The CoCP will provide details of storage methods and locations of the vegetated stones.

19.6.5.3.8. Residual Impact

261. Following the implementation of the mitigation, the impacts to hedgerows, trees, woodland, lowland fen and reedbed is considered to be **minor adverse** in significance, with impacts to OMH being **minor beneficial** in significance.

262. Upon implementation of the mitigation, the impact to Cloddiau is anticipated to be reduced to worst case low magnitude and **minor adverse** in significance in the medium-term for removal, storage and reconstruction activities and re-establishment of vegetation.

19.6.5.4. Construction Impact 4: habitat loss, disturbance or killing of otter

263. Given that the proposed route will not affect any significant watercourses, there is limited opportunity for impacts on otter or important otter habitat; however, three otter records have been made within or close to the Onshore Study Area and are therefore there is potential for the animals to be in the vicinity. There is also potential for otter to coastally commute around the Glannau Ynys Gybi / Holy Island coast. Although, as an EPS, otters are considered to be of **high value**, the habitat is considered to be of **low importance** for otter. As part of the embedded mitigation (Section 19.6.3), pollution prevention best practice will be adhered to throughout all phases of the project. There is limited habitat potential for otter across the Onshore Study Area and habitat fragmentation is not anticipated to occur. There are no freshwater watercourses at landfall to provide habitat for otters to clean their fur or shelter. Therefore, the magnitude of the impact is anticipated to be **low**. As such, the impact is assessment to be of **minor adverse** significance.

19.6.5.4.1. Mitigation

264. The following mitigation will be included in the EAP:

- As otter is a mobile species, a pre-construction survey for otter will be undertaken in all potential habitat prior to construction to confirm no otters have entered the project area since the 2018 surveys. This includes any watercourses, ditches or areas which may provide suitable resting sites. Should evidence of otter be found, further consultation with Natural Resources Wales will be conducted as ascertain the most appropriate procedures to follow;
- During construction activities, precautionary methods will be implemented to ensure risk of killing or injuring are minimised, such as including exit ramps on excavations; and
- Prior to construction, a tool box talk on otter will be delivered to all relevant parties by the ECoW.

19.6.5.4.2. Residual Impact

265. Following mitigation, impacts to otter will be **negligible**.

19.6.5.5. Construction Impact 5: habitat loss, disturbance or killing of water vole

266. A historic record of water vole was provided by Cofnod from a ditch in the former aluminium works (**Figure 19.8, Volume II**), however no evidence of water vole was found in this area during the 2018 ecology surveys, and very limited suitable water vole habitat was recorded throughout the Onshore Study Area. A number of ditches are present along the Onshore Cable Route which may be temporary impacted during construction, but these were not noted in the surveys to be suitable for water vole. More suitable habitat was recorded in the land surrounding Valley, which is now outwith the Onshore Study Area and will not be disturbed by the Project. As part of the embedded mitigation (**Section 19.6.3**), pollution prevention best practice will be adhered to throughout all phases of the project. Water vole habitat is of **low importance** within the Onshore Study Area and the magnitude of impact is anticipated to be **low**. As such, the impact is assessed to be **minor adverse** in significance.

19.6.5.5.1. Mitigation

267. The following mitigation will be included in the EAP:

- As water vole is a mobile species, a pre-construction survey for water vole will be undertaken in all potential habitat (i.e. ditches) prior to construction to confirm no water vole have entered the project area since the 2018 surveys. This includes any watercourses or ditches whether water vole were previously suitable or not. Should evidence of water vole be found, further consultation with NRW will be conducted to ascertain the most appropriate procedures to follow (such as micro siting, water vole method statement or displacement under licence (trapping is not anticipated to be necessary)); and
- Prior to construction, a tool box talk on water vole will be delivered to all relevant parties by the ECoW.

19.6.5.5.2. Residual Impact

268. Following mitigation, impacts to water vole will be **negligible**.

19.6.5.6. Construction Impact 6: habitat loss, disturbance or killing of red squirrel

269. There are no records for red squirrel within the study area however some of the woodland on the southside of the A55 offer suitable habitat. This habitat is considered to be of **medium importance** for red squirrel.

270. As part of the embedded mitigation (**Section 19.6.3**), micro-siting will occur during construction to avoid disturbance of this area of woodland habitat and potential red squirrel habitat. Sufficient space is available within the aluminium works and the cable will be located under the A55 and railway line via HDD. Given that the woodland habitats will be avoided, an impact on red squirrel is unlikely to occur as a result of the proposed work, therefore the magnitude of the impact is assessed to be **negligible.** As such, the impact to red squirrels is assessed to be **minor adverse** in significance in the vicinity of the old aluminium works and Grid Connection Substation.

19.6.5.6.1. Mitigation

271. As red squirrel habitat will be avoided, no further surveys are required.

272. Prior to construction, a tool box talk on red squirrel will be delivered to all relevant parties by the ECoW.

19.6.5.6.2. Residual Impact

273. Following mitigation, impacts to red squirrel are assessed to be **negligible**.

19.6.5.7. Construction Impact 7: habitat loss, disturbance or killing of badger

274. Impacts to badgers are discussed in **Confidential Appendix 19.3** (**Volume III**). However, and to summarise, prior to the implementation of mitigation, the worst case impact of **major adverse** significance is anticipated on the population of badgers using a badger sett in the vicinity of the onshore works. Following the implementation of the described mitigation (which includes a

licence to disturb badgers for works within 30m of an active sett, temporarily or permanently excluding a main sett under licence with provision of a nearby replacement sett if avoidance is not possible along with best practice precautionary methods including exit ramps in trenches and covering trenches greater than 1 m in depth, regular monitoring and toolbox talks) this impact is reduced to **minor adverse** in significance.

19.6.5.8. Construction Impact 8: Impacts to bats

19.6.5.8.1. Roosting bats

275. The proposed work is considered unlikely to give rise to a significant impact on bats, as existing buildings are limited within the Onshore Study Area and none are to be affected or removed, and that the work does not require the removal of trees or woodland.

276. No known bat roosts are present within the Onshore Development Area however at least one single common pipistrelle bat roost is located 27 m from the boundary of the Onshore Development Area at landfall. There will be no disturbance of this bat roost or the buildings it/they are located within as part of the proposed Project. In addition, the Project works closest to this roost will be limited to trenching activities (Option 2). This roost is considered to be of medium value, and any impact is anticipated to be short term and low magnitude due to the distance from the Onshore Development Area, the limited amount of worst case activity (trenching). No sudden noises are anticipated in the vicinity of the roost although there may be construction lighting. HDD works under Option 1 may require 24 hour working. There will be one transition pit, up to 15 m x 85 m x 1.5 m deep, equating to a footprint of 1,275 m^2, excavated volume 1,912.5 m^3 in addition to trenching excavation or HDD cutting volumes. As such, a **minor adverse impact** to roosting bats is anticipated.

19.6.5.8.2. Foraging and commuting bats

277. Potential impacts to foraging and commuting bats could result from night-time working or night-time lighting of the onshore site. Night-time lighting will disrupt bat foraging and commuting routes which may to cross the Onshore Development Area. This has the potential to disturb the species by impairing their ability to survive. This would occur if bats have to avoid lit areas and thus travel further to reach the same areas for roosting or foraging; or else have to forage in poorer quality areas. There is limited foraging potential for bats within the Onshore Development Area, due to the lack of woodland and exposed nature of the island, however a number of records for bats have been made, including a common pipistrelle close to the Onshore Development Area at the landfall location, and several records in woodland outside the Onshore Development Area in the vicinity of the aluminium works. Leading lines in the landscape such as hedgerows and Cloddiau will have medium value for navigation. The local bat population is considered to be of medium value.

278. The potential impact to foraging and commuting bats is considered to be negative, temporary and of short duration. The magnitude of the impact is assessed to be low due to the exposure, limited habitat potential and low activity of bat species. A **minor adverse impact** is predicted.

19.6.5.8.3. Mitigation

279. The following mitigation will be included under the EAP:

- Night-time lighting of construction sites should be avoided where possible;
- If night-time working is necessary, then lighting will be designed in accordance with Bats and artificial Lighting in the UK (BCT, ILE, 2018); and Guidance Notes for the Reduction of Obtrusive Light ILE (2011). This is likely to require:
    - No direct lighting of the woodland edges, scrub and hedgerow habitats, or historic roost site and use of dark buffer zones; and
    - Consideration of appropriate luminaire specifications, sensitive light configuration, screening, glazing, dimming and part-night lighting to minimise impacts;
- A toolbox talk by a suitably qualified ecologist will be undertaken as part of the induction of all construction staff;
- Should a bat be encountered on site during the works, works will cease in that area and the advice of an experienced bat ecologist sought prior to re-commencing;
- A survey will be undertaken to confirm the presence or absence of the historic bat roost record. If present, a buffer of 30 m will be placed around the bat roost and works will not take place within this zone to avoid disturbance to this feature.
- Building, tree or woodland removal is not anticipated. If it is required it is recommended that further survey and assessment is carried out, in consultation with NRW, to confirm that potential roost features are not present; and
- Hedgerow will be replanted following completion of construction works.

19.6.5.8.4. Residual Impact

280. Following mitigation, impacts to roosting and commuting / foraging bats are considered to be **negligible**.

19.6.5.9. Construction Impact 9: habitat loss, disturbance or killing of reptiles

281. There is an abundance of suitable reptile habitat within the Onshore Study Area. The heathland within Glannau Ynys Gybi / Holy Island Coast SSSI and Tre Wilmot SSSI is assessed to be a key area for reptiles and records for common lizard in this region extend into the Onshore Study Area. A record for common lizard is also provided in the vicinity of the aluminium works within the Onshore Study Area. Small pockets of taller grassland, scrub and wetland habitats provide further good habitats throughout the Onshore Study Area, often in close proximity to roads. Cloddiau which separate some of the fields also provide suitable habitats for common lizard and all of the above are considered to be of **medium value**. The pasture fields, with a short, grazed sward, without vegetation structure to provide cover, are likely to be of **low value** for reptiles.

282. Although the cable, permanent infrastructure and temporary storage compounds will be predominantly located in roads or within grazed improved or semi-improved grassland the risk of an impact on reptiles on reptiles may occur within suitable habitat in close proximity to the Onshore Development Area through construction activities or the movement of construction vehicles. As part of the embedded mitigation (**Section 19.6.3**), the habitats that are more suitable for use by reptiles (scrub, wetland, Cloddiau and heathland) will be avoided through micro-siting where possible.

283. If suitable habitats are to be affected, an impact on reptiles is possible, although the significance of this is likely to be limited, due to the limited working area and temporary nature of the proposed work. Impacts are considered to be of medium magnitude, being short term and temporary in nature, with vegetation re-establishing quickly once the construction period is complete. Overall, potential impacts to reptiles during construction are considered to be **minor** to **moderate adverse**.

19.6.5.9.1. Mitigation

284. As reptiles are mobile, a pre-construction survey for reptiles will be undertaken in all potential habitat prior to construction.

285. Precautionary methods of working will be utilised, including clearance of vegetation under supervision of an ECoW. The precautionary methods of working will be detailed in the CoCP and submitted to IoACC in advance of the works. The details will be dependent on the timings of the work, and may include the following:

- Where possible, vegetation clearance will be timed within the reptile active season (March to October inclusive);
- A mitigation strategy for reptiles will be informed by the pre-construction survey and will be produced prior to construction and submitted to the LPA, including:
  - Trapping and translocation, if required;
  - Details of appropriate habitat improvement works to receptor sites for displaced reptiles;
  - Post construction monitoring
  - Details of the temporary fencing (including type, location and maintenance methodology) to be used to prevent reptiles from re-entering the site;
  - Details of ecological supervision during construction including a toolbox talk; and
  - Reptile welfare (including handling methodology); and
- Following construction, habitat will be reinstated as a minimum to the same value as before, using native species of local provenance.

19.6.5.9.2. Residual Impact

286. Following the implementation of the mitigation, impacts to reptiles are considered to be **minor adverse**.

19.6.5.10. Construction Impact 10: habitat loss, disturbance or killing of great crested newt

287. The eDNA survey results provided negative results for all the ponds surveyed in 2018 and there are no previous records of this species within the 250 m buffer GCN Study Area. The Onshore Development Area does not fragment pond habitat where previous records of GCN exist.

288. From the results of the assessment it is concluded that GCN is likely to be absent from the majority of the GCN Study Area. Although there are previous records near Holyhead, the proposed route is not close to these areas, located 356 m at the closest point. There is no

evidence to indicate that GCN is present in any of the ponds within the proposed Landfall Substation area or close to the various proposed cabling routes on Holy Island. Although a number of ponds are present within the Onshore Study Area which provide good or average habitat suitability for GCN, the absence of any records or eDNA data suggests the habitat is of low value for GCN. The population of GCN is considered to be of medium value.

289. The construction work will be short term and temporary, with no ponds will be lost. As part of embedded mitigation, pollution prevention best practice guidelines will be adhered to avoid any damage or pollution to the pond habitats. No habitat fragmentation is anticipated to occur between known populations of GCN. Consequently, the magnitude of impact to GCN is anticipated to be low. Overall, an impact significance of **minor adverse** to GCN is anticipated.

19.6.5.10.1. Mitigation

19.6.5.10.2. Although no ponds will be lost and there is a lack of evidence of GCN within the GCN Study Area, suitable pond habitat does exist, and historic records have been made on the island. It is therefore appropriate to undertake pre-construction HSI and eDNA surveys (methodology to be agreed with IoACC in advance of surveys) to confirm the absence of GCN in the area and include a method statement within the CoCP for what to do in the unlikely event an GCN is encountered on site. In addition, a toolbox talk by a suitably qualified ecologist will be undertaken as part of the induction of all construction staff.

19.6.5.10.3. Residual Impact

290. Following mitigation, impacts to GCN will be reduced to **negligible** in significance.

19.6.5.11. Construction Impact 11: habitat loss, disturbance or killing of birds

19.6.5.11.1. Seabirds

291. Impacts on seabirds, including cliff nesting species are discussed fully in **Chapter 11, Offshore Ornithology**.

19.6.5.11.2. Chough

292. In relation to chough, the assessment considers construction at the cable landfall and the western section of onshore cable route, where it runs through habitats occupied by this species. Construction activities at the cable landfall and the onshore cable route will generate noise and visual disturbance due to the presence of plant, vehicles and staff (see **Chapter 4, Project Description**). The installation of cables will involve temporary excavation and reinstatement of vegetation. At the landfall a substation will be constructed, and, if HDD is not used to install cables at the landfall point, cables will be trenched through the coastal cliff habitats. These activities may displace chough from nesting, foraging and roosting areas.

293. Chough occupy traditional nest and roost sites (i.e. the same sites are used over many years). The nearest roost site to the Onshore Development Area is approximately 500 m from the cable landfall (**Figure A19.2-3** in **Confidential Appendix 19.2, Volume III**). At this distance, the risk of disturbance to birds using the roost is considered negligible.

294. The cable landfall is approximately 120 m at the nearest point from a regularly used chough nest site in sea cliffs (nest A25, **Figure A19.2-3** in **Confidential Appendix 19.2, Volume III**). Construction works at the landfall during the breeding season may cause disturbance to this nest. No specific information on chough responses to disturbance at the nest has been found in the published scientific literature. Adrienne Stratford of the Cross and Stratford Chough Project indicated in telephone discussions on 13 March 2019 that responses to disturbance at the nest were likely to vary between pairs and sites; she suggested that disturbance at distances beyond 100 m might not adversely affect a breeding attempt, unless there was a significant increase in disturbance to a nest around the time when eggs are being laid. She noted that choughs may nest close to areas with regular human disturbance (for example cliff nest sites overlooking beaches).

295. The onshore cable corridor passes through fields used by chough for foraging throughout the year. There is therefore potential for construction works to disturb and displace foraging chough, including foraging areas used by nesting birds. This includes foraging areas used by chough occupying the nest within 120 m of the landfall site (nest A25, **Figure A19.2-3** in **Confidential Appendix 19.2, Volume III**), and 19 other chough nests further south, located on the coast to the north and south of the Onshore Development Area (**Figure A19.2-3** in **Confidential Appendix 19.2, Volume III**).

296. Chough are most constrained in their foraging distances during the breeding season. Bullock et al. (1983) reported that choughs tend to feed very close to their nest sites, citing an average distance of 0.7 km between nest sites and feeding areas for 58 coastal nest sites in Britain and Ireland, with 88 % of pairs feeding within 1 km of the nest, although some might fly up to 2 km.

297. In Wales, choughs were found to forage in land compartments a mean of 289-607 m from their nests (Whitehead et al. 2005) and on the Scottish Hebrides, a mean of 270-432 m and a maximum of 610-1,200 m from their nests (Bignal et al. 1996). On the French island of Ouessant, the foraging areas of breeding pairs varied from 3,587 to 67,388 m^2; 59 % of observations of breeding chough were within 300 m, and less than 1 % were further than 1,800 m from the nest (Kerbiriou et al. 2006). Fledging success was related positively to the amount of feeding habitat, and negatively to the distance between foraging habitats and the nest. One consequence of adults foraging further from the nest was increased vulnerability of the nest to predation. As well as the location of the nest site, chough territories were also constrained by the presence of neighbouring pairs of choughs, if a breeding pair disappeared then part or all of their territory might be incorporated in that of adjacent pair(s) (Kerbiriou et al. 2006).

298. A study of chough disturbance by visitors to the French Island of Ouessant found that the presence of tourists during peak season resulted in a severe reduction in the available foraging area and reduced foraging time; in August (the peak month for tourism) the survival of juveniles was negatively correlated with the number of visitors (Kerbiriou et al. 2009). Flocks of chough without juvenile birds flushed at an average of 75 ± 9 m from disturbance by people, significantly less than the average of 147 ± 23 m for flocks with juveniles. Combining the average flush distance and the spatial distribution of paths on the coastline, it was estimated that 97 % of the main feeding habitat of chough on the island was potentially affected by human disturbance during the peak tourist season.

299. During construction, disturbance will be temporary and localised as it is anticipated that works will not be ongoing simultaneously along the whole of the Onshore Cable Route, but that different areas will be the focus of activity at different times throughout the construction period. It is noted also that beyond the landfall area, the Onshore Cable Route follows existing roads and chough may not use foraging habitats immediately adjacent to roads.

300. Considering the chough nest A25 within 120 m of the landfall area, assuming a circular home range and maximum regular foraging range of 1 km from the nest would give a total potential foraging area on land of 209.87 ha (**Table 19.2** in **Confidential Appendix 19.2, Volume III**). This foraging area would overlap completely with the cable landfall site (comprising the HDD / trenched cabling area, the transition pit area, the Landfall Substation area, and part of the onshore cable route (**Figure A19.2-6** in **Confidential Appendix 19.2, Volume III**). Assuming a worst-case scenario where construction activity is ongoing simultaneously throughout the entire cable landfall area where it overlaps with this foraging range (32.11 ha, **Table A19.2-2** in **Confidential Appendix 19.2**, **Volume III**) and chough are excluded from this area, this would represent a 15 % reduction in the available foraging area for chough at this nest site. In reality, construction activity will not be ongoing in all areas of the cable landfall area simultaneously so the reduction in chough foraging habitat would be less. However, it is also possible that chough may avoid foraging in areas outside but close to active works areas within the landfall construction area (for example if they avoid areas within distances similar to the flush distances from human activity cited in Paragraph 298 above).

301. Although this would be a temporary loss of feeding habitats, if exclusion from these areas occurs during the chough breeding season there is potential for an adverse effect on the breeding pair at nest A25, for example reduced fledging success or even nest failure.

302. In practice, the foraging range of chough from nest A25 is unlikely to be circular. Foraging transect data provided by RSPB gives an indication the relative use of fields in the vicinity of the landfall and nest A25 by chough (**Figure A19.2-6** in **Confidential Appendix 19.2, Volume III**). This indicates that the landfall construction area overlaps with areas of moderate use by chough (based on the total numbers of birds recorded during the survey period January 2013 to May 2017), but that choughs use areas immediately to the east of the landfall site and cable route more intensively and these are likely to be preferred feeding areas for birds nesting at A25. This suggests that while there may be less than 15 % (323,298 m^2) temporary loss of preferred feeding areas for nest A25 during construction, there could still be an adverse effect on the breeding success of chough at this nest.

303. There is potentially also overlap between foraging areas for pairs for chough breeding at nests A23, A13 and A12 and nests B1-13 (**Figure A19.2-6** in **Confidential Appendix 19.2, Volume III**) using these nests and the Onshore Development Area. Assuming maximum 1 km foraging ranges and exclusion from the onshore cable construction area only, the potential temporary loss of foraging area as a proportion of the foraging range would be 8 % combined for all nest sites (609,141 m^2).

304. Outside the breeding season, choughs are not so constrained in their foraging behaviour. Breeding pairs may move to communal roosts with fledged young to join immature / unpaired birds. Studies in Wales have demonstrated that non-breeding chough can forage up to 25 km from roost sites, but that 95 % of all observations of flocks of chough which contained colour-

ringed individuals were within 6 km of the roost (Cross & Stratford 2015). Outside the breeding season birds which may be temporarily displaced from foraging areas overlapping with or close to onshore construction works would be able to find alternative habitats elsewhere. No adverse effects on the survival or condition of individuals would be predicted.

305. Noise modelling has been undertaken for the onshore construction works to predict noise levels in surrounding area. This can be used to assess the likelihood that noise levels would be so high as to be potentially disturbing to birds including chough. Much of the work undertaken on bird responses to airborne noise disturbance in the UK has focussed on wintering estuarine waterbirds (Cutts et al. 2013, Wright et al. 2010). These studies tend to suggest that bird response to noise disturbance is likely to be minor at levels of 60 dBA and lower (note that A refers to A-weighting which approximates the frequency response of the human ear). A distinction may be made between ‘average’ noise levels (L_{Aeq}) and maximum (impulsive) noise levels (L_{Amax}) (**Chapter 21, Noise and Vibration**). Sudden impulsive noises (for example a gun shot or an explosion) are potentially most likely to cause disturbance reactions. Bird responses to noise may include increased vigilance, suspension of feeding behaviour and flushing. where birds walk, swim or fly away from a noise source. The findings from studies on wintering waterbirds can only be regarded as providing general context to the current assessment as they apply to different species during the non-breeding season (when behavioural responses may differ).

306. At the cable landfall, the worst-case scenario in terms of noise emissions would be HDD. Modelled noise levels (L_{Aeq}) during daytime and night time are shown in **Figures A19.2.9** and **A19.2.10** (**Volume II**) and are highest during the day. Daytime predictions indicate that levels in excess of 60dBLAeq, which might potentially cause chough to avoid these areas, are only predicted over small areas, mostly within the development footprint. These predictions indicate that noise associated with the works at the cable landfall is not likely to increase the areas from which birds are likely to be excluded due to the presence of construction plant and personnel, as discussed above. Predicted noise levels in the vicinity of the closest nest site to the landfall, A25, about 120 m from the landfall site, are less than 30 dBA and would not be expected to cause disturbance to birds at the nest.

307. As detailed in **Chapter 21, Noise and Vibration**, the impacts of the alternative open cut trenching construction method are expected to be no greater at the nearest sensitive receptors at the landfall location, than the HDD at the landfall.

308. For works associated with the installation of the onshore cable, running initially south and then southeast and east from the landfall site, noise modelling indicates that predicted noise levels reduce to 60 dB_{LAeq} at a maximum of 147 m from the outer boundary, without mitigation, and 83 m from the boundary with best practical mitigation measures in place. If chough avoid areas where sound levels are in excess of 60 dBA, then, with mitigation in place, they would potentially be displaced around 83 m from the onshore cable working areas. However, given that the noise sources are machinery and likely to be regular/continuous over the period that plant/vehicles are operation, rather than sudden or irregular and impulsive noise, birds may habituate to noise and displacement distances may decrease.

309. Noise and visual disturbance in the eastern part of the Onshore Development Area, associated with HDD for road and rail crossing, and works at the grid connection point (**Figure 19.1, Volume**

II) are not considered in relation to disturbance to chough, as these areas are more than 2 km from any chough nest sites.

310. Chough is a receptor of high importance (**Table 19-6**) and construction disturbance (noise and visual) is considered an impact of low adverse magnitude, due to the potential displacement of nesting pairs from foraging areas close to nest sites during the breeding season (in particular nest site A25 closest to the landfall). The impact is considered to be **moderate adverse** and ecologically significant.

19.6.5.11.3. Mitigation

311. To avoid adverse effects of construction activities at the landfall and the onshore cable route on breeding chough, no construction works (including any potential works in the intertidal area) will take place within 500 m of an active chough nest during the breeding season. The distance of 500m is selected to include the core foraging ranges of chough, based on the foraging distances from empirical studies described in paragraph 297 above. For the purposes of this project, the breeding season is defined as the period from the beginning of April until the end of July (to cover the period immediately before egg laying and the four stages of breeding identified for choughs in Wales by Whitehead et al. (2005): incubation (mid-April to early May), early chick rearing (early May to mid-May), late chick rearing (mid-May to early June), and post-fledging (early June to end of July).

19.6.5.11.4. Residual Impact

312. With this mitigation in place, the impact of construction disturbance on chough would be reduced to negligible and assessed as a **minor adverse** impact on a receptor of high importance.

313. Raptors

314. Peregrine falcons are present in the Onshore Study Area and known to be associated with the mountainous terrain of the Breakwater Country Park and the RSPB reserve and other cliff nesting sites. Peregrines tend to occupy traditional nest sites, with the same eyries being used over successive years, although a pair may have several nest sites within a territory which are used in different years. Records of peregrine falcon sourced during the desk study are shown on **Figure A19.2.7** in confidential **Appendix 19.2**, **Annex 19.2-2m** (**Volume III**).

315. Tawny owls are associated with woodland habitats which have been avoided through the site selection process.

316. Barn owls are present in the Onshore Study Area. The 2007-2011 atlas of breeding and wintering birds (Balmer et al. 2013) indicates that barns owls breed throughout Holy Island. Records of barn owl sourced during the desk study are included in **Confidential Appendix A19.2**, and **Figure A19-2-8** (**Volume III**); these records are mainly for the eastern part of the Study Area.

317. Barn owls nest mainly in agricultural buildings, as well as natural cavities in trees or rock faces and nest boxes (where available). They are associated with rough grassland such as wet meadow habitat where there is an abundance of voles. Most wet meadow habitat has also been

avoided by the site selection process, although under a worst-case scenario there may be some works within the wetland habitat west of the leisure centre.

318. Peregrines and barn owls would be most susceptible to disturbance if construction works within the Onshore Study Area take place close to active nest sites. As the onshore cable route beyond the landfall site follows existing roads, and the Grid Connection Substation is also adjacent to a major road, most of the Onshore Development Area is already subject to existing disturbance from human activity. The main potential for disturbance is therefore considered to be at the cable landfall site.

319. As they often nest near human dwellings, barn owls are considered to be generally tolerant of human activity, although disturbance close to a nest, particularly during the pre-laying and egg-laying periods, can cause nest failure (Ruddock and Whitfield 2007). A survey of expert opinion suggested that disturbance could occur from human activity within 50-100 m from a nest site, although many considered that human approach within 10 m of a nest would not cause disturbance (Ruddock and Whitfield 2007).

320. For peregrine, a survey of expert opinion suggested that nest sites might be disturbed by human activity within 500-750 m; although it was noted that this species may nest in active quarries and on buildings in urban centres, indicating the potential for tolerance / habituation to human activity (Ruddock and Whitfield 2007). Experts have reported that barn owl and peregrine can be conditioned over time (sometimes just a few days) to accept quite high levels of close human activity close to nests that they would not initially tolerate, although the responses of individual pairs may vary widely (Ruddock and Whitfield 2007).

321. Data gathered during the desk study include records of peregrine nest sites for the RSPB South Stack Reserve, which includes coastal and adjacent inland areas within about 500 m north west and about 750 km southeast of the cable landfall area. This information (**Confidential Appendix 19.2, Annex 19.2, Volume III**) indicates that all peregrine nest sites in this area are on coastal cliffs and the closest nest site to the cable landfall site is approximately 1km away, and thus beyond disturbance distance.

322. During the desk study it was not possible to source data on the location of barn owl nest sites, if any, close to the cable landfall site. Information from local sources (Adrienne Stratford, Cross and Stratford Chough Project, and Laura Kudelska, RSPB South Stack Reserve, pers. comm.) indicates that the species does nest in the vicinity of the cable landfall site, but it is not known at the time of writing if anyone undertakes regular monitoring of barn owl nest locations in this area.

323. The opportunity for a direct impact pathway with foraging raptors is very limited, and, although there will be permanent foraging habitat loss where permanent infrastructure is built above ground and temporary habitat loss where buried infrastructure will be located the areas of permanent loss are very small and habitat within the footprint of the Onshore Development Area is considered to be of lower importance for raptors than much of the other habitat on Holy Island. Beyond the cable landfall, the Onshore Cable Route will be located in the local road network as much as possible, which will be subject to ongoing disturbance.

324. Overall raptors are considered to be of medium importance. The magnitude of any indirect impact of disturbance / temporary or permanent habitat loss is considered to be low. Overall,

the risk of impact to raptors is assessed to be **minor adverse** in significance. As a precautionary measure, in case barn owls are found to be nesting close to the cable landfall or other areas of the Onshore Development Area, mitigation is proposed in the form of pre-construction checks for nest sites and consideration of the requirement for a works exclusion buffer (see paragraph 330 below).

19.6.5.11.5. Passerines and Other Species

325. Although the onshore cable route will be installed within the road network as much as possible, there will be requirement for it to extend into the neighbouring habitat which includes breeding habitat for passerines and other species. Suitable habitat for breeding birds within the Onshore Development Area includes hedgerow, scrub, reedbed and marshy grassland, cliff areas and woodland habitat. Woodland habitat will be avoided as part of embedded mitigation, however there is potential for pockets of scrub, hedgerow and marshy grassland habitat to be temporarily disturbed throughout the Onshore Development Area and, under a worst-case scenario, trenching at landfall will take place across a small section of maritime cliff and slope habitat.

326. As detailed in the embedded mitigation (**Section 19.6.3**), vegetation removal will be undertaken outwith the bird breeding season. Breeding birds are considered to be of medium value and under the embedded mitigation, habitat removal works will be undertaken outwith the breeding bird season. The majority of the habitats within the Onshore Development Area will be subject to short term and temporary loss with disturbance associated with the works including duct, noise and human presence. If birds are discouraged from breeding within this footprint (i.e. through the initiation of construction outwith the breeding season) the impact to passerines and other species is anticipated to be low in magnitude, leading to a **minor adverse** impact overall.

19.6.5.11.6. Mitigation

327. In addition to the mitigation described above for chough, the following would apply.

328. A toolbox talk by the ECoW or a suitably qualified ecologist with ornithological expertise will be undertaken as part of the induction of all construction staff.

329. Vegetation removal will be carried out outside the breeding season for birds as far as possible. If vegetation removal is required within the bird breeding period, checks for nesting birds will be carried out by an ecologist; if nests are present the work will be delayed until young have fledged. This mitigation is not practical for large scale development and therefore should only be used if vegetation removal cannot be undertaken outside the bird breeding season in small parcels of land (for example where land access has been a constraint).

330. Pre-construction checks for potential barn owl nesting sites (focusing on agricultural buildings) will be undertaken, in case there are any nests within potential disturbance distance of onshore works. Should any active nests be found, works in the vicinity of the nest will stop pending advice by the ECoW or a suitably qualified ecologist with ornithological expertise on the requirement for a works exclusion buffer around the nest until breeding activity is completed (chicks have fledged, or a nesting attempt has failed).

331. Scrub, hedgerow, marshy grassland and maritime cliff and slope habitat that cannot be avoided will be subject to pre-construction walkover habitat survey in advance of construction commencing to inform the habitat reinstatement plans.

332. Habitat reinstatement will be undertaken following completion of construction, using native species of local provenance. Landscaping plans will take into consideration of creation of breeding bird habitat.

19.6.5.11.7. Residual Impact

333. Following mitigation, impacts to breeding birds are considered to be **negligible** to **minor adverse**.

19.6.5.12. Construction Impact 12: habitat loss, disturbance or killing of Invertebrates

334. The majority of key habitats for invertebrate species identified during the EP1HS are within the SSSI habitats and have been avoided as part of the route selection process. As the work will be short term and temporary, followed by habitat reinstatement of habitat with native species of local provenance, the impacts to invertebrates are considered to be of low magnitude on low value habitat within the Onshore Development Area, and are therefore assessed to be of **negligible** adverse significance.

19.6.5.12.1. Mitigation

335. No further recommendations or mitigation are made in relation to invertebrates.

19.6.5.12.2. Residual Impact

336. Impact remains as **negligible adverse** significance.

19.6.5.13. Construction Impact 13: Damage to Notable Plant Species

337. The majority of key habitats for notable plant species identified during the EP1HS or from the desk study are within the SSSI areas and cliff top vegetation and have been avoided during the site selection process. Nevertheless, wild leek, spatulate fleawort, spotted rock rose, sea lavender and golden hair lichen have all been recorded within the vicinity of the Onshore Study Area. The wild leek *Allium ampeloprasum* was recorded in the road verge and field edge at Ty Mawr, South Stack Road (see **Figure 19.10, Volume II**), and is potentially at risk of disturbance or removal if work is required to create a new or wider road access point at the entrance to the existing track to Ty Mawr or if other cabling infrastructure is required in this area. Small flowered catchfly has been recorded in a grass verge along the onshore cable corridor. There is potential for damage or removal of these plants during construction activities.

338. These plants are considered to be of medium value and the magnitude of effect is anticipated to be high as wild leek and small flowered catchfly are located within the Onshore Study Area. In addition, further plants of this or other important species may have established within the footprint in the time between survey and construction, any of which would be at risk of damage or destruction during construction. The impact is therefore considered to be **major adverse**.

19.6.5.13.1. Mitigation

339. The location of the wild leek and small flowered catchfly will be clearly marked and identified with 5 m buffer fencing, and this area will be avoided during any construction work. This may require a bypass section of track to be temporarily constructed.

340. Several other notable plants are known to be present in the area surrounding the landfall and Landfall Substation. It is recommended that prior to construction, further detailed botanical survey work is undertaken to ensure the risk of impacts to spatulate (South Stack) fleawort, golden-hair lichen and spotted rock-rose (and other areas of botanically rich vegetation) can be avoided. Such survey work should be carried out in May or June when fleawort is in flower and morning time when spotted rock rose is more likely to flower.

341. If, under a worst-case scenario, the cables are trenched at landfall, further consultation will be undertaken with NRW and RSPB to determine appropriate methods, mitigation and any appropriate consents to undertake the work. This would include any habitat reinstatement and planting schemes which will be detailed in the EAP, along with frequency of any required monitoring programme.

342. A toolbox talk detailing the importance of these plant species will be delivered by the ECoW to all personnel working on site.

19.6.5.13.2. Residual Impact

343. Following the mitigation, the locations of plants will be known and avoided. As a worst case, habitat loss of neutral grassland and maritime cliff and slope will be temporary in the footprint of the landfall cable trenching and onshore cable corridor, with permanent habitat loss within the improved grassland fields for the permanent infrastructure and the magnitude of impact would be reduced to low and therefore the residual impact to notable plant species is assessed to be **minor adverse**.

19.6.5.14. Construction Impact 14: Spread of Non-Native Invasive Species

344. **Table 19-15** shows that Japanese knotweed was identified in four locations on Holy Island during the Extended Phase 1 Habitat Survey, two of which are within the Onshore Development Area. As the construction works will involve bringing in plant and equipment to the Onshore Study Area, including plant which will be used in other areas of the onshore infrastructure where presence of invasive species is known to occur, there is a risk of releasing non-native species into the study area during the construction phase. The risk of introducing non-native species over the long term is anticipated to have an effect of medium magnitude on a medium importance receptor, and results in an impact of at worst **moderate adverse** significance.

345. Location b is in a small walled field just to the south of Ty Mawr at the landfall location. It is recommended that this area is avoided, since roots can extend 7 m laterally (Welsh Government, 2011) a buffer of at least 10 m from the plant is recommended. If work is required in this part of the Onshore Development Area advice from a specialist contractor is recommended.

346. Location c is in the grass verge on the north side of the road adjacent to the onshore cable corridor. This is a small stand of Japanese knotweed and therefore unlikely to have an extensive underground root system; however, the excavation of soil in close proximity to this plant may have potential to spread root material, by disturbing rhizomes of the plant.

347. Since this plant occurs in various locations in the local area, as good practice it is recommended that contractors on the project are made aware of the presence of this species and the correct course of action to be followed if they encounter it (i.e. avoid, stop work in this area and seek further advice).

19.6.5.14.1. Mitigation

348. Mitigation measures to minimise risks will include the following:

- A pre-construction survey will be undertaken to ascertain up-to-date locations of any non-native invasive species within the Study Area;
- An Invasive Species Management Plan (specific to Japanese knotweed) will be included in the CoCP; and
- A toolbox talk will be delivered by the ECoW to all personnel working on site.

349. A buffer of 10 m will be placed around the known strands. If work is required in close proximity to the plants (e.g. within 7 m), advice from a specialist contractor is recommended to determine how any spoil generated from the work should be dealt with (for example, any possibly contaminated spoil may need to be disposed of at waste facility that is licenced to accepted controlled waste), and to agree an appropriate working method in this area. Treatment of strands of Japanese knotweed may be required if avoidance is not possible.

19.6.5.14.2. Residual Impact

350. Following mitigation, the potential impact of risk if spread of non-native invasive species is reduced to **minor adverse** significance.

19.6.6. Potential Impacts During Operation

351. Potential operational impacts include noise associated with the transformers, cooling systems within the Landfall Substation, Grid Connection Substation and Switchgear Building, and occasional staff / tenant vehicle movements during site visits (see also **Chapter 22, Noise and Vibration**). Planned maintenance visits would be undertaken in the daytime. Unplanned maintenance could (if an emergency) potentially be undertaken at night but would be very rare.

352. Due to the very low presence of vehicles and staff anticipated for operation and maintenance of the onshore infrastructure (See **Chapter 4, Project Description** for details), negligible disturbance impacts are predicted for all ecological receptors identified at the construction phase, with the exception of bats.

19.6.6.1. Operational Impact 1: Disturbance to Foraging and Commuting Routes for Bats

353. Any lighting of the permanent buildings will have the potential to affect foraging and commuting bats using the woodland edges in the surrounding area. As mentioned under **Section 19.6.5.8**,

this may require bats to change their foraging and commuting route, thus expending more energy.

354. The potential impact is considered to be negative, probable, permanent and of long-term duration (37 years). The magnitude of the impact is considered to be low due to the limited habitat potential and exposure of the island for foraging and commuting with low activity of bat species. Overall, a **minor adverse** impact is predicted at the local level.

19.6.6.1.1. Mitigation

355. Lighting will be designed in accordance with Bats and artificial Lighting in the UK (BCT, ILE, 2018); and Guidance Notes for the Reduction of Obtrusive Light ILE (2011). This is likely to require:

- No direct lighting of the woodland edges, scrub and hedgerow habitats, and use of dark buffer zones;
- Consideration of appropriate luminaire specifications, sensitive light configuration, screening, glazing, dimming and part-night lighting to minimise impacts;

19.6.6.1.2. Residual impact

356. Following the implementation of the mitigation proposed above, a **negligible** adverse impacted is predicted.

19.6.7. Potential Impacts During Decommissioning

357. The onshore cable will remain in situ where buried either under the road or verge but removed where laid on surface at landfall. If any portion of cable is buried the ends would be terminated and it left in situ. The worst case for the decommissioning phase would be the complete removal of the Landfall Substation, the Grid Connection Substation, the Switchgear Building. In this case, decommissioning is expected to give rise to similar impacts as those described for the construction phase. However, as certain activities would not be undertaken (e.g. HDD) the magnitude of any impact will be lower.

358. As mentioned in **Chapter 4, Project Description**, a detailed decommissioning plan will be submitted for approval by the regulatory authorities prior to construction.

19.6.8. Cumulative Impacts

359. This section describes the CIA for terrestrial ecology, taking into consideration other plans, projects and activities. This has been undertaken as a two-stage process, with the first stage comprising assessing all the impacts from the previous sections for the potential to act cumulatively with other projects. This summary assessment is set out in **Table 19-22** below.

Table 19-22 Potential Cumulative Impacts

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Construction			
Impact 1: habitat loss or disturbance of features of statutory designated nature conservation sites	Yes	Medium	Impacts to interest features of designated sites may be exacerbated by other projects
Impact 2: habitat loss or disturbance of features of non-statutory designated nature conservation sites	Yes	Medium	Impacts to interest features of designated sites may be exacerbated by other projects
Impact 3: habitat loss (grasslands, wetland habitat, hedgerow)	Yes	Medium	Loss of habitat due to other projects may increase the cumulative loss of habitat within the county
Impact 4: habitat loss, disturbance or killing of otter	Yes	Medium	Impact to species due to other projects may increase the cumulative impacts to species within the county
Impact 5: habitat loss, disturbance or killing of water vole	Yes	Medium	Impact to species due to other projects may increase the cumulative impacts to species within the county
Impact 6: habitat loss, disturbance or killing of red squirrel	Yes	Medium	Impact to species due to other projects may increase the cumulative impacts to species within the county
Impact 7: habitat loss, disturbance or killing of badger	Yes	Medium	Impact to species due to other projects may increase the cumulative impacts to species within the county
Impact 8: habitat loss, disturbance or killing of bats	Yes	Medium	Impact to species due to other projects may increase the cumulative impacts to species within the county
Impact 9: habitat loss, disturbance or killing of reptiles	Yes	Medium	Impact to species due to other projects may increase the cumulative impacts to species within the county
Impacts 10: habitat loss, disturbance or killing of GCN	Yes	Medium	Impact to species due to other projects may increase the cumulative impacts to species within the county
Impacts 11: habitat loss, disturbance or killing of birds	Yes	Medium	Impact to species due to other projects may increase the cumulative impacts to species within the county
Impact 12: habitat loss, disturbance or killing of invertebrates	Yes	Medium	Impact to species due to other projects may increase the cumulative impacts to species within the county

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Impact 13: damage to notable plants	Yes	Medium	Impact to species due to other projects may increase the cumulative impacts to species within the county
Impact 14: Spread of non-native invasive species	Yes	Medium	Other projects may exacerbate the risk from invasive species within the county
Operation			
Impact 1: Disturbance to foraging and commuting routes for bats	Yes	Medium	Impact to species due to other projects may increase the cumulative impacts to species within the county
Decommissioning			
Contractual details relating to decommissioning are yet to be finalised, however the ultimate responsibility for the decommissioning of the general onshore electrical infrastructure will lie with Menter Môn. At this stage, this is expected to consist primarily of removal of the Landfall Substation, the Grid Connection Substation, the Switchgear Building.			

360. The second stage of the CIA is an assessment of whether there is spatial or temporal overlap between the extent of potential effects of the onshore project area, and the extent of potential effects of other projects scoped into the CIA on the same receptors. To identify whether this may happen, the potential nature and extent of effects arising from all projects scoped into the CIA have been identified and any overlaps between these and the effects identified above. Where there is an overlap, an assessment of the cumulative magnitude of effect is provided.

361. Projects taking place in the marine areas surrounding Holy Island and Anglesey have been scoped out of this chapter due to the limited potential for impacts to act cumulatively between marine and terrestrial ecology. Marine impacts are covered within **Chapter 9, Benthic and Intertidal Ecology**. In addition, due to the small-scale nature of the onshore project area and its island location in respect of terrestrial ecology receptors, those projects at a greater distance than 10 km away have also been scoped out.

362. **Table 19-23** summarises those projects which have been scoped into the CIA due to their temporal or spatial overlap with the potential effects arising from the project. The remainder of the section details the nature of cumulative impacts against all those receptors scoped in for cumulative assessment.

363. The assessment set out in **Table 19-23** demonstrates that there is no potential for cumulative impacts arising between the proposed onshore elements of the Project and other proposed onshore developments in the study area for onshore ecology.

Table 19-23 Summary of Projects Considered for the CIA in relation to onshore ecology

Project	Status	Distance from the Project (km)	Project data status	Included in CIA	Rationale
Reclamation adjacent to Terminal 4 of the Port of Holyhead	Scoping Report submitted 28/04/17	2	Medium	No	This project is unlikely to have an impact on the same onshore ecology receptors as the proposed Morlais project due to its distance from the designated sites and habitats considered as part of the Morlais onshore ecology assessment. There is not anticipated to be an interaction or cumulative impact on onshore ecology receptors between these two projects and therefore it has been scoped out of further assessment.
Holyhead Waterfront Redevelopment	Pre-application	2	Medium	No	This project is unlikely to have an impact on the same onshore ecology receptors as the proposed Morlais project due to its distance from the designated sites and habitats considered as part of the Morlais onshore ecology assessment. There is not anticipated to be an interaction or cumulative impact on onshore ecology receptors between these two projects and therefore it has been scoped out of further assessment.
Holy Island Resort	Planning permission granted.	2.5	Medium	No	Project components located close to the Holy Island Resort proposed project area are being constructed on land that formed part of the demolished aluminium works near the location of the proposed Morlais Grid Connection Substation and are therefore potential to impact on OMH and other habitats at this location. The Morlais project will avoid sensitive habitats such as woodland and marshy land, and there is anticipated to be minor beneficial impacts to OMH due to removal of scrub habitat. There is not anticipated to be a significant impact to ecological connectivity at this site and therefore there is not anticipated to be a cumulative impact between these two projects and therefore it has been scoped out of further assessment.
Sirius SBC	Pre-application	4	Medium	No	This project is unlikely to have an impact on the same onshore ecology receptors as the proposed Morlais project due to its distance from the designated sites and habitats considered as part of the Morlais onshore ecology assessment. There is not anticipated to be an interaction or cumulative impact on onshore ecology receptors between these two projects and therefore it has been scoped out of further assessment.

Project	Status	Distance from the Project (km)	Project data status	Included in CIA	Rationale
Anglesey Eco Park Power Station	Outline planning permission is in place. A full planning application for the development is expected to have an accompanying Environmental Statement, but this is not yet available.	5	Medium	No	This project is unlikely to have an impact on the same onshore ecology receptors as the proposed Morlais project due to its distance from the designated sites and habitats considered as part of the Morlais onshore ecology assessment. There is not anticipated to be an interaction or cumulative impact on onshore ecology receptors between these two projects and therefore it has been scoped out of further assessment.

19.6.9. Inter-relationships

364. **Table 19-24** lists out the inter-relationships between other chapters within the ES.

Table 19-24 Inter-topic relationships

Topic	Related Chapter	Where addressed in this Chapter	Rationale
Marine Ornithology	Chapter 11	**Section 19.6.5** (Impacts 1,2 and 11)	Both chapters consider the potential effects of the project on birds and the designated sites which create their habitat, however **Chapter 11, Marine Ornithology** looks at sea birds (including cliff nesting) and the Onshore Ecology chapter considers terrestrial species.
Benthic and Intertidal Ecology	Chapter 9	**Section 19.6.5** (Impact 1)	Both chapters consider the potential effects of the project on designated sites
Water Resources and Flood Risk	Chapter 17	**Section 19.6.5** (Impacts 1 and 2)	The Onshore Ecology chapter takes account of the assessments made in **Chapter 17, Water Resources and Flood Risk** which consider potential impacts to groundwater to assess any associated impacts to designated sites and habitats.
Noise and Vibration	Chapter 21	**Section 19.6.5** (all impacts).	The Onshore Ecology chapter takes account of the assessments made in **Chapter 21, Noise and Vibration** for considering potential impacts of noise and vibration to designated sites and species.
Air Quality	Chapter 22	**Section 19.6.5** (all impacts)	The Onshore Ecology chapter takes account of the assessments made in **Chapter 22, Air Quality** for considering potential impacts of air quality to designated sites, habitats and species.
Seascape, Landscape and Visual Impact Assessment (SLVIA)	Chapter 24	**Section 19.6.5** (Impacts 1,2 and 3)	Both chapters consider the potential effects of hedgerow and tree removals, the LVIA considering the impact on hedgerows and trees as landscape elements (**Chapter 25, SLVIA**) and the Onshore Ecology assessment considering the impact on hedgerows and trees as important ecological assets. Both chapters consider the mitigation of hedgerow and tree loss in respect of proposals to replant. The OLEMS (document reference 8.7) sets out the approach to replanting.

19.6.10. Interactions

365. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 19-25**, along with an indication as to whether the interaction may give rise to synergistic impacts.

366. The table shows potential interactions during construction. As only one potential impact is anticipated during operation, there are not predicated to be interactions between impacts during the operation phase.

Table 19-25 Potential interactions

Potential interaction between impacts														
Impact	1: Statutory designated nature conservation designated sites	2: Non-statutory designated nature conservation designated sites	3: Habitat loss and fragmentation	4 habitat loss, disturbance or killing of otter	5 habitat loss, disturbance or killing of water vole	6 habitat loss, disturbance or killing of red squirrel	7 habitat loss, disturbance or killing of badger	8 habitat loss, disturbance or killing of bats	9 habitat loss, disturbance or killing of reptiles	10 habitat loss, disturbance or killing of GCN	11: habitat loss, disturbance or killing of birds	12: habitat loss, disturbance or killing of invertebrates	13: damage to notable plant species	14: Spread of non-native invasive species
Construction														
1: Statutory designated nature conservation designated sites	-	Yes	Yes	Yes	No	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes
2: Non-statutory designated nature conservation designated sites	Yes	-	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3: Habitat loss and fragmentation	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

Potential interaction between impacts														
Impact	1: Statutory designated nature conservation designated sites	2: Non-statutory designated nature conservation designated sites	3: Habitat loss and fragmentation	4 habitat loss, disturbance or killing of otter	5 habitat loss, disturbance or killing of water vole	6 habitat loss, disturbance or killing of red squirrel	7 habitat loss, disturbance or killing of badger	8 habitat loss, disturbance or killing of bats	9 habitat loss, disturbance or killing of reptiles	10 habitat loss, disturbance or killing of GCN	11: habitat loss, disturbance or killing of birds	12: habitat loss, disturbance or killing of invertebrates	13: damage to notable plant species	14: Spread of non-native invasive species
Construction														
4 habitat loss, disturbance or killing of otter	Yes	Yes	Yes	-	No	No	No	No	No	No	No	No	No	No
5 habitat loss, disturbance or killing of water vole	No	Yes	Yes	No	-	No	No	No	No	No	No	No	No	No
6 habitat loss, disturbance or killing of red squirrel	No	Yes	Yes	No	No	-	No	No	No	No	No	No	No	No
7 habitat loss, disturbance or killing of badger	No	Yes	Yes	No	No	No	-	No	No	No	No	No	No	No

Potential interaction between impacts														
Impact	1: Statutory designated nature conservation designated sites	2: Non-statutory designated nature conservation designated sites	3: Habitat loss and fragmentation	4 habitat loss, disturbance or killing of otter	5 habitat loss, disturbance or killing of water vole	6 habitat loss, disturbance or killing of red squirrel	7 habitat loss, disturbance or killing of badger	8 habitat loss, disturbance or killing of bats	9 habitat loss, disturbance or killing of reptiles	10 habitat loss, disturbance or killing of GCN	11: habitat loss, disturbance or killing of birds	12: habitat loss, disturbance or killing of invertebrates	13: damage to notable plant species	14: Spread of non-native invasive species
Construction														
8 habitat loss, disturbance or killing of bats	No	Yes	Yes	No	No	No	No	-	No	No	No	No	No	No
9 habitat loss, disturbance or killing of reptiles	Yes	Yes	Yes	No	No	No	No	No	-	No	No	No	No	No
10 habitat loss, disturbance or killing of GCN	No	Yes	Yes	No	No	No	No	No	No	-	No	No	No	No
11: habitat loss, disturbance or killing of birds	Yes	Yes	Yes	No	No	No	No	No	No	No	-	No	No	No

Potential interaction between impacts														
Impact	1: Statutory designated nature conservation designated sites	2: Non-statutory designated nature conservation designated sites	3: Habitat loss and fragmentation	4 habitat loss, disturbance or killing of otter	5 habitat loss, disturbance or killing of water vole	6 habitat loss, disturbance or killing of red squirrel	7 habitat loss, disturbance or killing of badger	8 habitat loss, disturbance or killing of bats	9 habitat loss, disturbance or killing of reptiles	10 habitat loss, disturbance or killing of GCN	11: habitat loss, disturbance or killing of birds	12: habitat loss, disturbance or killing of invertebrates	13: damage to notable plant species	14: Spread of non-native invasive species
Construction														
12: habitat loss, disturbance or killing of invertebrates	Yes	Yes	Yes	No	No	No	No	No	No	No	No	-	No	No
13: damage to notable plant species	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	-	No
14: Spread of non-native invasive species	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	-

19.7. SUMMARY

367. The main potential impacts of the Project on terrestrial ecological receptors have been identified. These have included impacts to statutory and non-statutory designated sites, temporary habitat loss, and potential injury or killing of protected and notable species during the construction phase of the project.

368. Potential impacts during the construction phase, without mitigation, were considered to range from **negligible** to **major adverse** significance.

369. Following the adoption of the recommended best practice guidance and mitigation measures, the residual impacts to the majority of ecological receptors from construction of Morlais will be of **negligible to minor adverse significance** in the short to medium term whilst disturbed habitats re-stablish following habitat reinstatement.

370. The preference for bringing the cables ashore at landfall is to use HDD technology. Under this scenario, there will be no impact to the Glannau Ynys Gybi / Holy Island Coast SSSI/SPA/SAC or its designated / notified species or habitats. Should HDD not be possible, there will be impacts up to **moderate adverse** in significance to the vegetated sea cliffs of the Atlantic Coast habitat feature. There will be temporary habitat loss in the 70m corridor of cable trenching and 60 m of construction footprint on the cliff face during construction and recovery of this vegetation type. All structures laid upon the cliff face and foreshore will be removed upon decommissioning, any buried cables will remain *in situ*.

371. Although the project will impact on the designated habitat, the percentage of the designated site affected is assessed to be *de minimis* with permanent impacts affecting 0.004% of the designated site, and no impact to site integrity is anticipated.

372. A summary of the potential impacts identified is provided in **Table 19-26** below.

Table 19-26 Potential Impacts Identified for Onshore Ecology

Potential Impact	Receptor	Value	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction						
Impact 1: Statutory designated nature conservation designated sites	Glannau Ynys Gybi / Holy Island Coast SSSI/SPA/SAC and Tre Wilmot SSSI	Worst case High	Medium	Worst case Major adverse	Habitat management plan, in consultation with IOACC and NRW, appropriate turf storage for habitat reinstatement.	Worst case Moderate adverse
	Beddmanarch-Cymryan SSSI	High	Low	Minor adverse		Negligible
Impact 2: Non-statutory designated nature conservation designated sites	Local Wildlife Sites	Medium	No impact	No impact	Habitat reinstatement plan	Minor adverse
	Ancient woodlands	Medium	Negligible	Negligible		Negligible
	South stacks RSPB Reserve	Medium	Low	Minor adverse		Negligible
	Breakwater Country Park	Medium	low	Minor adverse		Negligible -
Impact 3: Habitat loss and fragmentation	Grasslands	Low	Medium	Minor adverse	Micro-siting, management of construction boundaries tool box talks, habitat reinstatement	Minor adverse
	Hedgerows and trees	Medium	medium	Moderate adverse		Minor adverse
	Lowland fen and reedbed	Medium	Medium	Moderate adverse		Minor adverse
	Open mosaic habitat	Low	Low	Minor adverse		Minor beneficial
	Cloddiau	Medium	Low - high	Minor adverse – major adverse		Minor adverse
Impact 4 habitat loss, disturbance or killing of otter	Otter	Low	Low	Minor adverse	Pre- construction survey, tool box talks, use of exit ramps	Negligible
Impact 5 habitat loss, disturbance	Water vole	Low	Low	Minor adverse	Pre- construction survey, tool box talks	Negligible

Potential Impact	Receptor	Value	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
or killing of water vole						
Impact 6 habitat loss, disturbance or killing of red squirrel	Red squirrel	Medium	Negligible	Minor adverse	Pre- construction survey, tool box talks	Negligible
Impact 7 habitat loss, disturbance or killing of badger	Badger	Medium	High	Moderate adverse	Preconstruction survey, tool box talks, licence for works within 30m of active sett, monitoring, potential sett exclusion under licence and creation of replacement set, exit ramps	Minor adverse
Impact 8 habitat loss, disturbance or killing of bats	Roosting bats	Medium	Low	Minor adverse	Sensitive lighting regime, toolbox talks, bat survey of historic roost, buffers	Negligible
	Foraging and commuting bats	Low	Low	Minor adverse		
Impact 9 habitat loss, disturbance or killing of reptiles	Reptiles	Low - Medium	Medium	Minor - moderate	Pres construction survey, precautionary methods of vegetation clearance, mitigation strategy, toolbox talks	Minor adverse
Impacts 10 habitat loss, disturbance or killing of GCN	GCN	Low	Low	Minor adverse	Pre- construction eDNA survey, toolbox talk	Negligible
Impacts 11: habitat loss, disturbance or killing of birds	Seabirds	See **Chapter 11, Offshore Ornithology**				
	Chough	High	Low	Moderately adverse	no construction works will take place within 500m of an active chough nest during the breeding season	Minor adverse
	Raptors	Medium	Low	Minor adverse	Toolbox talks, pre-construction surveys for barn owls in any agricultural buildings within the Onshore Study Area	Negligible - Minor adverse

Potential Impact	Receptor	Value	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
	Passerines and other species	Medium	Low	Minor adverse	Commence work outwith the breeding bird season, toolbox talks, micro-siting, habitat reinstatement	Negligible – minor adverse
Impact 12: habitat loss, disturbance or killing of invertebrates	Invertebrates	Low	Low	Negligible	None	negligible
Impact 13: damage to notable plant species	Notable plants	Medium	High	Major adverse	Pre construction surveys, protective buffers, habitat reinstatement, toolbox talks	Minor adverse
Impact 14: Spread of non-native invasive species	Japanese knotweed	Medium	Medium	Moderate adverse	Pre construction survey, invasive species management plan, toolbox talks	Minor adverse
Operation						
Impact 1: Disturbance to foraging and commuting routes for bats	Bats	Low	Low	Minor adverse	Sensitive lighting regime, toolbox talks	Negligible
Contractual details relating to decommissioning are yet to be finalised, however the ultimate responsibility for the decommissioning of the general onshore electrical infrastructure will lie with Menter Mon. At this stage, this is expected to consist primarily of removal of the Landfall Substation, the Grid Connection Substation, the Switchgear Building.						

19.8. REFERENCES

Balmer et al. (2013). Bird Atlas 2007-11: the breeding and wintering birds of Britain and Ireland. BTO Books, Thetford.

Bat Conservation Trust (2012). Professional Training Standards for Ecological Consultants.

Bat Conservation Trust (2016). Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd ed.).

Bat Conservation Trust and Institute of Lighting Engineers (2018). Bats and artificial Lighting in the UK: Bats and the Built Environment Series, Guidance note 08/18.

Biggs, J., Ewald. N., Valentini, A., Gaboriaud, C., Griffiths. R.A., Foster, J., Wilkinson, J., Arnett, A., Williams, P. and Dunn, F. (2014). Analytical and methodological development for improved surveillance of the Great Crested Newt. Appendix 5. Technical advice note for field and laboratory sampling of great crested newt (Triturus cristatus) environmental DNA. Freshwater Habitats Trust, Oxford.

Bignal, E.M., McCracken, D.I., Stillman, R.A. & Ovenden, G.N. (1996). Feeding behaviour of nesting choughs in the Scottish Hebrides. Journal of Field Ornithology 67, 25-43.

British Standard (2013) British Standard 42020:2013 – Biodiversity. Code of Practice for planning and development.

British Standard (2012) British Standard 5837: 2012 – Trees in relation to design, demolition and construction;

BSBI (2018) Anglesey Rare Plant Register – Summary Tables. Available at URL: https://bsbi.org/anglesey accessed 01/04/2019

Bullock, I.D., Drewett, D.R. & Mickleburgh, S.P. (1983). The Chough in Britain and Ireland. British Birds 79, 377-401.

Chartered Institute of Ecology and Environmental Management (2016). Professional Code of Conduct, Revised June 2016.

CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine.

Construction Industry Research and Information Association (2016) Guidance note C692 Environmental Good Practice on Site Guide (3rd Edition)

Construction Industry Research and Information Association (CIRIA) Guidance note C692 Environmental Good Practice on Site Guide (3rd Edition).

Construction Industry Research and Information Association (CIRIA) C648 (2006) Control of water pollution from linear construction projects

Countryside Council For Wales (2008) Core Management Plan including Conservation Objectives Glannau Ynys Gybi SAC & Glannau Ynys Gybi SPA Available from URL: https://naturalresources.wales/media/672152/Glannau%20Ynys%20Gybi%20WES%20Plan%20English.pdf. Accessed 20/04/2019

Creswell, W. & Whitworth, R. (2004) An assessment of the efficiency of capture techniques and the value of different habitats for the great crested newt Triturus cristatus. English Nature Research Reports: Number 576

Cutts, N., Hemingway, K., Spencer, J., 2013. Waterbird Disturbance Mitigation Toolkit Informing Estuarine Planning & Construction Projects. Institute of Estuarine & Coastal Studies (IECS) University of Hull

Dean et al. (2016) The Water Vole Mitigation Handbook (The Mammal Society Guidance Series);

Dean, M., Strachan R., Gow, D. and Andrews, R. (2016). The Water Vole Mitigation handbook (the mammal Society Mitigation Guidance Series. Eds Fiona Matthews and Paul Chanin. The Mammal Society, London.

Department for Energy and Climate Change (2011) Overarching NPS for Energy (EN-1) Available at URL: https://www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure Accessed 01/04/2019

Department for Energy and Climate Change (2011b) NPS for Renewable Energy Infrastructure (EN-3) Available at URL: https://www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure Accessed 01/04/2019

Department for Energy and Climate Change (2011c) NPS for Electricity Networks Infrastructure(EN-5) Available at URL: https://www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure Accessed 01/04/2019

Department for Environment, Food and Rural Affairs (2011) Natural Environment White Paper (2011, as amended) available at URL: https://www.gov.uk/government/publications/natural-environment-white-paper-implementation-updates Accessed 01/04/2019

Department for Environment, Food and Rural Affairs (2013) MAGIC website. Available at URL: http://www.magic.gov.uk accessed 01/04/2019

Edgar, P., Foster, J. and Baker, J. (2010). Reptile Habitat Management Handbook. Amphibian and Reptile Conservation, Bournemouth.

English Nature (2001) Great crested newt mitigation guidelines. English Nature.

Environment Agency (2006) Managing Japanese knotweed on development sites: the knotweed code of practice;

Forestry Commission (2014). Standing Advice for Ancient Woodland and Veteran Trees. StAdv/AWVT/NE/Apr2014

Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.

GB Non-native Species Secretariat (2015) Species Information.

Gwynedd Council and Isle of Anglesey County Council (2017) Joint Local Development Plan (Anglesey and Gwynedd) available at URL: https://www.gwynedd.llyw.cymru/en/Council/Documents---Council/Strategies-and-policies/Environment-and-planning/Planning-policy/Anglesey-and-Gwynedd-Joint-Local-Development-Plan-Written-Statement.pdf Accessed 01/04/2019

HM Government (2018) A Green Future: Our 25 Year Plan to Improve the Environment 2018. Available at URL https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf Accessed 01/04/2019

Institute of Environmental Assessment (1995). Guidelines for Baseline Ecological Assessment.

Isle of Anglesey County Council (undated) Anglesey's Local Biodiversity Action Plan. Available at URL: https://www.anglesey.gov.uk/en/Residents/Countryside/Biodiversity/What-are-we-doing-to-help-biodiversity-on-Anglesey.aspx Accessed 01/04/2019

Johnstone, I., Mucklow, C., Cross, T., Lock, L & Carter, I. The return of the Red-billed Chough to Cornwall: the first ten years and prospects for the future. British Birds. 104, pp.416–431.

Joint Nature Conservation Committee (2003). Herpetofauna Worker's Manual.

Joint Nature Conservation Committee (2010). Handbook for Phase 1 habitat survey: A technique for environmental audit.

Kerbiriou, C. et al. (2006). Linking territory quality and reproductive success in the Red-billed Chough *Pyrrhocorax pyrrhocorax*: implications for conservation management of an endangered population. Ibis 148, 352-364.

Kerbiriou, C., et al. 2009. Tourism in protected areas can threaten wild populations: from individual response to population viability of the chough *Pyrrhocorax pyrrhocorax*. Journal of Applied Ecology 46, 657-665

Llywodraeth Cymru (2012) Energy Wales: A Low Carbon Transition Available at URL: https://gov.wales/docs/desh/publications/120314energywalesen.pdf Accessed 01/04/2019

Maddock, A. (Ed) (2011) UK Biodiversity Action Plan; Priority Habitat Descriptions (First published in 2008, updated December 2011). BRIG

Medcalf K. A., Parker J.A., Turton, N., and Bell, G. (2013). Making Earth Observation Work for UK Biodiversity Conservation – Phase 2. Report to the JNCC and Defra.

Natural England (2007) Lowland Grassland Management Handbook (Second edition) (GRASSLAND)

Natural England (2014). Otters: surveys and mitigation for development projects. Natural England Standing Advice.

Natural England (2015a) Badgers: surveys and mitigation for development projects. Natural England Standing Advice;

Natural England (2015b) Bats: surveys and mitigation for development projects. Natural England Standing Advice;

Natural England (2015c) Great crested newts: surveys and mitigation for development projects. Natural England Standing Advice;

Natural England (2015d) Invertebrates: surveys and mitigation for development projects. Natural England Standing Advice;

Natural England (2015e) Reptiles: surveys and mitigation for development projects. Natural England Standing Advice;

Natural England (2015f) Water voles: surveys and mitigation for development projects. Natural England Standing Advice;

Natural England and Forestry Commission (2018) Ancient woodland and veteran trees: protecting them from development. Natural England and Forestry Commission Standing Advice;

Neal, E., & Cheeseman, C. (1998) Badgers. Poyser Natural History.

NRW (2018) Glannau Ynys Gybi / Holy Island Coast SSSI citation, accessed via: http://naturalresources.wales/media/656113/SSSI_0963_Citation_EN001c75d.pdf Accessed 01/04/2019

Oldham R.S., Keeble J., Swan M.J.S. & Jeffcote M. (2000). Evaluating the suitability of habitat for the Great Crested Newt (Triturus cristatus). Herpetological Journal 10(4), 143-155.

Oldham R.S., Keeble J., Swan M.J.S. & Jeffcote M. (2000). Evaluating the suitability of habitat for the Great Crested Newt (Triturus cristatus). Herpetological Journal 10 (4), 143-155.

Planning Inspectorate (2015) Morlais Scoping Opinion

Planning Inspectorate (2017) Morlais Scoping Opinion

Planning Inspectorate (2018) Morlais Scoping Opinion

Royal HaskoningDHV (2015) Morlais Scoping report

Royal HaskoningDHV (2017) Morlais Scoping Report

Royal HaskoningDHV (2018) Morlais Scoping Report

Ruddock, M. and Whitfield, D.P. (2007). A review of disturbance distances in selected bird species. Report from Natural Research (Projects) to Scottish Natural Heritage.

Spatial Action Plan for Great Crested Newts in Anglesey was provided to BSG Ecology by NRW

Stone, E.L. (2013) Bats and lighting: Overview of current evidence and mitigation guidance.

Strachan and Moorhouse (2011) Water Vole Conservation Handbook, 3rd Edition;

Strachan, Moorhouse and Gelling (2011). Water Vole Conservation Handbook 3rd Edition. Wildlife Conservation Unit, University of Oxford.

Welsh Government (2011) The Control of Japanese Knotweed (Fallopia japonica) in Construction and Landscape Contracts.

Whitehead, S., Johnstone, I. & Wilson, J. (2005) Choughs Pyrrhocorax pyrrhocorax breeding in Wales select foraging habitat at different spatial scales, Bird Study, 52,193-203,

Williams, P. (2013), How to collect a water sample to detect Great Crested Newt eDNA. Freshwater Habitats Trust, Oxford. August 2013

Wright, M.D., Goodman, P., Cameron, T., 2010. Exploring behavioural responses of shorebirds to impulsive noise. Wildfowl 60, 150–167.

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Morlais Project
Environmental Statement

Chapter 20: Onshore Archaeology and Cultural Heritage

Volume I

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-020

Chapter 20: Onshore Archaeology and Cultural Heritage

Author: Royal HaskoningDHV

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GLOSSARY OF ABBREVIATIONS

ADS	Archaeology Data Service
EIA	Environmental Impact Assessment
ES	Environmental Statement
CIfA	Chartered Institute for Archaeologists
DBA	Desk-Based Assessment
GAPS	Gwynedd Archaeological Planning Services
GAT	Gwynedd Archaeological Trust
GHER	Gwynedd Archaeological Trust Historic Environment Record
GIS	Geographical Information Systems
HDD	Horizontal Directional Drilling
MHWS	Mean High Water Springs
NMRW	National Monuments Record of Wales
NRW	Natural Resources Wales
PDE	Project Design Envelope
PINS	The Planning Inspectorate
RCAHMW	Royal Commission on the Ancient and Historical Monuments of Wales
RSPB	Royal Society for the Protection of Birds
SLVIA	Seascape, Landscape and Visual impact assessment
TWAO	Transport and Works Act Order
WCS	Worst-Case Scenario
WSI	Written Scheme of Investigation
ZTV	Zone of Theoretical Visibility

GLOSSARY OF TERMINOLOGY

Designated heritage asset	Heritage assets which have been afforded protection under current acts and regulations (e.g. scheduled monuments, listed buildings, registered parks and gardens).
Geoarchaeology	The application of earth science principles and techniques to the understanding of the archaeological record. Includes the study of soils and sediments and of natural physical processes that affect archaeological sites.
Historic Landscape Character	The attributes that contribute to the formation of the historic character of the landscape.
Listed buildings	A Listed Building is that which is seen to be of special architectural or historic interest. Listed buildings are designated as (from highest perceived significance to lowest): Grade I, II*, or II.
Non-Designated heritage asset	Heritage assets not currently afforded protection by current acts and regulations. Often in the form of buried archaeological remains, or locally listed buildings.
Palaeoenvironmental	Study of preserved organic remains (preserved through burning, waterlogging, etc) which survive within subsurface deposits and can be used to put archaeological sites into the historic environmental context.
Setting	The surroundings in which a heritage asset is experienced
Significance	Collective term for the sum of all archaeological, architectural, artistic and historic interest of a heritage asset.

20. ONSHORE ARCHAEOLOGY AND CULTURAL HERITAGE

20.1. INTRODUCTION

1. This chapter has been undertaken to assess the impact of the Morlais Project (the Project) upon the onshore historic environment and includes an assessment of potential impacts of the construction and operation of the Project upon the historic environment; principally designated and non-designated heritage assets, as as-yet unknown buried archaeological remains and their setting.

2. This chapter has been produced by Patrick Moan, BA, ACIfA, Heritage Consultant at Royal HaskoningDHV (RHDHV). The chapter is supported by a desk-based assessment (DBA) produced by Wessex Archaeology (**Appendix 20.1, Volume III**), which contains heritage baseline data for the Project along with assessments of significance and the contribution of setting to that significance.

3. As there is no industry-standard methodology for heritage impact assessment in terms of Environmental Impact Assessment (EIA), the approach to this chapter has followed standards and guidance set out in documents prepared by: Cadw, Chartered Institute for Archaeologists (CIfA), Historic England, and the Welsh Government (**Section 20.2.3**).

4. The key sections of the chapter are:

- Policy, Legislation and Guidance (**Section 20.2**): Outlines the legislation, planning policy and guidance relevant to this Project in terms of onshore archaeology and cultural heritage;
- Consultation (**Section 20.3**): Identifies the comments from consultation with relevant stakeholders (the Scoping Opinions from 2015, 2017 and 2018) and where their comments are addressed in this report;
- Assessment Methodology (**Section 20.4**): Outlines the methodologies employed for this report (baseline data procurement, study area etc.);
- Existing Baseline (**Section 20.5**): Summarises the data produced within the DBA (**Appendix 20.1, Volume III**) for use in the following impact assessment;
- Impact Assessment (**Section 20.6**): Identifies the impact the Project may have on identified (onshore) heritage assets during the Project's construction, operation and decommissioning, and potential mitigation;
- Summary (**Section 20.7**); and
- References (**Section 20.8**).

20.2. POLICY, LEGISLATION AND GUIDANCE

5. There are a number of relevant Policies, Acts and guidance documents which inform the approach to the assessment of impacts to archaeology and cultural heritage as part of an EIA framework, although no industry-standard methodology is currently available. A full description of all policy and legislation relevant to the Project is included in **Chapter 2, Policy and Legislation** of this ES.

20.2.1. Policy

6. The following policies have been reviewed to inform the approach to this chapter:

- Planning Policy Wales, Edition 10, Chapter 6 (Welsh Government, 2018);
- Technical Advice Note (TAN) 24: The Historic Environment (Welsh Government, 2017);
- Welsh Office Circular 11/99: Environmental Impact Assessment (Welsh Office 1999);
- Conservation principles for the sustainable management of the historic environment in Wales (Cadw, 2011); and
- Anglesey and Gwynedd Joint Local Development Plan 2011 - 2026 (Isle of Anglesey County Council and Gwynedd Council, 2017).

20.2.1.1. National Policy Statement

7. The Project is seeking consent for a Transport and Works Act Order from the Welsh Government and a Marine Licence from Natural Resources Wales (NRW). Although this project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP), therefore guidance relevant to NSIPs is considered appropriate to use for this Project. Guidance that is relevant to assessing impacts on marine water and sediment quality for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to marine water and sediment quality include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3), July 2011 (DECC, 2011b).

8. **Table 20-1** sets out how specific NPS policies relevant to onshore archaeology and cultural heritage are addressed within this chapter. Further detail on legislation and policy in relation to the wider project is provided in Chapter 3, Policy and Legislation.

Table 20-1 NPS EN-1 and EN-3 Assessment Requirements Relevant to Onshore Archaeology and Cultural Heritage

NPS Requirement	NPS Reference	ES Reference
"As part of the Environmental Statement the applicant should provide a description of the significance of the heritage assets affected by the proposed development and the contribution of their setting to that significance. The level of detail should be proportionate to the importance of the heritage assets and no more than is sufficient to understand the potential impact of the proposal on the significance of the heritage asset."	EN-1, Section 5.8.8	The significance of the archaeological receptors (heritage assets) considered in this chapter has been detailed in **Section 20.5**.
"Where a development site includes, or the available evidence suggests it has the potential to include, heritage assets with an archaeological interest, the applicant should carry out appropriate desk-based assessment and, where such desk-based research is insufficient to properly assess the interest, a field evaluation. Where proposed development will affect	EN-1, Section 5.8.9	As described in **Section 20.4**, this chapter is informed by a Desk-based Assessment undertaken by Wessex Archaeology (Wessex Archaeology, 2019). A settings assessment was undertaken to inform the DBA, and is updated as

NPS Requirement	NPS Reference	ES Reference
the setting of a heritage asset, representative visualisations may be necessary to explain the impact."		part of the impact assessment for this chapter (**Section 20.6**)
"The applicant should ensure that the extent of the impact of the proposed development on the significance of any heritage assets affected can be adequately understood from the application and supporting documents."	EN-1, Section 5.8.10	The potential impacts of the Project are assessed in **Section 20.6**, informed by the findings of the DBA (Wessex Archaeology, 2019).
In considering applications, the Infrastructure Planning Commission (IPC) [now the Planning Inspectorate and the Secretary of State] should seek to identify and assess the particular significance of any heritage asset that may be affected by the proposed development, including by development affecting the setting of a heritage asset, taking account of: ▪ Evidence provided with the application; ▪ Any designation records; ▪ The Historic Environment Record, and similar sources of information; ▪ The heritage assets themselves; ▪ The outcome of consultations with interested parties; and ▪ Where appropriate and when the need to understand the significance of the heritage asset demands it, expert advice'	EN-1, Section 5.8.11	This ES chapter assesses the potential for impacts to occur upon the onshore archaeology and cultural heritage resource as a result of the Project. Impacts of a direct (e.g. physical) and indirect (e.g. non-physical) nature are considered within the context of the project in a manner that is proportionate to those assets present (and their perceived heritage significance), as agreed in consultation with GAT and Cadw. This approach is outlined in **Section 20.4** with the heritage assets set out in the Existing Baseline in **Section 20.5** and assessment detailed in **Section 20.6**.
"In considering the impact of a proposed development on any heritage assets, the IPC [now the Planning Inspectorate and the Secretary of State] should take into account the particular nature of the significance of the heritage assets and the value that they hold for this and future generations. This understanding should be used to avoid or minimise conflict between conservation of that significance and proposals for development."	EN-1, Section 5.8.12	Heritage significance is assigned (**Section 20.5**) in line with the methodology set out in **Section 20.4**, based on available data. A precautionary approach has been adopted with regard to below ground remains which will be further substantiated post-consent following an initial informative stage of mitigation work (e.g. further geophysical survey and archaeological trial trenching).
The IPC [now the Planning Inspectorate and the Secretary of State] should take into account the desirability of sustaining and, where appropriate, enhancing the significance of heritage assets, the contribution of their settings and the positive contribution they can make to sustainable communities and economic vitality... This can be by virtue of: ▪ heritage assets having an influence on the character of the environment and an area's sense of place;	EN-1, Section 5.8.13	In order to assess the positive contributions of the Project in the context of onshore archaeology and cultural heritage, the magnitude of positive effect has also been considered in this chapter. The magnitude of positive effect directly relates to the level of public value associated with an individual beneficial impact and may correspond directly to the project itself (e.g. by means of route refinement or micrositing which seek to avoid heritage

NPS Requirement	NPS Reference	ES Reference
▪ heritage assets having a potential to be a catalyst for regeneration in an area, particularly through leisure, tourism and economic development; ▪ heritage assets being a stimulus to inspire new development of imaginative and high-quality design; ▪ the re-use of existing fabric, minimising waste; and, ▪ the mixed and flexible patterns of land use in historic areas that are likely to be, and remain, sustainable. ...The IPC [now the Planning Inspectorate and the Secretary of State] should take into account the desirability of new development making a positive contribution to the character and local distinctiveness of the historic environment. The consideration of design should include scale, height, massing, alignment, materials and use. The IPC [now the Planning Inspectorate and the Secretary of State] should have regard to any relevant local authority development plans or local impact report on the proposed development in respect of the factors set out [above]'.		assets) or where a project will enhance the historic environment and / or public understanding (e.g. by adding to the archaeological record). This is discussed in **Section 20.4** and assessed in **Section 20.7**.
There should be a presumption in favour of the conservation of designated heritage assets and the more significant the designated heritage asset, the greater the presumption in favour of its conservation should be. Once lost heritage assets cannot be replaced and their loss has a cultural, environmental, economic and social impact. Significance can be harmed or lost through alteration or destruction of the heritage asset or development within its setting. Loss affecting any designated heritage asset should require clear and convincing justification. Substantial harm to or loss of a grade II listed building, park or garden should be exceptional. Substantial harm to or loss of designated assets of the highest significance, including Scheduled Monuments; registered battlefields; grade I and II* listed buildings; grade I and II* registered parks and gardens; and World Heritage Sites, should be wholly exceptional.'	EN-1, Section 5.8.14	The potential impacts arising on designated heritage assets are assessed within **Section 20.6**.
"Any harmful impact on the significance of a designated heritage asset should be weighed against the public benefit of development, recognising that the greater the harm to the significance of the heritage asset the greater the justification will be needed for any loss. Where the application will lead to substantial harm to or total loss of significance of a designated heritage asset the IPC [now the Planning Inspectorate and the Secretary of State] should refuse consent unless it can be demonstrated that the substantial harm to or loss of significance is	EN-1 Section 5.8.15	The potential impacts arising on designated heritage assets are assessed within **Section 20.6**. A heritage settings assessment was undertaken as part of the DBA (Wessex Archaeology, 2019) and is updated in Section 20.5.which undertakes Stages 1 and 2 of the Cadw setting guidance (Cadw 2017a) for assets not assessed as part of the DBA (**Appendix 20.1,**

NPS Requirement	NPS Reference	ES Reference
necessary in order to deliver substantial public benefits that outweigh that loss or harm."		**Volume III**), whilst assessment of potential impacts and consideration of mitigation (Stages 3 and 4) is undertaken in **Section 20.6**.
"Not all elements of a World Heritage Site or Conservation Area will necessarily contribute to its significance. The policies set out in paragraphs 5.8.11 to 5.8.15 above apply to those elements that do contribute to the significance. When considering proposals, the IPC [now the Planning Inspectorate and the Secretary of State] should take into account the relative significance of the element affected and its contribution to the significance of the World Heritage Site or Conservation Area as a whole.'	EN-1, Section 5.8.16	There are no World Heritage Sites or conservation areas within the study areas considered within this chapter.
"Where loss of significance of any heritage asset is justified on the merits of the new development, the IPC [now the Planning Inspectorate and the Secretary of State] should consider imposing a condition on the consent or requiring the applicant to enter into an obligation that will prevent the loss occurring until it is reasonably certain that the relevant part of the development is to proceed"	EN-1, Section 5.8.17	The results of the impact assessment (**Section 20,6**) including proposed mitigation measures and residual impacts are summarised in **Section 20.7** in **Table 20-14**.
"When considering applications for development affecting the setting of a designated heritage asset, the IPC [now the Planning Inspectorate and the Secretary of State] should treat favourably applications that preserve those elements of the setting that make a positive contribution to, or better reveal the significance of, the asset. When considering applications that do not do this, the IPC [now the Planning Inspectorate and the Secretary of State] should weigh any negative effects against the wider benefits of the application. The greater the negative impact on the significance of the designated heritage asset, the greater the benefits that will be needed to justify approval."	EN-1, Section 5.8.18	The results of the impact assessment (**Section 20,6**) including proposed mitigation measures and residual impacts are summarised in **Section 20.7** in **Table 20-14**. As set out in **Section 20.4** the assessment is based on a desk-based review and a settings assessment.
"Consultation with the relevant statutory consultees should be undertaken by the applicants at an early stage of the development."	EN-3, Section 2.6.140	Consultation undertaken to inform this chapter is discussed in **Section 20.3**.
"Assessment should be undertaken asset out in Section 5.8 of EN-1. Desk-based studies should take into account any geotechnical or geophysical surveys that have been undertaken to aid the wind farm design."	EN-3, Section 2.6.141	This chapter has been undertaken in accordance with Section 5.8 of EN-1, as detailed above. It has also been informed by an ADBA (Wessex Archaeology, 2019) and a visual setting assessment (**Section 20.5.5**).

9. **Table 20-1** sets out the national and regional policies that are of relevance to Onshore Archaeology and Cultural Heritage.

Table 20-2 National and Regional Policy Requirements Relevant to Onshore Archaeology and Cultural Heritage

Policy Description	Reference	ES Reference
Planning Policy Wales		
The Welsh Government's specific objectives for the historic environment seek to: • protect the Outstanding Universal Value of the World Heritage Sites; • conserve archaeological remains, both for their own sake and for their role in education, leisure and the economy; • safeguard the character of historic buildings and manage change so that their special architectural and historic interest is preserved; • preserve or enhance the character or appearance of conservation areas, whilst the same time helping them remain vibrant and prosperous; • preserve the special interest of sites on the register of historic parks and gardens; and • protect areas on the register of historic landscapes in Wales.	6.1.6	A Desk-based Assessment and walk over survey (**Appendix 201., Volume III**) was undertaken to identify all known and unknown, designated and undesignated heritage assets within the onshore study area. This is presented in **Section 20.5**.
Any decisions made through the planning system must fully consider the impact on the historic environment and on the significance and heritage values of individual historic assets and their contribution to the character of place.	6.1.9	The significance of heritage assets key to the Project is presented in **Table 20-9**.
If the planning authority is minded to approve an application and where archaeological remains are affected by proposals that alter or destroy them, the planning authority must be satisfied that the developer has secured appropriate and satisfactory provision for their recording and investigation, followed by the analysis and publication of the results and the deposition of the resulting archive in an approved repository.	6.1.27	Mitigation measures that have been proposed for the Project are summarised in **Section 20.6.11**.
Development proposals should aim to protect or enhance the natural or historic character and landscape of undeveloped coastlines. The particular landscapes of the coastline should be recognised and protected where they represent significant characteristics of place. Designation as a heritage coast does not directly affect the status of the area in planning terms, however, the features which contributed to the designation of such areas will be important considerations in development plans and in making development management decisions.	6.5.12	As above
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
1. All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced; 2. That the proposal does not have a significant unacceptable effect on visual amenities;	Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	The impact assessment of the Project on heritage assets, including proposed mitigation measures is presented in **Section 20.6**.

Policy Description	Reference	ES Reference
3. That the proposal is mitigated to ensure that there aren't any significant unacceptable effects on sensitive uses located nearby;		
The Councils will manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline, and proposals that have a significant adverse effect on them will be refused unless the need for and benefits of the development in that location clearly outweighs the value of the site or area and national policy protection for that site and area in question.	Strategic Policy PS 19: Conserving and Where Appropriate Enhancing the Natural Environment	As above
It is important that heritage assets - encompassing archaeology and ancient monuments, listed buildings, conservation areas and historic parks, gardens and landscapes are preserved	Policy PS 20: Preserving and Where Appropriate Enhancing Heritage Assets	As above

20.2.2. Legislation

10. The principal legislation relevant to protecting the historic environment in Wales are set out below. These acts also influence how cultural heritage is assessed in the EIA framework.

20.2.2.1. The Historic Environment (Wales) Act 2016

11. This Historic Environment (Wales) Act 2016 forms part of a suite of policies, advice and guidance to make improvements to the existing protection and management of Welsh heritage assets.

20.2.2.2. Planning (Listed Buildings and Conservation Areas) Act (1990)

12. Statutory protection for Listed Buildings and Conservation Areas, and their setting, is provided under the Planning (Listed Buildings and Conservation Areas) Act (1990). A Listed Building is that which is seen to be of special architectural or historic interest, and a Conservation Area comprises an area of special architectural or historic interest, the character or appearance of which is desirable to preserve or enhance. Grades of listing are:

- Grade I: buildings of exceptional interest;
- Grade II*: particularly important buildings of more than special interest; and
- Grade II: buildings of special interest, warranting every effort to preserve them.

20.2.2.3. The Planning (Listed Buildings and Conservation Areas) (Wales) Regulations 2012

13. The Planning (Listed Buildings and Conservation Areas) (Wales) Regulations 2012 dictate the process of statutory protection for Listed Buildings and Conservation Areas in Wales. It states that the process of listing is administered by Cadw on behalf of the National Assembly for Wales.

20.2.2.4. Ancient Monuments and Archaeological Areas Act 1979 (as amended)

14. Any archaeological site or historic building of national importance can be designated as a Scheduled Monument under the terms of the Ancient Monuments and Archaeological Areas Act

1979 (as amended), and is registered with the Department of Culture, Media and Sport. Any development that might physically affect a scheduled monument is subject to the granting of Scheduled Monument Consent. Cadw advise the government on individual cases for consent and offers advice on the management of Scheduled Monuments.

20.2.3. Guidance

15. A suite of documents have been produced by Cadw which provide guidance on how the historic environment in Wales is to be protected, managed and assessed. Similarly, standards and guidance and the Code of Conduct by the Chartered Institute for Archaeologists (CIfA) also informed the production of this ES and the Wessex DBA (**Appendix 20.1, Volume III**). The full list of guidance used to inform methodologies in this ES are:

- Historic Environment Guidance for Wave and Tidal Energy (Historic England, 2013);
- CIfA's Standard and guidance for historic environment desk-based assessments (2014a) and Code of Conduct (2014b);
- Guide to Good Practice on using the Register of Landscapes of Historic Interest in Wales in the Planning and Development Process, Revised (2nd) edition (Cadw and Countryside Council for Wales, 2007);
- Setting of Historic Assets in Wales (Cadw, 2017a);
- Heritage Impact Assessment in Wales (Cadw, 2017b);
- Managing Change to Listed Buildings in Wales (Cadw, 2017c);
- Managing Conservation Areas in Wales (Cadw, 2017d); and
- Managing Historic Character in Wales (Cadw, 2017e).

20.3. CONSULTATION

16. Consultation with stakeholders has been ongoing during Project development (**Table 20-3**), through comments obtained from Scoping Opinion documents (2015, 2017 and 2018), along with a conference call with a Gwynedd Archaeological Planning Services (GAPS) planning archaeologist.

17. A request for scoping opinion for the Project was issued to the Welsh Government Planning Inspectorate (PINS) under different consenting regimes in 2015 and 2017, with a final scoping opinion requested in April 2018 from Natural Resources Wales (NRW) and the Welsh Government PINS. All comments relevant to onshore heritage received in these scoping opinions have been compiled in **Table 20-3** and have been responded to in this Chapter.

18. A number of comments from the scoping opinion relate to the offshore/marine environment. These comments are responded to in **Chapter 13, Offshore Archaeology**.

19. A conference call with GAPS has also been undertaken at this stage of the Project, to inform GAPS of the project design, archaeology and cultural heritage considerations that will be included within this ES chapter and to identify the approach to mitigation moving forward.

Table 20-3 Consultation Responses

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Scoping Comments	The onshore study area should be defined and justified within the ES.	The onshore study area is defined in **Section 20.4.1** and in the Wessex Archaeology DBA (**Appendix 20.1, Volume III**).
		The Scoping Report identifies a number of Scheduled Monuments within the onshore scoping corridor. Cadw has also identified the Holyhead Road: Quay on the Stanley Embankment. This should be included as a receptor within the assessment of effects.	Scheduled Monuments and the quay of Stanley embankment are discussed in **Section 20.6** and in the Wessex Archaeology DBA (**Appendix 20.1, Volume III**).
		Assessment of Potential impact on the historical setting of assets should include consideration of noise and visual effects from construction activities.	The setting of heritage assets is discussed in **Section 20.6.2**.
		The assessment should be undertaken in line with best practice guidance documents identified by Cadw	The guidance documents used to inform this assessment are presented in **Section 20.2**.
NRW (inclusive of comments provided to NRW by Cadw)	Scoping Opinion 2018	Cadw is the primary source of information for designated assets and is also directly responsible for the management of some of the scheduled monuments within the study area.	Cadw data on designated assets has been downloaded from Lle (GIS data).
		In addition, other data sources (including primary sources) should be considered within the assessment, including, where appropriate, information held by the local archives and Oriel Ynys Mon. As noted in the scoping report, walk-over surveys are also likely to be required.	Wessex Archaeology undertook a paid Historic Environment Record search, records office visit and walkover survey as part of their DBA.
		The impact on the following designated historic assets, and their setting, should be assessed in the ES Scheduled Monuments: ▪ AN011 Trefignath Burial Chamber ▪ AN012 Ty-Mawr Standing Stone ▪ AN016 Holyhead Mountain Hut Circles	These assets form part of the baseline data, produced as part of the DBA (**Appendix 20.1, Volume III**), updated for this ES and are included in the Impact Assessment in **Section 20.6**.

Consultee	Date/Document	Comment	Response
		▪ AN017 Penrhos Feilw Standing Stones ▪ AN019 Caer y Twr ▪ AN033 Plas Meilw Hut Circles ▪ AN034 Porth Dafarch Hut Circles ▪ AN146 The Holyhead Road: quay on the Stanley Embankment Listed Buildings ▪ 14733 Ebenezer Chapel II ▪ 14743 No 1, Stanley Cottages, Tyn Pwll Road II ▪ 14744 No 2, Stanley Cottages, Tyn Pwll Road II ▪ 14745 No 3, Stanley Cottages, Tyn Pwll Road II ▪ 14746 No 4, Stanley Cottages, Tyn Pwll Road II ▪ 14747 No 5, Stanley Cottages, Tyn Pwll Road II ▪ 14748 No 6, Stanley Cottages, Tyn Pwll Road II ▪ 16524 Pont Cytir, Cytir Road II ▪ 16525 Pont Penlech Nest, Penllech West II ▪ 16526 Bridge over Railway near Ty Mawr Farmhouse, Kingsland II ▪ 19231 Stanley Embankment II ▪ 19232 Milestone II ▪ 19233 Valley Station Signal Box II ▪ 19234 Cleifiog Fawr II ▪ 20069 Stanley Tollhouse II ▪ 20073 Milestone II ▪ 20074 Stanley Embankment II ▪ 20077 Fynnon y Wrach II ▪ 20081 Tan-y-Cytiau II ▪ 5714 Old Customs Post II ▪ 5759 Valley Railway Station Main Building II ▪ 5762 Kingsland Windmill, Mill Road, (S side) II* Within the offshore buffer:	

Consultee	Date/Document	Comment	Response
		▪ 18032 Enclosure Walls at South Stack Lighthouse II ▪ 18033 Storehouse at South Stack Lighthouse II ▪ 18034 Former Oil Store at South Stack Lighthouse II ▪ 18035 Bridge Towers at South Stack Lighthouse II ▪ 5284 South Stack Lighthouse and former keeper accommodation II	
		The Scoping Report provides a basic outline of the methodology proposed to be applied for assessing impact on Archaeology and Cultural Heritage. Currently this is very minimal in detail and needs to be worked up providing greater detail on the methodology of investigation and assessments proposed to understand and evaluate the potential impact on historic assets.	The methodology for assessment is presented in **Section 20.4**.
		A number of scheduled monuments lie within the onshore scoping area or close to it. Many of these – including Trefignath Burial Chamber, Ty-Mawr Standing Stone, Holyhead Mountain Hut Circles and Caer y Twr are in the care of Welsh Ministers and are popular visitor attractions. Many of these sites were located specifically to take advantage of elevated viewpoints and have extensive settings – for example Caer y Twr watchtower. The onshore study area must therefore take account of this and ensure that full account of the potential impact of the works on the settings of these designated historic assets. The scoping report indicates that this will be the case however it would be advisable for the boundary of the scoping area be re-drawn to include the designated assets described in section 9.6.1 of the scoping report within the assessment area. The same comments apply to the important group of listed buildings, including those at South Stack. It will also be particularly important to	Undertaken as part of setting study in Wessex Archaeology DBA (**Appendix 20.1, Volume III**) and summarised in **Sections 20.5.4** and **20.6**. Scoping in of heritage assets outside of the study area has also been undertaken as part of the ES chapter, to include the South Stack lighthouse listed structures. All heritage assets of relevance to the final project design are within the study area.

Consultee	Date/Document	Comment	Response
		consider the impact on non-designated historic assets.	
		In addition, three Conservation Areas are located in close proximity to the onshore scoping area, these being the Holyhead Beach, Holyhead Central and Holyhead Mountain Conservation Areas. A detailed Cultural Heritage record and Heritage Impact Assessment is expected as part of the EIA.	Conservation Areas are discussed and assessed in the Wessex Archaeology DBA (**Appendix 20.1, Volume III**), as summarised in **Section 20.5.2**. Impact assessment is not undertaken on Conservation Areas as the onshore infrastructure is not in a position to affect the Conservation Area within the study area (Holyhead Mountain).
		The EIA should take account of the potential impact on the settings of all historic assets within the scoping area. This should be undertaken in line with Welsh Government Guidance provided in the document Managing Setting of Historic Assets in Wales.	Agreed, and undertaken following guidance as part of this chapter and in the Wessex Archaeology DBA and see **Section 20.2** and **20.5**.
		Geophysical measures and potentially test pitting may also be required onshore to assess suitable locations for the substation and onshore cable route. A method statement for onshore evaluation will be required commencing with a Desk Based Assessment	Discussed with GAPS and proposed mitigation identified for each impact (**Section 20.6**) with an overview in **Section 20.6.11**.
		The work required to determine the magnitude of impact of the development on the historic environment will need to be assessed using professional judgement by a competent expert.	DBA undertaken by CIfA Registered Organisation and this chapter completed by a Heritage Consultant (ACIfA) (**Section 20.1**).
Cadw	Scoping Opinion 2018	Table 8.5 should include consideration of designated Conservation Areas as the Holyhead Beach and Holyhead Central Conservation Areas are within scoping area B. Holyhead Mountain Conservation Area lies directly between sub-areas A and B and given the importance of outward views from this conservation area, should be included. A detailed Cultural Heritage record and Heritage Impact Assessment would be expected as part of the EIA.	Conservation Areas are discussed in the Wessex Archaeology DBA (**Appendix 20.1, Volume III**), as summarised in **Section 20.5.2**, and impacts assessed in **Section 20.6**.

Consultee	Date/Document	Comment	Response
		Cadw has published guidance clarifying the required methodologies for assessing impact of developments on the setting of historic assets – see list below.	The Cadw guidance on setting has been taken into account (**Section 20.2.3**)
		The following policy and guidance documents will need to be taken into account: ▪ Planning Policy Wales ▪ UK Marine Policy Statement ▪ Conservation Principles for the Sustainable Management of the Historic ▪ Environment in Wales ▪ Welsh Government Technical Advice Note 24: the Historic Environment ▪ Draft Welsh National Marine Plan ▪ Managing Setting of Historic Assets in Wales. ▪ Managing Heritage Impact Assessment in Wales ▪ Managing Conservation Areas in Wales	The policy and guidance relevant to onshore heritage are taken into account (**Section 20.2**)
GAT	Scoping Opinion 2017	Impacts need to be considered in EIA	The impact assessment is presented in **Section 20.6**.
		WSI must be agreed (GAPS, Cadw and RCHAMW) prior to assessment and evaluation work	The requirement for a Written Scheme of Investigation (WSI) to be agreed in advance of further assessment and valuation work is described **in Section 20.6.11**.
		Coflein and Archwilio datasets are not to be used for development management/commercially.	A commercial search of the HER search was undertaken as part of Wessex Archaeology DBA (**Appendix 20.1, Volume III**).
	Conference Call, 28/03/19	Highlight that it is a false economy to defer archaeological evaluation work until post-consent and surveys are required to inform their response	Commitment from the Menter Môn to undertake geophysics and, if required, trial trenching pre-determination (**Section 20.6.11**).

Consultee	Date/Document	Comment	Response
		An Iron Age settlement is located within the area at Parc Cybi.	This forms part of the Wessex Archaeology DBA (**Appendix 20.1, Volume III**) and also informs proposed mitigation within this ES (**Section 20.6.11**)

20.4. ASSESSMENT METHODOLOGY

20. The overarching methodologies used for EIA are outlined in **Chapter 5, EIA Methodology**. This section provides methodologies specific to the historic environment.

20.4.1. Study Area

21. The study area comprises the onshore cable corridor and the boundary of substation locations plus a 1 km buffer, implemented in order to capture all records of onshore archaeology and cultural heritage relevant to establishing the baseline (**Figure 20-1, Volume II**). A selective approach has also been used to undertake the setting study, whereby designated heritage assets outside of the study area which are identified as potentially being affected through a change in setting have been included, to allow for a bespoke approach to impact assessment. Some of these assets were identified through consultation with GAPS and Cadw (See **Section 20.3**).

22. The onshore study area stops at mean high water springs (MHWS). Any heritage data below this forms part of **Chapter 13, Offshore Archaeology**.

23. These study areas were agreed between Wessex Archaeology, Royal HaskoningDHV and GAPS prior to assessment.

24. For the purposes of this ES, all designated heritage assets and select non-designated heritage assets have been given an RHDHV-specific reference number (**Section 20.5.4**, **Section 20.5.3**). The RHDHV-specific reference numbers are used on the figures referred to within this chapter (**Figures 20-1 to 20-4, Volume II**) and are cross-referenced with the designation references within **Appendix 20.2, Volume III**. Groupings of non-designated heritage assets have been combined under one RHDHV reference, due to their inter-relationships, with a number of records often forming one larger archaeological site (e.g. Parc Cybi; RHDHV38).

20.4.2. Desk-Based Assessment

25. To assess impacts to onshore archaeology and cultural heritage from the Project, the presence of known heritage assets and the potential for as-yet unknown heritage assets to be present needs to be identified. This includes designated and non-designated assets. To compile this data-set, a desk-based assessment (DBA) was undertaken by Wessex Archaeology (2019). The DBA has been used to inform the baseline data presented in this chapter.

26. The DBA compiled data from the following sources:

- Data from Cadw (the Welsh Government's Historic Environment Service) regarding Welsh designated sites: including (where present) World Heritage Sites, Scheduled Monuments, Listed Buildings, Parks and Gardens, Conservation Areas and Historic Landscape Areas;
- Data from the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) – the National Monuments Record of Wales (NMRW) regarding onshore and offshore sites;
- Data from Gwynedd Archaeological Trust (GAT) – the Gwynedd Historic Environment Record (GHER);
- Regional, Local and Period Archaeological Studies and Journals;
- Geological, palaeoenvironmental and historical literature relating to the development and land-use of the study area;
- The Archaeology Data Service (ADS);
- A Research Framework for the Archaeology of Wales (CIfA Wales, first published in 2008 – present: on-going);
- Previous archaeological studies in the area; and
- Historical cartographic sources.

27. Full methodologies for how the Wessex Archaeology DBA was produced can be found in **Appendix 20.1** (**Volume III**).

28. Following production of the DBA, further heritage assets were identified that may be affected by the Project. These new heritage assets form part of an updated baseline data section (**Section 20.5.2**) and setting study (**Section 20.5.5**) within this ES chapter.

20.4.3. Setting Assessment

29. An initial heritage setting assessment was also undertaken as part of the DBA, which is further refined as part of this chapter. This assessment is undertaken following the Setting of Historic Assets in Wales guidance (Cadw, 2017) which defined the setting of a historic asset as: "*the surroundings in which it is understood, experienced and appreciated, embracing present and past relationships to the surrounding landscape*" (Cadw 2017, p2). The setting of a heritage asset can affect its significance either positively or negatively and many elements can affect it, for example, intervisibility with other assets, its current surroundings, noise, smells, artistic representations and historic associations.

30. The Cadw guidance recommends a stepped approach for assessing the implications of project proposals, as follows:

- Step 1: Identify the historic assets that might be affected by a proposed change or development;
- Step 2: Define and analyse the settings to understand how they contribute to the significance of the historic assets and, in particular, the ways in which the assets are understood, appreciated and experienced;

- Step 3: Evaluate the potential impact of a proposed change or development on that significance; and
- Step 4: If necessary, consider options to mitigate or improve the potential impact of a proposed change or development on that significance.

31. Steps 1 and 2 of this approach were undertaken as part of the DBA. Steps 3 and 4 are considered in this chapter, following a summary of the DBA results and an update to the baseline data. Assessment of potential impact on setting was undertaken following confirmation of the preferred project design envelope (PDE).

32. Heritage assets were identified as being potentially affected through assessment of Seascape, Landscape and Visual Impact Assessment (SLVIA) work undertaken for this Project (**Chapter 24, Seascape, Landscape and Visual Assessment**).

33. As part of the DBA, heritage assets within the study area were screened to identify if there was intervisibility between them and the Project, informed by a site walkover. If there was potential for intervisibility, the assets were brought forward for setting assessment. Further assessment as part of this ES chapter has assessed the Zone of Theoretical Visibility (ZTV) of the Project to identify if other assets may require scoping into the study.

20.4.4. Impact Assessment

34. The overarching methodologies used for EIA are outlined in **Chapter 5, EIA Methodology**. This section details the methodology used to determine the significance of the impacts of the Project on archaeological and cultural heritage assets. The assessment criteria and assignment of significance with respect to archaeology and cultural heritage are based on available standards and guidance, good practice, consultation and professional judgement. The methodology will remain the same for both construction, operational and decommissioning phases of the Project.

35. Identifying the impact of a development upon heritage assets is a four-stage approach. Initially, heritage assets potentially impacted need to be identified (Stage 1), whilst their significance (heritage interest) also needs to be understood (Stage 2). Identification of heritage assets is undertaken as part of the DBA (**Appendix 20.1, Volume III**), whilst an initial assessment of significance is also undertaken in the DBA and refined as part of this ES. Following this, the magnitude of effect needs to be identified (Stage 3) followed by an assessment of impact significance to the heritage asset (Stage 4).

36. A heritage assets' significance, for the purposes of this report, is identified as anywhere from **negligible** (no significant heritage interest) to **high** (an asset with significant heritage interest) (**Table 20-4**). The categories and definitions of heritage significance do not necessarily reflect a definitive level of importance of an asset. They are intended to provide a provisional guide to the assessment of perceived heritage significance, which is to be based upon professional judgement incorporating the evidential, archaeological, historical, aesthetic, architectural and communal heritage values of the asset or assets.

37. The evidence for some heritage assets, particularly non-designated buried archaeological remains, is often an incomplete picture due to a lack of data on the remains (i.e. from a lack of intrusive investigations, ground truthing and associated reporting). Thus, the categories and

definitions of heritage significance do not necessarily reflect a definitive level of importance of an asset. Where uncertainty occurs, the precautionary approach is to assign high significance; a good practice in impact assessments which reduces the potential for impacts to be under-estimated. Judgements on heritage significance, therefore, should be regarded as providing a preliminary significance level based on available information.

Table 20-4 Definitions of Significance (Heritage interest)

Heritage Significance (non-exhaustive, examples only)	
High (perceived International / National Importance)	For example: World Heritage Sites; Scheduled Monuments; Grade I, II* and II Listed Buildings or structures; Designated historic landscapes of outstanding interest; and Conservation Areas containing very important buildings. Assets of acknowledged international / national importance. Assets that can contribute significantly to acknowledged international / national research objectives. Significance is related to an outstanding level of evidential, archaeological, historic, aesthetic, architectural and communal heritage interest, or combination of these values.
Medium (perceived Regional Importance)	For example: 'Locally Listed' buildings or structures; Conservation Areas containing buildings that contribute significantly to its historic character; and Designated historic landscapes of special interest. Assets that contribute to regional research objectives. Assets with regional value, educational interest or cultural appreciation. Significance is related to a high level of evidential, archaeological, historic, aesthetic, architectural and communal heritage interest, or combination of these values.
Low (perceived Local Importance)	For example: Assets that contribute to local research objectives Assets with local value, educational interest or cultural appreciation. Assets that may be heavily compromised by poor preservation and/or poor contextual associations. Significance is related to a certain level of evidential, archaeological, historic, aesthetic, architectural and communal heritage interest, or combination of these values.
Negligible	For example: The nature, form, level of survival, condition or ability to appreciate the asset or similar, means that it cannot be assigned heritage asset status in its own right. Assets with no significant value or archaeological / historical interest.

38. The classification of the magnitude of effect (**Table 20-5**) on known heritage assets takes account of such factors as:

- The physical scale and nature of the anticipated impact; and
- Whether specific features or evidence would be lost that are fundamental to the historic character and integrity of a given asset, and its understanding and appreciation.

Table 20-5 Definitions of Magnitude of Effect

Magnitude	Definition
High	Total loss of or substantial harm to an asset
Medium	Partial loss of, harm to or alteration of an asset which will affect its significance
Low	Minor loss of or alteration to an asset which leaves its significance largely intact
Negligible	Minor alteration to an asset which does not affect its significance in any notable way.
None / Nil	No alteration to an asset.

39. Following identification of the magnitude of effect, the significance of impact is predicted. To provide a consistent framework for the consideration and evaluation of impacts on different environmental parameters, the following terminology will be used (**Table 20-6**).

Table 20-6 Definitions for Impact Significance

Impact	Definition
Major adverse	The impact gives rise to serious concern that should factor into the decision-making process for the development.
Moderate adverse	The impact gives rise to some concern, but it is likely to be tolerable (depending on its scale and/or duration)
Minor adverse	The impact is undesirable, but of limited concern
Negligible	The impact is considered to be of limited or no concern
Minor beneficial	The impact is of minor significance but has some heritage-related benefit
Moderate beneficial	The impact provides some tangible benefit to the historic environment
Major beneficial	The impact provides a significant positive benefit to the historic environment

40. Assessment of the impact significance is reliant on professional judgement and experience and is tailored to each heritage asset. Any judgment is accompanied by a narrative description to qualify that opinion. The following matrix (**Table 20-7**) for calculation of impact significance should therefore be seen as a framework to aid in understanding how the level has been reached, rather than as a direct tool for direct decision making.

Table 20-7 Impact Significance Assessment Matrix

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

41. Both direct physical and indirect non-physical (e.g. visual, setting) impacts on heritage assets are considered relevant. Impacts may be adverse or beneficial. Depending on the nature of the impact and the duration of development, impacts can also be temporary and / or reversible

or permanent and / or irreversible. The finite nature of archaeological remains means that physical impacts are almost always adverse, permanent and irreversible; the 'fabric' of the asset and, hence, its potential to inform our historical understanding, will be removed.

42. In EIA terms, 'major' and 'moderate' impacts are generally deemed to be significant. In addition, whilst minor impacts are not significant in their own right, it is important to distinguish these from other non-significant (negligible) impacts as they may contribute to significant impacts cumulatively or through interactions between heritage assets or elements of the historic environment (or historic landscape).

20.5. EXISTING BASELINE

43. Data on the historic environment has been compiled using data sources listed in the **Section 20.4.2** above. The initial baseline data was collated by Wessex Archaeology in the walkover survey and DBA (**Appendix 20.1, Volume III**). This has been supplemented during production of this ES chapter with further heritage assets which were identified as potentially being affected, following revision of the PDE. These are included in the below baseline information (**Section 20.5**).

44. This baseline data is collated from records held in the GHER and other sources, which is not a record of all heritage assets, but a record of those currently discovered/identified. As such, the information held within it is not a complete record and does not preclude the subsequent discovery of further sites and finds which currently remain unknown.

20.5.1. Historic and Archaeological Background Summary

45. The onshore study area is located on Holy Island (Ynys Gybi), a small island off the coast of Anglesey, North-west Wales. The island has seen occupation from the Mesolithic period onwards, with worked flint of this date being recovered on the island. Neolithic to Bronze Age funerary activity is well attested to, with the regionally significant Neolithic Trefignath Burial Chamber (RHDHV10) located on the east of the island and numerous Bronze Age round barrows found across the island, including three which were excavated by antiquarians in the 19th century at Porth Dafarch (RHDHV04). A scheduled round cairn (RHDHV12) is located on the Holyhead Mountain-side, with impressive views of Gogarth Bay.

46. Standing stones of probable Bronze Age date are also extant within the landscape, with the Ty Mawr standing stone close to the eastern end of the onshore cable route (RHDHV05), at Parc Cybi, and a rare pair of standing stones at Plas Meilw (RHDHV11).

47. Iron Age and Romano-British settlement is also regularly found within the landscape, reflected in the large number of both non-designated and designated heritage assets of this date within the study area. The Caer y Twr hillfort (RHDHV07) is located on the top of Holyhead Mountain, with a small hut circle settlement found to the west (RHDHV06) whilst the impressive Holyhead Mountain hut circles (RHDHV08) are found 600 m north-west of the Project's landfall. Two other scheduled monuments of Iron Age settlement are within the study area; Plas Meilw Hut Circles (RHDHV03) and the defended settlement at Dinas Porth Ruffydd, located on a promontory separated from the mainland by a deep ravine (RHDHV09). A late 3rd century Roman coin and

two bronze ox-head bucket handle mounts of similar date were recovered from the monument during the 1970's.

48. A large number of non-designated heritage assets (GHER monuments) are found within the locality of Parc Cybi (upwards of 75), which relate to archaeological remains of Neolithic, Bronze Age, Iron Age and Roman date (combined as one reference for this ES; RHDHV38) and show the local area was well settled throughout the past. Most of these remains were revealed during development works and have been recorded and since built over by modern development.

49. By the medieval period, Holyhead was an important town, due to the establishment of the Caer Gybi monastery. Viking raids were common during the 9th century. The monastery was thought to have been located within the remains of the old Roman fort within Holyhead. Medieval Christian cemeteries are relatively common across the island, including four early Christian burials, dug into the top of a Bronze Age round barrow, at Porth Dafarch (RHDHV35). The settlement at Holyhead developed throughout the medieval period, thanks to the monastery, and became increasingly important through to the modern era. During the post-medieval period it became the principal port to Ireland and was important enough during the Civil War that the town was garrisoned by Oliver Cromwell's New Model Army.

50. The port of Holyhead continued to grow during the 18th and 19th centuries, thanks in part to better road connections, with Telford's London to Holyhead road (the A5) being completed in 1823, which included construction of the Stanley Embankment, connecting Holy Island to Anglesey. The railway was introduced soon afterwards, with a station built directly next to the port.

51. The South Stack lighthouse is closely associated with the development of the Port. The lighthouse was built by Trinity House in 1809, with improvements made throughout the following centuries and the lighthouse being automated in 1984. A lighthouse had been requested at this location since the 17th century, with South Stack presenting a significant danger to seafaring vessels.

52. Currently, Holy Island has maintained an agricultural character outside of Holyhead itself. Holyhead is a busy port town and has been densely urbanised and industrialised, particularly from the 1970's onwards, when Anglesey Aluminium opened a factory on the eastern edge of the town. The factory is now shut, but still forms a major part of the town's industrial townscape, along with the port itself.

20.5.2. Designated Assets

53. There is a total of 45 designated heritage assets within the 1 km study area, identified in the DBA produced for the Project (**Figure 20-1, Volume II**). These consist of 11 scheduled monuments, 25 listed buildings, one conservation area (Holyhead Mountain) and eight areas of ancient woodland (which are considered as one for this report). There are no registered parks and gardens within the study area. None of these assets fall within the Project's footprint.

54. The scheduled monuments are listed in **Table 20-8** below. These mostly relate to the prehistoric landscape, with hillforts, enclosed settlements and funerary monuments. The nearest to the landfall is Holyhead Mountain Hut Circles (RHDHV08), whilst the onshore cable route passes

directly west of the Porth Dafarch Hut Circles (RHDHV04) and is just south of Ty-Mawr Standing Stone (RHDHV05).

Table 20-8 Scheduled Monuments within study area

RHDHV No.	Cadw Ref.	Name	Broad Class	Period	Site Type
02	256 / AN092	Tre-Arddur Hut Group	Domestic	Prehistoric	Enclosed hut circle
03	528 / AN033	Plas Meilw Hut Circles	Domestic	Prehistoric	Unenclosed hut circle
04	529 / AN034	Porth Dafarch Hut Circles	Religious, Ritual and Funerary	Prehistoric	Round barrow
05	530 / AN012	Ty-Mawr Standing Stone	Religious, Ritual and Funerary	Prehistoric	Standing stone
06	1520 / AN133	Enclosed Hut Circle Settlement at Capel Llochwydd	Domestic	Prehistoric	Enclosed hut circle
07	2509 / AN019	Caer y Twr	Defence	Prehistoric	Hillfort
08	2512 / AN016	Holyhead Mountain Hut Circles	Domestic	Prehistoric	Unenclosed hut circle settlement
09	2547 / AN121	Dinas Porth Ruffydd	Defence	Prehistoric	Hillfort
10	3247 / AN011	Trefignath Burial Chamber	Religious, Ritual and Funerary	Prehistoric	Chambered round barrow
11	3249 / AN017	Penrhos Feilw Standing Stones	Religious, Ritual and Funerary	Prehistoric	Standing stone
12	4173 / AN147	Gogarth Bay round cairn	Religious, Ritual and Funerary	Prehistoric	Round cairn

55. The listed buildings within the study area are detailed in **Table 20-9**. Generally, the few listed buildings in the western half of the Project are often lone buildings, whilst the listed buildings located in the eastern half of the study area are often located in clusters, most within Penrhos Coastal Park and Kingsland. The highest designated structure is the grade II* listed Kingsland Windmill (RHDHV13).

Table 20-9 Listed buildings within study area

RHDHV Ref.	Cadw Ref	Name	Grade	Description
13	5762	Kingsland Windmill	II*	Prominent building set within a modern housing estate reached to the west off B4545 approximately 1 km south of Holyhead town centre.
14	5713	Ellin's Tower (Twr Ellin)	II	In an elevated position, overlooking the sea, c250m southeast of South Stack Island.
15	5714	Old Customs Post	II	In a sheltered location set within the cliffs on the northwest side of Porth Dafarch, northwest of Trearddur Bay.

RHDHV Ref.	Cadw Ref	Name	Grade	Description
16	5764	Candle Tower and walls adjoining remains of Penrhos House	II	Located at the heart of the Penrhos Coastal Park at the southeast end of Holy Island; reached by private driveway north of the A5(T) and c1.25km north-northeast of the northern end of the Stanley Embankment. The Candle Tower and walls lie east of the remains of Penrhos House.
17	5765	Tower, walls and courtyard buildings	II	Located at the heart of the Penrhos Coastal Park at the southeast end of Holy Island; reached by private driveway north of the A5(T) and c1.25km north-northeast of the northern end of the Stanley Embankment. The tower is adjacent to the remains of Penrhos House.
18	5766	Baillifs Tower and with boundary wall, gates and attached outbuildings at Penrhos Home Farm	II	Located at the heart of the Penrhos Coastal Park at the southeast end of Holy Island; reached by private driveway north of the A5(T) and c1.25km north-northeast of the northern end of the Stanley Embankment. The Baillifs Tower lies north of the entrance to the home farm.
19	5767	Barn and cartsheds, Penrhos Home Farm	II	Located at the heart of the Penrhos Coastal Park at the southeast end of Holy Island; reached by private driveway north of the A5(T) and c1.25km north-northeast of the northern end of the Stanley Embankment; this range at east side of the Home Farm.
20	5768	Watertower	II	Located at the heart of the Penrhos Coastal Park at the southeast end of Holy Island; reached by private driveway north of the A5(T) and c1.25km north-northeast of the northern end of the Stanley Embankment. The Watertower is at southeast corner of the walled garden south of Penrhos House.
21	5769	The Betting Stand (aka Rotten Tower)	II	Situated towards the southern end of the park at the edge of woodland and overlooking the broad expanse known as Penrhyn Quillet. Penrhos Coastal Park lies at the southeast end of Holy Island.
22	5770	The Battery	II	On the headland at the northwest edge of the park; Penrhos Beach below to the west. Penrhos Coastal Park lies at the southeast end of Holy Island.
23	14733	Ebenezer Chapel	II	Approximately 100 m south of junction with Cytir Road. Behind low wall with stone posts, iron railings and gates.
24	14743, 4, 5, 6, 7 & 8	Stanley Cottages	II	On corner of Tyn Pwll Road and Cytir Road. U-plan layout of three ranges. Nos 1&2 face Tyn Pwll Road, Nos 3-5 face Cytir Road, no 6 faces side lane.
25	16524	Pont Cytir	II	Carries Cytir Road over main railway lines.
26	16525	Pont Penllech Nest	II	Carried footpath over main railway line, to west of Holland Park industrial units.
27	16526	Bridge Over Railway near Ty Mawr Farmhouse	II	Carries footpath over main railway line near Ty Mawr Farm.

RHDHV Ref.	Cadw Ref	Name	Grade	Description
28	20069	Stanley Tollhouse	II	Set back from the north side of the A5(T), directly over the northern end of the Stanley Embankment and within Penrhos Coastal Park.
29	20073	Milestone	II	Located at the northeast side of the A5 directly over the north end of the Stanley Embankment.
30	20074	Stanley Embankment	II	Spanning the strait between the main island, north of Valley, and Holyhead Island.
31	20077	Fynnon y Wrach	II	Set back slightly from the southeast side of the road below Holyhead mountain, southwest of Holyhead.
32	20081	Tan-y-Cytiau	II	In an elevated position on the slopes of Holyhead Mountain, approached from the lane that leads to South Stack Lighthouse.

56. Further designated heritage assets located beyond the 1 km study area, but which have been identified for the purposes of this ES chapter as they are also subject to potential settings impacts are detailed in **Table 20-10**.

Table 20-10 Further designated heritage assets scoped into the report

RHDHV Ref.	Cadw Ref.	Description	Grade
01	5284	South Stack Lighthouse and former keepers' accommodation	II
01	18032	Enclosure Walls at South Stack Lighthouse	II
01	18033	Storehouse at South Stack Lighthouse	II
01	18034	Former Oil Store at South Stack Lighthouse	II
01	18035	Bridge Towers at South Stack Lighthouse	II

57. One conservation area falls within the study area: Holyhead Mountain (RHDHV33). This is located on the north-east facing slopes of the mountain and is masked from the Project’s proposed landfall, whilst having broad views of Holyhead and the surrounding farmland. As no intervisibility with the route was identified as part of this ES, the asset is not considered further.

58. The eight sections of ancient woodland within the study area (RHDHV34), are all located within the Penrhos coastal park, adjacent to the old London Road (A5) and forming part of the setting for a number of listed buildings within the locality, whilst masking most of the Aluminium Works from the listed buildings.

20.5.3. Non-designated Assets

59. There is a total of 330 non-designated heritage assets within the study area (**Figure 20-2, Volume II**), relating to monuments, findspots and locally listed buildings. These assets are included in a gazetteer compiled by Wessex Archaeology (**Appendix 20.1, Volume III**). There is also a total of 36 archaeological events (watching briefs, evaluations and excavations) recorded within the GHER. Six RHDHV-specific references have been given to non-designated heritage assets due to their relevance to the Project. Often, these references relate to numerous non-designated records; e.g. RHDHV 38, Parc Cybi remains, consists of 75 HER entries which relate to known or potential buried archaeological remains within the vicinity. These have been

grouped for ease of reference to what is clearly a very 'busy' area in terms of archaeological remains (and potential remains).

60. Many of these non-designated assets relate to archaeological features and findspots, often of prehistoric date, whilst others relate to locally listed buildings or documentary or cartographic evidence (historic farmsteads etc.). These assets all add greatly to the known picture of Holy Island's past and aid in building a picture of a well settled landscape from the prehistoric period onwards.

61. Non-designated assets scoped in for impact assessment of settings impacts were identified through screening of their monument type, preservation quality and their above-ground survival. In principal, this resulted in extant buildings being the main non-designated assets scoped in for assessment of settings impact. Non-designated buried remains were also assessed for indirect impacts to their setting but were identified as not being impacted.

62. There are a number of areas where non-designated assets have been recorded which should be highlighted along the route, which could indicate a higher potential for buried remains to be found within the Project's footprint within these areas. The landfall area is located near to designated assets (Holyhead Mountain Hut Circles, RHDHV08), whilst non-designated records nearby indicate there is potential for further remains of prehistoric date to be found within the area. This includes a group of hut circles nearly completely destroyed by ploughing, which contained Romano-British pottery, and a cist burial found nearby in the 19th century (RHDHV39), south-east of the landfall area, whilst similar remains were found to the east (RHDHV40).

63. Another section of the route, at Porth Dafarch, contains non-designated assets recorded within the GHER which indicate the area was settled during prehistoric and historic periods. The area is located near to the scheduled Porth Dafarch Hut Circles (RHDHV04) and the non-designated records indicate that the hut circles were built over three early Bronze Age round barrows. An Early Christian cemetery was also excavated and recorded at this location, with four inhumations interred within the top of the Bronze Age monuments (RHDHV35).

64. The area around Parc Cybi contains numerous non-designated heritage assets (RHDHV38) ranging from the Neolithic to Roman periods, found during archaeological works prior to development, indicating a high potential for further buried remains (**Section 20.5.7**).

65. Along the route, no hedgerows of historic significance are identified. The majority of field boundaries across the island are formed of drystone walls, whilst where hedgerows are maintained, they are often immature and form the roadside boundary.

20.5.4. Key Heritage Assets

66. A number of these designated and non-designated heritage assets were identified as key to the Project as part of the DBA and during this ES production (**Figure 20-3, Volume II**) and form the basis of the resource assessed as part of the impact assessment (**Section 20.6**).

67. Beyond these key assets, other designated assets have been identified as not being affected by the Project, due to distance from the Project and a lack of intervisibility. This was undertaken following production of the DBA, cross referencing the DBA key assets with the ZTV and SLVIA information. The non-designated heritage assets have been included as a key asset where there

is potential for these known assets, or potential remains associated with them, to be directly or indirectly impacted by the Project, or where their inclusion aids in identifying archaeological potential along the route.

68. The heritage significance of these assets is summarised in **Table 20-11**, whilst statements of significance for them are included in the DBA and referred to in the impact assessment.

Table 20-11 Heritage Assets identified as key to the Project

RHDHV Ref.	Cadw / GHER Ref.	Name	Designations	Heritage Significance
1	Cadw 5284	South Stack Lighthouse group	Grade II (5 assets)	Medium
4	Cadw 529 / AN034	Porth Dafarch Hut Circles	Scheduled	High
5	Cadw 3249 / AN012	Ty-Mawr Standing Stone	Scheduled	High
8	Cadw 2509 / AN016	Holyhead Mountain Hut Circles	Scheduled	High
10	Cadw 2547 / AN011	Trefignath Burial Chamber	Scheduled	High
11	Cadw 3249 / AN017	Penrhos Feilw Standing Stones	Scheduled	High
13	Cadw 5762	Kingsland Windmill	Grade II*	High
14	Cadw 5713	Ellin's Tower (Twr Ellin)	Grade II	Medium
15	Cadw 5714	Old Customs Post	Grade II	Medium
23	Cadw 14733	Ebenezer Chapel	Grade II	Medium
32	Cadw 20081	Tan-y-Cytiau	Grade II	Medium
34	n/a	Ancient Woodland, Penrhos coastal park	Ancient Woodland	Low
35	GHER 1776	Cemetery, Porth Dafarch	Non-designated	High
36	GHER 7683	Penrhosfeilw Chapel	Non-designated	Medium
37	GHER 597365	Pillbox, north-east of Tre God	Non-designated	Medium
38	Multiple	Parc Cybi archaeological remains	Non-designated	Medium
39	GHER’s 3802 & 3808	Cist burial, remains of hut circles and finds	Non-designated	Medium
40	GHER 3806	Remains of hut circles and finds	Non-designated	Medium

20.5.5. Updated Setting Assessment

69. An initial assessment of the setting of key heritage assets was undertaken as part of the DBA (**Appendix 20.1, Volume III**). As part of this ES, a screening of coastal heritage assets that have the potential to be affected by the introduction of the offshore infrastructure has also been undertaken. This screening assessed the potential for intervisibility between the offshore infrastructure location and any designated and non-designated assets within the study area.

70. It was found that the South Stack Lighthouse (RHDHV01) and Ellin's Tower (RHDHV14) had intervisibility. Other assets, such as the scheduled monuments on Holyhead Mountain (RHDHV06, 07, 08 and 12) were found to have no visibility to the seascape due to the local topography. This section undertakes Stages 1 and 2 of the Cadw setting guidance (Cadw 2017a) for assets not assessed as part of the DBA (**Appendix 20.1, Volume III**), whilst assessment of potential impacts and consideration of mitigation (Stages 3 and 4) is undertaken in **Section 20.6**.

20.5.5.1. South Stack Lighthouse Group (RHDHV01)

71. This group of assets are located on a small outcrop off the north-west limits of Holy Island. The current setting of the group is one of open coastland, with rocky cliffs dropping away to a wide seascape. The lighthouse is accessed by a narrow footpath from a country lane. There is intervisibility with Ellin's Tower to the south-east, whilst impressive views of the lighthouse are obtained from the mainland, with the outcrop the lighthouse is built upon set lower than the main island. There are expansive views out from the lighthouse to the sea. There are no significant views inland from the lighthouse, due to the local topography. Currently, the setting makes a **moderate** contribution to the **medium** historic and architectural interest of the group.

20.5.5.2. Ellin's Tower (RHDHV14)

72. Ellin's Tower (Twr Ellin) is a Grade II listed picturesque castellated folly, built in 1868. It is now used as an information centre and observation tower for the Royal Society for the Protection of Birds (RSPB). The current setting is currently one of major seascape views, located on the cliff edge. The area is often busy with the general public due to the tower's use as an information point. Currently, the setting of the asset makes a **high** contribution to its **medium** historic and architectural interest. There are no views towards inland, due to the local topography.

20.5.6. Identified Heritage Viewpoints

73. Assessment of viewpoints which could have potential for demonstrating the heritage significance of assets has been undertaken as part of this ES, through assessment of work done for the SLVIA chapter (**Chapter 24, Seascape, Landscape and Visual Assessment**) and through data obtained as part of the Wessex DBA (**Appendix 20.1, Volume III**). The SLVIA results and assessment work covers all potential visual impacts resulting from the project (i.e. visual amenity etc.). The views have been considered as part of this chapter in the said views contribute to the heritage significance of an asset.

74. Some of the SLVIA viewpoints have been taken from a heritage asset. One of the key views identified was from Ellin's Tower (RHDHV14, SLVIA Viewpoint 04) on the coast, which shared intervisibility with the South Stack lighthouse (RHDHV01, SLVIA Viewpoint 03) and has large-scale views of the seascape, which will include the offshore infrastructure for the Project. This view is considered to make a **moderate** contribution to the significance of the asset, as the seascape vistas were part of the building's design, whilst the views towards the lighthouse also aid in appreciation of the historic interest of both buildings.

75. Similarly, views from the Standing Stones at Penrhos Feilw (RHDHV11) were identified as key, with views eastwards to the Plas Meilw Hut Circles (RHDHV03, SLVIA Viewpoint 05) and north-

westwards to the Holyhead Mountain hut Circles (RHDHV08). The ZTV identified that visibility of the landfall substation at Ty Mawr (hereafter referred to as the landfall substation) may be obtained when looking westwards from the standing stones. Upon assessment, it is considered that this view makes a low contribution to the already high heritage significance of the standing stones. The landscape view does contain many features which block the views westwards (existing hedgerows across the landscape and buildings at Bodwarren), whilst the SLVIA work undertaken identified that the landfall substation, whilst a prominent change in the landscape, would form part of the modern infrastructure backdrop to the view, marrying in with the modern barn outbuildings at Ty Mawr farmhouse. The noticeable change is identified as being at a very localised level, but beyond a distance of approximately 400m it would form a relatively recessive element in the landscape

76. Other viewpoints identified were at the Ty-Mawr Standing Stone (RHDHV05; SLVIA Viewpoint S11) and Trefignath Burial Chamber (RHDHV10, SLVIA Viewpoint S09), located at the eastern end of the Project, at Parc Cybi. Again, the ZTV indicated views of the switchgear building at Parc Cybi (hereafter referred to as the switchgear building) could be obtained from the heritage assets. Upon assessment however, the minimal scale of the switchgear building, the current tree cover within the area, and modern development to the north and west, reduce the intervisibility significantly and the view was not considered to make a contribution to the already high significance of the assets.

20.5.7. Archaeological Potential of the Project

77. The archaeological potential of the Project was assessed as part of the DBA (**Appendix 20.1, Volume III**). In summary, due to the lack of previous archaeological investigation within the western half of the Project, the archaeological potential of land included in the Project's landfall and onshore cable route is currently difficult to accurately assess. It is suggested that the near vicinity of the scheduled Holyhead Mountain Hut Circles (RHDHV08) and other identified prehistoric remains (RHDHV39 and 40) results in moderate potential for remains of this date to be within the landfall area and fields either side of the onshore cable route to Porth Dafarch.

78. At Porth Dafarch, the route passes directly adjacent to the scheduled Porth Dafarch Hut Circles (RHDHV04), where other non-designated remains have also been recorded (RHDHV35). Within this area, it is identified that there is high potential for buried archaeological remains, even within the footprint of the existing road network, which would have been constructed over the top of archaeological remains which relate to the settlement that has been scheduled. Similarly, the road's junction with Lon Isallt road was identified as being built up from the original ground surface, which would increase the potential for buried archaeological remains to be preserved under the road, having not been damage form the road's construction.

79. Following Porth Dafarch, the onshore cable route to Parc Cybi has an unclear potential, although geophysical survey and evaluation trenching by GAT has been undertaken in the fields which the proposed onshore cable route passes through (GAT, 2012) towards and past Holyhead Leisure Centre. A moderate amount of archaeology was revealed within the trenches, including a possible prehistoric roundhouse. This area is considered to have moderate potential for archaeological remains to be within the onshore cable route's footprint.

80. Within the locality of the switchgear building are numerous (75) non-designated records associated with known buried archaeological remains. These remains were found during archaeological fieldwork prior to development and identify the area as having very high archaeological potential in any areas where archaeological excavation has not preserved the remains by record.

81. In terms of the grid connection substation at Orthios (hereafter referred to as the grid connection substation), a hoard of Roman coins was found in the 18th century to the west of the Aluminium Works whilst a number of post-medieval buildings are recorded to the south of the A55 from historic cartographic sources. No other evidence of archaeological remains is known within the aluminium works. Due to this lack of known buried archaeological remains, along with the construction of the aluminium works having likely impacted what would have been the archaeological horizon, it is considered there is very low potential for remains to be within the locality of the grid connection substation.

82. It should be highlighted that there are certain areas that the onshore cable route runs through which the DBA identified as being boggy/waterlogged, which could hold potential for preserved palaeoenvironmental remains.

20.6. IMPACT ASSESSMENT

20.6.1. The Project Infrastructure

83. The offshore and onshore infrastructure for the Project is described in **Chapter 4, Project Description**. In summary, the Project consists of up to 620 offshore tidal devices, an offshore export cable corridor, a 8.1 km long onshore cable corridor, a landfall substation, a switchgear building and a grid connection substation. Most of the onshore cable will be installed via open cut trenching within the footprint of current country roads between landfall and the A55, with Horizontal Directional Drilling (HDD) used to pass under the A55 to the grid connection substation.

20.6.2. Overview of Potential Impacts

84. The identified potential impacts on designated and non-designated heritages assets by the proposed Project are:

- Direct Impact to potential buried archaeological remains;
- Direct Impact to designated heritage assets (scheduled monument);
- Indirect impact upon the setting of designated heritage assets; and
- Indirect impact upon the setting of recorded non-designated heritage assets.

85. The direct impact to potential buried archaeological remains may occur during the excavation of any open-cut trenches to lay the onshore cable (including within the footprint of existing roads), excavation of transition pits at landfall (from the HDD to open cut trench to the landfall substation), during construction of the landfall substation, switchgear building and grid connection substation, or during the construction of any temporary works areas or associated infrastructure related to the Project.

86. Direct impact to designated heritage assets has been identified where the route passes adjacent to a scheduled monument (RHDHV04), which may result in hydrological changes or impact from vibration to the remains.

87. Direct impacts identified relate to the excavation of material during excavation of the onshore cable route or construction of the substations/switchgear building. Similarly, as part of the direct impact to designated heritage assets, impact from vibration and dust were assessed and have not been identified as a factor for this Project if mitigation is followed (**Section 20.5.6**).

88. Indirect impact upon the setting of designated and non-designated heritage assets may occur through the introduction of the substations into the landscape, which could affect a heritage assets' setting, or appreciation of such.

89. Furthermore, indirect impact to setting may occur due to interactions with the Project's offshore infrastructure, which could change views from certain assets which may alter the historic interest of an asset.

20.6.3. Worst Case Scenario

90. This section establishes the Worst-Case Scenario (WCS) for the construction of the Project, forming the basis for the subsequent impact assessment. Full details of the range of development options being considered are provided within **Chapter 4, Project Description**.

91. For the purposes of this chapter, only those Project parameters with the potential to influence the impact of known and potential heritage assets are identified. Therefore, if the design parameter is not described below in **Table 20-12**, it is not considered to have a bearing on the outcome of this assessment.

Table 20-12 Worst-Case Scenario impacts from the Project

Impact	Parameter
Construction	
General	Onshore construction programme estimated to take 12 months. Work hours for offshore work and HDD are 24 hours per day, seven days a week. All other works are daylight hours only, six days per week
Direct impacts related to cable landfall	Landfall cable HDD to last ten months. Up to nine cable tails at landfall. Up to nine separate drills; each up to 550 m long, nominally 450 mm diameter. Separation of 10 m between HDD entry points. Separation of 20 m between HDD exit points. Total drill cuttings volume could be up to 900 m^3 (total amount for all 9 drills). Excavation of one transition pit (up to 15m x 85m x 1.5m deep), equating to a footprint of 1,275 m^2, excavated volume 1,912.5 m^3 in addition to trenching excavation or HDD cutting volumes.

Impact	Parameter
	Temporary works area up to 120 m x 70 m (total area for HDD rig, site office and equipment plus laydown area).
Direct impacts related to cable landfall (trenched option)	Excavation of trenched installation and cables down the cliff face (if HDD option is not used). Up to nine cable tails at landfall. Up to nine separate shallow trenches (slots within the cliff face), each between 480 m and 740 m long. Individual trench widths of up to 600 mm. Or a single trench with all nine cables laid within it of approximately 10 m width and 0.5 m to 1.2 m deep Duct or split pipe over 370 m to 550 m of each cable, up to 350 mm external diameter. Total material removed could be up to 2,400 m^3; however, the majority would be replaced to backfill the trench after the ducts / cables were installed. Temporary works area up to 100 m x 50 m (for site office and equipment plus laydown area).
Direct impacts related to landfall substation at Ty-Mawr	Construction estimated to take 4 months total. Excavation of topsoil and subsoil to formation level (A fenced site compound approximately 80 m by 80 m. Within this would be three separate buildings of approximately 62 m by 22.5 m by 7 m high, the second will be 28 m by 10 m by 7 m high and the third 8 m by 8 m by 7 m) Associated infrastructure. Associated temporary works area construction.
Direct impacts related to grid connection substation at Orthios	Construction estimated to take 6 months total. Excavation of topsoil and subsoil to formation level (104m x 62m footprint). Associated infrastructure. Associated temporary works area construction (estimated to be 50m x 100m).
Direct impacts related to substation construction of switchgear building at Parc Cybi	Construction estimated to take 4 months total. Excavation of topsoil and subsoil to formation level. (9.4m x 5m footprint) Associated infrastructure Associated temporary works area construction
Direct impacts related to onshore cable installation	Up to 10 months to install onshore cable from landfall to grid connection substation Maximum 8.1km of onshore cable to be installed Works corridor up to a maximum of 30m. Open cut trenching within footprint of existing roads to switchgear building. Trench width 1.5m, depth 1.7m. Open cut trenching within fields adjacent to roads where the road is not suitable for installation of the cable. Open cut trenching crossing open fields within certain section of the route. Transition pits for areas where HDD may be used for sections of the onshore cable route. 20 joint boxes along cable route, measuring 15m long x 3m wide x 1.65m deep. 20m x 7m hard standing around each joint bay

Impact	Parameter
	42 draw pits along cable route, measuring 8m long x 3m wide x 1.65m deep. Temporary works areas of 50m x 50m for the HDD drill rig and 30m x 30m temporary works area at exit points. Associated temporary work area construction. Vibration and dust from construction activity. HDD drilling from switchgear building to grid connection substation. Drill pits x2 for HDD crossing at rail line, measuring 80m x 15m x 1.5m deep.
Indirect impacts related to construction activity (offshore/onshore)	Construction activity and noise will be apparent within the wider landscape. Increased traffic movements within the vicinity of heritage assets Peak two-way daily HGV movements: 46 Peak two-way daily LGV movements: 140
Operation	
Indirect impacts related to offshore infrastructure	Changes in seascape views from heritage assets, affecting setting, due to introduction of up to 620 tidal devices (supporting up to 1,648 TECs) off the coast. Up to 300 of the TECs could be floating at surface-level. Up to 93 floating hubs or up to eight seabed mounted surface emergent hubs Up to 60 navigation and communication buoys Supporting structure of tidal devices deployed in the MDZ will not emerge more than 6.5 m above the sea surface
Indirect impacts related to switchgear building at Parc Cybi	Change in landscape, views and setting of heritage assets. Building 4m tall, footprint 9.4m x 5m.
Indirect impacts related to grid connection substation at Orthios	Building maximum height of 9m, footprint 104m x 62m.
Decommissioning	
Indirect impacts related to substations	Demolition of landfall substation, switchgear building and grid connection substation and associated ground works. Change in views within wider landscape.
Direct impacts related to onshore cable route	Cables anticipated to be terminated and left in-situ Works areas could impact on buried archaeological remains if they are outside of the Onshore Development Area.

20.6.4. Embedded Mitigation

92. The current preferred PDE has been chosen to minimise the impact on archaeological remains as far as reasonably possible. The decision to install the cable within the current road network wherever possible has been taken as this will reduce the likelihood of archaeological remains being present and thus disturbed. Similarly, HDD has been chosen as a preferred option at landfall, to negate the need to open cut trenching which may impact buried archaeological remains.

93. Considered design of the offshore elements of the project has taken place, with input from stakeholders, to ensure the visual impact from offshore infrastructure will be limited. For example, no visually prominent devices would be placed in northern parts of subzones 4 and 8.

94. Please see **Chapter 4, Project Description**, Table 4-1, for a full account of embedded mitigation measures.

20.6.5. Potential Impacts During Construction

20.6.5.1. Construction Impact 1: Direct Impact to Potential Archaeological Remains

95. There are no known designated archaeological sites or remains within the onshore footprint of the Project, whilst non-designated monuments related to archaeological remains are records from past excavations, meaning the archaeology is no longer present. As such, direct impact to archaeological remains relates to any potential remains within the footprint, which are yet to be revealed or recorded.

96. It is worth highlighting that the Parc Cybi locality has revealed significant evidence for buried archaeological remains (RHDHV38), identified during archaeological excavations prior to previous development work in the locality, whilst a number of records within the region indicate a potential for further remains to be within the area, which may be impacted during construction. A large part of the area around Parc Cybi has been previously archaeologically excavated (resulting in the large number of non-designated records) and as such the location of any substation here (if chosen as the option) could potentially be sited upon an area previously excavated.

97. Potential buried archaeological remains can take the form of archaeological features or deposits (e.g. pits, ditches, building foundations), palaeoenvironmental remains and findspots (isolated discoveries of artefacts). There is potential for archaeological remains of prehistoric to post-medieval date to be located within the onshore footprint of the Project. Areas of potential are highlighted within the DBA as at landfall and any areas of the onshore cable route where it passes through pastoral farmland. Potential for buried remains is also noted where the onshore cable route follows the existing road network, although these potential remains will have been previously damaged or at least partially removed by the construction of the roads. It should be noted that the onshore cable route passes directly west of the Porth Dafarch Hut Circles (RHDHV04), and there is potential for remains associated with this site to be found underneath the road (outside of the scheduled area).

98. There is also potential at the switchgear building and grid connection substation, although large parts of Parc Cybi has previously been archaeologically investigated and the grid connection substation is located in an area previously heavily developed, which may have damaged or at least partially removed archaeological remains.

99. Impacts from the construction of the landfall substation, switchgear building, grid connection substation and onshore cable route may result in impacts on buried archaeological remains, if present, through their partial or complete removal due to excavation of the substations' and switchgear building footprint to formation level, and the excavation of the cable trench, associated temporary work areas or associated works infrastructure.

100. In summary, the whole Project footprint has potential for archaeological remains, although key areas to highlight for archaeological potential are:

- Landfall area and landfall substation footprint;

- The road and fields adjacent to Porth Dafarch hut Circles (RHDHV04);
- The fields crossed by the onshore cable route east of Mill Road, towards Holyhead Leisure Centre;
- Fields crossed by the onshore cable route adjacent to the A55. In particular, fields near to Trefignath Burial Chamber (RHDHV10);
- Any fields passed through where installation of cable into the existing road is not viable; and
- The Parc Cybi area.

101. It is deemed that the Project could result in anywhere from a **low** to **high** magnitude of impact upon any archaeological remains that are present within its footprint. This is due to the potential for permanent damage, disturbance or complete removal of the remains.

102. These buried remains have the potential to be anything from **low** to **high** significance, with the potential to contribute to an understanding of the development of the prehistoric and historic landscape on Holy Island. As these potential remains may be permanently destroyed or damaged (as a WCS), the development could have a **permanent major adverse effect** upon potential archaeological remains within its footprint.

20.6.5.1.1. Mitigation

103. Initial (pre-determination) mitigation for this impact will include identification of potential archaeological sites through evaluation (geophysical survey potentially followed by trial trenching) which will in turn feed into decisions regarding micro-siting or route refinement on sections as part of the post-consent works. This will result in the avoidance of sites wherever possible, ensuring they are preserved *in-situ.*

104. Where avoidance is identified as not being viable, consultation with GAPS will be undertaken to confirm where phases of archaeological excavation or monitoring of ground works will be required, to ensure any remains are identified and recorded.

105. The predicted phases of archaeological evaluation and mitigation for the Project are:

- Geophysical survey of the landfall area, landfall substation location and onshore cable route where it passes through fields or adjacent to the road where archaeological potential has been identified. This would be undertaken pre-determination of the Transport and Works Act Order (TWAO) application, to further inform stakeholders of the Project's archaeological potential;
- Archaeological trial trenching, to be undertaken in areas where archaeology is identified in the geophysical survey results. This will be done following consultation with GAPS, potentially pre-determination;
- Areas of pre-construction archaeological excavation, if the trenching results reveal that significant archaeological remains are located within the Project's footprint;
- Archaeological monitoring (Watching Brief) of the cable installation within the road footprint, in areas where archaeological potential is identified;

- Results would be presented in a grey literature report, followed by a publication if the results are worthy of such; and
- Wider dissemination of the results of archaeological works, through talks to local history and archaeology groups, schools or interested parties, to inform the public.

20.6.5.1.2. Residual Impact

106. Archaeological excavation and recording of any potential archaeological remains is identified in Planning Policy Wales as not mitigating the impact to the remains, since they are still removed. However, it is considered that the impact following project design choices have been implemented (micro-siting, use of HDD, re-routing) and any further archaeological excavation offsets the impact, whilst also furthering understanding of the known heritage assets within the study area, which can feed in to assessment of the historic environment for other potential developments in the future. As such, the residual impact is considered to be non-significant in EIA terms.

20.6.5.2. Construction Impact 2: Direct Impact to Designated Heritage Assets (Scheduled Monument)

107. No potential direct impacts to designated assets apart from the one described below have been identified as part of the Project. This includes no material impact occurring from the works from vibration and dust, due to distances involved between the Project and the designated assets.

108. The current onshore cable route indicates that it will pass directly west of the Porth Dafarch Hut Circles (RHDHV04), north-eastwards up Porth Dafarch Road. The current PDE details that if this section of the road network is unsuitable for burying the cable in, the onshore cable route will be buried within the adjoining western field (within a 30 m buffer from the road).

109. If the cable were buried within the road, there is potential for direct impact to the scheduled monument area due to potential changes in hydrology or impacts from vibration from the nearby excavation works.

110. It should also be highlighted that there is the potential for archaeological remains associated with the scheduled monument area to survive underneath the road, but outside of the scheduled area (see **Section 20.6.5.1**).

111. Changes to the hydrology or formation of archaeological deposits due to vibration from nearby excavation is judged to be a **high** magnitude of impact.

112. This monument is of **high** significance, with the potential to contribute to an understanding of the development of the prehistoric environments on Holy Island, having significant archaeological and historic interest. Any impact to archaeological deposits from hydrological changes or vibration is considered a **permanent major adverse** effect.

20.6.5.2.1. Mitigation

113. If the field to the west of the road is used for installation, it would be far enough away to remove any potential impact to the monument from vibration or hydrological changes, resulting in no impact. Archaeological evaluation and investigation of the western field would be undertaken

(as described in the mitigation measures in **Section 20.6.5.1.1** above), to ensure any archaeological remains within the field that might be associated with the scheduled monument are preserved by record.

20.6.5.2.2. Residual Impact

114. Following mitigation, the scheduled monument area would not be impacted by the Project and any potential non-designated archaeological remains associated with the monument and outside the scheduled area would be identified, excavated and preserved by record, it is deemed that the residual impact is **minor adverse**, whilst no direct impact will occur to the scheduled monument area itself.

115. If further remains are identified in the western field during archaeological evaluation which are considered to be of high significance, there is the potential for the area to be added to the currently scheduled area. As such, if HDD was considered for this section, it would remove any potential impact to the designated archaeological remains.

20.6.5.3. Construction Impact 3: Indirect Impact upon the Setting of Designated Heritage Assets

116. Indirect settings impacts upon designated heritage assets could occur, which may affect the significance, or appreciation of, certain assets' historic, architectural or archaeological interest.

117. During the construction phase, indirect impacts would be temporary (up to 24 months), occurring during installation of offshore infrastructure, the cable landfall, the cable within the onshore cable corridor, construction of the landfall substation, switchgear building, grid connection substation and any associated infrastructure. This is due to the introduction of construction activity into the setting of some assets, as described below, by Project-sections (offshore infrastructure, landfall, onshore cable route and grid connection). These indirect impacts can be caused by the presence of site compounds or temporary works areas, machinery, construction traffic and general construction activities. In terms of the Project, it is considered that these impacts would result in temporary minor visual and audible changes in the setting, with assets often located at a distance from the Project where the impact would be of limited concern.

20.6.5.3.1. Offshore infrastructure

118. The designated assets potentially indirectly impacted by the installation of the offshore infrastructure are the South Stack lighthouse group (RHDHV01) and Ellin's Tower (RHDHV14). All other nearby designated assets do not have intervisibility with the offshore location.

119. The impact during construction will be from the visible introduction of activity within the seascape views from the assets. It is expected that noise will not result in an effect on setting, due to the distances between the assets and the offshore works location. The impact upon the South Stack lighthouse group is deemed to be **negligible**. This is due to the fact that the asset's design-purpose is to be seen from the sea, rather than from the lighthouse out to sea. This means the temporary, minor change in view from the lighthouse in the form of offshore construction activity, will not affect the significance of the asset or its setting.

120. The impact upon Ellin's Tower is considered to be **low**. This folly was built with views of the seascape in mind, as noted by the large windows viewing out towards sea. Currently, it is expected that the construction activity offshore will be a small addition to a wide seascape vista and as such will have a **low** impact upon its setting and so significance. These assets are deemed to be of **medium** heritage significance, due to their architectural and historical interest, along with their communal value and links to local historical figures.

121. The indirect effect upon the assets by the construction works offshore are deemed to be of **temporary minor adverse** significance, due to the limited scope and timeframe (24 months) that the introduced construction activity will have on an impressively large vista of the seascape.

20.6.5.3.1.1. Mitigation

122. No mitigation measures are recommended.

20.6.5.3.1.2. Residual Impact

123. The residual effect is **temporary minor adverse**.

20.6.5.3.2. Landfall and landfall substation at Ty-Mawr

124. Temporary changes during construction of the landfall substation, and during activities associated with the installation of the cable at the landfall, may occur to the setting of the scheduled Holyhead Mountain Hut Circles (RHDHV08) and the Grade II listed Tan-y-Cytiau farmhouse (RHDHV32). Other assets within the vicinity (e.g. the Fynnon y Wrach holy well; RHDHV31) are not affected due to the topography precluding intervisibility to the landfall location.

125. The listed Tan-y-Cytiau farmhouse has views towards landfall, sitting slightly higher up the hillside above the landfall area. The farmhouse is approximately 600 m to the north-west of the landfall area and as such noise and vibration are not considered an issue that will affect the setting. The main impact will be a change in views during the construction phase. These views are partially blocked by Ty-Mawr Farm however, as a large outbuilding blocks portions of the view towards the landfall from the farmhouse, whilst also introducing modern agricultural buildings into the listed farmhouse's setting. As such, the magnitude of impact during construction is considered **low**.

126. The Holyhead Mountain hut circles also have partial views towards the landfall location, although this is masked by Tan-y-Cytiau and Ty-Mawr farms, along with Ty'n-Nant house. Similarly, the hedgerows forming field boundaries, along with the gorse within the boundary of the scheduled monument also block views. As such, it is considered the magnitude of impact is **negligible**.

127. These hut circles are deemed to be of **high** heritage significance, due to their architectural, archaeological and historical interest, whilst the Tan-y-Cytiau farmhouse is of **medium** significance, being a good example of 20th century Arts and Crafts style architecture.

128. The indirect effect upon the setting of these assets by the construction works at the landfall are, therefore, deemed to be of **temporary minor adverse** significance.

20.6.5.3.2.1. Mitigation

129. Other than ensuring construction hours are limited to core work hours, the impact to setting during landfall construction work is considered to be one that cannot be mitigated against but is minor enough to not be of concern.

20.6.5.3.2.2. Residual Impact

130. The impact upon these assets during construction is considered to stay as **temporary minor adverse**.

20.6.5.3.3. Onshore Cable Route

131. Assets whose setting may be temporarily affected during the installation of the cable along the onshore cable route are the Porth Dafarch Hut Circles (RHDHV04), Ty-Mawr Standing Stone (RHDHV05), Trefignath Burial Chamber (RHDHV10), the Old Customs Post (RHDHV15), Kingsland Windmill (RHDHV13) and Ebenezer Chapel (RHDHV23). Public access to the other designated assets may be impacted due to road closures, although this is expected to be of low magnitude, with access still being possible through diverted routes.

132. Impacts to the setting of these assets will occur during the installation of the cable along the onshore cable route, when the construction works are within vicinity of the assets. There is potential for construction noise and visual impacts to the setting of the monuments during the cable installation. This impact is considered to be **negligible** and **temporary**, with assets only occasionally being affected during the installation of the cable. This is because, despite the 24-month time frame for cable installation, the construction works in direct vicinity of the assets would occur over a shorter period, before moving on to the next section of cable installation.

133. The majority of these assets are of **high** heritage significance, due to their architectural and historical interest, along with their communal value and links to local historical figures. Ebenezer Chapel and the Old Customs Post are considered **medium** heritage significance. The indirect impact from the onshore cable route is deemed to be **temporary minor adverse** during installation.

20.6.5.3.3.1. Mitigation

134. Other than ensuring construction hours are limited to core work hours, the impact to setting during installation of the cable is considered to be one that cannot be mitigated against but is minor enough to not be of concern.

20.6.5.3.3.2. Residual Impact

135. The residual impact upon these assets during construction is, therefore, **temporary minor adverse** and will stop once construction is complete.

20.6.5.3.4. Switchgear Building at Parc Cybi

136. The setting of the Ty-Mawr Standing Stone (RHDHV05) and Trefignath Burial Chamber scheduled monument (RHDHV10) may be indirectly impacted by the location of the switchgear

building, with the standing stone 300 m to the west and the burial chamber located 450 m to the south-east. Other nearby heritage assets (e.g. Kingsland Windmill; RHDHV13) are expected to not be impacted, with modern buildings and tree cover precluding intervisibility.

137. It is possible that there would be partial visibility of the switchgear building and installation of the cable in the onshore cable route when within the setting of both assets, which would have a **temporary negligible** impact upon the setting, with the potential for construction work and machinery noticeable from the monuments. This will be most noticeable at the standing stone, whilst it will most likely be blocked by the tree cover which surrounds the burial chamber, and the large lorry park located to the north-west.

138. The burial chamber and standing stone are of **high** heritage significance, due to its archaeological and historical interest. This indirect impact from the switchgear building and cable installation is deemed to be **temporary minor adverse** upon the assets.

20.6.5.3.4.1. Mitigation

139. Other than ensuring construction hours are limited to core work hours, the impact to setting during construction of the switchgear building at this location is considered to be one that cannot be mitigated against but is minor enough to be of limited concern.

20.6.5.3.4.2. Residual Impact

140. The residual impact upon these assets during construction, therefore, is **temporary minor adverse** and will stop once construction is complete.

20.6.5.3.5. Grid Connection Substation at Orthios

141. The grid connection substation is located within the old Aluminium Works, north of the A55 and south of the old London Road (A5). The area is already heavily industrialised, and a substation is already located within the vicinity. No built designated heritage assets were identified as being indirectly impacted by this option during construction, with all nearby designated built assets (located within the Penhros coastal park) being masked from view by the belts of ancient woodland (RHDHV34). The construction works will be undertaken in an area that is visible from the back edge of the ancient woodland however.

142. The impact of construction works at this location is considered **negligible** upon the historic environment, with potential for the work to indirectly affect the setting of the ancient woodland. This woodland’s main heritage value is in its contribution to the setting of the listed buildings nearby however, which will not be impacted by the nearby construction activity. Similarly, the construction activity is taking place within an area already heavily industrialised, which forms part of the ancient woodland’s current setting.

143. The ancient woodland is considered to be of **low** heritage significance, with its main heritage value in a contribution to the setting of other nearby heritage assets, along with its communal value forming part of a coastal park. The significance of effect upon the ancient woodland is considered **negligible** and **temporary**.

20.6.5.3.5.1. Mitigation

144. No mitigation is required.

20.6.5.3.5.2. Residual Impact

145. The impact upon these assets during construction is considered to stay as **negligible** and **temporary**.

20.6.5.4. Construction Impact 4: Indirect Impact upon the Setting of Recorded Non-designated Heritage Assets

146. As with construction impact 3 (**Section 20.6.5.3**), this impact could occur due to changes in views to/from certain heritage assets which may affect appreciation of certain assets' historic, architectural or archaeological interest. This indirect impact has been identified for the Penrhosfeilw Chapel (RHDHV36), near the onshore cable route (central) and a World War II pillbox at the eastern-most end (RHDHV37).

147. The impact of construction works at these locations is considered **negligible** upon the setting of two assets. The Chapel will be impacted by temporary noise and general construction activity within its setting during installation of the cable in the adjacent road. The pillbox's setting may be impacted by the cable installation or works associated with drilling the cable at this point under the A55.

148. The Chapel is considered to be of **medium** heritage significance, due to its historic interest and communal value. The pillbox is also considered to be of **medium** heritage significance, due to its historic interest. The significance of effect is considered **minor** and **temporary**.

20.6.5.4.1.1. Mitigation

149. No mitigation is required.

20.6.5.4.1.2. Residual Impact

150. The impact upon these assets during construction is considered to stay as **negligible** and **temporary**.

20.6.6. Potential Impacts During Operation

20.6.6.1. Operational Impact 1 and 2: Direct Impact to Potential Archaeological Remains and Designated Heritage Assets

151. There will be no further direct impact to potential archaeological remains during operation of the Project as no further groundworks are planned in new areas and maintenance work, if required, will be taking place within the existing footprint, already mitigated during construction.

20.6.6.2. Operational Impact 3 and 4: Indirect Impact upon the Setting of Non-designated and Designated Heritage Assets

152. The operation of the Project may result in an indirect impact upon the setting of non-designated and designated heritage assets as well as the appreciation of the historic landscape and seascape character surrounding the Project (See **Chapter 24, Seascape, Landscape and Visual Impact Assessment**).

153. Indirect impacts upon setting could occur due to:

- The introduction of the offshore infrastructure, visible from coastal assets (the South Stack Lighthouse and Ellin's Tower; RHDHV 01 and 14);
- The introduction of the landfall substation, visible from certain locations within the landscape, principally Holyhead Mountain hut circles (RHDHV 08);
- The introduction of the switchgear building;
- The introduction of the grid connection substation; and
- The introduction of any associated infrastructure required for the Project (new access roads, other infrastructure etc.).

154. The designated heritage assets potentially affected by the operation of the Project are the same as those identified during construction.

20.6.6.2.1. Offshore Infrastructure

155. The installation of the offshore infrastructure will result in some changes to the seascape views from the identified coastal assets (South Stack lighthouse group, RHDHV01, and Ellin's Tower, RHDHV14). The seascape will change due to the visibility of the buoys and other infrastructure off the coast. The magnitude of impact for this is are assessed against a worst-case scenario (as set out in **Chapter 4, Project Description** and **Section 20.6.3**). The views from the South Stack lighthouse group out to sea are considered not to make a major contribution to the heritage significance of the assets, as the heritage significance of the lighthouse is in views from the sea towards the coast. The seascape views from Ellin's Tower, however, do contribute. The magnitude of impact has been considered alongside the results of the SLVIA (**Chapter 24**) and identified as **medium**.

156. These assets are deemed to be of **medium** heritage significance, due to their architectural and historical interest, along with their communal value and links to local historical figures. The impact significance, with the currently known information of the offshore infrastructure is **permanent minor to moderate adverse**. As this is a moderate adverse impact, it is therefore significant in EIA terms.

20.6.6.2.1.1. Mitigation

157. Embedded mitigation includes the considered siting, design and layout of the offshore infrastructure, which has been used in the above impact significance result (see **Figure 4-1**, **Volume II**).

158. Other mitigation could include neutral colouring of the tidal devices and deciding on the least impactful navigational lighting requirements. These potential mitigation considerations would be further detailed during the detailed design stage, through consultation with stakeholders in relation to the discharge of appropriate condition which could be included on the planning consent.

20.6.6.2.1.2. Residual Impact

159. A residual **permanent minor to moderate adverse** effect will result, for the duration of the Project.

20.6.6.2.2. Landfall Substation

160. The new landfall substation could result in a change of Holyhead Mountain Hut Circles' (RHDHV08), the Penrhosfeilw Standing Stones' (RHDHV11) and the Grade II listed Tan-y-Cytiau farmhouse's (RHDHV12) setting through the introduction of the substation into the wider landscape.

161. However, the views towards and between the assets already contain modern infrastructure and agriculture elements and the substation will not affect intervisibility between the assets. From distance, the new substation will look similar to the modern agricultural buildings within the landscape, whilst the height of the buildings is not overly dominant and will not draw the eye away from the heritage assets. As such, the magnitude of impact is considered **negligible**.

162. The hut circles and standing stones (RHDHV08 and 11) are deemed to be of **high** heritage significance, due to their architectural, archaeological and historical interest, whilst the Tan-y-Cytiau farmhouse is of **medium** heritage significance, being a good example of 20th century Arts and Crafts style architecture. The indirect effect upon the assets by the construction works within landfall are deemed to be of **permanent minor adverse** significance.

20.6.6.2.2.1. Mitigation

163. As the new landfall substation will result in a minor adverse impact significance upon the identified assets' setting, no further mitigation is required. Broader mitigation may be put in place by the Project however, including use of screening to reduce visual impacts of the substation.

20.6.6.2.2.2. Residual Impact

164. The impact upon these assets during operation is considered to stay as **minor adverse**.

20.6.6.2.3. Onshore Cable Route

165. During operation, there will be no indirect impacts to the setting of heritage assets because of the onshore cable route, which will be buried and not visible. Impacts may occur if repairs to the cable are required; however, this would result in the same temporary impacts as those described during construction.

20.6.6.2.4. Switchgear Building at Parc Cybi

166. The switchgear building could result in an indirect impact to the setting of Ty-Mawr Standing Stone (RHDHV05) and Trefignath Burial Chamber (RHDHV10). This is due to the building potentially being visible from the assets. Currently, both assets are located within a landscape which contains significant modern infrastructure, as described in the DBA (**Appendix 20.1, Volume III**).

167. The standing stone is located approximately 300 m west of the switchgear building location opposite the services off the main road. Views towards the substation would be potentially available, although there is some tree cover which will mask the views and the setting already contains the modern infrastructure of the road and services. As such, the impact is considered **permanent** but **negligible**. The asset has a **high** heritage significance due to its archaeological and historic interest, resulting in a **permanent minor adverse** impact.

168. For the burial chamber, views towards the switchgear building will be at least partially masked by the existing tree cover and some of the modern buildings within the area, whilst the current setting of the asset is one which includes significant modern infrastructure (the A55 and the Aluminium Works). As such, the impact is considered **permanent** but **negligible**. This asset has a **high** heritage significance, due to its archaeological and historic interest and as such construction of the switchgear building would result in a **permanent minor adverse** impact to the burial chamber.

20.6.6.2.4.1. Mitigation

169. No mitigation is required, although broader mitigation may be put in place by the Project, including use of screening to reduce visual impacts of the substation.

20.6.6.2.4.2. Residual Impact

170. The impact upon these assets during operation is considered to stay as **minor adverse**.

20.6.6.2.5. Grid Connection Substation at Orthios

171. It is considered that there will be no indirect impact to the heritage significance of nearby heritage assets due to the construction of the grid connection substation. The new grid connection substation will blend in with the existing baseline environment, with another substation being located nearby, whilst the views to/from the substation are masked from the majority of the nearby area by existing infrastructure, and the woodland at Penrhos.

20.6.7. Potential Impacts During Decommissioning

172. It is anticipated that the impacts during any decommissioning phase would be no worse than construction. The main potential impacts could be:

- Removal of the facility would require work areas, which may directly impact buried archaeological remains, if new compounds are constructed on areas not archaeologically evaluated or mitigated for during the construction phase.

- Introduction of construction machinery into the wider landscape which may indirectly impact the setting of heritage assets (temporarily).

173. Upon decommissioning, there could be a negligible or minor beneficial effect on the setting of the assets which were identified as previously being adversely impacted during operation. This is due to the impacts that were identified during the operational phase of the Project being removed.

20.6.8. Cumulative Impacts

174. Cumulative impacts between this Project and other nearby planned developments are summarised within **Chapter 26, Cumulative and In-Combination Impacts**.

175. In terms of onshore archaeology and cultural heritage, any new developments within the locality of the landfall substation, switchgear building or grid connection substation could result in a cumulative indirect impact upon the setting of certain heritage assets. Currently, a total of 55 planning applications were assessed, and none have been identified which could cause this cumulative impact.

20.6.9. Inter-relationships

176. This chapter has inter-relationships with **Chapter 13, Offshore Archaeology** and **Chapter 24, Seascape, Landscape and Visual Impact Assessment**.

177. These interrelationships occur due to use of tool-kits employed in **Chapter 24, Seascape, Landscape and Visual Impact Assessment** (photomontages, ZTVs), which were assessed to inform the results of this chapter. Inter-relationship with **Chapter 13, Offshore Archaeology** occurs due to a technical relation between the subjects of the chapters, with results from the offshore archaeology chapter and this chapter combining to give an overview of all impacts to the historic environment by the Project.

178. **Table 20-13** lists out the inter-relationships between this chapter and other chapters in the ES.

Table 20-13 Inter-topic relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Offshore Archaeology	Chapter 13, Offshore Archaeology	Section 20.6	There is a technical relation between the subjects of the chapters, with results from the offshore archaeology chapter and this chapter combining to give an overview of all impacts to the historic environment by the Project.
Ground Conditions and Contamination	Chapter 18, Ground Conditions and Contamination	Section 20.5	This chapter has an inter-relationship due to its consideration of the current ground conditions and identification of areas which may be contaminated, which has been used as an aid to identify areas where previous modern impacts could have occurred which would impact any potential archaeological remains.

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Noise and vibration	Chapter 21, Noise and Vibration	Section 20.6 (all indirect impacts)	Consideration of Noise and Vibration results informs the assessment of indirect (non-physical) impacts upon heritage assets.
Traffic and Transport	Chapter 23, Traffic and Transport	Section 20.6 (all indirect impacts)	Increases in traffic around heritage assets has the potential to cause an adverse impact to the setting of a heritage asset and so consideration of the predicted traffic movement presented in this chapter are included in the historic environment WCS and considered as part of the assessment.
Seascape, Landscape and Visual Impact Assessment	Chapter 24, Seascape, Landscape and Visual Impact Assessment	Section 20.6 (all indirect impacts)	The historic environment assessment has drawn upon images produced for the SLVIA chapter to aid in identification of potential indirect (non-physical) impacts to heritage assets by the Project. Similarly, the visualisation produced aid in identifying if the appreciation of the heritage assets will be impacted by the development. One of the visualisations produced by the SLVIA team was undertaken from one of the key heritage assets: Ellin's Tower (RHDHV14).

20.6.10. Interactions

179. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts because of that interaction. The worst-case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity, the areas of interaction between impacts are presented in **Table 20-14**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 20-14 Interaction between Impacts

Potential interaction between impacts			
Construction	Direct impact to potential buried archaeological remains	Indirect impact upon setting of designated heritage assets	Indirect impact upon setting of recorded non-designated assets
Direct impact to potential buried archaeological remains	-	No	No
Indirect Impact upon setting of designated heritage assets	No	-	Yes
Indirect impact upon setting of recorded non-designated assets	No	Yes	-
Operation	Direct impact to potential buried archaeological remains	Indirect impact upon setting of designated heritage assets	Indirect impact upon setting of recorded non-designated assets

Potential interaction between impacts			
Direct impact to potential buried archaeological remains	-	No	No
Indirect Impact upon setting of designated heritage assets	No	-	Yes
Indirect impact upon setting of recorded non-designated assets	No	Yes	-
Decommissioning			
It is anticipated that the decommissioning impacts will be similar in nature to those of construction.			

20.6.11. Mitigation Summary

180. A number of mitigation measures have been proposed for the Project to mitigate the impacts identified. These would be undertaken as part of an archaeological works package, beginning pre-determination and continuing through the potential construction programme, as set out below.

181. In terms of mitigating impact to buried archaeological remains, a phase of geophysical survey at the landfall location, agricultural land along the onshore cable route and any other areas which have potential for archaeological remains within the Project's onshore footprint will be undertaken pre-determination of the TWAO application. Following this geophysical survey, trial trenching may also occur, following consultation with Cadw and GAPS. The results of these phases of archaeological investigation will be used to further inform stakeholders of the archaeological potential of the route, whilst also enabling suitable mitigation measures to be designed, to be undertaken post-consent and pre-construction.

182. These further mitigation measures could include monitoring of geoarchaeological works, further evaluation (trial trenching), followed by archaeological monitoring or excavation, if the results of the evaluation identify significant remains within the onshore footprint of the Project. Similarly, areas where evaluation is not viable (e.g. within the road network, which is identified as the preferred installation option for the onshore cable), phases of intermittent archaeological monitoring could be undertaken within areas along the road network where archaeological potential was identified (e.g. where the onshore cable route passes Porth Dafarch Hut Circles; RHDHV04).

183. Results of the archaeological works would be presented in grey-literature reports and publications, resulting in the remains being preserved by record. Public outreach could also form part of the mitigation, with the archaeological contractors presenting the results through talks to interested parties, such as local history groups, schools or parish councils.

184. Any on-site archaeological works and resulting post-excavation works undertaken as part of the Project would be set out within a Written Scheme of Investigation (WSI), which would detail the requirements and be approved by stakeholders and followed by the archaeological contractor on-site. This WSI would be produced prior to any geophysical survey undertaken pre-determination of the application and sent to GAPS for review and approval.

185. Based upon the results of the impact assessment, no mitigation for settings impacts is required for heritage assets onshore. However, there is the potential option of screening at the location of permanent above-ground infrastructure, undertaken with heritage input, to reduce landscape and visual impacts from the Project which may also be considered beneficial in screening visual impacts upon the heritage assets in the vicinity.

20.6.12. Do-Nothing Scenario

186. If the Project were not to take place, buried archaeological remains would remain in-situ, whilst indirect impacts to the setting of heritage assets would not occur. Erosion of buried archaeological remains is currently minimal within the locality of the Project, as the farmland throughout the landscape is pastoral, with minimal to no ploughing being undertaken in the landscape, resulting in no damage to buried remains. This would remain the baseline if the Project didn’t take place.

187. Without the Project occurring, no further information would be learned on the historic environment within the western half of Holy Island, which is currently relatively poorly understood.

20.7. SUMMARY

188. In summary, a number of heritage-specific impacts could occur due to the Project. Principally, potential archaeological remains could be partially or completely removed within the footprint of the Project due to excavation works during construction, whilst a number of designated and non-designated heritage assets could be indirectly impacted due to a change in their setting during construction and operation. The potential impacts have been identified by each heritage asset affected (**Table 20-15**), to provide an easily referenced summary.

189. Currently, heritage considerations have fed into the design process for the Project. HDD is the preferred option to make landfall, to reduce the need for open-cut trenching, whilst the landfall substation location has been situated at such a location in the landscape to make it as visually neutral as possible, with limited views to it from designated heritage assets. Similarly, the route chosen for the onshore cable route is to utilise the existing road network as much as reasonably possible, in part due to this location having less archaeological potential than if it were situated within the open pastoral fields of the island. Furthermore, the grid connection substation located within the old Aluminium Works is an area where there is no identified impact to the setting of heritage assets, whilst also have less potential for archaeological remains, due to the previous development works.

190. Proposed mitigation measures include phases of archaeological fieldwork, such as the geophysical survey and trial trenching identified above, which will then potentially be followed by phases of archaeological monitoring (during construction) or excavation (pre-construction), dependant on the results of the evaluation work. Arguably, this Project represents one of the best opportunities to evaluate the archaeological potential for a part of Holy Island which is poorly understood archaeologically, due to a lack of developer funded work having taken place within the area.

191. At this stage of the Project, a commitment is made to undertake geophysical survey of the Project to further inform Menter Môn and stakeholders on the Project's archaeological potential. This work will be undertaken pre-determination, to feed into the decision-making process. Following geophysical survey, trial trenching of high-potential areas may be undertaken following consultation with GAPS and Cadw.

Table 20-15: Summary of Impacts by key asset

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Residual effect (post-mitigation)
1	South Stack Lighthouse group	Medium	Construction Impact 3: Indirect impact to setting of assets during construction of offshore infrastructure.	Negligible	Minor	Minor
			Operation Impact 3: Indirect impact to setting of assets from offshore infrastructure.	Medium	Moderate	Minor to Moderate
4	Porth Dafarch Hut Circles	High	Construction Impact 3: Indirect impact to setting of designated assets during installation of landfall cable.	Negligible	Minor	Minor
			Construction Impact 2: Direct impact to designated archaeological remains due to hydrological changes or vibration	High	Major	Minor
			Construction Impact 1: Direct impact to non-designated buried remains associated with (but outside of) the scheduled area.	High	Major	Non-significant
			Operation: No Impact	N/A	N/A	N/A
5	Ty-Mawr Standing Stone	High	Construction Impact 3: Indirect impact to setting of assets during installation of onshore cable.	Negligible	Minor	Minor
			Construction Impact 1: Direct impact to non-designated buried remains associated with (but outside of) the scheduled area.	High	Major	Non-significant
			Operation Impact 3: Indirect impact to setting of assets from landfall substation	Negligible	Minor	Minor
8	Holyhead Mountain Hut Circles	High	Construction Impact 3: Indirect impact to setting of assets during construction of landfall substation and landfall cable.	Negligible	Minor	Minor
			Operation Impact 3: Indirect impact to setting of assets from landfall substation	Negligible	Minor	Minor
10	Trefignath Burial Chamber	High	Construction Impact 3: Indirect impact to setting of assets during installation of onshore cable and switchgear building	Negligible	Minor	Minor

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Residual effect (post-mitigation)
			Operation Impact 3: Indirect impact to setting of assets from switchgear building	Negligible	Minor	Minor
11	Penrhosfeilw Standing Stones	High	Construction Impact 3: Indirect impact to setting of the asset during construction of the landfall substation.	Negligible	Minor	Minor
			Operation Impact 3: Indirect impact to setting of assets from landfall substation	Negligible	Minor	Minor
13	Kingsland Windmill	High	Construction Impact 3: Indirect impact to setting of assets during installation of onshore cable.	Negligible	Minor	Minor
			Operation: No Impact	N/A	N/A	N/A
14	Ellin's Tower (Twr Ellin)	Medium	Construction Impact 3: Indirect impact to the setting of asset during installation of onshore cable.	Negligible	Minor	Minor
			Operation Impact 3: Indirect impact to the setting of asset due to offshore infrastructure	Medium	Moderate	Minor to Moderate
15	Old Customs Post	Medium	Construction Impact 3: Indirect impact to the setting of asset during installation of onshore cable.	Negligible	Minor	Minor
			Operation: No Impact	N/A	N/A	N/A
23	Ebenezer Chapel	Medium	Construction Impact 3: Indirect impact to the setting of asset during installation of onshore cable.	Negligible	Minor	Minor
			Operation: No Impact	N/A	N/A	N/A
32	Tan-y-Cytiau	Medium	Construction Impact 3: Indirect impact to the setting of asset during installation of onshore cable.	Low	Minor	Minor
			Operation Impact 3: Indirect impact to setting of assets from landfall substation	Negligible	Minor	Minor
34	Ancient Woodland, Penrhos coastal park	Low	Construction Impact 3: Indirect impact to the setting of asset during construction of grid connection substation	Low	Minor	Minor
			Operation: No Impact	N/A	N/A	N/A
35	Cemetery, Porth Dafarch	High	Construction Impact 1: Direct impact to non-designated buried remains associated with this monument record.	High	Major	Non-significant

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Residual effect (post-mitigation)
			Operation: No Impact	N/A	N/A	N/A
36	Penrhosfeilw Chapel	Medium	Construction Impact 4: Indirect impact to the setting of a non-designated asset during installation of onshore cable.	Negligible	Minor	Minor
			Operation: No Impact	N/A	N/A	N/A
37	Pillbox, north-east of Tre God	Medium	Construction Impact 4: Indirect impact to the setting of a non-designated asset during installation of onshore cable.	Negligible	Minor	Minor
			Operation: No Impact	N/A	N/A	N/A
38	Parc Cybi archaeological remains	Medium	Construction Impact 1: Direct impact to potential buried archaeological remains associated with known (recorded) archaeological remains during installation of onshore cable and switchgear building.	High	Major	Non-significant
			Operation: No Impact	N/A	N/A	N/A
39	Cist burial, remains of hut circles & finds	Medium	Construction Impact 1: Direct Impact to potential buried archaeological remains associated with known (recorded) archaeological remains during installation of onshore cable.	High	Major	Non-significant
			Operation: No Impact	N/A	N/A	N/A
40	Remains of Hut circles & finds	Medium	Construction Impact 1: Direct Impact to potential buried archaeological remains associated with known (recorded) archaeological remains during installation of onshore cable.	High	Major	Non-significant
			Operation: No Impact	N/A	N/A	N/A

20.8 REFERENCES

Cadw (2011). Conservation principles for the sustainable management of the historic environment in Wales. Available at: https://cadw.gov.wales/advice-support/conservation-principles/conservation-principles [Accessed on 09/07/19]

Cadw (2017a). Setting of Historic Assets in Wales. Welsh Government, Cadw. Available at: https://cadw.gov.wales/docs/cadw/publications/historicenvironment/20170531Setting%20of%20Historic%20Assets%20in%20Wales%2026918%20EN.pdf [Accessed on 09/07/19]

Cadw (2017b). Heritage Impact Assessment in Wales. Welsh Government, Cadw. Available at: https://cadw.gov.wales/docs/cadw/publications/historicenvironment/20170531Heritage%20Impact%20Assessment%20in%20Wales%2026917%20EN.pdf [Accessed on 09/07/19]

Cadw (2017c). Managing Change to Listed Buildings in Wales. Welsh Government, Cadw. Avalable at: https://cadw.gov.wales/advice-support/historic-assets/scheduled-monuments/best-practice-guidance/#section-caring-for-coastal-heritage [Accessed on 09/07/19]

Cadw (2017d). Managing Conservation Areas in Wales. Welsh Government, Cadw.

Cadw (2017e). Managing Historic Character in Wales. Welsh Government, Cadw. Available at: https://cadw.gov.wales/docs/cadw/publications/historicenvironment/20170531Managing%20Historic%20Character%20in%20Wales%2031145%20EN.pdf [Accessed on 09/07/19]

Cadw and Countryside Council for Wales (2007). Guide to Good Practice on using the Register of Landscapes of Historic Interest in Wales in the Planning and Development Process, Revised (2nd) edition Welsh Government, Cadw.

Chartered Institute for Archaeologists (CIfA) (2014a). Standard and guidance for historic environment desk-based assessment. Reading.

Chartered Institute for Archaeologists (CIfA) (2014b). Code of Conduct. Reading. Available at: https://www.archaeologists.net/sites/default/files/CodesofConduct.pdf [Accessed on 09/07/19]

GAT (2012). Penrhos Leisure Village, Holyhead, Anglesey. Report on Archaeological Evaluation Trenches. GAT unpublished technical report. Available at:

Historic England (2013). Historic Environment Guidance for Wave and Tidal Energy. November 2013

Isle of Anglesey County Council and Gwynedd Council (2017). Joint Local Development Plan (Anglesey and Gwynedd). Available at: https://www.gwynedd.llyw.cymru/en/Council/Documents---Council/Strategies-and-policies/Environment-and-planning/Planning-policy/Anglesey-and-Gwynedd-Joint-Local-Development-Plan-Written-Statement.pdf [Accessed on 09/07/19]

Welsh Government (2018). The Planning Policy Wales (Edition 10, November 2018): Chapter 6 – Distinctive and Natural Places. Welsh Government. Available online:

https://gov.wales/sites/default/files/publications/2019-02/planning-policy-wales-edition-10.pdf [Accessed on 09/07/19]

Welsh Government (2017). Technical Advice Note 24: The Historic Environment Welsh Government

Welsh Office (1999). Welsh Office Circular 11/99: Environmental Impact Assessment. Welsh Government.

Wessex Archaeology (2019). *Morlais Tidal Array: Desk -based Assessment on Onshore Archaeology & Walkover Survey*. Wessex Archaeology unpublished technical report

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Morlais Project
Environmental Statement

Chapter 21: Noise and Vibration

Volume I

Applicant: Menter Môn Morlais Limited Document Reference: PB5034-ES-021 Chapter 21: Noise and Vibration Author: Royal HaskoningDHV			
Morlais Document No.: MOR/RHDHV/DOC/0044	Status: Final	Version No: F3.0	Date: July 2019

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GLOSSARY OF ABBREVIATIONS

AAWT	Annual Average Weekday Traffic
BAT	Best Available Technology
BPM	Best Practicable Means
BS	British Standard
CNMP	Construction Noise Management Plan
CoCP	Code of Construction Practice
CRTN	Calculation of Road Traffic Noise
DMRB	Design Manual for Roads and Bridges
EPA	Environmental Protection Act
EPP	Evidence Plan Process
eVDV	Estimated Vibration Dose Value
HVAC	High Voltage Alternating Current
ISO	International Standards Organisation
LOAEL	Lowest Observed Adverse Effect Level
NOEL	No Observed Effect Level
NPF	National Planning Framework
NPPG	National Planning Practice Guidance
NSR	Noise Sensitive Receptor
OAE	Observed Adverse Effect
PDS	Project Design Statement
PPG	Planning Practice Guidance
PPV	Peak Particle Velocity
PPW	Planning Policy Wales
SLM	Sound Level Meter
SOAEL	Significant Observed Adverse Effect Level
SPSS	Strategic Planning Policy Statement
TAN	Technical Advice Note
TMP	Traffic Management Plan
TRL	Transport Research Laboratory
TRRL	Transport and Road Research Laboratory
UAE	Unacceptable Adverse Effect
UAEL	Unacceptable Adverse Effect Level
VDV	Vibration Dose Value
WG	Welsh Government
WHO	World Health Organisation

GLOSSARY OF TERMINOLOGY

Construction consolidation sites	Compounds which will contain laydown, storage and work areas for onshore construction works. The HDD construction compound will also be referred to as a construction consolidation site.
dB(A)	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting)

	which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
dB(Z) (or previously L_{Leq})	Decibels measured on a sound level meter incorporating a flat frequency weighting (Z weighting) across the frequency range.
Decibel (dB)	A unit of noise level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 µPa, the threshold of normal hearing is 0 dB, and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions. Under normal conditions a change in noise level of 3 dB(A) is the smallest perceptible change.
Horizontal Directional Drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
$L_{A10,T}$	The A weighted noise level exceeded for 10 % of the specified measurement period (T). L_{A10} is the index generally adopted to assess traffic noise.
$L_{A90,T}$	The A weighted noise level exceeded for 90 % of the specified measurement period (T). In BS 4142:2014+A1:2019 it is used to define the 'background' noise level.
$L_{Aeq,T}$	The equivalent continuous sound level – the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). $L_{Aeq,T}$ is used to describe many types of noise and can be measured directly with an integrating sound level meter.
L_{Amax}	The maximum A-weighted sound pressure level recorded during a measurement.
Mitigation areas	Areas captured within the Development Area specifically for mitigating expected or anticipated impacts.
SoundPLAN	Noise Modelling Software used to predict noise impacts from Construction and Operational Phases associated with the Project.

21. NOISE AND VIBRATION

21.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) considers the potential airborne noise and vibration impacts of the Morlais Project (hereafter 'the Project'). This chapter provides an overview of the baseline noise conditions for the onshore development area and identifies potentially sensitive receptors to noise and vibration. The chapter presents an assessment of the potential impacts and associated mitigation for the construction, operation and decommissioning of the Project on these receptors.

2. The assessment also considers cumulative impacts of other proposed projects. The proposed methodology adhered to for the Environmental Impact Assessment (EIA) and Cumulative Impact Assessment (CIA) is discussed in **Section 21.13**.

3. This chapter is supported by **Appendix 21.1** Baseline Noise Survey (**Volume III**), **Appendix 21.2** Construction Phase Assessment (**Volume III**), **Appendix 21.3** Operational Phase Assessment (**Volume III**) and **Appendix 21.4** Morlais Noise and Vibration Consultation Responses (**Volume III**). Figures which accompany this chapter are provided in **Volume II**.

4. The onshore development area is detailed in **Figure 21.1** (**Volume II**). The key components of the onshore works associated with the Project include:

   - Landfall cable installation works;
   - Landfall substation at Ty-Mawr (hereafter referred to as Landfall Substation);
   - Switchgear Building at Parc Cybi (hereafter referred to as Switchgear Building);
   - Grid Connection Substation at Orthios (hereafter referred to as Grid Connection Substation);
   - Onshore cable route joint bays (along onshore cable route between Landfall Substation and Grid Connection Substation); and
   - Onshore cable circuits installed between Landfall Substation and Grid Connection Substation.

5. Potential impacts in relation to noise and vibration inter-relate with other technical topics as presented within other chapters of the ES. These are referenced within this chapter and consist of:

   - **Chapter 11**, Marine Ornithology;
   - **Chapter 19**, Onshore Ecology;
   - **Chapter 20**, Onshore Archaeology;
   - **Chapter 23**, Traffic and Transport; and
   - **Chapter 25**, Socio-economics, Tourism and Recreation and Human Health.

6. The chapter has been prepared by Royal HaskoningDHV.

21.2. POLICY, LEGISLATION AND GUIDANCE

7. This section provides details on key international and UK legislation which is relevant to this chapter.

21.2.1. Environmental Protection Act 1990

8. Section 79 of the Environmental Protection Act 1990 (the EPA 1990) defines statutory nuisance with regard to noise and determines that local authorities have a duty to detect such nuisances in their area.

9. The EPA 1990 also defines the concept of 'Best Practicable Means' (BPM) as:

"'Practicable' means reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications;

The means to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and structures;

The test is to apply only so far as compatible with any duty imposed by law; and

The test is to apply only so far as compatible with safety and safe working conditions, and with the exigencies of any emergency or unforeseeable circumstances."

10. Section 80 of the EPA 1990 provides local authorities with powers to serve an abatement notice requiring the abatement of a nuisance or requiring works to be executed to prevent their occurrence.

21.2.2. The Control of Pollution Act 1974

11. Section 60 of the Control of Pollution Act 1974 provides powers to local authority officers to serve an abatement notice in respect of noise nuisance from construction works.

12. Section 61 provides a method by which a contractor can apply for 'prior consent' for construction activities before commencement of works. The 'prior consent' is agreed between the local authority and the contractor and may contain a range of agreed working conditions, noise limits and control measures designed to minimise or prevent the occurrence of noise nuisance from construction activities. Application for a 'prior consent' is a commonly used control measure in respect of potential noise impacts from major construction works.

21.2.3. National Planning Policy

21.2.3.1. National Policy Statements (NPS)

13. The Project is seeking consent for a Transport and Works Act Order from the Welsh Ministers and a Marine Licence from Natural Resources Wales (NRW). Although this Project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP), therefore guidance relevant to NSIPs is

considered appropriate to use for this Project. Guidance that is relevant to assessing impacts on marine water and sediment quality for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to noise and vibration include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a);
- NPS for Renewable Energy Infrastructure (EN-3), July 2011 (DECC, 2011b); and
- NPS for Electricity Networks Infrastructure (EN-5) (DECC, 2011c).

14. Details of specific policies within EN-1 and EN-3 used to inform this assessment are provided in **Table 21-1** below. The specific assessment requirements for noise and vibration are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 21-1 Summary of NPS Requirements

NPS Requirement	NPS Reference	ES Chapter Reference
Where noise impacts are likely to arise, the applicant should include: ▪ A description of the noise generating aspects of the development proposal leading to noise impacts including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise; ▪ Identification of noise sensitive premises and noise sensitive areas that may be affected; ▪ The characteristics of the existing noise environment; ▪ A prediction of how the noise environment will change with the proposed development; ▪ In the shorter term such as during the construction period; ▪ In the longer term during the operating life of the infrastructure; ▪ At particular times of the day, evening and night as appropriate; ▪ An assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas; and ▪ Measures to be employed in mitigating noise. ▪ The nature and extent of the noise assessment should be proportionate to the likely noise impact.	EN-1, paragraph 5.11.4	Refer to **Section 21.6** for the assessment methodology for assessing potential noise and vibration impacts, **Section 21.8** for details on the existing noise environment including the identification of noise sensitive receptors and **Section 21.9** where any changes in noise levels as a result of the Project are assessed, and any potential impacts and potential mitigation measures are identified.
The noise impact of ancillary activities associated with the development, such as increased road and rail traffic movements, or other forms of transportation, should also be considered.	EN-1, paragraph 5.11.5	Refer to **Section 21.9** where any changes in noise levels as a result of the Project from ancillary works, for example vehicle movements, are assessed and any potential impacts and potential mitigation measures are identified.
Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance. Further information on assessment of particular noise sources	EN-1, paragraph 5.11.6	Noise assessment described within EN-3 and EN-5 relates to the offshore environment. Those potential noise impacts

NPS Requirement	NPS Reference	ES Chapter Reference
may be contained in the technology-specific NPSs. In particular, for renewables (EN-3) and electricity networks (EN-5) there are assessment guidance for specific features of those technologies. For the prediction, assessment and management of construction noise, reference should be made to any relevant British Standards and other guidance which also give examples of mitigation strategies.		are considered separately within **Chapter 10, Fish and Shellfish Ecology** and **Chapter 12, Marine Mammals**. The current relevant British Standards (BS) have been used within this assessment detailed within **Section 21.4**.
The applicant should consult EA and Natural England (NE), or the Countryside Council for Wales (CCW), as necessary and in particular with regard to assessment of noise on protected species or other wildlife. The results of any noise surveys and predictions may inform the ecological assessment. The seasonality of potentially affected species in nearby sites may also need to be taken into account.	EN-1, paragraph 5.11.7	Noise impacts on terrestrial protected species or other wildlife is considered within **Chapter 11, Ornithology and Chapter 19, Onshore Ecology**.
While standard methods of assessment and interpretation using the principles of the relevant British Standards are satisfactory for dry weather conditions, they are not appropriate for assessing noise during rain. This is when overhead line noise mostly occurs, and when the background noise itself will vary according to the intensity of the rain. Therefore, an alternative noise assessment method to deal with rain-induced noise is needed, such as the one developed by National Grid as described in report TR (T) 94,199319. This follows recommendations broadly outlined in ISO 1996 (BS 7445:1991) and in that respect, is consistent with BS 4142:1997. The IPC [now the Planning Inspectorate and the Secretary of State] is likely to be able to regard it as acceptable for the applicant to use this or another methodology that appropriately addresses these particular issues.	EN-5, paragraphs 2.9.8 and 2.9.9	Construction of a new overhead line will not be required. BS 4142:1997 was superseded in 2014. A full revision was published in 2014, with an amendment in 2019. Where BS 4142 is referred to in this document, the 2014 revision with 2019 amendments has been applied which is in accordance with current best practice. See **Chapter 4, Project Description** for more information on works related to onshore infrastructure and National Grid connections.

15. EN-1 states in paragraph 4.1.5 that:

"*Other matters that the Infrastructure Planning Commission (IPC) may consider important and relevant to its decision-making may include Development Plan Documents or other documents in the Local Development Framework. In the event of a conflict between these or any other documents and an NPS, the NPS prevails for the purposes of IPC decision making given the national significance of the infrastructure*".

21.2.4. Noise and Soundscape Action Plan for Wales 2018-2024 (Draft)

16. The Preface to the 2018 Draft revision states:

"*Under the Environmental Noise Regulations, the Welsh Ministers have an obligation to draw up action plans for places near major roads and major railways, and for agglomerations. The Regulations apply to environmental noise to which humans are exposed in particular in built-up areas, in public parks or other quiet areas in an agglomeration, and near schools, hospitals and other noise-sensitive buildings and areas*."

21.2.5. Planning Policy Wales, 2018

17. The Planning Policy Wales (PPW) was originally published by the Welsh Government in 2002 and sets the context for planning in Wales, under which Local Planning Authorities prepare their statutory Development Plans. It is the principal and authoritative source of national planning policy.

18. Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government (WG). The planning policy is supplemented by a series of Technical Advice Notes (TANs), Welsh Government Circulars, and policy clarification letters, which together with PPW provide the national planning policy framework for Wales.

19. Updates to the national planning policy are issued for consultation and then incorporated into the latest version of PPW. Planning Policy Wales (Edition 10) is the latest version of PPW and stipulates the following in relation to noise:

20. Paragraph 6.7.6 states the following in relation to noise issues arising from new developments:

"*6.7.6 - In proposing new development, planning authorities and developers must therefore:*

Address any implication arising as a result of its association with, or location within, air quality management areas, noise action planning priority areas or areas where there are sensitive receptors;

Not create areas of poor air quality or inappropriate soundscape; and,

Seek to incorporate measures which reduce overall exposure to air and noise pollution and create appropriate soundscapes".

21.2.6. Technical Advice Note (Wales) 11, 1997

21. TAN11 contains noise specific guidance and recommends that it is read in conjunction with Planning Guidance (Wales). The document considers controls for noise generating and noise-sensitive developments (construction and operational), mitigation measures, provides examples of assessment of noise from different sources, and details noise exposure categories (NECs) for dwellings.

22. Further standards and guidance are referenced which are superseded; BS4142:1990, BS8233:1987, BS5228 Parts 1-4:1984.

21.3. LOCAL PLANNING POLICY

23. The onshore development area also falls within the jurisdiction of Isle of Anglesey County Council (IoACC).

21.3.1. Anglesey and Gwynedd Joint Local Development Plan 2011 - 2026

24. Isle of Anglesey County Council stipulates the following noise impacts policy:

Policy PCYFF 2: Development Criteria – Planning permission will be refused where the proposed development would have an unacceptable adverse impact on:

"*7. The health, safety or amenity of occupiers of local residences, other land and property uses or characteristics of the locality due to increased activity, disturbance, vibration, noise, dust, fumes, litter, drainage, light pollution, or other forms of pollution or nuisance*."

25. **Table 21-2** sets out national and regional policies that are of relevance to Noise and Vibration.

Table 21-2 National and Regional Policy Requirements Relevant to Noise and Vibration

Policy Description	Reference	ES Reference
MPS		
Noise from marine activities can also affect people. An EU Directive on Environmental Noise (EU 2002/49/EC) that deals with noise impacts on people is currently under review. Excessive noise can have wide ranging impacts on the quality of human life, health, and use and enjoyment of areas, including those with high visual quality. Its impact therefore needs to be considered and managed appropriately.	2.6.3.3	Refer to **Section 21.6** for the assessment methodology for assessing potential noise and vibration impacts, **Section 21.8** for details on the existing noise environment including the identification of noise sensitive receptors and **Section 21.9** where any changes in noise levels as a result of the Project are assessed, and any potential impacts and potential mitigation measures are identified.
Planning Policy Wales		
The planning system must protect amenity and it is not acceptable to rely on statutory nuisance under the Environmental Protection Act 1990 to do so.	6.7.3	The current relevant British Standards (BS) have been used within this assessment detailed within **Section 21.4**.
In proposing new development, planning authorities and developers must, therefore: • address any implication arising as a result of its association with, or location within, air quality management areas, noise action planning priority areas or areas where there are sensitive receptors; • not create areas of poor air quality or inappropriate soundscape; and • seek to incorporate measures which reduce overall exposure to air and noise pollution and create appropriate soundscapes.	6.7.6	The baseline noise survey detailed in **Section 21.8** and **Appendix 21.1** (**Volume III**) outlines the existing soundscape within the study area of the Project. The impact assessment is presented in **Section 21.10**.
To assist decision making it will be important that the most appropriate level of information is provided and it may be necessary for a technical air quality and noise assessment	6.7.7	The Existing Environment with regards to Noise is

Policy Description	Reference	ES Reference
to be undertaken by a suitably qualified and competent person on behalf of the developer.		presented in **Section 21.7**.
Good design, for example setting back buildings from roads to avoid canyon effects and using best practice in terms of acoustic design to ensure the appropriate and intended acoustic environment of completed developments should be incorporated at an early consideration in the design and planning process. Other mitigation measures must be capable of being effectively implemented for their intended purpose,	6.7.8	A Construction Noise Management Plan will be produced in line with The Control Of Pollution Act and BS 5228 (**Section 21.10.7**).
Relevant considerations in making planning decisions for potentially polluting development are likely to include: • the risk and impact of potential pollution from the development, insofar as this might lead to the creation of, or worsen the situation in, an air quality management area, a noise action planning priority area or an area where there are sensitive receptors; and	6.7.16	Menter Môn has committed to providing a final design of the Project which is able to meet the rigorous standards of low noise emissions expected by both the UK regulatory bodies and stakeholders. (**Para. 213**)
The potential impacts of noise pollution arising from existing development, be this commercial, industrial, transport related or cultural venues (such as music venues, theatres or arts centres), must be fully considered to ensure the effects on new development can be adequately controlled to safeguard amenity and any necessary measures and controls should be incorporated as part of the proposed new development.	6.7.24	Please see the impact assessment (**Sections 21.10, 21.11** and **21.12**) and the Cumulative Impact Assessment (**Section 21.13**).
Planning authorities should identify areas of cultural or historic importance to be given special consideration in terms of soundscape where this may be necessary to safeguard the vibrancy of places or provide tranquil, restorative environments within busy built-up areas.	6.7.25	Noise Sensitive Receptors are defined in **Section 21.6**.
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
Planning permission will be refused where the proposed development would have an unacceptable adverse impact on the health, safety or amenity of occupiers of local residences, other land and property uses or characteristics of the locality due to increased activity, disturbance, vibration, noise, dust, fumes, litter, drainage, light pollution, or other forms of pollution or nuisance	Policy PCFF 2: Development Criteria	An impact assessment on residential and commercial areas is presented in **Sections 21.10, 21.11** and **21.12.**
1. All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced; 3. That the proposal is mitigated to ensure that there aren't any significant unacceptable effects on sensitive uses located nearby;	Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	An impact assessment and proposed mitigation measures are for residential and commercial areas is presented in **Sections 21.10, 21.11** and **21.12.**
Wellbeing of Future Generations (Wales) Act 2015		

Policy Description	Reference	ES Reference
A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).	A resilient Wales	See **Section 21.9** for the impact assessment results.

21.4. GUIDANCE

26. The guidance in the following sections has been applied to the noise and vibration assessment. Planning Policy Wales and supporting guidance (TAN11) refer to some standards which have been revised, and thus superseded, i.e. BS4142:1997 was replaced with BS4142:2014. Further changes were included in a 2019 amendment. Where a revision has occurred, the assessment herein relates to the most recent published document.

21.4.1. British Standard (BS) 4142:2014+A1:2019 – Method for Rating and Assessing Industrial and Commercial Sound

27. BS4142:2014+A1:2019 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incidental.

21.4.2. BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise

28. Part 1 of this Standard provides recommendations for basic methods of noise and vibration control relating to construction and open sites where work activities/operations generate significant noise and/or vibration levels. The legislative background to noise and vibration control is described and recommendations are given regarding procedures for the establishment of effective liaison between developers, site operators and local authorities. This British Standard provides guidance on methods of predicting and measuring noise and assessing its impact on those exposed to it.

21.4.3. BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 2: Vibration

29. Part 2 of this Standard gives recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels. The Standard includes tables of vibration levels measured during piling operations throughout the UK. It provides guidance concerning methods of mitigating vibration from construction, particularly with regard to percussive piling.

21.4.4. BS 6472-1:2008 – Guide to Evaluation of Human Exposure to Vibration in Buildings

30. This standard provides general guidance on human exposure to building vibration in the range of 1Hz to 80Hz and includes curves of equal annoyance for humans. It also outlines the measurement methodology to be employed. It introduces the concept of Vibration Dose Value (VDV) and estimated Vibration Dose Value (eVDV) for the basis of assessment of the severity

of impulsive and intermittent vibration levels, such as those caused by a series of trains passing a given location.

21.4.5. BS 7445: Parts 1 and 2 – Description and Measurement of Environmental Noise

31. This Standard provides details of the instrumentation and measurement techniques to be used when assessing environmental noise and defines the basic noise quantity as the continuous A-weighted sound pressure level (LAeq). Part 2 of BS 7445 replicates International Standards Organisation (ISO) 1996-2.

21.4.6. BS 8233:2014 – Guidance on Sound Insulation and Noise Reduction for Buildings

32. This Standard provides a methodology to calculate the noise levels entering a building through facades and facade elements and provides details of appropriate measures for sound insulation between dwellings. It includes recommended internal noise levels which are provided for a variety of situations and are based on World Health Organisation (WHO) recommendations.

21.4.7. Calculation of Road Traffic Noise (CRTN) 1988

33. The Calculation of Road Traffic Noise (CRTN) document provides a method for assessing noise from road traffic in the UK and a method of calculating noise levels from the Annual Average Weekday Traffic (AAWT) flows and from measured noise levels. Since publication in 1988 this document has been the nationally accepted standard in predicting noise levels from road traffic. The calculation methods provided include correction factors to take account of variables affecting the creation and propagation of road traffic noise, accounting for the percentage of heavy goods vehicles (HGV), different road surfacing, inclination, screening by barriers and relative height of source and receiver.

21.4.8. Design Manual for Roads and Bridges, 2011

34. Volume 11, Part 3, Section 7 provides guidance on the environmental assessment of noise impacts from road schemes. The Design Manual for Roads and Bridges (DMRB) contains advice and information on transport-related noise and vibration, which has relevance regarding the construction and operational traffic impacts affecting sensitive receptors adjacent to road networks. It also provides guideline significance criteria for assessing traffic related noise impacts.

21.4.9. ISO 3744

35. ISO 3744 specifies a method for measuring the sound pressure levels on a measurement surface enveloping a noise source, under essentially free field conditions near one or more reflecting planes, to calculate the sound power level produced by the noise source.

21.4.10. ISO 717

36. ISO 717 defines single-number quantities for airborne sound insulation in buildings and of building elements such as walls, floors, doors, and windows.

21.4.11. ISO 9613-2

37. ISO 9613 specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a noise source.

21.4.12. WHO (1999) Guidelines for Community Noise

38. These guidelines present health-based noise limits intended to protect the population from exposure to excess noise. They present guideline limit values at which the likelihood of particular effects, such as sleep disturbance or annoyance, may increase. The guideline values are 50 or 55 dB L_{Aeq} during the day, related to annoyance, and 45 dB L_{Aeq} or 60 dB L_{Amax} at night, related to sleep disturbance.

39. The Guidance states:

"*The effects of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30 dB L_{Aeq} for continuous noise and 45 dB L_{Amax} for single sound events. Lower noise levels may be disturbing depending on the nature of the source*."

40. The WHO guidance also highlights that:

"*Night-time, outside sound levels about 1 metre from facades of living spaces should not exceed 45 dB L_{Aeq}, so that people may sleep with bedroom windows open. This value was obtained by assuming that the noise reduction from outside to inside with the window open is 15 dB. To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35 dB L_{Aeq}. To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development*."

21.4.13. WHO (2009) Night Noise Guidelines for Europe

41. In 2009, the WHO published the Night Noise Guidelines for Europe, which it describes as an extension to the WHO Guidelines for Community Noise (1999). It concludes that:

"*Considering the scientific evidence on the thresholds of night noise exposure indicated by L_{night} outside as defined in the Environmental Noise Directive (2002148/EC), an L_{night} outside of 40 dB should be the target of the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. L_{night} outside value of 55 dB is recommended as an interim target for those countries where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach*."

21.4.14. WHO (2018) Environmental Noise Guidelines for the European Region

42. The guidance states:

"*The main purpose of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise originating from various sources: transportation (road traffic, railway and aircraft) noise, wind turbine noise and leisure noise. They provide robust public health advice underpinned by evidence, which is essential to drive policy action that will protect communities from the adverse effects of noise*."

21.4.15. Institute of Environmental Management and Assessment Guidelines for Environmental Noise Impact Assessment (2014)

43. This Institute of Environmental Management and Assessment (IEMA) guidance states:

"The NPPF/NPF/PPW/SPSS do not contain specific policies for nationally significant infrastructure projects for which particular considerations apply. These are determined in England and Wales in accordance with the decision-making framework set out in the Planning Act 2008 and relevant national policy statements for major infrastructure, as well as any other matters that are considered both important and relevant (which may include the National Planning Policy Framework). National policy statements form part of the overall framework of national planning policy, and are a material consideration in decisions on planning applications."

44. The IEMA guidance discusses concepts from toxicology which are being applied to noise impacts for EIA guidelines:

- LOAEL – Lowest Observed Adverse Effect Level; this is the level above which adverse effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level which is defined as the level above which significant effects on health and quality of life occur.

21.5. CONSULTATION

45. Consultation is a key part of the EIA process and is an ongoing process throughout the lifecycle of the Project, from the initial stages through to consent and post-consent.

46. Full details of the Project consultation process are presented within **Chapter 6, Consultation**. A scoping report was issued in 2015, 2017 and 2018.

47. A summary of the consultation undertaken for the Project and scoping opinion responses received specific to noise and vibration is provided in **Table 21-3**.

Table 21-3 Consultation Responses

Consultee	Date/Document	Comment	Response
IoACC - EHO	25 March 2019 Telephone call between Royal HaskoningDHV and IoACC	Telephone conversation to discuss baseline measurement survey and assessment approach.	N/A

Consultee	Date/Document	Comment	Response
IoACC - EHO	25 March 2019 Email sent to Royal HaskoningDHV from IoACC	Email follow up from Major Consents Planning Manager to Royal HaskoningDHV stating the relevant EHO will be in contact 26 March 2019.	N/A
IoACC - EHO	26 March 2019 Email sent to Royal HaskoningDHV from IoACC	Email follow up from EHO providing contact details.	N/A
IoACC - EHO	26 March 2019 Email sent from Royal HaskoningDHV to IoACC	Email follow to EHO providing baseline measurement survey and assessment approach.	N/A
IoACC - EHO	26 March 2019 Email sent to Royal HaskoningDHV from IoACC	Email follow up from EHO providing comments. Approval of methodology BS4142:2014 and BS5228:2009+A1:2014. Highlight the use of TAN11. Increase measurement period from 30 minutes to 1 hour at the 4 cable corridor locations. Use of 1/3rd Octave Band measurements.	Consultation with the Environmental Health Officers at Isle of Anglesey County Council was undertaken. Details are provided in **Appendix 21.4** (**Volume III**). A baseline noise survey was undertaken at various locations representative of the nearest sensitive receptors as agreed with the relevant local authorities. Full details in **Appendix 21.2** (**Volume III**) and Section 21.8.
Planning Inspectorate	2018 Scoping	"Site-specific survey and noise sensitive receptors: It is recommended that the baseline survey and assessment methodology and choice of NSRs should be agreed with the relevant Environmental Health Officers. The choice of receptors and assessment of impacts arising during construction and operation should be based on a justified worst case scenario."	Consultation with the Environmental Health Officers at Isle of Anglesey County Council was undertaken. Details provided in **Appendix 21.4** (**Volume III**). A baseline noise survey was undertaken at various locations representative of the nearest sensitive receptors as agreed with the relevant local authorities. Full details in **Appendix 21.2** (**Volume III**) and **Section 21.8**.
Planning Inspectorate	2018 Scoping	"Operational impacts: With the exception of noise arising from activities at Holyhead Harbour, Table 9-8 of the Scoping Report does not consider noise during operation. It is agreed that operational noise from movement of the offshore TECs would be unlikely	Refer to **Section 21.7.5**.

Consultee	Date/Document	Comment	Response
		to result in significant effects to onshore receptors. Similarly, having regard to the characteristics of the Proposed Works, operation of the electrical connection is unlikely to result in significant effects. However, in absence of a defined location for the onshore substation(s) and potential switch gear facility, it is considered that the ES should assess potential operational noise and vibration impacts from the substation. It is also noted that Section 9.12 (Health) of the Scoping Report proposes to assess noise disturbance from operation of the substation and National Grid infrastructure."	
Planning Inspectorate	2018 Scoping	"Noise generating activities: The ES should provide a description of the noise generating elements of the Proposed Works during both the construction and operation stages. Any distinctive tonal, impulsive or low frequency characteristics of the noise should be identified and assessed"	Refer to **Section 21.7.1** for Construction. Refer to **Section 21.7.5** for Operational.
Planning Inspectorate	2018 Scoping	"Impacts to ecological receptors: The results of the noise and vibration assessment should be used to inform the assessment of impacts on ecological receptors."	Not covered in this Chapter. Refer to **Chapter 19, Onshore Ecology**.
NRW	2018 Scoping	We currently have no comments to make on this topic.	Not Applicable.

21.6. METHODOLOGY

21.6.1. Study Area

48. The study area for this noise and vibration assessment comprises the entire onshore development area, as described in **Chapter 4, Project Description** and as shown in **Figure 21.1** (**Volume II**). Noise measurement positions (for the baseline survey) and noise receptor locations identified within the study area can be found in **Figure 21.1** (**Volume II**) and **Section 21.6.4**.

49. The study area for the Landfall Substation, onshore cable route, Switchgear Building and Grid Connection Substation and identified traffic routes (Onshore Development Area) are located within the administrative region of IoACC.

50. The extent of the study area for the construction phase road traffic noise and vibration assessment was based on details provided in **Chapter 23, Traffic and Transport**.

51. This noise and vibration assessment draws on the information provided within **Chapter 4, Project Description** in order to define worst case assumptions which are outlined in **Section 21.9**. These assumptions have been used in the noise and vibration impact assessments in **Section 21.9**.

21.6.2. Data Sources

52. In order to inform this assessment, consideration of the project infrastructure and surrounding environment within the onshore development area utilised existing available geographical information including aerial and satellite photography and mapping data. This data was used in order to determine the nearest noise sensitive receptors (NSRs) or groups of receptors and noise sources present within the study area for use in the assessment.

53. The data sources used and their associated confidence levels which informed the desk-based assessment are provided in **Table 21-4**.

Table 21-4 Data Sources

Data	Year	Coverage	Confidence
Google Maps Aerial Photography	2018	Noise and Vibration study area	High
OS Mastermap	2019	Noise and Vibration study area	High
NRW Open Licence LIDAR data	2018	Noise and Vibration study area	High
OS 5050	2019	Noise and Vibration study area	High
Construction Phasing	2019	Landfall: Duct installation including HDD works; and Cable pulling, jointing and commissioning. Onshore cable route: Duct installation works; and Cable pulling, jointing and commissioning. Landfall Substation: Temporary works; Onshore infrastructure installation and commission.	High
Operational	2019	Landfall Substation	High

54. The boundary of the Onshore Development Area is illustrated in **Figure 1-2** (**Volume II**). This a complex terrestrial boundary and will therefore not be represented as co-ordinates in this chapter.

55. Landfall will be located within the bay on the western coast of Holy Island known as ‘Abraham’s Bosom’. The landfall consists of exposed rocky shore, backed by a hinterland of coastal heath and farmland. The landfall substation location is currently farmed land in the area of Holy Island known as Penrhos Feilw.

56. From the Landfall Substation the majority of the onshore cable will be trenched within the existing minor road network (**Figure 1-2, Volume II**). The proposed cable corridor follows South Stack Road, Porthdafarch Road and Mill Road towards the Switchgear Building.

57. The cable will be trenched from the Switchgear Building to the Grid Connection Substation, with a section installed via Horizontal Directional Drilling (HDD) beneath the A55 and the Holyhead to Bangor rail line.

58. The Landfall Substation is located in an area rural in nature near Abraham's Bosom, close to South Stack Road. South Stack Road is a minor road through Anglesey (see **Chapter 23, Traffic and Transport** for more details).

59. The Switchgear Building is close to the A55, a major road link, with the A5 further to the north. The immediate area is generally undeveloped or commercial property, with a retail park on the opposite side of the A55 to the north. The area detailed as Kingsland and Holyhead form the largest concentration of residential properties. Smaller villages and individual residential properties are also located within the study area.

60. The Grid Connection Substation is proposed on the former Anglesey Aluminium Metal Limited works between the A55 located to the south and the A5 situated to the north. The nearest residential properties are approximately 300m to the north along the London Road. Identified NSRs are detailed in **Section 21.6.4**.

21.6.3. Anticipated Trends in Baseline Conditions

61. The baseline noise survey detailed in **Section 21.8** and **Appendix 21.1** (**Volume III**) outlines the existing soundscape within the study area of the Project. Noise is managed and driven by EU, UK and local legislation and policies. The UK's noise strategy and standards are enacted through management actions at a local authority level as detailed in **Section 21.2**. There is a policy trend towards the achievement and maintenance of the noise environment across the UK, which is reflected in the local planning policies detailed in **Sections 21.2.4**, **21.2.5**, **21.2.6**, and **21.3**.

62. Predicted noise levels due to a change in land use, new developments and associated vehicles are assessed as part of the development planning and consent process. Potential impacts to the prevailing soundscape should be minimised, avoided, or mitigated to suitable levels (in accordance with current legislation, policy and guidance), avoiding an adverse impact, where possible. In addition to planning controls there is a clear trend for noise from vehicle, commercial and industrial sources to be reduced, in compliance with stricter legislation and guidance. Consequently, in relation to the Project and its immediate receiving environment it is reasonable to predict a general steady baseline soundscape would be maintained.

21.6.4. Data Sources – Desk Study

63. Consideration of the project infrastructure and surrounding environment within the onshore development area was used in order to determine the nearest NSRs present within the study area for use in the assessment. The nearest sensitive receptors are detailed in **Table 21-5** and on **Figure 25.1** (**Volume II**).

Table 21-5 Noise Sensitive Receptors – Landfall Substation, Grid Connection Substation and Switchgear Building

Assessment Receptor Identifier	Baseline Noise Survey Identifier	Classification	Location	Coordinates	
				X	Y
NSR1	LF1	Residential	Landfall Substation	221542.4	381627.0
NSR2	LF1	Residential		221933.5	381573.0
NSR3	LF1	Residential		221688.5	381846.5
NSR4	LF1	Residential		221439.3	381740.8
NSR5	SS2	Residential	Switchgear Building and Grid Connection Substation	226395.7	380082.0
NSR6	SS1	Residential		227059.5	381056.4
NSR7	SS1	Residential		227115.4	381161.0
NSR8	SS2	Residential/Hotel		225300.3	381080.6
NSR9	SS1	Residential		227015.9	381265.4
NSR10	SS2	Residential		225974.2	380222.6

21.6.1. Data Sources – Site-Specific Surveys and Reports

64. Measurements of the existing ambient noise level were required to be taken at locations considered representative of nearby NSRs that had the potential to be affected by the construction and operation of the Project.

65. Further details of the baseline noise survey are discussed in **Section 21.8** and full details can be found in **Appendix 21.1** (**Volume III**).

21.7. IMPACT ASSESSMENT METHODOLOGY

66. This section presents the potential noise impacts associated with the construction and operation of the Project.

21.7.1. Construction Phase Noise Assessment

67. BS 5228:2009+A1:2014 describes several methods for assessing noise impacts during construction projects.

68. The approach outlined and utilised in this ES chapter is the threshold based 'ABC' method. The method, as detailed within BS 5228, specifies a construction noise limit based on the existing ambient noise level and for different periods of the day. The predicted construction noise levels were assessed against noise limits derived from advice within Annex E of BS 5228. **Table 21-6**, reproduced from BS 5228:2009+A1:2014 Table E.1, presents the criteria for selection of a noise limit for a specific receptor location.

Table 21-6 Construction Noise Threshold Levels Based on the ABC Method (BS 5228)

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A A)	Category B B)	Category C C)
Night time (23.00 – 07.00)	45	50	55
Evenings and weekends D)	55	60	65

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A[A)]	Category B[B)]	Category C[C)]
Daytime (07.00 – 19.00) and Saturdays (07.00 – 13.00)	65	70	75
A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.			
B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.			
C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.			
D) 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.			

69. The 'ABC method' described in BS 5228 establishes that there is no impact below the three thresholds presented above.

70. BS 5228 states:

"*If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect*."

71. The SoundPLAN construction noise model used in the assessment of cumulative Landfall Substation works, Switchgear Building and cumulative Grid Connection Substation works incorporated noise sources located in the study area, nearby residential dwellings and other buildings, intervening ground cover and topographical information.

72. Noise levels for the construction phase were calculated using the methods and guidance in BS 5228. This Standard provides methods for predicting receptor noise levels from construction works based on the number and type of construction plant and activities operating on site, with corrections to account for:

- The 'on-time' of the plant, as a percentage of the assessment period;
- Distance from source to receptor;
- Acoustic screening by barriers, buildings or topography; and
- Ground type.

73. Construction noise impacts were assessed using the impact magnitude presented in **Table 21-7** for the daytime period, **Table 21-8** for the evening and weekend periods, and **Table 21-9** for the night time.

Table 21-7 Day Time Construction Noise Significance Criteria

Impact magnitude	Construction noise level (dB)		
	A 65 dB threshold	B 70 dB threshold	C 75 dB threshold
No Impact	<65	<70	<75
Negligible Adverse	>65.1 - <65.9	>70.1 - <70.9	>75.1 - <75.9
Minor Adverse	>66.0 - <67.9	>71.0 - <72.9	>76.0 - <77.9

Impact magnitude	Construction noise level (dB)		
	A 65 dB threshold	B 70 dB threshold	C 75 dB threshold
Moderate Adverse	>68.0 - <69.9	>73.0 - <74.9	>78.0 - <79.9
Major Adverse	>70	>75	>80

Table 21-8 Evening and Weekends Construction Noise Significance Criteria

Impact magnitude	Construction noise level (dB)		
	A 55 dB threshold	B 60 dB threshold	C 65 dB threshold
No Impact	<55	<60	<65
Negligible Adverse	>55.1 - <55.9	>60.1 - <60.9	>65.1 - <65.9
Minor Adverse	>56.0 - <57.9	>61.0 - <62.9	>66.0 - <67.9
Moderate Adverse	>58.0 - <59.9	>63.0 - <64.9	>68.0 - <69.9
Major Adverse	>60	>65	>70

Table 21-9 Night Time Construction Noise Significance Criteria

Impact magnitude	Construction noise level (dB)		
	A 45 dB threshold	B 50 dB threshold	C 55 dB threshold
No Impact	<45	<50	<55
Negligible Adverse	>45.1 - <45.9	>50.1 - <50.9	>55.1 - <55.9
Minor Adverse	>46.0 - <47.9	>51.0 - <52.9	>56.0 - <57.9
Moderate Adverse	>48.0 - <49.9	>53.0 - <54.9	>58.0 - <59.9
Major Adverse	>50	>55	>60

74. A proposed construction phase programme is provided in **Chapter 4, Project Description**. Noise modelling scenarios considered in the assessment are:

- Cumulative Landfall Substation HDD works, temporary works areas, temporary access tracks, duct installation concurrently during the daytime;
- HDD works at Landfall Substation during the night time;
- Cumulative Grid Connection Substation HDD works, temporary works areas, temporary access tracks, duct installation, Switchgear Building concurrently during the daytime; and
- HDD works at Grid Connection Substation during the evening and night time.

75. Noise propagation calculations were undertaken for the indicated activities expected along the cable corridor:

- Duct installation during the daytime only; and
- Cable pulling during the daytime only.

76. Noise measurements were taken at representative locations at the Landfall Substation search area, Grid Connection Substation and Switchgear Building search areas, and along the cable route during the baseline survey. These noise levels were used to determine the 'ABC' threshold category in accordance with BS5228:2009+A1:2014 for use in the assessment and are detailed in **Table 21-10**.

Table 21-10 BS5228 Threshold Category

Baseline Noise Survey Identifier	Classification	Location	BS5228 'ABC' threshold category (limit)		
			Daytime	Evening and Weekends	Night time
LF1	Residential	Landfall Substation	A (65)	A (55)*	C (55)
LF2	Residential		A (65)	A (55)*	C (55)
CC1	Residential	Cable Corridor	A (65)	A (55)*	B (50)[1]
CC2	Residential	Cable Corridor	A (65)	A (55)*	B (50)
CC3	Residential	Cable Corridor	A (65)	A (55)*	C (55)
CC4	Residential	Cable Corridor	A (65)	A (55)*	C (55)
SS1	Residential	Switchgear Building/Grid Connection Substation	A (65)	A (55)*	C (55)
SS2	Residential		A (65)	A (55)*	C (55)[2]
*taken as the lowest category based on daytime measurements [1]taken from CC2 measurement, [2]taken from SS1 measurement					

21.7.2. Assumptions and Indicative Plant List

77. Based on **Chapter 4, Project Description**, an indicative list of construction equipment has been developed and is detailed in **Table 21-11** to **Table 21-15**.

Table 21-11 Construction Noise – Grid Connection Substation and Landfall Substation

Name	No.	Source Type	BS5228 Reference	LwA dB(A)	On time Correction
Tracked Excavator	2	Point	C2.17	103.9	75 %
Backhoe Loader	2	Point	C2.8	95.8	75 %
Bulldozer	2	Point	C2.11	106.9	75 %
Dumper	2	Point	C2.32	101.9	75 %
Mobile Crane	2	Point	C4.38	106.2	75 %
Cement Mixer Truck (Discharging)	1	Point	C4.18	103.1	50 %
Truck Mounted Concrete Pump and Boom Arm	1	Point	C4.32	105.8	50 %

Table 21-12 Construction Noise – Duct Installation (per Workfront)

Name	No.	Source Type	BS5228 Reference	LwA dB(A)	On time Correction
Bulldozer	1	Point	C2.11	106.9	75 %
Dump Truck	1	Point	C2.30	107.0	75 %
Tracked Excavator	1	Point	C2.17	103.9	75 %

Name	No.	Source Type	BS5228 Reference	LwA dB(A)	On time Correction
Generator	1	Point	C4.76	89.4	100 %
Water Pump	1	Point	C2.45	93.1	75 %
Dump Truck	1	Point	C2.30	107.0	50 %
Lorry	1	Point	C4.53	104.9	50 %

Table 21-13 Construction Noise – Temporary Access Tracks and Pre-Construction Works

Name	No.	Source Type	BS5228 Reference	LwA dB(A)	On time Correction
Bulldozer	1	Point	C2.11	106.9	75 %
Tracked Excavator	1	Point	C2.17	103.9	75 %
Dump Truck	1	Point	C2.30	107.0	75 %
Asphalt spreader and road roller*	1	Point	C5.33	103.6	75 %
*Permanent access road to Landfall Substation only					

Table 21-14 Construction Noise – Trenchless Crossing (including Landfall Works and Grid Connection Substation Works)

Name	No.	Source Type	BS5228 Reference	LwA dB(A)	On time Correction
Tracked Excavator	1	Point	103.9	107	50 %
Backhoe Loader*	1	Point	95.8	96	50 % (25 %)*
Bulldozer	1	Point	106.9	108	50 %
Dumper*	1	Point	101.9	101	50 % (25 %)*
Mobile Crane	1	Point	106.2	106	25 %
Cement Mixer Truck (Discharging)	1	Point	103.1	103	25 %
Truck Mounted Concrete Pump and Boom Arm	1	Point	105.8	108	25 %
Drilling Rig*	1	Point	105.0	105	75 % (75 %)*
Water Pump*	1	Point	93.1	93	75 % (75 %)*
Generator*	1	Point	89.4	105	100 % (100 %)*
*Plant to be utilised would be limited to that at a trenchless crossing and outside of normal working hours					

Table 21-15 Construction Noise – Cable Pulling (per Workfront)

Name	No.	Source Type	BS5228 Reference	LwA dB(A)	On time Correction
Conveyor Drive Unit	1	Point	C10.22	97.2	100 %
Field Conveyor (Rollers)	2	Point	C10.23	80.5	100 %
Tracked Excavator	1	Point	C2.17	103.9	50 %
Cement Mixer Truck (Discharging)	1	Point	C4.18	103.1	50 %

Name	No.	Source Type	BS5228 Reference	LwA dB(A)	On time Correction
Dump Truck	1	Point	C2.30	107.0	50 %
Water Pump	1	Point	C2.45	93.1	75 %
Generator	1	Point	C4.76	89.4	100 %

21.7.3. Road Traffic Noise and Vibration Emissions Assessment

78. Following the methodology contained in DMRB (Volume 11, Section 3, Chapter 3) an initial screening assessment was undertaken to assess whether there would be any significant changes in traffic volume and composition on surrounding local roads as a result of the Project. Any road links with a predicted increase in traffic volume of 25 % or a decrease of 20 % were identified. Such changes in traffic volume would correspond to a 1 dB(A) change in noise level at the relevant road link. A change in noise level of less than 1 dB(A) is regarded as being imperceptible in the short term and, therefore, of negligible magnitude. If there are no increases greater than 25 % or a decrease of 20 % or greater, then the DMRB guidance indicates that no further assessment needs to be conducted.

79. Links showing an increase of greater than 25 % were assessed following the Basic Noise Level (BNL) calculation procedure within CRTN to predict a dBA change for each link. The calculation also incorporates a correction for mean traffic speed and the percentage of heavy vehicles.

80. Construction phase road link dBA change was assessed using the impact magnitude criteria in **Table 21-16**. The thresholds for differentiating the criteria are taken from DMRB for short-term impacts and are an indication of the relative change in ambient noise as a result of the Project.

Table 21-16 Magnitude Criteria for Relative Change Due to Road Traffic (Short Term)

Change in noise level ($L_{A10\ (18\ hour)}$ dB)	Impact magnitude
0.0	No change
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
5.0+	Major

81. Screening of the baseline 2021 versus baseline 2021 (including development) road traffic flows was undertaken, in accordance with DMRB for the identified study area links during the construction phase and is detailed in **Table 21-17**.

Table 21-17 Screening of 18hr AAWT Road Traffic Flows and % Change Due to Construction (Short Term)

Link ID	Link Description	Speed (km/h)	Baseflows 2021		Baseflows 2021 + 'with development'		Change	
			18hr AAWT Total flows	Number HGVs	18hr AAWT Total flows	Number HGVs	18hr AAWT Total flows	Number HGVs
1	A5 London Road	60.0	6,735	139	6,833	179	1.5 %	**28.8 %**

Link ID	Link Description	Speed (km/h)	Baseflows 2021		Baseflows 2021 + 'with development'		Change	
			18hr AAWT Total flows	Number HGVs	18hr AAWT Total flows	Number HGVs	18hr AAWT Total flows	Number HGVs
2	A55 North Wales Expressway	70.0	12,037	968	12,217	1,008	1.5 %	4.1 %
3	A55 North Wales Expressway / Victoria Road	50.0	13,361	1,075	13,469	1,095	0.8 %	1.9 %
4	A5154	30.0	3,368	70	3,476	90	3.2 %	**28.6 %**
5	Market Street / Thomas Street / S Stack Road	25.9	3,382	101	3,490	121	3.2 %	19.9 %
6	Unnamed Road from Ty Mawr in South Stack to Penrhos Feliw	30.3	437	9	469	17	7.3 %	**93.4 %**
7	Longford Road / Plas Road	17.1	500	7	500	7	0.0 %	0.0 %
8	Unnamed Road from Penrhos Feliw to Porthdafarch Road	30.3	437	9	469	17	7.3 %	**93.4 %**
9	Lon Isalit	27.0	993	20	993	20	0.0 %	0.0 %
10	Lon Towyn Capel	28.3	1,215	339	1,273	367	4.8 %	8.2 %
11	Longford Road / Plas Road	43.2	1,942	114	1,974	122	1.6 %	7.0 %
12	A5153	30.0	8,745	188	8,875	236	1.5 %	**25.6 %**
13	B4545 Kingsland Road / Lon St Ffraid	34.6	4,173	145	4,173	145	0.0 %	0.0 %

82. For the assessment year 2021 'with development', road network links (1, 4, 6, 8, and 12) have been identified through the screening exercise as resulting in a change in composition or flow exceeding the DMRB criteria of -20 % to >25 %. Therefore, the CRTN Basic Noise Level (BNL) calculation procedure was followed to predict a dBA change for each link.

83. Any impacts would be temporary in nature. A Traffic Management Plan (TMP) will be developed to ensure that the spatial and temporal impacts associated with the construction phase are minimised. An Outline Traffic Management Plan (OTMP) has been prepared and submitted as part of **Chapter 23, Traffic and Transport**.

21.7.4. Construction Phase Vibration Assessment

84. Ground-borne vibration can result from construction works and may lead to perceptible levels of vibration at nearby receptors, which at higher levels can cause annoyance to residents. In extreme cases, cosmetic or structural building damage can occur, however vibration levels have to be of a significant magnitude for this effect to be manifested and such cases are rare.

85. High vibration levels generally arise from ‘heavy’ construction works such as piling, deep excavation, or dynamic ground compaction. The use of piling during the construction of the Landfall Substation may be required.

86. Annex E of BS 5228-2:2009+A1:2014 contains empirical formulae derived by Hiller and Crabb (2000) from field measurements relating to resultant peak particle velocity (PPV) with a number of other parameters for vibratory compaction, dynamic compaction, percussive and vibratory piling, the vibration of stone columns and tunnel boring operations. These prediction equations are based on the energy approach. Use of these empirical formulae enables resultant PPV to be predicted and for some activities (vibratory compaction, vibratory piling and vibrated stone columns) they can provide an indicator of the probability of these levels of PPV being exceeded.

87. The empirical equations for predicting construction-related vibration provide estimates in terms of PPV. Therefore, the consequences of predicted levels in terms of human perception and disturbance can be established through direct comparison with the BS 5228-2:2009+1A:2014 guidance vibration levels.

88. Ground-borne vibration assessments may be drawn from the empirical methods detailed in BS 5228-2:2009+1A:2014, in the Transport and Road Research Laboratory (TRRL) 246: Traffic: Traffic induced vibrations in buildings, and within the Transport Research Laboratory (TRL) Report 429 (2000): Ground-borne vibration caused by mechanical construction works.

89. However, these calculation methods rely on detailed information, including the type and number of plant being used, their location and the length of time they are in operation. Given the mobile nature of much of the plant that has the potential to impart sufficient energy into the ground, and the varying ground conditions in the immediate vicinity of the construction works, it was considered that an accurate representation of vibration conditions using these predictive methods was not possible.

90. Consequently, a series of calculations, following the methodologies referred to above, were carried out based on typical construction activities that have the potential to impart sufficient energy into the ground, applying reasonable worst case assumptions in order to determine set-back distances at which critical vibration levels may occur.

91. Humans are very sensitive to vibration, which can result in concern being expressed at energy levels well below the threshold of damage. Guidance on the human response to vibration in buildings is found in BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings, Part 1, Vibration sources other than blasting.

92. BS 6472 describes how to determine the vibration dose value (VDV) from frequency-weighted vibration measurements. VDV is defined by the following equation:

$$VDV_{b/d,\ day/night} = (\int_0^T a^4(t)dt)^{0.25}$$

93. The VDV is used to estimate the probability of adverse comment which might be expected from human beings experiencing vibration in buildings. Consideration is given to the time of day and use made of occupied space in buildings, whether residential, office or workshop.

94. BS 6472 states that in homes, adverse comment about building vibrations is likely when the vibration levels to which occupants are exposed are only slightly above thresholds of perception.

95. BS 6472 contains a methodology for assessing the human response to vibration in terms of either the VDV, or in terms of the acceleration or the peak velocity of the vibration, which is also referred to as PPV. The VDV is determined over a 16-hour daytime period or 8-hour night-time period.

96. The response of a building to ground-borne vibration is affected by the type of foundation, ground conditions, the building construction and the condition of the building. For construction vibration, the vibration level and effects detailed in **Table 21-18** were adopted based on BS 5228. Limits for transient vibration, above which cosmetic damage could occur, are given numerically in terms of PPV.

Table 21-18 Transient Vibration Guide Values for Cosmetic Damage

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4Hz to 15Hz	15Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50mms-1 at 4Hz and above	
2	Un-reinforced or light framed structures Residential or light commercial type buildings	15mms-1 at 4Hz increasing to 20mms-1 at 15Hz	20mms-1 at 15Hz increasing to 50mms-1 at 40Hz and above

97. **Table 21-19** lists the minimum set-back distances at which vibration levels of reportable significance for other typical construction activities may occur. BS 5228 calculation methods were used to derive the set-back distances.

Table 21-19 Predicted Distances at Which Vibration Levels May Occur

Activity	Set-back distance at which vibration level (PPV) occurs			
	0.3 mm/s	1.0 mm/s	10 mm/s	15 mm/s
Vibratory Compaction (Start-up)	166m	65m	9m	6m
Vibratory Compaction (Steady State)	102m	44m	8m	6m
Percussive Piling	48m	19m	3m	2m
HGV Movement[1] on uneven Haul Route	277m	60m	3m	2m

[1] Vibration level based on an HGV moving at 5mph.

98. For construction vibration from sources other than blasting, the vibration level and effects presented in **Table 21-20** were adopted based on Table B-1 of BS 5228-2. These levels and effects are based on human perception of vibration in residential environments.

Table 21-20 Construction Vibration - Impact Magnitude

Vibration limit PPV (mm/s)	Interpreted significance to humans	Impact magnitude
<0.14	Vibration unlikely to be perceptible	No Impact
0.14 to 0.3	Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction	Negligible - Adverse
0.3 to 1.0	Vibration might just be perceptible in residential environments	Minor – Adverse
1.0 to <10.0	It is likely that vibration at this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents	Moderate – Adverse
>10.0	Vibration is likely to be intolerable for any more than a brief exposure to this level	Major – Adverse

21.7.5. Operation Phase Assessment

99. Where there are noise sources such as fixed plant associated with onshore assets, the most appropriate assessment guidance is BS4142:2014+A1:2019. The guidance describes a method of determining the level of noise of an industrial noise source and the existing background noise level.

100. BS4142:2014+A1:2019 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident, and combines procedures for assessing the impact in relation to:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

101. This standard is applicable to the determination of the following levels at outdoor locations:

"*a) rating levels for sources of sound of an industrial and/or commercial nature; and*

b) ambient, background and residual sound levels, for the purposes of:

1) investigating complaints;

2) assessing sound from existing, proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and

3) assessing sound at proposed new dwellings or premises used for residential purposes."

102. The standard is not intended to be applied to the assessment of indoor sound levels.

103. The standard incorporates a requirement for the assessment of uncertainty in environmental noise measurements and introduces the concepts of 'significant adverse impact' rather than likelihood of complaints. Common principles with the previous edition are the consideration of the characteristics of the sound under investigation, time of day and frequency of occurrence.

104. BS4142:2014+A1:2019 applies to industrial/commercial and background noise levels outside residential buildings and for assessing whether existing and new industrial/commercial noise sources are likely to give rise to significant adverse impacts on the occupants living in the vicinity.

105. Assessment is undertaken by subtracting the measured background noise level from the rating level; the greater this difference, the greater the magnitude of the impact.

106. BS4142+A1:2019 refers to the following:

"*A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;*

A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and

The lower the rating level relative to the measured background sound level the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context".

107. When assessing the noise from a source, which is classified as the Rated Noise Level, it is necessary to have regard to the acoustic features that may be present in the noise. Section 9.1 of BS 4142:2014+A1:2019 states:

"*Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level*."

108. For clarity, an explanation of each penalty correction type (taken from BS4142:2014+A1:2019, page 13 and 14) is provided here:

Tonality

For sound ranging from not tonal to prominently tonal a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible.

Impulsivity

A correction of up to +9 dB can be applied for sound that is impulsive. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible.

Other sound characteristics

Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

Intermittency

When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. If intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

109. An operational assessment in accordance with BS4142:2014+A1:2019 has been undertaken for the Landfall Substation, Switchgear Building and Grid Connection Substation; the only noise sources associated with the operation phase.

110. Due to the separation distance and existing ambient soundscape, no penalty corrections for intermittency, tonality, other characteristics or impulsivity have been included at the Grid Connection Substation or Switchgear Building. These acoustic features are added based on perceptibility at the receptor location.

111. Due to the separation distance no penalty corrections for intermittency, impulsivity or other characteristics have been included at the Landfall Substation. A +2 dBA penalty for tonality (just perceptible at the noise receptor) has been included in the Rating Level.

112. An indicative layout of the Landfall Substation, Switchgear Building and Grid Connection Substation are detailed in **Appendix 21.3** (**Volume III**).

113. The determination of the specific sound level free from sounds influencing the ambient sound at the assessment location is obtained by measurement or a combination of measurement and calculation. This is to be measured in terms of the $L_{Aeq,T}$, where 'T' is a reference period of:

- 1 hour during daytime hours (07:00 to 23:00 hours); and
- 15 minutes during night-time hours (23:00 to 07:00 hours).

114. The assessment of noise from proposed fixed plant and infrastructure associated with the Project was considered at the nearest receptors.

115. To predict the noise from the operational aspects of the Project, SoundPLAN noise modelling software was utilised. The model incorporated proposed buildings based on elevation drawings,

proposed fixed plant and additional noise sources (such as temporary generating plant) associated with the Project. The model also included nearby residential dwellings and other buildings in the onshore development area, intervening ground cover and topographical information.

116. Noise levels for the operational phase were predicted at the same Noise Sensitive Receptor (NSR) locations detailed in **Table 21-5**. The calculation algorithm described in ISO 9613 was used in the operational noise propagation modelling exercise.

117. The magnitude of impacts based on a quantitative assessment of noise impact using BS 4142:2014+A1:2019 and applied to the operational assessment are summarised in **Table 21-21**.

Table 21-21 Operational Noise Impact Magnitude Criteria for Industrial/Commercial Noise Sources

Rating level ($L_{Ar, Tr}$ dB)	Impact magnitude
≤ Measured LA90	No impact
= Measured LA90 dB to +3 dB	Negligible
Measured LA90 + 3 dB to 5 dB	Minor
Measured LA90 + 5 dB to 9.9 dB	Moderate
≥ Measured LA90 + 10 dB	Major

21.7.6. Landfall Substation

118. The impact assessment has been undertaken using the proposed design for the components that could be used at the Landfall Substation and based on the fixed plant requirements detailed in **Chapter 4, Project Description** and presented in **Table 21-22**, **Table 21-23** and **Table 21-24**.

119. Operations at the Landfall Substation are proposed 24 hours a day. A detailed SoundPLAN noise model was created to assess noise levels as a result of the proposed plant required. Ground absorption was incorporated into the SoundPLAN model using a coefficient of 0.5 to represent the mixed ground between the sound sources and receiver for the topographical data.

Table 21-22 Modelled Noise Sources – Landfall Substation

Name/Description	No. Of Units	Sound Power Level dB(A)	Sound Pressure Level dB(A)	Height (m)	On-time (%)
Building Internal Reverberant Noise Level	3	N/A	85	7 (building maximum to apex)	100
Main External Transformers (3No. at 60MVA)	3	87	N/A	7.1 (maximum height)	100
Externally mounted auxiliary transformer (500kVA)	1	60	N/A	1.5	100
Backup diesel generator (200kVA, intermittent operation)	1	N/A	89	1.5	25
Annex located Cooler Fans (for converter cooling)	9	65	N/A	1.5	100

Name/Description	No. Of Units	Sound Power Level dB(A)	Sound Pressure Level dB(A)	Height (m)	On-time (%)
Building 2 Air Conditioning Unit	1	79	N/A	1	100
Building 2 extract ventilation	1	N/A	50 at 3m	>2m	100
Building 1 extract ventilation	1	N/A	50 at 3m	>2m	100

120. Spectral data for plant included in the noise model of the Landfall Substation are detailed in **Table 21-23**.

Table 21-23 Frequency Spectrum 1/1 Octave – Landfall Substation Plant

Plant	Octave Band Centre Frequency (Hz)/ dB(A)							
	63	125	250	500	1K	2K	4K	8K
Building Internal Reverberant Noise Level	34	34	49	61	77	80	81	76
Annex located Coolers Fans	46	56	68	68	70	65	54	42
Backup Diesel Generator (200 kVA)	82	86	76	79	81	77	74	64
Building 2 Air conditioning Unit	51	61	73	73	75	70	59	47
Main external Transformers (60 MVA)	75	75	77	77	71	70	85	64
Externally mounted aux. Transformer (500 kVA)	55	56	49	45	42	35	33	51

121. Spectral sound reduction values included in the noise model for the Landfall Substation are detailed in **Table 21-24**.

Table 21-24 Landfall Substation Building Envelope Sound Reduction Index Frequency Spectrum 1/1 Octave

Element	Rw	Octave Band Centre Frequency (Hz)/ dB(A)							
		63	125	250	500	1K	2K	4K	8K
Building 1, 2, 3	41	10	20	29	43	48	56	57	47
Access to Building 1 Bay 1 to Bay 9	35	8	18	23	33	43	48	39	29
Acoustic Enclosure for Backup Diesel Generator (200 kVA)	32	5	15	20	28	37	43	40	30

21.7.7. Switchgear Building (Parc Cybi)

122. Operations at the Switchgear Building are proposed 24 hours a day. A detailed SoundPLAN noise model was created to assess noise levels as a result of the proposed plant required.

123. The impact assessment has been undertaken using the proposed design for the components that could be used at the Switchgear Building and presented in **Table 21-25** and **Table 21-26**.

Table 21-25 Modelled Noise Sources – Switchgear Building and Metering Annexe

Name/Description	No. Of Units	Sound Power Level dB(A)	Sound Pressure Level dB(A)	Height (m)	On-time (%)
Switchgear Building Internal Reverberant Noise Level	1	N/A	85	4.0m (building maximum to apex)	100
Switchgear Building Metering Annexe Internal Reverberant Noise Level	1	N/A	85	3.5m (building maximum to apex)	100

Table 21-26 Switchgear Building and Annexe Building Envelope Sound Reduction Index Frequency Spectrum 1/1 Octave

Element	Rw	Octave Band Centre Frequency (Hz)/ dB(A)							
		63	125	250	500	1K	2K	4K	8K
Switchgear Building and Metering Annexe Building	48	30	34	37	42	49	55	65	62

21.7.8. Grid Connection Substation

124. Operations at the Grid Connection Substation are proposed 24 hours a day. A detailed SoundPLAN noise model was created to assess noise levels as a result of the proposed plant required.

125. The impact assessment has been undertaken using the proposed design for the components that could be used at the Grid Connection Substation and based on the fixed plant requirements detailed in **Chapter 4, Project Description** and presented in **Table 21-27**, **Table 21-28** and **Table 21-29**.

Table 21-27 Modelled External Noise Sources – Grid Connection Substation

Name/Description	No. Of Units	Sound Power Level dB(A)	Sound Pressure Level dB(A)	Height (m)	On-time (%)
Battery storage system cast resin transformers (each at 1800kVA)	7	65	N/A	3.4 including concrete plinth	100
Battery storage system converters	14	73	N/A	2.5	100
Battery storage HVAC – pumps	7	79	N/A	2	100
Battery storage HVAC – fans	7	79	N/A	2	100
Battery storage HVAC – compressors	7	79	N/A	0.5	100
Shed (132kV grid substation building) Internal Reverberant Noise Level	1	N/A	85	9 (top of building above ground level)	100

Name/Description	No. Of Units	Sound Power Level dB(A)	Sound Pressure Level dB(A)	Height (m)	On-time (%)
Shed (132kV Morlais substation building) Internal Reverberant Noise Level	1	N/A	85	9 (top of building above ground level)	100
33kV substation Internal Reverberant Noise Level	1	N/A	85	9 (top of building above ground level)	100
Externally mounted auxiliary transformer (500kVA)	1	68	N/A	1.5	100
Backup diesel generator (200kVA, intermittent operation)	1	N/A	89	1.5	10
Air Coolers	16	80 per unit	N/A	2	100
STATCOM HVAC Unit	4	79 per unit	N/A	2	100
STATCOM Air core reactor	3	88/3 phase	N/A	2	100
STATCOM Filter Air Core Reactor	3	75/3 phase	N/A	2, 4 and 5	100
STATCOM Filter Capacitor Bank	3	88/3 phase	N/A	2, 4 and 5	100
Aux. Transformer for STATCOM	2	67	N/A	2	100
132 kVA/33kV 20MVA transformer external	1	87	N/A	1.5	100
Shed (132kV grid substation building) extract ventilation	2	N/A	50 at 3m	2m	100
Shed (132kV Morlais substation building) extract ventilation	2	N/A	50 at 3m	2m	100
33kV substation building extract ventilation	4	N/A	50 at 3m	2m	100

126. Spectral data for plant included in the noise model of the Grid Connection Substation are detailed in **Table 21-28**.

Table 21-28 Frequency Spectrum 1/1 Octave – Grid Connection Substation Plant

Plant	Octave Band Centre Frequency (Hz)/ dB(A)							
	63	125	250	500	1K	2K	4K	8K
Shed (132kV grid substation building) Internal Reverberant Noise Level	34	34	49	61	77	80	81	76
Shed (132kV Morlais substation building) Internal Reverberant Noise Level	34	34	49	61	77	80	81	76
33kV substation building Internal Reverberant Noise Level	34	34	49	61	77	80	81	76
132kVA/33kV 20 MVA external transformer	75	75	77	77	71	70	85	64
Backup Diesel Generator (200 kVA)	82	86	76	79	81	77	74	64
STATCOM HVAC Unit	51	61	73	73	75	70	59	47
STATCOM Air core reactor	44	80	45	77	75	18	14	14

Plant	Octave Band Centre Frequency (Hz)/ dB(A)							
	63	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
STATCOM Filter Air Core Reactor	31	67	32	64	62	5	1	1
STATCOM Filter Capacitor Bank	44	80	45	77	75	18	14	14
Externally mounted auxiliary transformer (500kVA)	63	64	57	53	50	43	41	59
Aux. Transformer for STATCOM	**62**	**63**	**56**	**52**	**49**	**42**	**40**	**58**
Battery Converter	**45**	**55**	**67**	**67**	**69**	**64**	**53**	**41**
Battery storage HVAC – pumps	51	61	73	73	75	70	59	47
Battery storage HVAC – fans	52	62	74	74	76	71	60	60
Battery storage HVAC – compressors	51	61	73	73	75	70	59	47

127. Spectral sound reduction values included in noise model for the Grid Connection Substation are detailed in **Table 21-29**.

Table 21-29 Grid Connection Substation Building Envelope Sound Reduction Index Frequency Spectrum 1/1 Octave

Element	Rw	Octave Band Centre Frequency (Hz)/ dB(A)							
		63	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
Shed (132kV grid substation building)	41	10	20	29	43	48	56	57	47
Shed (132kV Morlais substation building)	41	10	20	29	43	48	56	57	47
33kV substation building	41	10	20	29	43	48	56	57	47

128. Calculated operational noise levels have been determined at GF – Ground Floor (Daytime) and 1st Floor levels (Night time) and compared with the background noise levels at each receptor, which have been derived from the measured baseline noise data contained within **Appendix 21.1** (**Volume III**).

129. The impact of the predicted noise levels from the substation at surrounding residential receptors (medium sensitivity) are presented in **Section 21.7.11**. The magnitude of effects has been assessed in accordance with BS 4142:2014+A1:2019 and against the impact criteria within **Table 21-21**. Noise contour plots are provided in **Appendix 21.3** (**Volume III**).

21.7.9. Sensitivity

130. Sensitive receptors, in the context of noise and vibration, are typically residential premises but can also include schools, places of worship and noise sensitive commercial premises. **Table 21-30** presents the definitions used relating to the sensitivity of the receptor.

Table 21-30 Definitions of the Different Sensitivity Levels for Noise and Vibration

Sensitivity	Definition	Examples
High	Receptor has very limited tolerance of effect	Noise Receptors have been categorised as high sensitivity where noise may be detrimental to vulnerable receptors. Such receptors include certain hospital wards (e.g. operating theatres or high dependency units) or care homes at night. Vibration Receptors have been categorised as high sensitivity where the receptors are listed buildings or Scheduled Monuments.
Medium	Receptor has limited tolerance of effect	Noise Receptors have been categorised as medium sensitivity where noise may cause disturbance and a level of protection is required but a level of tolerance is expected. Such subgroups include residential accommodation, private gardens, hospital wards, care homes, schools, universities, research facilities, national parks, (during the day); and temporary holiday accommodation at all times. Vibration Receptors have been categorised as medium sensitivity where the structural integrity of the structure is limited but the receptor is not a listed building or Scheduled Monument.
Low	Receptor has some tolerance of effect	Noise Receptors have been categorised as low sensitivity where noise may cause short duration effects in a recreational setting although particularly high noise levels may cause a moderate effect. Such subgroups include offices, shops, outdoor amenity areas, long distance footpaths, doctor's surgeries, sports facilities and places of worship. Vibration Receptors have been categorised as low sensitivity where the structural integrity of the structure is expected to be high. The level of vibration required to cause damage is very high and such levels are not expected to be reached during the Project.
Negligible	Receptor generally tolerant of effect.	Noise Receptors have been categorised as negligible sensitivity where noise is not expected to be detrimental. Such subgroups include warehouses, light industry, car parks, and agricultural land. Vibration Receptors have been categorised as negligible sensitivity where vibration is not expected to be detrimental.

131. The closest human receptors to the Project were determined during consultation with IoACC. For each identified receptor or group of receptors a representative location was chosen for the assessment as detailed on **Figure 21.1** (**Volume II**) and in **Table 21-5**. All receptors detailed in **Table 21-5**, and along the cable corridor are classified as Medium sensitivity for the purposes of this assessment.

21.7.10. Magnitude

132. Impact magnitude has been defined with consideration to the relevant guidance, spatial extent, duration, frequency and severity of the effect. Impact magnitude is defined in **Table 21-31**.

Table 21-31 Definitions of Magnitude Levels for Noise and Vibration Receptors

Magnitude	Definition
Major	Fundamental, permanent / irreversible changes, over the whole receptor, and / or fundamental alteration to key characteristics or features of the particular receptors character or distinctiveness.
Moderate	Considerable, permanent / irreversible changes, over the majority of the receptor, and / or discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Minor	Discernible, temporary (throughout project duration) change, over a minority of the receptor, and / or limited but discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Negligible	Discernible, temporary (for part of the project duration) change, or barely discernible change for any length of time, over a small area of the receptor, and/or slight alteration to key characteristics or features of the particular receptors character or distinctiveness.
No Impact	No discernible, temporary change, or change for any length of time, over a small area of the receptor, and/no alteration to key characteristics or features of the particular receptors character or distinctiveness.

21.7.11. Impact Significance

133. Following the identification of receptor sensitivity and magnitude of the effect, it is possible to determine the significance of the impact. A matrix is presented in **Table 21-32** and will be used wherever relevant.

Table 21-32 Impact Significance Matrix

		Negative magnitude				
		Major	**Moderate**	**Minor**	**Negligible**	**No Impact**
Sensitivity	High	Major	Major	Moderate	Minor	Minor
	Medium	Major	Moderate	Minor	Minor	Negligible
	Low	Moderate	Minor	Minor	Negligible	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible

134. Assessment of impact significance is qualitative and reliant on professional experience, interpretation and judgement. The matrix should therefore be viewed as a framework to aid understanding of how a judgement has been reached, rather than as a prescriptive, formulaic tool. Definition of the impact significant categories are provided in in **Table 21-33.**

Table 21-33 Impact Significance Definitions

Impact Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.

Impact Significance	Definition
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision-making process.
Negligible	No discernible change in receptor condition.
No impact	No change, therefore no impact to receptor condition.

135. Note that for the purposes of this ES chapter, major and moderate impacts are considered to be significant. In addition, whilst minor impacts are not significant in their own right, it is important to distinguish these from other non-significant impacts as they may contribute to significant impacts cumulatively or through interactions.

136. Embedded construction mitigation at the Landfall Substation, Switchgear Building and Grid Connection Substation is presented in **Section 21.10** and will be referred to and included in the initial assessment of impact. If the impact does not require further mitigation (or none is possible) the residual impact will remain the same. If, however, mitigation is required there will be an assessment of the post-mitigation residual impact.

21.7.12. Cumulative Impact Assessment

137. For a general introduction to the methodology used for the Cumulative Impact Assessment (CIA), please refer to **Chapter 5, EIA Methodology**. This chapter will focus on those cumulative impacts that are specific to noise and vibration.

138. For further details of the methods used for the CIA for noise and vibration, see **Section 21.13**.

21.7.13. Transboundary Impact Assessment

139. There are no transboundary impacts with regards to noise and vibration as the onshore development area including access would not be sited in proximity to any international boundaries. Transboundary impacts are therefore scoped out of this assessment and will not be considered further.

21.8. EXISTING ENVIRONMENT

140. The characterisation of the existing environment is undertaken using data sources listed in the Data Sources sections above plus other relevant literature.

141. In order to characterise the existing noise climate within the Project study area, a baseline noise survey was undertaken at locations representative of the nearest sensitive receptors (see **Appendix 21.1, Volume III**) as agreed with the relevant local authorities during consultation. Measurements were conducted between 28th March and 29th March 2019.

142. Please refer to **Appendix 21.1** (**Volume III**) for further details on the baseline noise survey methodology.

21.8.1. Survey Practice

143. Baseline survey measurements were conducted in accordance with current guidance, including BS4142:2014 Method for rating and assessing industrial and commercial sound[2] and BS 7445:2003 Description and measurement of environmental noise and the methodology used was agreed with relevant stakeholders during consultation.

144. Sound level meters (SLM) were fully calibrated, traceable to UKAS standards and satisfied the requirements of BS EN 61672-1:20131F for a 'Class 1' Sound Level Meter (SLM).

145. For all measurement locations during the noise survey, SLMs were set to record the following:

- L_{Aeq} – the equivalent continuous sound pressure level over the measurement period. This parameter was standardised as pertinent for land use within BS 7445;
- L_{Amax} – the maximum sound pressure level occurring within the defined measurement period;
- L_{A90} – the sound pressure level exceeded for 90 % of the measurement period and is indicative of the background noise level; and
- L_{A10} - the sound pressure level exceeded for 10 % of the measurement period. The L_{A10} index is used within the CRTN as an appropriate descriptor of traffic noise.

146. The equivalent continuous sound pressure level (L_{Aeq}) is the conventional descriptor of environmental noise and is defined below:

$$L_{eq,T} = 10 \times \log\left[\frac{1}{T}\int \frac{\rho^2(t)\partial t}{\rho_0^2}\right] dB$$

147. Noise measurements are normally taken with an A-weighting (denoted by a subscript 'A') to approximate the frequency response of the human ear.

148. Noise measurements were conducted with the SLMs mounted on tripods at a height of between 1.2 m and 1.5 m above ground level and 3.5 m away from any reflecting surface other than the ground, i.e. in free-field conditions. The instruments were calibrated before and after the survey using a portable calibrator. No significant deviation in the calibration level was observed.

149. A record of the meteorological conditions during the survey was made. Any measurements taken during periods of rain or when average wind speeds exceed 5 ms-1 were screened from the results.

[2] Baseline survey undertaken in 2019 before amendments to latest BS4142 in 2019. A review confirmed compliance with BS4142:2014+A1:2019 requirements

21.8.2. Deriving Background Levels

150. Background noise levels used in the assessment were obtained from the baseline measurements. The measurement locations used were considered to be representative of the nearest NSR and have been agreed with stakeholders during consultation for the Project.

151. The background noise levels for the unattended measurement periods (up to 24hrs) were assessed using statistical analysis of the measured L_{A90} values.

152. Assessment values for receptor locations at the Landfall Substation have been derived from long term and short-term measurements. Details of the baseline noise survey are presented in **Appendix 21.1** (**Volume III**). At some locations, there was no long-term monitor set up, due to land access issues. At these locations, short-term attended monitoring was conducted. These locations are identified and discussed further in **Appendix 21.1** (**Volume III**).

21.9. IMPACT ASSESSMENT

21.9.1. Overview of Potential Impacts

153. This section identifies those parameters during construction, operation and decommissioning relevant to potential impacts on noise and vibration.

21.9.2. Mitigation

21.9.2.1. Embedded Mitigation

154. During the development of the detailed engineering design, a number of embedded mitigation measures have been included to reduce the potential impacts of the project. Full details of these are included in **Chapter 4, Project Description**. The embedded mitigation measures specific to Noise and Vibration comprise the inclusion of a 3.5 m high acoustic demountable fence located around the equipment and a 2 m high solid hoarding fence around the compound boundary. Both measures apply to the landfall location only.

21.9.2.2. Additional Mitigation

155. Where significant adverse impacts have been identified as a result of the Project, additional site specific mitigation measures are proposed to seek to reduce residual impacts to acceptable (non-significant) levels. These are described where required within **Section 21.10** and follow guidance in identifying the appropriate good practice mitigation measures required based on the findings of the initial impact assessment.

21.9.3. Worst Case Scenario

156. The onshore project infrastructure will consist of an HVAC converter substation. There will be a single Landfall Substation, with a Switchgear Building at Parc Cybi, and a Grid Connection Substation.

157. For the purposes of assessing the onshore infrastructure, the Project consists of a Landfall Substation, a Switchgear Building and a Grid Connection Substation, using worst case equipment quantities.

158. As such, the Landfall Substation will comprise of:

- Building 1 – housing developer bays, 33kV switchgear, 33kV battery room, junction room, equipment and power electronics for connection to the national grid;
- Building 2 – offices and welfare, lv supply, metering;
- Building 3 and external compound – Outdoor compounds will contain three transformers;
- Access roads – for operation and maintenance access to equipment; and
- Associated connections between equipment via overhead busbar and cabling, including buried earthing system.

159. The Switchgear Building will comprise of:

- Building 1 – housing switchgear, metering annexe;
- Access roads – for operation and maintenance access to equipment; and
- Associated connections between equipment and cabling, including buried earthing system.

160. The Grid Connection Substation will comprise of:

- Building – housing 33kV switchgear, 33kV battery room, junction room, equipment and power electronics for connection to the national grid;
- Building (Morlais substation) – housing 132kV indoor substation complete with controls/SCADA room, battery room, facilities;
- Building (Grid substation) – housing 132kV indoor substation complete with controls/SCADA room, battery room, facilities;
- External compound – will contain 7 battery sets, converters, transformers, HVAC pumps, fans and compressors;
- External compound – will contain a Statcom, filters, reactors, transformers;
- Access roads – for operation and maintenance access to equipment; and
- Associated connections between equipment and cabling, including buried earthing system.

161. The largest element of equipment within the Landfall Substation will be the buildings with an approximate height of 7 m, all other equipment will not exceed a height of 8 m.

162. A worst case approach has been incorporated throughout the assessment within the calculation methodologies, modelling and assumptions in order to present a conservative estimation of any potentially adverse effects of noise and vibration and ensure the correct level of mitigation measures are to be taken forward into the detailed design stage.

163. **Chapter 4 Project Description** outlines the timings to be assessed in relation to the phasing of the works. In all cases for noise and vibration; the construction phase option at the Landfall Substation, Switchgear Building, and Grid Connection Substation, where duct installation, HDD works, temporary lay-down areas, construction of access tracks is undertaken simultaneously is assumed to be the worst case. This is due to the number of potential noise sources operating

together, and that there will be a requirement to undertake 24-hour HDD works, therefore nearest sensitive receptors will be potentially impacted by the Project. Therefore, the noise and vibration assessment has considered the most realistic worst case scenario for the cumulative activities at the landfall location during construction.

164. As discussed in **Chapter 4, Project Description**, should HDD not be feasible, the alternative method of construction at the landfall is open cut trenching. This would involve cutting shallow trenches across the beach and pinning and /or ducting the subsea cable, within a split-pipe to the cliff face. From the cliff top, cables will be buried in trenches that cross the fields and South Stack Road to the transition pits and onwards to the Landfall Substation. The activities and equipment involved in the trenching works (i.e. duct installation and cable pulling) are assessed along the onshore cable route and separation distances to 65 dB(A) provided within the impact assessment for the worst case HDD scenario. For the works required to pin and/or duct the cable to the cliff face, the separation distance from the preferred location on the cliff face to the nearest sensitive receptors is greater than the distance from the receptors to the modelled cumulative activities involved for the proposed HDD works.

165. Therefore, the impacts of the alternative open cut trenching construction method are expected to be no greater at the nearest sensitive receptors at the landfall location, than the HDD works at the landfall. Furthermore, these works would be restricted to daylight hours. The embedded mitigation measures that form part of the BPM for the HDD works would also be incorporated at this work front. The anticipated short and sharp characteristics of the noise on the cliff face would be comparative to the short and sharp noise characteristics of the activities associated with duct installation, the construction of temporary works areas and the construction of temporary access tracks.

21.9.4. Assumptions and Limitations

166. Landowner access was arranged for baseline noise surveys; however, some locations where access was not agreed were subject to shorter term, attended baseline noise monitoring surveys, on publicly accessible/adjacent land where possible (identified in **Appendix 21.1, Volume III**).

167. Following agreement with stakeholders (IoACC) as detailed in **Section 21.5**, the baseline measurements collected are considered representative of the receptors identified.

21.9.5. Construction Assumptions

168. The following assumptions for the construction programme have been made:

- For the purposes of this assessment it was assumed construction activities would normally take place between 07:00 and 19:00 hours Monday to Friday and between 07:00 and 13:00 hours on Saturday;
- For the purposes of this assessment it was assumed that construction activities that may require 24-hour working would be during duct installation for the HDD at the landfall and at trenchless crossing zones;
- All ground was assumed to have an absorption factor of 0.5 to represent the mixed ground conditions in the area;

- All noise sources were modelled as point sources at a height of 1.5m;
- All trenchless crossing zones (e.g. HDD) have been considered as requiring the specific plant associated with trenchless drilling operations;
- Residential properties were modelled as two-storey buildings at a height of 8.5m;
- Receiver levels were predicted at ground floor level (+1.5m) considered representative of daytime resting and amenity space;
- Acoustic propagation effects were calculated using the BS 5228 methodology which takes into account distance attenuation, barriers and ground absorption; and
- For the derivation of buffer zones along the cable route, all plant was assumed to be located at the edge of the Onshore Development Area.

169. The results of the calculation are presented as the dB $L_{Aeq,T}$ noise level in **Appendix 21.2** (**Volume III**), covering the activity period highlighted in the assumptions section above, representing a conservative prediction of the noise level that might affect adjacent receptors during construction activity.

21.9.6. Operation Phase Assumptions

170. The following assumptions for the operation phase were made:

- No specific noise mitigation has been embedded into the design of the electrical infrastructure;
- All sound power levels were calculated using typical sound power level data for associated plant taking source type, dimensions and relative height into consideration within calculations;
- All sources were modelled using 100 % output at all times, unless otherwise stated in **Table 21-22** to **Table 21-29**, to present a conservative assessment;
- Residential properties were modelled as two-storey buildings at a height of 8.5m (industry standard);
- Receiver levels were predicted at ground floor (+1.5m) and 1st floor level (+4.0m) considered representative of both daytime and night time, resting and amenity space; and
- Acoustic propagation effects were calculated using the ISO 9613-2 method. The calculation methodology takes into account distance attenuation, barriers and ground absorption, air absorption, topographical screening effects and light downwind conditions from source to receptor.

171. The results of the calculations are presented as the dB $L_{Aeq,T}$ noise level covering the daytime (07:00 to 23:00 hours) and night time (23:00 to 07:00 hours) reference periods representing a conservative prediction of the noise level that might affect adjacent receptors during operation of the onshore assets.

21.10. POTENTIAL IMPACTS DURING CONSTRUCTION

172. This section presents the potential noise impacts associated with the construction of the Project based upon the proposed phasing, as detailed in **Chapter 4, Project Description**.

173. For the SoundPLAN construction noise modelling at the Landfall Substation, Grid Connection Substation and Switchgear Building, calculated noise levels have been determined at the receiver floor level (GF – Ground Floor) and compared with the BS 5228 construction threshold noise limit for each receptor which has been derived from the measured baseline noise data contained within **Appendix 21.1** (**Volume III**).

174. Noise levels from proposed construction activities along the cable corridor/route were calculated to achieve a No Impact i.e. no greater than the BS5228:2009+A1:2014 'ABC' threshold for each receptor. **Figure 21.3** (**Volume II**) details the unmitigated and mitigated buffer distance for each proposed activity according to the BS5228 threshold for the reference daytime, evening and weekends and night time periods.

175. The results of the daytime weekday (07:00 to 19:00 hours) and Saturday (07:00 to 13:00 hours) noise propagation calculations are presented in **Appendix 21.2** (**Volume III**) and noise receptor locations are shown on **Figure 21.1** (**Volume II**).

176. Evening and night-time calculations are also presented for the Landfall Substation, Grid Connection Substation and Switchgear Building receptors closest to the trenchless crossing works as there may be the requirement to undertake construction activity over a 24 hour/7-day week programme during trenchless crossing operations. The need to extend into longer working hours is generally dependent on locations where ground conditions are less favourable/stable and where risk to the integrity of the works may increase if left in a partially complete state overnight. Continuous, or extended working hours could also be expected at significant crossings where completing the works in one occasion is considered to reduce any risks. This is often requested at railway or major highway crossings where the asset, such as the tracks or highway surface is required not to be in use or in reduced use for the duration of the works.

177. Impact magnitudes have been assessed in accordance with the criteria detailed in **Table 21-7**, **Table 21-8**, and **Table 21-9** and the significance criteria in **Table 21-32**.

178. The assessment of construction generated noise is based on worst case assumptions. It should be noted that most noisy construction activities within the onshore cable route adjacent to each respective receptor will be of relatively short duration as the active work fronts progress along the onshore cable route in sections, rather than works taking place throughout the onshore area for the duration of construction.

21.10.1. Daytime Construction noise

179. **Table 21-34** summarises the potential daytime construction noise impacts at the agreed receptor locations for the combined Landfall Substation, Grid Connection Substation and Switchgear Building locations (further details included in **Appendix 21.2, Volume III**). Impact magnitudes have been assessed in accordance with the criteria detailed within **Table 21-7** and the significance criteria detailed in **Table 21-32**.

180. For the scenarios detailed in **Table 21-34** construction noise mitigation measures included a 3.5 m high acoustic demountable fence located around the equipment at the landfall location only. Furthermore, it was assumed a 2 m high solid hoarding fence would be built around the compound boundary at the landfall location only. These measures were not included in the Grid

Connection Substation and Switchgear Building locations. Mitigation measures are denoted by shading in the table to show embedded mitigation.

Table 21-34 Predicted Daytime Construction Noise – Landfall Substation, Grid Connection Substation and Switchgear Building Receptors

Phase	BS5228 Daytime Threshold dB(A)	Predicted Daytime noise level $L_{Aeq,T}$ dB	Impact Significance
Landfall Substation receptors			
Cumulative Duct Installation/Temp Access Tracks and Pre-construction works/Temporary works areas/HDD and Trenchless crossing works	65	46.7 to 60.4	No Impact
Grid Connection Substation and Switchgear Building receptors			
Cumulative Duct Installation/Temp Access Tracks and Pre-construction works/Temporary works areas/HDD and Trenchless crossing works	65	46.1 to 49.6	No Impact
Required Mitigation Key			
No additional mitigation required beyond standard Best Practicable Measures (BPM) measures to avoid significant adverse impacts.			
Embedded construction mitigation techniques included to avoid significant adverse impact. Specific construction mitigation measures will be agreed during the detailed design stage.			

181. **Table 21-34** demonstrates that a No impact magnitude is predicted at the assessed receptors when incorporating the specified mitigation measures; therefore, at a medium sensitivity receptor, a Negligible impact significance.

182. **Table 21-35** summarises the potential daytime construction noise impacts at the agreed receptor locations for each proposed activity (further details included in **Appendix 21.2, Volume III**). The approach calculates a buffer/set-back distance from the unmitigated works to achieve a No Impact magnitude in accordance with the criteria detailed within **Table 21-7** and the significance criteria detailed in **Table 21-32**.

183. The lower section of **Table 21-35** summarises the potential daytime construction noise impacts at the agreed receptor locations for each proposed activity calculating a buffer/set-back distance from the mitigated works (using BPM) to achieve a No Impact magnitude in accordance with the criteria detailed within **Table 21-7** and the significance criteria detailed in **Table 21-32**.

Table 21-35 Predicted Daytime Construction Noise Buffers

Phase/Activity	BS5228 Daytime Threshold dB(A)	Buffer distance (m) to achieve Daytime BS5228 threshold	Impact Significance
Landfall Substation, Cable Route, Grid Connection Substation, Switchgear Building Receptors			
Landfall Substation and Grid Connection Substation	65 (A)	107.0	No Impact
Cable Pulling (per workfront)	65 (A)	52.5	No Impact
Duct Installation (per workfront)	65 (A)	82.5	No Impact
Temporary access tracks and Pre-construction works	65 (A)	74.0	No Impact
Trenchless Crossing	65 (A)	70.0	
Temporary works areas	65 (A)	41.0	No Impact
Landfall Substation, Cable Route, Grid Connection Substation, Switchgear Building Receptors			
Phase/Activity	**BS5228 Daytime Threshold dB(A)**	**Buffer distance to achieve Daytime threshold) with BPM mitigation**	**Impact Significance**
Grid Connection Substation	65 (A)	60.5	No Impact
Cable Pulling (per workfront)	65 (A)	29.5	No Impact
Duct Installation (per workfront)	65 (A)	46.5	No Impact
Temporary access tracks and Pre-construction works	65 (A)	42.0	No Impact
Trenchless Crossing	65 (A)	39.5	No Impact
Temporary works areas	65 (A)	23.0	No Impact
Required Mitigation Key			
Mitigation incorporating standard Best Practical Measures (BPM) measures to avoid significant adverse impacts.			

184. **Table 21-35** demonstrates that a No impact magnitude is predicted at the assessed receptors when the activity specific buffer zone/separation distance between the construction activity and the receptors is maintained. Through incorporating the BPM mitigation measures; the separation distance can be reduced between the construction activity and the receptors.

185. Therefore, where the buffer zone/separation distance is maintained and through using BPM, at a medium sensitivity receptor, a Negligible impact significance is predicted.

21.10.2. Evening and Weekends Construction Noise

186. **Table 21-36** summarises the potential evening and weekends construction noise impacts at the agreed receptor locations for the combined Landfall Substation, Grid Connection Substation and Switchgear Building locations (further details included in **Appendix 21.2, Volume III**). Impact

magnitudes have been assessed in accordance with the criteria detailed within **Table 21-8** and the significance criteria detailed in **Table 21-32**.

187. For the scenarios detailed in **Table 21-36** construction noise mitigation measures included a 3.5 m high acoustic demountable fence located around the equipment at the landfall location only. Furthermore, it was assumed a 2 m high solid hoarding fence would be built around the compound boundary at the landfall location only.

188. These measures were not included in the Grid Connection Substation and Switchgear Building locations. Mitigation measures are denoted by shading in the table to show embedded mitigation.

Table 21-36 Predicted Evening and Weekends Construction Noise – Landfall Substation, Grid Connection Substation, Switchgear Building Receptors

Phase	BS5228 Evening and Weekends Threshold dB(A)	Predicted Evening and Weekends noise level $L_{Aeq,T}$ dB	Impact Significance
Landfall Substation receptors			
HDD and Trenchless crossing works	55	37.5 to 49.5	No Impact
Grid Connection Substation and Switchgear Building receptors			
HDD and Trenchless crossing works	55	37.0 to 41.4	No Impact
Required Mitigation Key			
No additional mitigation required beyond standard Best Practical Measures (BPM) measures to avoid significant adverse impacts.			
Embedded construction mitigation techniques included to avoid significant adverse impact. Specific construction mitigation measures will be agreed during the detailed design stage.			

189. **Table 21-36** demonstrates that a No impact magnitude is predicted at the assessed receptors when incorporating the specified mitigation measures; therefore, at a medium sensitivity receptor, a Negligible impact significance.

21.10.3. Night time Construction Noise

190. **Table 21-37** summarises the potential evening and weekends construction noise impacts at the agreed receptor locations for the combined Landfall Substation, Grid Connection Substation and Switchgear Building locations (further details included in **Appendix 21.2, Volume III**). Impact magnitudes have been assessed in accordance with the criteria detailed within **Table 21-9** and the significance criteria detailed in **Table 21-32**.

191. For the scenarios detailed in **Table 21-37** construction noise mitigation measures included a 3.5 m high acoustic demountable fence located around the equipment at the landfall location

only. Furthermore, it was assumed a 2 m high solid hoarding fence would be built around the compound boundary at the landfall location only.

192. These measures were not included in the Grid Connection Substation and Switchgear Building locations. Mitigation measures are denoted by shading in the table to show embedded mitigation.

Table 21-37 Predicted Night Time Construction Noise – Landfall Substation, Grid Connection Substation and Switchgear Building Receptors

Phase	BS5228 Night time Threshold dB(A)	Predicted Night time noise level $L_{Aeq,T}$ dB	Impact Significance
Landfall Substation receptors			
HDD and Trenchless crossing works	50	37.5 to 49.5	No Impact
Grid Connection Substation and Switchgear Building receptors			
HDD and Trenchless crossing works	55	37.0 to 41.4	No Impact
Required Mitigation Key			
No additional mitigation required beyond standard Best Practical Measures (BPM) measures to avoid significant adverse impacts.			
Embedded construction mitigation techniques included to avoid significant adverse impact. Specific construction mitigation measures will be agreed during the detailed design stage.			

193. **Table 21-37** demonstrates that a No impact magnitude is predicted at the assessed receptors when incorporating the specified mitigation measures; therefore, at a medium sensitivity receptor, a Negligible impact significance.

194. It should be noted that noise impacts would be short term and temporary in nature. The assessment undertaken assumes that all plant would be operating at a static location on the boundary of the works; whereas in reality, plant is likely to be more mobile within the onshore cable route.

21.10.4. Construction Road Traffic Noise Emissions

195. An assessment was undertaken following the methodology contained in DMRB (Volume 11, Section 3, Chapter 3) to assess whether there would be any significant changes in traffic volumes and composition on surrounding local roads as a result of the Project. The significance of any predicted change in noise level was then assessed in accordance with the criteria contained in the DMRB.

196. Traffic impacts were assessed for the construction phase years of 2021 and 2024 (as per the programme details in **Chapter 23, Traffic and Transport**), taking base flows, annual growth and Project-generated construction traffic into consideration. Traffic flows and assumptions are detailed within **Chapter 23 Traffic and Transport** and, for the 2021 construction phase scenario screening, detailed in **Table 21-17**. The predicted $L_{10,18hr}$ relative change in noise level from Baseline 2021 versus Baseline 2021 'with development' (construction related traffic) is detailed in **Table 21-38**.

Table 21-38 18hr AAWT Road Traffic Flows and dBA Change Due to Construction (Short Term)

Link ID	Link Description	Predicted noise level change (dBA)	Impact Magnitude	Impact Significance
1	A5 London Road	0.2	Negligible	Negligible Impact
2	A55 North Wales Expressway	0.1	No change	No Impact
3	A55 North Wales Expressway / Victoria Road	0.1	No change	No Impact
4	A5154	0.3	Negligible	Negligible Impact
5	Market Street / Thomas Street / S Stack Road	0.3	Negligible	Negligible Impact
6	Unnamed Road from Ty Mawr in South Stack to Penrhos Feliw	0.9	Negligible	Negligible Impact
7	Longford Road / Plas Road	0.0	No change	No Impact
8	Unnamed Road from Penrhos Feliw to Porthdafarch Road	0.9	Negligible	Negligible Impact
9	Lon Isalit	0.0	No change	No Impact
10	Lon Towyn Capel	0.3	Negligible	Negligible Impact
11	Longford Road / Plas Road	0.1	Negligible	Negligible Impact
12	A5153	0.2	Negligible	Negligible Impact
13	B4545 Kingsland Road / Lon St Ffraid	0.0	No change	No Impact

197. Relative change in ambient noise as a result of construction road traffic noise emissions is not expected to be greater than 0.9 dB in 2021 on any associated road links. In accordance with the DMRB criteria detailed in **Table 21-16**, it is anticipated that Project generated construction traffic will have at most a negligible adverse impact.

198. **Chapter 23 Traffic and Transport** outlines links in the study area where there is a potential impact and introduces potential mitigation measures to reduce the severity of these impacts.

199. Traffic management measures are to be implemented through a TMP. Through the development of a TMP, Menter Mon and its contractors would engage stakeholders (detailed in Chapter 24 Traffic and Transport) to try and establish opportunities to co-ordinate activities and avoid peak traffic impacts.

21.10.5. Vibration

200. Construction modelling along the onshore cable route assumed that all plant was located at the closest point to each sensitive receptor. At this stage the exact location of works is not known,

and any drilling required at trenchless crossing zones (e.g. HDD) and landfall will need to be located subject to vibration criteria.

201. Sources of vibration such as HGV movements on uneven haul routes may be perceptible at receptor locations in the vicinity of the landfall. HGV activity within the site would rarely be at the site boundary for any extended period, and given the proximity of receptors to adjacent roads, noise management controls, and restricted vehicle speeds, this activity would not be expected to generate vibration effects any greater than present at receptor locations in the vicinity of the Project.

202. In order to prevent cosmetic damage to buildings in the vicinity of the works priority should be given to drilling methods which minimise vibration (subject to suitable ground conditions).

21.10.6. Standard Mitigation (BPM)

203. Standard construction noise mitigation practices and good practice construction management will be adopted throughout the construction phase. These will be captured within a Construction Noise Management Plan (CNMP) which forms part of the Code of Construction Practice (CoCP). A summary of the measures is set out in the following sections.

21.10.7. Construction Noise Management Plan

204. The Control of Pollution Act and BS 5228 define a set of Best Practice working methods and mitigation measures, referred to as BPM. Examples of these measures include:

- Where possible, locating temporary plant so that it is screened from receptors by on-site structures, such as site cabins;
- Using modern, quiet equipment and ensuring such equipment is properly maintained and operated by trained staff;
- Applying enclosures to particularly noisy equipment where possible;
- Ensuring that mobile plant is well maintained such that loose body fittings or exhausts do not rattle or vibrate;
- Ensuring plant machinery is turned off when not in use;
- Providing local residents with 24 hour contact details for a site representative in the event that disturbance due to noise from the construction works is perceived; and
- Establishing a community engagement process including informing local residents about the construction works, detailing the timing and duration of any particularly noisy elements, and providing a contact telephone number to them;
- Keeping noisy deliveries to the middle of the day where possible.

205. Although the effect of adopting such methods cannot be precisely quantified, these methods are considered to typically reduce noise levels by between 5 – 10 dB(A).

21.10.8. Training of Construction Staff

206. The site induction programme and site rules should include good working practice instructions for site staff, managers, visitors and contractors to help minimise noise whilst working on the site.

207. Good working practice guidelines/instructions could include, but not be limited to, the following points:

- Avoiding unnecessary revving of engines;
- Plant used intermittently should be shut-down between operational periods, where possible;
- Avoiding reversing wherever possible;
- Reporting any defective equipment/plant as soon as possible so that corrective maintenance can be undertaken; and
- Handling material in a manner that minimises noise.

208. Maintenance of construction plant

- Maintenance of temporary plant should be carried out routinely and in accordance with the manufacturers' guidance.
- A regular inspection of all plant and equipment should be undertaken to ensure that:
- All plant is in a good state of repair and fully functional;
- Any plant found to be requiring interim maintenance has been identified and taken out of use;
- Acoustic enclosures fitted to plant are in a good state of repair;
- Doors and covers to such enclosures remain closed during operation; and
- Any repairs are being undertaken by a fully qualified maintenance engineer.

21.10.9. Enhanced Mitigation

209. In order to ensure these impacts are mitigated as far as reasonably possible, the aforementioned standard mitigation should (where necessary) be augmented by a suite of enhanced mitigation measures. The detail of the enhanced mitigation measures will be drawn up and agreed as part of the Construction Noise Management Plan (CNMP).

210. The enhanced mitigation measures will include the selection and deployment of particularly low noise plant near the identified receptors.

21.10.10.Use of Noise Barriers as Enhanced Mitigation

211. The use of noise barriers is well tried and documented mitigation measure to reduce noise impacts at receptor locations. As an example of the relative effectiveness of applying a temporary localised noise barrier BS 5228 states:

“*as a working approximation, if there is a barrier or other topographic feature between the source and the receiving position, assume an approximate attenuation of 5 dB when the top of the plant is just visible to the receiver over the noise barrier, and of 10 dB when the noise screen completely hides the sources from the receiver. High topographical features and specifically designed and positioned noise barriers could provide greater attenuation*.”

21.10.11.Use of Construction Plant Selection as Enhanced Mitigation

212. Careful scrutiny of plant selection at procurement stage would ensure that the associated noise impact of the aforementioned plant is reduced as much as reasonably possible.

213. Initial calculations determined that with the application of standard mitigation measures as detailed in **Table 21-34**, **Table 21-35**, **Table 21-36**, and **Table 21-37** and where necessary an increased separation distance from the noisiest mobile and stationary plant, would ensure that the BS 5228 daytime construction noise thresholds are not exceeded.

214. With the incorporation of enhanced mitigation measures, it is predicted that the separation distance between construction activities and sensitive receptors could be reduced whilst ensuring a no impact to minor magnitude of impact for all medium sensitivity receptors during all phases of construction; using the significance matrix detailed in **Table 21-32**, this represents a negligible impact.

21.11. POTENTIAL IMPACTS DURING OPERATION

215. This section presents a worst case overview of potential noise impacts associated with the operation of the onshore infrastructure. The only onshore operational noise sources associated with the Project are expected to be from the Landfall Substation, Switchgear Building and Grid Connection Substation.

21.11.1. Predicted Operational Noise

216. SoundPLAN noise modelling software was utilised to predict noise from the normal anticipated site operational aspects of the Project. Operations are proposed 24 hours a day at the Landfall Substation, Switchgear Building and the Grid Connection Substation. Equipment assumptions and on-time of plant were defined in **Table 21-22** (Landfall Substation), **Table 21-25** (Switchgear Building), and **Table 21-27** (Grid Connection Substation).

217. The impact assessment has been undertaken using the unmitigated worst case scenario for the potential components that could be used at the substation. The aim of this worst case assessment is to inform the design of mitigation that may be required to ensure the Project can be operated without causing a significant impact on the noise environment of communities around them.

218. TAN11 refers to a superseded version of the standard (BS4142:1997); it was therefore considered prudent to use the current guidance for the EIA. BS4142:2014+A1:2019 is the most suitable current guidance for the assessment of sound of an industrial or commercial nature impacting on residential premises.

219. The soundscape within the vicinity of the Landfall Substation receptor locations is dominated by sea noise; around the Switchgear Building and Grid Connection Substation, principally by road traffic noise from the A55 and A5.

220. Calculated operational noise levels have been determined at GF – Ground Floor and 1st Floor levels and compared with the background noise levels at each receptor, which have been derived from the measured baseline noise data contained within **Appendix 21.1** (**Volume III**). The highest predicted noise level of each building façade was derived and corrected to free-field using a 3 dBA reduction.

221. The magnitude of effects has been assessed in accordance with BS 4142:2014+A1:2019 derived thresholds, detailed within **Table 21-21**, and the significance criteria detailed in **Table 21-32**.

21.11.2. Landfall

222. The Landfall Substation footprint is defined in **Figure 21.1** (**Volume II**) and the SoundPLAN modelling was based on the infrastructure being operational at this location.

223. **Table 21-39** contains a summary of the potential unmitigated operational noise impacts associated with the Landfall Substation at the agreed NSRs. A BS 4142:2014+A1:2019 +2 dBA tonal character penalty was applied.

224. A contour isopleth showing the predicted operational noise from the Landfall Substation infrastructure is detailed in **Appendix 21.3** (**Volume III**).

Table 21-39 Predicted Landfall Substation Worst Case Operational Noise Impacts

NSR	Floor	Landfall Substation Noise Level Contribution at Receptor [dB(A)]		Background Noise Level at Receptor L_{90} [dB(A)]		BS4142 derived Impact Magnitude (Night time)	BS4142 Impact Significance (Night time)
		Daytime	Night Time	Daytime	Night Time		
NSR1	GF (Ground Floor)	20.0	20.0	36.5	38.5	No Impact	No Impact
	FF (First Floor)	20.1	20.1	36.5	38.5	No Impact	No Impact
NSR2	GF	27.0	27.0	36.5	38.5	No Impact	No Impact
	FF	26.6	26.6	36.5	38.5	No Impact	No Impact
NSR3	GF	18.6	18.6	36.5	38.5	No Impact	No Impact
	FF	19.8	19.8	36.5	38.5	No Impact	No Impact

NSR	Floor	Landfall Substation Noise Level Contribution at Receptor [dB(A)]		Background Noise Level at Receptor L_{90} [dB(A)]		BS4142 derived Impact Magnitude (Night time)	BS4142 Impact Significance (Night time)
		Daytime	Night Time	Daytime	Night Time		
NSR4	GF	17.0	17.0	36.5	38.5	No Impact	No Impact
	FF	18.5	18.5	36.5	38.5	No Impact	No Impact

225. **Table 21-39** shows that there are no predicted impacts at the Landfall Substation based on the design and details presented in **Table 21-22**, **Table 21-23**, and **Table 21-24**. Therefore, at a medium sensitivity receptor, **no impact significance**.

21.11.3. Grid Connection Substation and Switchgear Building

226. The Grid Connection Substation and Switchgear Building footprints are defined in **Figure 21.1** (**Volume II**) and the SoundPLAN modelling was based on the infrastructure being operational at these locations.

227. **Table 21-40** contains a summary of the potential unmitigated operational noise impacts associated with the Grid Connection Substation and Switchgear Building at the agreed NSRs. No BS 4142:2014+A1:2019 character penalties have been applied.

228. A contour isopleth showing the predicted operational noise from the Grid Connection Substation and Switchgear Building infrastructure is detailed in **Appendix 21.3 Volume III**).

Table 21-40 Predicted Grid Connection Substation and Switchgear Building Worst Case Operational Noise Impacts

NSR	Floor	Grid Connection Substation and Switchgear Building Noise Level Contribution at Receptor [dB(A)]		Background Noise Level at Receptor L_{90} [dB(A)]		BS4142 derived Impact Magnitude (Night time)	BS4142 Impact Significance (Night time)
		Daytime	Night Time	Daytime	Night Time		
NSR5	GF (Ground Floor)	24.6	24.6	49.0	45.5	No Impact	No Impact
	FF (First Floor)	25.0	25.0	49.0	45.5	No Impact	No Impact
NSR6	GF	31.7	31.7	49.0	45.5	No Impact	No Impact
	FF	32.2	32.2	49.0	45.5	No Impact	No Impact
NSR7	GF	29.2	29.2	49.0	45.5	No Impact	No Impact
	FF	29.5	29.5	49.0	45.5	No Impact	No Impact

NSR	Floor	Grid Connection Substation and Switchgear Building Noise Level Contribution at Receptor [dB(A)]		Background Noise Level at Receptor L_{90} [dB(A)]		BS4142 derived Impact Magnitude (Night time)	BS4142 Impact Significance (Night time)
		Daytime	Night Time	Daytime	Night Time		
NSR8	GF	16.9	16.9	49.0	45.5	No Impact	No Impact
	FF	17.2	17.2	49.0	45.5	No Impact	No Impact
NSR9	GF	28.1	28.1	49.0	45.5	No Impact	No Impact
	FF	28.3	28.3	49.0	45.5	No Impact	No Impact
NSR10	GF	20.1	20.1	49.0	45.5	No Impact	No Impact
	FF	22.5	22.5	49.0	45.5	No Impact	No Impact

229. **Table 21-40** shows that there are no predicted impacts at the Grid Connection Substation and Switchgear Building based on the design and details presented in **Table 21-25** to **Table 21-29**. Therefore, at a medium sensitivity receptor, **no impact significance**.

230. The magnitude of effect has been assessed in accordance with BS4142:2014+A1:2019 derived thresholds. The results of the modelling will inform the detailed design of the Grid Connection Substation and Switchgear Building, post-consent. Commitments relating to operational noise will be secured to ensure that noise emissions will avoid significant effects at the Landfall Substation and Grid Connection Substation receptor locations.

231. It should be noted the noise source data and assumptions are conservative for the purposes of a worst case assessment.

232. This assessment provides indicative information on the operational noise levels which would be required within the final design of the Landfall Substation, Switchgear Building and Grid Connection Substation (to be addressed at detailed design stage).

233. Menter Môn has committed to providing a final design of the Project which is able to meet the rigorous standards of low noise emissions expected by both the UK regulatory bodies and stakeholders.

21.12. POTENTIAL IMPACTS DURING DECOMMISSIONING

234. This section describes the potential impacts of the decommissioning of the onshore infrastructure with regards to impacts on noise and vibration. Further details with regards to decommissioning are provided in **Chapter 4, Project Description**.

235. No decision has been made regarding the final decommissioning policy for the onshore cables, as it is recognised that industry best practice, rules and legislation change over time. It is likely

the cables would be pulled through the ducts and removed, with the ducts themselves left in situ.

236. In relation to the landfall substations and associated infrastructure, the programme for decommissioning is expected to be similar in duration to the construction phase. The detailed activities and methodology would be determined later within the Project lifetime, but are expected to include:

- Dismantling and removal of outside electrical equipment from outside of the Landfall Substation, Switchgear Building and Grid Connection Substation;
- Removal of cabling from site;
- Dismantling and removal of electrical equipment from within the Landfall Substation, Switchgear Building and Grid Connection Substation;
- Removal of Landfall Substation, Switchgear Building and Grid Connection Substation and minor services equipment;
- Demolition of the support buildings and removal of fencing;
- Landscaping and reinstatement of the site (including land drainage); and
- Removal of areas of hard standing.

237. Whilst details regarding the decommissioning of the Landfall Substation, Switchgear Building and Grid Connection Substation is currently unknown, considering the worst case which would be the removal and reinstatement of the current land use at the site, it is anticipated that the impacts would be no worse than those during construction.

238. The decommissioning methodology would need to be finalised nearer to the end of the lifetime of the Project to be in line with current guidance, policy and legislation at that point. Any such methodology would be agreed with the relevant authorities and statutory consultees. The decommissioning works could be subject to a separate licencing and consenting approach.

21.13. CUMULATIVE IMPACTS

239. The potential for cumulative impacts to occur as a result of the interaction between the Project and other plans, projects and activities was considered. Firstly, the potential for impacts identified in the noise and vibration assessment to act cumulatively with other projects was identified. This includes consideration of projects identified for potential cumulative impacts, and any relevant development applications submitted since consultation. Cumulative projects have been considered and their anticipated potential for cumulative impact are detailed in **Table 21-41**.

Table 21-41 Potential for Cumulative Impacts

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Construction			
Construction phase Noise and vibration	Yes	High	Multiple projects could lead to increases in noise and vibration, human health and ecological impacts at receptors.
Construction phase road traffic noise	Yes	High	Multiple projects could lead to increases in traffic flows which may lead to impacts at human and ecological receptors.
Operation			
Operational phase noise and vibration	No	High	There are not anticipated to be any substantial noise and vibration sources, or traffic movements generated during the operational phase, that would give rise to significant cumulative impacts at human or ecological receptors.
Operational phase road traffic emissions	No	High	
Decommissioning			
Decommissioning phase noise and vibration	No	High	There are not anticipated to be any substantial noise and vibration sources, or traffic movements generated during the decommissioning phase that would give rise to significant cumulative impacts at human or ecological receptors.
Decommissioning phase road traffic noise	No	High	

240. The next stage of the CIA is to identify other plans or projects which have a spatial or temporal overlap with the potential effects considered in this assessment.

241. All offshore cumulative projects were scoped out of the noise and vibration CIA, as it was assumed that the potential for significant impacts to occur in combination with the onshore aspects considered in this assessment was minimal.

242. The projects considered in the CIA included those on Holy Island only, as due to the geography of the area is it not considered that traffic associated with projects elsewhere in North Wales would impact upon roads on Holy Island. Cumulative road traffic noise impacts may occur where the same road network will be used for multiple projects, plans or activities.

243. Traffic flow data for a base year (2021) and peak construction year of the Project (2021) were detailed in **Table 21-17**. The uplift in traffic flows between the 2019 and 2021 scenarios includes additional traffic associated with smaller-scale committed developments within the Holy Island area.

244. There are several larger-scale projects on Holy Island which are principally located in the vicinity of Holyhead Port. It is anticipated that increases in road traffic emissions associated with these projects would primarily occur on the A55 and A5, as these are the main routes on to Holy Island.

245. Given that the predicted traffic flows associated with the construction of the Project were well below the relevant screening criteria, it is not anticipated that additional traffic associated with cumulative projects would give rise to a significant noise impacts at receptors. Furthermore, the Project will generate the largest amount of traffic during the construction phase, which is temporary in nature, and therefore the potential for any significant impacts to occur would be limited to a relatively short duration.

246. Given the above, cumulative impacts associated with road traffic noise are not anticipated to be significant and have therefore not been considered further in this assessment.

247. A summary of the potential for cumulative impacts to occur is detailed in **Table 21-42**.

Table 21-42 Potential for Cumulative Impacts to Occur

Project	Status	Distance from Project (km)	Included in CIA	Rationale
Extensions to dwelling	Consented 13/03/19, construction status unknown	0	No	Due to the small scale of this project it is not anticipated that significant construction noise impacts would occur cumulatively with the Project.
Parc Cybi	Consented, construction status unknown	0	No	If a temporal overlap of the construction phases were to occur, it is anticipated that the cumulative project would employ best-practice methods to minimise noise generated during construction, as recommended for the Project. With the implementation of these measures, significant cumulative noise impacts have limited potential to occur.
Roadking Parc Cybi	Consented, construction status unknown	0	No	If a temporal overlap of the construction phases were to occur, it is anticipated that the cumulative project would employ best-practice methods to minimise noise generated during construction, as recommended for the Project. With the implementation of these measures, significant cumulative noise impacts have limited potential to occur.
Penrhos Coastal Park	Consented, construction status unknown	0.35	No	If a temporal overlap of the construction phases were to occur, it is anticipated that the cumulative project would employ best-practice methods to minimise noise generated during construction, as recommended for the Project. With the implementation of these measures, significant cumulative noise impacts have limited potential to occur.
Conversion of outbuilding	Consented, construction status unknown	0.4	No	Due to the small scale of this project it is not anticipated that significant impacts would occur cumulatively with the Project.

Project	Status	Distance from Project (km)	Included in CIA	Rationale
Penrhos Industrial Estate	Application validated: 06/03/2019	0.5	No	If a temporal overlap of the construction phases were to occur, it is anticipated that the cumulative project would employ best-practice methods to minimise noise generated during construction, as recommended for the Project. With the implementation of these measures, significant cumulative noise impacts have limited potential to occur.
Trearddur Bay Hotel	Consented, construction status unknown	1.3	No	Due to the separation distance, cumulative construction phase noise impacts would not be expected to occur.
Holyhead Port	Application validated: 23/11/2018	1.3	No	Due to the separation distance, cumulative construction phase noise impacts would not be expected to occur.
Breakwater Country Park	Application validated: 04/03/2019, awaiting decision	1.6	No	Due to the separation distance, cumulative construction phase noise impacts would not be expected to occur.
Holyhead	Application validated: 03/01/2019	1.8	No	Due to the separation distance, cumulative construction phase noise impacts would not be expected to occur.
Tyn Towyn Caravan Park	Consented, construction status unknown Date valid: 26/03/2019	1.8	No	Due to the separation distance, cumulative construction phase noise impacts would not be expected to occur.
Porth Diana Boat Yard	Application validated: 28/02/2019, awaiting decision	2.4	No	Due to the separation distance, cumulative construction phase noise impacts would not be expected to occur.

21.14. INTER-RELATIONSHIPS

248. This assessment considered the potential noise and vibration impacts at human receptor locations during the construction, operation and decommissioning phases of the Project. The approach to the assessment was informed by the Scoping Opinion and through additional consultation with IoACC. A summary of the impact assessment is detailed in **Table 21-45**.

249. **Table 21-43** lists the inter-relationships between this chapter and other chapters within the ES.

Table 21-43 Inter-Topic Relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Onshore Ecology	Chapter 19	**Section 21.10** (construction phase impacts) **Section 21.11** (operational phase impacts)	Both chapters consider the potential effects of the Project during the construction phase. Both chapters consider the potential effects of the Project during operational phase.
Onshore Archaeology	Chapter 20	**Section 21.10** (construction phase impacts) **Section 21.11** (operational phase impacts)	Both chapters consider the potential effects of the Project during the construction phase. Both chapters consider the potential effects of the Project during operational phase.
Traffic and Transport	Chapter 23	**Section 21.10** (construction phase impacts) **Section 21.11** (operational phase impacts)	Both chapters consider the potential effects of the Project during the construction phase. Both chapters consider the potential effects of the Project during operational phase.
Seascape, Landscape and Visual Impact Assessment	Chapter 24	**Section 21.10** (construction phase impacts) **Section 21.11** (operational phase impacts)	Both chapters consider the potential effects of the Project during the construction phase. Both chapters consider the potential effects of the Project during operational phase.
Socio-Economics	Chapter 25	**Section 21.10** (construction phase impacts) **Section 21.11** (operational phase impacts)	Both chapters consider the potential effects of the Project during the construction phase. Both chapters consider the potential effects of the Project during operational phase.

21.15. INTERACTIONS

250. The impacts identified in **Table 21-43** have the potential to interact with each other, which could give rise to synergistic impacts because of that interaction. The interactions are detailed in **Table 21-44**.

Table 21-44 Potential Interaction Between Impacts

Potential interaction between impacts		
Construction	Construction traffic using Highways	Construction related activities and plant
Construction traffic using Highways	-	Yes
Construction related activities and plant	Yes	-
Operation	Operational noise at Ecological receptors	Operational noise at Human receptors

Potential interaction between impacts		
Construction	Construction traffic using Highways	Construction related activities and plant
Operational noise at Ecological receptors	-	No
Operational noise at Human receptors	No	-
Decommissioning		
It is anticipated that the decommissioning impacts will be no worse than those during construction.		

21.16. SUMMARY

251. This assessment considered the potential noise and vibration impacts at human receptor locations during the construction, operation and decommissioning phases of the Project. The approach to the assessment was informed by the Scoping Opinion and through additional consultation with IoACC. A summary of the impact assessment is detailed in **Table 21-45**.

252. Impacts associated with offshore aspects of the Project were scoped out of the assessment, as it was considered that there was limited potential for effects at receptors onshore.

253. A cumulative impact assessment was carried out to identify the potential for significant impacts through the interaction of the Project with other plans and projects. No significant cumulative effects were identified.

Table 21-45 Summary of Noise and Vibration Impact Assessment

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction and operational phase noise and vibration impacts	Human receptors	Medium	No Impact	No Impact	Best practice measures. Noise and Vibration Management Plan.	Not significant
	Ecological receptors	Considered in **Chapter 11, Marine Ornithology** and **Chapter 19, Onshore Ecology**.				N/A
Construction, operational and decommissioning phase road traffic noise and vibration impacts	Human receptors within road network study area	Medium	Negligible at worst	Negligible Impact	Not required	Not significant
	Ecological receptors	Considered in **Chapter 11, Marine Ornithology** and **Chapter 19, Onshore Ecology**.				N/A

21.17. REFERENCES

BSI (2003). British Standards Institution [BS] 7445-1:2003 - Description and measurement of environmental noise. Guide to quantities and procedures. BSI, London.

BSI (2003) British Standards Institution [BS] 7445-2:2003 Description and measurement of environmental noise. Guide to the acquisition of data pertinent to land use. BSI, London.

BSI (2003). British Standards Institution [BS] EN 61672-1:2003 Electroacoustics. Sound level meters. Specifications. BSI, London.

BSI (2008). British Standards Institution [BS] 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting, BSI, London.

BSI (2014). British Standards Institution [BS] 5228-1:2009+A1:2014 "Code of practice for noise and vibration control on construction and open sites – Part 1: Noise".

BSI (2014). British Standards Institution [BS] 5228-2: 2009+A1:2014 "Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration".

BSI (2014). British Standards Institution [BS] 8233: Sound Insulation and Noise Reduction for Buildings. BSI, London.

BSI (2019). British Standards Institution [BS] 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound, BSI, London.

Department of Energy and Climate Change (2011a) Overarching NPS for Energy (EN-1) Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf. Accessed 23/03/2018

Department of Energy and Climate Change (2011b) NPS for Renewable Energy Infrastructure (EN-3) Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/37048/1940-nps-renewable-energy-en3.pdf. Accessed 23/03/2018

Department of Energy and Climate Change (2011c) NPS for Electricity Networks Infrastructure (EN-5) Available online at: http://www.nemo-link.com/pdf/cpo/The_National_Policy_Statement_for_Electricity_Networks_Infrastructure_(EN-5).pdf. Accessed 23/03/2018

Department of Transport, Welsh Office (1988). Calculation of Road Traffic Noise. HMSO, London.

Environmental Protection Act (1990). HMSO, London.

Highways Agency (2011). Design Manual for Roads and Bridges, Volume 11, Section 3, Part 7: Noise and Vibration. The Highways Agency.

Hiller. DM and Crabb GI (2000). Ground borne vibrations caused by mechanised construction works. Highways Agency, Transport Research Laboratory, TRL report 429.

Institute of Environmental Management and Assessment. 2014. Guidelines for Environmental Noise Impact Assessment.

International Organization for Standardization (1996). ISO9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation. ISO, Switzerland.

International Organization for Standardization (2010). ISO 3744:2010 Acoustics –Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Engineering methods for an essentially free field over a reflecting plane. ISO, Switzerland.

Isle of Anglesey County Council and Gwynedd Council. 2017. Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026 – Written Statement.

Rockhill D.J, Bolton M.D and White D.J (2014). Ground-borne vibrations due to press-in piling operations. Cambridge University Engineering Department.

Transport Research Laboratory (2000). Hiller D.M and Crabb G.I Groun dBorne vibration caused by mechanised construction works. TRL Report 429. Wokingham:TRL,2000.

Watts, GR (1990). Traffic induced vibrations in building. Department for Transport, Transport and Road Research Laboratory Research Report (TRRL), Research Report 246.

Welsh Assembly Government. 1997. Technical Advice Note 11: Noise.

Welsh Government. 2018. Planning Policy Wales (Edition 10).

Welsh Government. 2018. Draft Noise and Soundscape Action Plan 2018-2023.

World Health Organization (2000). Guideline for Community Noise. WHO, Geneva.

World Health Organization (2009). Night Noise Guidelines for Europe; available at URL: http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf

World Health Organization (2018). Environmental Noise Guidelines for the European Region. World Health Organization, Denmark.

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Morlais Project
Environmental Statement

Chapter 22: Air Quality

Volume I

Applicant: Menter Môn Morlais Limited

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Chapter 22: Air Quality

Author: Royal HaskoningDHV

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GLOSSARY OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
APIS	Air Pollution Information System
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
CEH	Centre for Ecology and Hydrology
CIA	Cumulative Impact Assessment
DCO	Development Consent Order
Defra	Department of Environment Food and Rural Affairs
DETR	Department of the Environment, Transport and the Regions
DMP	Dust Management Plan
DMRB	Design Manual for Roads and Bridges
DPF	Diesel Particulate Filters
EC	European Commission
EIA	Environmental Impact Assessment
EPUK	Environmental Protection United Kingdom
ES	Environmental Statement
EU	European Union
HDV	Heavy Duty Vehicle
IAQM	Institute of Air Quality Management
IoACC	Isle of Anglesey County Council
JLDP	Joint Local Development Plan
km	Kilometres
LAQM	Local Air Quality Management
LDV	Light Duty Vehicle
LNR	Local Nature Reserve
$\mu g.m^{-3}$	Micrograms (of pollutant) per cubic meter (of air)
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
NPS	National Policy Statement
NRMM	Non-Road Mobile Machinery
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
NWCA	North Wales Combined Authority
PM_{10}	Particulate Matter with an aerodynamic diameter of less than 10 µm
$PM_{2.5}$	Particulate Matter with an aerodynamic diameter of less than 2.5 µm
SAC	Special Areas of Conservation
SPA	Special Protection Areas
SSSI	Site of Special Scientific Interest

TG	Technical Guidance
UK	United Kingdom

GLOSSARY OF TERMINOLOGY

Air pollutants	Amounts of foreign and/or natural substances occurring in the atmosphere that may result in adverse effects on humans, animals, vegetation and/or materials.
Air quality objectives	A series of objectives set by the UK Government's Expert Panel on Air Quality to be achieved either without exception or with a permitted number of exceedances within a specific timescale. For nitrogen dioxide the annual mean limit value and the annual mean objective value are set at the same concentration.
Ambient air quality	The concentrations of gases and particles in the atmosphere (tropospheric boundary layer) to which the general population would be exposed, as opposed to the concentration of pollutants emitted by a specific source.
Annual average daily traffic	A daily traffic flow (24hrs), expressed as a mean daily flow across all 365 days of the year (AADT) in units of vehicles per hour.
Annual mean concentration	The average (mean) of the hourly pollutant concentrations measured or predicted for a one-year period.
Dust	A generic term that BS6069 (Part 2) used to describe particulate matter in the size range 1 – 75 µm (micrometres) in diameter.
Ecological receptors	Area where the ecology is considered valuable and has one or more designations such as SSSI, SPA, SAC, RAMSAR, LNR or Ancient Woodlands.
Heavy Duty Vehicle	A vehicle type classification, including rigid and articulated heavy goods vehicles, plus buses and coaches, that is used by air quality dispersion models.
Human receptors	Areas where the occupants are more susceptible to the adverse effects of pollutants.
Light Duty Vehicle	A vehicle type classification, including motorcycles, cars and light goods vehicles, that is used by air quality dispersion models.
Particulate matter	Solid particles or liquid droplets suspended or carried in the air.
Road links	Individual sections of the road network, usually divided by junctions, used in the modelling of scenarios.
Trackout	The transport of mud and other dusty materials from a works area onto the public highway. Usually on the wheels and body work of vehicles.

22. AIR QUALITY

22.1. INTRODUCTION

1. This chapter of the ES considers the potential impacts of the Morlais Project (the Project) on air quality. This chapter was produced by Royal HaskoningDHV, on behalf of Menter Môn.

2. This chapter provides an overview of the existing baseline environment in respect to air quality, the findings of which have been used to inform an assessment of the potential impacts of the onshore development area and associated infrastructure for the Project.

3. The potential air quality impacts arising from the construction, operation and decommissioning of the offshore elements of the proposed Project have been scoped out of this assessment. As a result, they are not considered further within this chapter.

4. The proposed Project also has the potential to impact other receptors with a link to air quality, which are discussed in other chapters within this ES. Therefore, this chapter refers to other onshore chapters where appropriate. The relevant chapters are:

- **Chapter 19, Onshore Ecology**; and
- **Chapter 23, Traffic and Transport**.

22.2. POLICY, LEGISLATION AND GUIDANCE

5. The assessment within this section has been guided and informed by the following key relevant legislation, guidance and policy. Further detail on legislation and policy in relation to the wider Project is provided in **Chapter 2, Policy and Legislation**.

22.2.1. Legislation

6. The European Union (EU) Air Quality Framework Directive 96/62/EC on Ambient Air Quality Assessment and Management entered into force in 1996 (European Parliament, 1996). Directive 96/62/EC and the first three Daughter Directives were combined to form the Directive 2008/50/EC (European Parliament, 2008) on Ambient Air Quality and Cleaner Air for Europe.

7. The 1995 Environment Act required the preparation of a national Air Quality Strategy which sets air quality standards for specified pollutants. The Act also outlined measures to be taken by local planning authorities in relation to meeting these standards and Objectives, which became the Local Air Quality Management (LAQM) system.

8. The UK Air Quality Strategy was originally adopted in 1997 (Department of Environment, 1997) in response to the Environment Act and has been reviewed and updated to take account of the evolving EU legislation, technical and policy developments and the latest information on health effects of air pollution. The strategy was revised and reissued in 2000 as the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Department of the Environment, Transport and the Regions (DETR), 2000). This was subsequently amended in 2003 (DETR, 2003) and was last updated in 2007 (Defra, 2007).

9. The standards and Objectives relevant to the LAQM framework have been prescribed through the Air Quality (Wales) Regulations (2000) (HMSO, 2000), and the Air Quality (Wales) (Amendment) Regulations (2002) (HMSO, 2002). The EU Limit Values have been implemented via the Air Quality Standards Regulations (2010), which set out the combined Daughter Directive limit values and interim targets for Member State compliance (HMSO, 2010).

10. The current air quality standards and Objectives of relevance to this assessment are presented in **Table 22-1**. Pollutant standards relate to ambient pollutant concentrations in air, set on the basis of medical and scientific evidence of how each pollutant affects human health. Pollutant Objectives, however, incorporate target dates and averaging periods which take into account economic considerations, practicability and technical feasibility.

11. Where an air quality Objective is unlikely to be met by the relevant deadline, local planning authorities must designate those areas as Air Quality Management Areas (AQMAs) and take action to work towards meeting the Objectives. Following the designation of an AQMA, local planning authorities are required to develop an Air Quality Action Plan (AQAP) to work towards meeting the Objectives and to improve air quality locally.

12. Possible exceedances of air quality Objectives are usually assessed in relation to those locations where members of the public have the potential to be regularly present and over the same period of time as the averaging period of the Objective.

Table 22-1 Air Quality Strategy Objectives (Wales) for the Purpose of Local Air Quality Management

Pollutant	Air Quality Objective		To be achieved by
	Concentration	Measured as*	
Nitrogen dioxide (NO_2)	200 µg.m^{-3}	1 hour mean not to be exceeded more than 18 times per year	31/12/2005
	40 µg.m^{-3}	Annual mean	31/12/2005
Particles (PM_{10})	50 µg.m^{-3}	24-hour mean not to be exceeded more than 35 times per year	31/12/2004
	40µg.m^{-3}	Annual mean	31/12/2004
Particles ($PM_{2.5}$)	25 µg.m^{-3}	Annual mean (target)	2020
	15% cut in annual mean (urban background exposure)		2010 – 2020

*Note: *how the Objectives are to be measured is set out in the UK Air Quality (Wales) Regulations (2000)*

22.2.2. National Planning Policy

22.2.2.1. National Policy Statements

13. Although this Project is not seeking a Development Consent Order (DCO), its size (up to 240 MW) means it is of equivalent scale and magnitude as a Nationally Significant Infrastructure Project (NSIP). Guidance that is relevant to assessing impacts on air quality for NSIPs are set out within National Policy Statements (NPS) which are the principal decision-making documents for NSIPs.

14. The assessment of potential impacts within this chapter was therefore undertaken with specific reference to the relevant NPS. The specific assessment requirements for air quality in the NPS

are detailed the overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a).

15. The requirements of NPS EN-1 with regard to air quality are as follows:

16. *"The ES should describe:*

Any significant air emissions, their mitigation and any residual effects distinguishing between the project stages and taking account of any significant emissions from any road traffic generated by the project;

The predicted absolute emission levels of the proposed project, after mitigation methods have been applied;

Existing air quality levels and the relative change in air quality from existing levels; and

Any potential eutrophication impacts."

17. The requirements of the NPS were considered in the assessment.

18. The NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b) and the NPS for Electricity Networks Infrastructure (EN-5) (DECC 2011c) are also applicable to the Project, but they do not include specific reference to air quality.

19. The Wellbeing of Future Generations (Wales) Act 2015

20. The Wellbeing of Future Generations (Wales) Act 2015 aims to deliver a number of well-being goals which are designed to provide better decision-making for public bodies and ensure long-term improvements.

21. There is no specific well-being goal relating to air quality, though good air quality contributes to the goal of 'a healthier Wales'. An assessment of how the Project meets this goal is detailed in **Chapter 25, Socioeconomics, Tourism and Recreation**.

22.2.2.2. Planning Policy Wales

22. Planning Policy Wales (Welsh Government, 2018) states that:

In proposing new development, planning authorities and developers must, therefore:

Address any implication arising as a result of its association with, or location within, air quality management areas, noise action planning priority areas or areas where there are sensitive receptors;

Not create areas of poor air quality or inappropriate soundscape; and

Seek to incorporate measures which reduce overall exposure to air and noise pollution and create appropriate soundscapes.

22.2.2.3. Local Planning Policy

23. The Isle of Anglesey County Council (IoACC) and Gwynedd Council have adopted a Joint Local Development Plan (JLDP) for the area (IoACC & Gwynedd Council, 2017). The JLDP is a land use development strategy which concentrates on sustainable development in Anglesey (and Gwynedd) up to 2026.

24. The JLDP was reviewed for policies of relevance to air quality and odour. The following relevant policies were identified:

"Strategic Policy PS 5: Sustainable Development

Development will be supported where it is demonstrated that they are consistent with the principles of sustainable development. All proposals should:
[…]

7. Reduce the effect on local resources, avoiding pollution and incorporating sustainable building principles in order to contribute to energy conservation and efficiency; using renewable energy; reducing / recycling waste; using materials from sustainable sources; and protecting soil quality;"

"Policy PCYFF 2: Development Criteria
[…]

Additionally, planning permission will be refused where the proposed development would have an unacceptable adverse impact on:

7. The health, safety or amenity of occupiers of local residences, other land and property uses or characteristics of the locality due to increased activity, disturbances, vibration, noise, dust, fumes, litter, drainage, light pollution, or other forms of pollution or nuisance;"

25. The requirements of these policies are considered in the air quality assessment.

26. **Table 22-2** sets out the national and regional policies that are relevant to air quality and the Project.

Table 22-2 National and Regional Policy Requirements Relevant to Air Quality

Policy Description	Reference	ES Reference
MPS		
Activities and developments in the marine and coastal area can have adverse effects on air quality at various stages. The construction, operation and decommissioning phases of projects can involve emissions to air which could lead to adverse impacts on human health, biodiversity, or on the wider environment. Other key sources that impact air quality include emissions from shipping, oil and gas platforms at sea, oil and gas importing facilities, vehicle emissions as a result of increased coastal activity, and dust from construction. The generation of energy from	2.6.2.1	Offshore air quality impacts were scoped out and are therefore not considered further in this ES. Potential onshore air quality impacts are assessed within **Section 22.6**.

Policy Description	Reference	ES Reference
renewable sources has an overall beneficial effect on air quality, as compared with fossil fuels.		
Planning Policy Wales		
In proposing new development, planning authorities and developers must, therefore: • address any implication arising as a result of its association with, or location within, air quality management areas, noise action planning priority areas or areas where there are sensitive receptors; • not create areas of poor air quality or inappropriate soundscape; and seek to incorporate measures which reduce overall exposure to air and noise pollution and create appropriate soundscapes.	6.7.6	Mitigation measures to reduce any adverse impacts are presented in **Section 22.6** and are summarised in **Table 22-18**.
To assist decision making it will be important that the most appropriate level of information is provided and it may be necessary for a technical air quality and noise assessment to be undertaken by a suitably qualified and competent person on behalf of the developer.	6.7.7	Impact assessment has been undertaken in line with industry guidance (IAQM and EPUK) (**Section 22.4**)
Good design, for example setting back buildings from roads to avoid canyon effects and using best practice in terms of acoustic design to ensure the appropriate and intended acoustic environment of completed developments should be incorporated at an early consideration in the design and planning process. Other mitigation measures must be capable of being effectively implemented for their intended purpose,	6.7.8	Standard mitigation measures and best practice, as recommended by the IAQM are considered within the impact assessment (**Section 22.6**).
Relevant considerations in making planning decisions for potentially polluting development are likely to include: • the risk and impact of potential pollution from the development, insofar as this might lead to the creation of, or worsen the situation in, an air quality management area, a noise action planning priority area or an area where there are sensitive receptors.	6.7.16	There are no AQMAs within the onshore study area (**Section 22.4**)
Planning authorities must consider the potential for temporary environmental risks, including airborne pollution and surface and subsurface risks, arising during the construction phases of development. Where appropriate planning authorities should require a construction management plan, covering pollution prevention, noisy plant, hours of operation, dust mitigation and details for keeping residents informed about temporary risks.	6.7.26	The production of a construction phase management plan is suggested as a mitigation measure for the Project (**Section 22.6.3.6**)
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
Planning permission will be refused where the proposed development would have an unacceptable adverse impact on: The health, safety or amenity of occupiers of local residences, other land and property uses or characteristics of the locality due to increased activity, disturbance, vibration, noise, dust, fumes, litter, drainage, light pollution, or other forms of pollution or nuisance	Policy PCFF 2: Development Criteria	The impact assessment (**Section 22.6** and summarised in **Table 22-18**) does not predict any significant effects to air quality.

Policy Description	Reference	ES Reference
Proposals for renewable and low carbon energy technologies, other than wind or solar, which contribute a low carbon future will be permitted, provided that the proposal conforms to the following criteria: 1. All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced; 3. That the proposal is mitigated to ensure that there aren't any significant unacceptable effects on sensitive uses located nearby;	Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	Potential onshore air quality impacts are assessed within **Section 22.6**. Mitigation measures to reduce any adverse impacts are presented in **Section 22.6** and are summarised in **Table 22-18**.

22.3. CONSULTATION

27. Consultation undertaken during the pre-application phase has informed the approach to the air quality assessment.

28. A scoping opinion was sought from Natural Resources Wales (NRW) in 2015 and from IoACC in 2017 for previous versions of the Project, which are now considered to be superseded by the latest scoping opinion received in 2018. Note that no comments regarding air quality were received from IoACC in 2017 and the comments made by NRW in 2015 were reiterated in the 2018 scoping opinion.

29. Details of the scoping opinion responses of relevance to air quality are detailed in **Table 22-3**, in addition to subsequent consultation with IoACC regarding the assessment methodology.

Table 22-3 Consultation Responses

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Scoping Report	Offshore air quality: The Scoping Report identifies exhaust emissions from vessels as the main source of atmospheric emissions. However, it states that the number of vessels on site would be negligible and there are no receptors nearby that would be impacted by the increase. Section 9.8.1.2 of the Scoping Report requests to scope this matter out (although it is identified as a potential impact in Table 9-9). Although numbers of vessel movements have not been provided within the Scoping Report, it is agreed that this is unlikely to result in significant effects to air quality and that this matter can be scoped out.	Offshore air quality impacts were scoped out and therefore not considered in this assessment.
Planning Inspectorate	2018 Scoping Report	Site-specific survey and sensitive receptors: It is recommended that the baseline survey and assessment methodology and choice of sensitive receptors	The receptor distances for consideration were agreed with IoACC during consultation (described below). It was agreed with

Consultee	Date/Document	Comment	Response
		should be agreed with the relevant Environmental Health Officers.	IoACC that a baseline survey was not required, as described in **Section 22.4.3**.
Planning Inspectorate	2018 Scoping Report	Increased emissions onshore: Where effects are likely to be significant, increased emissions onshore should be assessed for the decommissioning phase.	An assessment of potential impacts during decommissioning is provided in **Section 22.6.7**.
Planning Inspectorate	2018 Scoping Report	Study area: The study area for road traffic emissions should be informed by the affected road network which should be determined to inform the Traffic and Transport chapter.	The road links considered in the assessment were based on the study area considered in **Chapter 23, Traffic and Transport**, as described in **Section 22.4.1**.
Natural Resources Wales	2018 Scoping Report	The ES should take into account roads and transport links that are likely to be used to transport construction materials and whether the potential change in traffic pollution will be significant. When further information on the roads that are likely to be used is available NRW will be able to provide more detailed scoping advice on the potential air quality impacts.	The road links considered in the assessment are detailed on **Figure 22-1 (Volume II)**. The assessment of potential impacts from construction phase road traffic is detailed in **Section 22.6.5**.
Natural Resources Wales	2018 Scoping Report	Protected sites within 200m of the selected roads will need to be identified. The amount of NO_X , SO_2, dusts, nitrogen deposition that is likely to occur at the sites within 200m of the roads and whether this pollution is greater than 1% of the relevant nutrient nitrogen critical loads. NO_X and SO_2 critical level and dusts deposition for these sites should also be assessed.	The identification of protected sites was undertaken and is presented in **Section 22.5.4**.
Natural Resources Wales	2018 Scoping Report	The ES should take into account roads and transport links that are likely to be used to transport construction materials and whether the potential change in traffic pollution will be significant.	The assessment of impacts associated with road traffic generated during the construction phase is detailed in **Section 22.6.5**.
IoACC	Consultation on assessment methodology via email April 2019	The 2018 scoping report stated that there is potential for additional vessels used for the offshore cable installation to lead to increases in pollutant emissions at the chosen base port. However, no announcement has yet been made regarding a preferred base port for the offshore construction and operation of the Morlais project. Such facilities would be provided or brought into operation by means of one or more planning applications or as port operations enjoying permitted	The assessment methodology as agreed with IoACC is detailed in **Section 22.4.4**.

Consultee	Date/Document	Comment	Response
		development rights. This element was therefore scoped out of the assessment as any impacts would be considered as part of a separate application. This approach was agreed by IoACC during consultation. IoACC also confirmed that a site-specific baseline monitoring survey was not required. In addition to the above, IoACC provided agreement on the approach to the assessments undertaken as presented in this chapter.	

22.4. METHODOLOGY

30. The terminology and impact assessment methodologies used in this chapter differ from the generic impact assessment terminology presented within **Chapter 5, EIA Methodology**, as air quality guidance documents include specific assessment criteria.

31. As previously discussed, offshore impacts have been scoped out.

32. The methodology presented in this section was agreed with IoACC during consultation.

22.4.1. Study Area

33. The study area for the air quality assessment is defined as follows:

- Construction phase dust and particulate matter emissions:
  - Human receptors within 350 m of the onshore development area and within 50 m of routes used by construction vehicles, up to 500 m from the boundary of the onshore development area; and
  - Ecological receptors within 50 m of the onshore development area and within 50 m of routes used by construction vehicles, up to 500 m from the boundary of the onshore development area.
- Construction and operational phase road traffic emissions:
  - Human and ecological receptors within 200 m of roads expected to experience an increase in vehicle movements as a result of the Project.

22.4.2. Data Sources – Desk Study

34. The data sources used to inform the air quality assessment are detailed in **Table 22-4**.

Table 22-4 Data Sources

Organisation	Data/Document	Notes
North Wales Combined Authority	2018 Air Quality Progress Report	Local monitoring data and baseline information

Organisation	Data/Document	Notes
Natural England/Defra	MAGIC ecological mapping	Locations of designated ecological sites and habitats
Centre for Ecology and Hydrology (CEH)	Air Pollution Information System (APIS)	Details of critical loads for ecological habitats
Defra	Local Air Quality Management Technical Guidance LAQM.TG(16)	Assessment methodology
Defra	2015-based 1 x 1 km grid background pollutant mapping (issued 2017)	Background pollutant concentrations
Institute of Air Quality Management (IAQM)	Guidance on the Assessment of Dust from Demolition and Construction 2014	Construction phase dust assessment methodology
IAQM and Environmental Protection UK (EPUK)	Land-Use Planning and Development Control: Planning for Air Quality 2017	Assessment screening criteria
Highways Agency (now Highways England)	Design Manual for Roads and Bridges (DMRB) HA207/07 Air Quality	Assessment screening criteria

22.4.3. Data Sources – Site-Specific Surveys and Reports

35. Site-specific baseline air quality monitoring surveys were not considered to be required for the Project, given its size, the rural nature of the surrounding area and the number of sensitive receptors in the vicinity of the works. Baseline dust deposition monitoring data collected by IoACC from the Isle of Anglesey were provided for use in the baseline assessment.

36. Baseline air quality conditions were therefore derived as part of the desk-based study as described above.

22.4.4. Impact Assessment Methodology

22.4.4.1. Construction Phase Dust and Particulate Matter Assessment

37. The assessment of potential impacts associated with construction phase dust and particulate matter emissions was undertaken in accordance with the latest IAQM guidance (IAQM, 2016). A summary of the assessment process is provided below:

    1. Screen the need for a more detailed assessment;
    2. Separately for demolition, earthworks, construction and trackout:
       A. Determine potential dust emission magnitude;
       B. Determine sensitivity of the area; and
       C. Establish the risk of dust impacts.
    3. Determine site specific mitigation; and
    4. Examine the residual effects to determine whether additional mitigation is required.

38. It should be noted that ‘trackout’ is defined as the transport of dust and dirt from the construction site onto the public road network. Full details of the assessment methodology are provided in **Appendix 22.1** (**Volume III**).

39. Defra technical guidance (Defra, 2016) states that emissions from Non-Road Mobile Machinery (NRMM)[1] used on construction sites are unlikely to have a significant impact on local air quality where relevant control and management measures are employed. As such, emissions from NRMM were not considered quantitively in this assessment, and the relevant control measures to be employed are detailed in **Section 22.6.4.6**.

40. Definitions of the different sensitivity levels for human and ecological receptors to dust are provided in the IAQM guidance (IAQM, 2016) and are shown in **Table 22-5**.

Table 22-5 Definitions of Sensitivity Levels of Receptors to Construction Dust

Sensitivity	Sensitivity of people to dust soiling	Sensitivity of people to the health effects of PM_{10}	Sensitivity of ecological receptors
High	Dwellings, museums and other culturally important collections, medium and long-term car parks and car showrooms.	Residential properties, hospitals, schools and residential care homes.	International or national designation and features affected by dust soiling or locations with dust-sensitive species.
Medium	Parks, places of work.	Office and shop workers not occupationally exposed to PM_{10}.	Locations with important plant species or national designation with features affected by dust soiling.
Low	Playing fields, farmland, footpaths, short-term car parks and roads.	Public footpaths, playing fields, parks and shopping streets.	Local designation where features may be affected by dust deposition.

41. The IAQM guidance (IAQM, 2016) requires the definition of the magnitude of construction phase dust emissions for each type of activity. These are broken down into four categories: demolition, earthworks, construction and trackout. The dust emission magnitudes can either be small, medium or large and are dependent on the methods of work undertaken and the scale of the activity. It was anticipated that there would be no demolition required as part of the Project; therefore, this was not considered as part of the assessment.

42. The dust emission magnitudes for each activity are detailed in **Table 22-6**.

Table 22-6 Definitions of the Different Magnitudes of Dust Emission

Activity	Criteria used to Determine Dust Emission Magnitude		
	Small	**Medium**	**Large**
Earthworks	Total site area <2,500 m^2	Total site area 2,500 – 10,000 m^2	Total site area >10,000 m^2
Construction	Total building volume <25,000 m^3	Total building volume 25,000 – 100,000 m^3	Total building volume >100,000 m^3

[1] Non-Road Mobile Machinery is defined as any mobile machinery, transportable industrial equipment or vehicle fitted with an internal combustion engine not intended for passenger or goods transport by road. Explanatory Memorandum to the UK Non Road Mobile Machinery (Emissions of Gaseous & Particulate Pollutants) (Amendment) Regulations (2006).

Activity	Criteria used to Determine Dust Emission Magnitude		
	Small	**Medium**	**Large**
Trackout	<10 outward Heavy Duty Vehicle (HDV) trips in any one day Unpaved road length <50 m	10-50 outward HDV trips in any one day Unpaved road length 50-100 m	>50 outward HDV trips in any one day Unpaved road length >100 m

43. The dust emission magnitude should be combined with the sensitivity of the area to determine the risk of impacts prior to mitigation. This is shown in more detail in **Appendix 22.1** (**Volume III**). Once appropriate mitigation measures have been identified, the significance of construction phase impacts can be determined. The aim is to prevent significant effects at receptors due to the implementation of effective mitigation.

44. A matrix is not provided in the guidance to determine significance as it is considered that, with the implementation of effective mitigation measures, the residual impacts can be considered to be 'not significant' in accordance with guidance provided by the IAQM (IAQM, 2016).

22.4.4.2. Construction and Operational Phase Road Traffic Emissions Assessment

45. The requirement for a detailed assessment of construction phase vehicle exhaust emissions at human and ecological receptors was considered using screening criteria provided by the IAQM and Environmental Protection UK (EPUK) (IAQM and EPUK, 2017), and the Design Manual for Roads and Bridges (DMRB) (Highways Agency, 2007). Only the DMRB guidance contains criteria relating to assessment of designated ecological sites.

46. The criteria are detailed in **Table 22-7**. Receptors within 200 m of roads which exceed these criteria are required to be assessed.

Table 22-7 IAQM and EPUK and DMRB Road Traffic Assessment Criteria

Guidance document	Criteria	
IAQM and EPUK	Light Duty Vehicles (LDVs)	A change in annual average daily traffic (AADT) of more than 100 within or adjacent to an AQMA, or more than 500 elsewhere
	HDVs	An increase in HDV movements of more than 25 per day within or adjacent to an AQMA, or more than 100 elsewhere
DMRB	Light Duty Vehicles (LDVs)	Increase of 1,000 AADT or more
	HDVs	An increase in HDV movements of more than 200 per day

47. Where road links do not experience increases in traffic flows above the criteria, impacts on local air quality can be considered to be insignificant and do not require further assessment, in accordance with IAQM and EPUK guidance (IAQM and EPUK, 2017).

22.4.4.3. Cumulative Impact Assessment

48. The potential for cumulative impacts to occur as a result of the interaction between the Project and other committed developments within the study area was carried out as detailed in **Chapter 5, EIA Methodology**.

22.5. EXISTING ENVIRONMENT

22.5.1. Air Quality Monitoring Data

49. As part of the North Wales Combined Authority (NWCA), IoACC has published its latest 2017 air quality monitoring data in the 2018 Air Quality Progress Report (NWCA, 2018). This report was reviewed to determine any monitoring of relevance carried out within the study area.

50. IoACC does not carry out air quality monitoring on Holy Island. The closest monitoring locations are two nitrogen dioxide (NO_2) diffusion tubes located on Anglesey. Sites A1 and DT7, situated adjacent to the A5 and A5025 respectively, are located approximately 2.3 km south-east of the onshore development area. Due to the distance between these tubes and the study area and given that the location of the tubes relative to a busy road is likely to be unrepresentative of air quality conditions in the predominantly rural onshore development area, air pollution concentrations monitored at these locations were not considered in the baseline assessment.

22.5.2. Dust Deposition Monitoring Data

51. IoACC has collected dust deposition data on Anglesey since October 2017, as shown in **Plate 22-1**. The results of the baseline dust deposition surveys show that the typical baseline dust deposition rates on the Isle of Anglesey correlate well to the 50th percentile of 5-year mean dust deposition rates of 38 $mg.m^{-2}.day^{-1}$ at ‘open country’ reported by Vallack and Shillito in the paper ‘Suggested Guidelines for Deposited Ambient Dust’ (Vallack and Shillito, 1998).

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Plate 22-1 Baseline Dust Deposition Results on the Isle of Anglesey (provided by IoACC)

22.5.3. Background Pollutant Concentrations

52. Background concentrations of NO_2 and particulate matter (as PM_{10} and $PM_{2.5}$) for 2019 were obtained from the air pollutant concentration maps provided by Defra for the grid squares covering the study area (Defra 2017).

53. There are twenty-one 1 x 1 km grid squares which cover the onshore development area. The minimum (Min), maximum (Max) and average (Avg) background pollutant concentrations across the area are presented in **Table 22-8**.

Table 22-8 Background Pollutant Concentrations

Annual mean background concentration 2019 (µg.m-3)								
NO_2			PM_{10}			$PM_{2.5}$		
Min	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**
2.6	5.6	3.3	7.2	10.8	8.0	4.4	7.1	5.0

54. As shown in **Table 22-8**, background pollutant concentrations were ‘well below’ (i.e. less than 75 % of) the annual mean NO_2 and PM_{10} Objectives (both 40 $\mu g.m^{-3}$) and the $PM_{2.5}$ target value of 25 $\mu g.m^{-3}$. This is to be expected in an area that is predominantly rural with no major roads or industrial processes in the immediate vicinity.

22.5.4. Identification of Receptors

22.5.4.1. Construction Phase Dust Emissions

55. The IAQM guidance (IAQM 2016) states that a detailed assessment is required where there are human receptors within 350 m of the site boundary and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s). Ecological receptors within 50 m of the site boundary or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s), are also identified at this stage.

56. Receptor locations were identified in the areas closest to the anticipated maximum construction dust impact within the study area. In these areas, receptors were identified as follows:

- There are human receptors within 350 m of the onshore development area and within 50 m of the planned construction vehicle route up to 500 m from the boundary; and
- The onshore development area is partially within a designated ecological site, and a planned construction vehicle route will run adjacent to the site.

57. A Detailed Assessment was therefore required to assess the impact of dust during the construction phase at human and ecological receptors.

58. The onshore development area at landfall is located within the Glannau Ynys Gybi / Holy Island Coast Site of Special Scientific Interest (SSSI), Special Protection Area (SPA) and Special Area of Conservation (SAC). The Glannau Ynys Gybi / Holy Island Coast SSSI, SPA and SAC is within 50 m of roads to be used by construction vehicles, up to 500 m from the site access. This is the worst-case area with regards to ecological receptors.

59. The onshore development area from landfall to the grid connection substation at Orthios (hereafter referred to as ‘Grid Connection Substation’) was assessed and the worst-case scenario was identified based on the number of receptors within 350 m from the site boundaries and 50 m from the routes of construction traffic. Kingsland, approximately 2 km west of the grid connection substation, was identified as the area with the most human receptors within 350 m of the onshore development area.

22.5.4.2. Construction and Operational Phase Road Traffic Emissions

60. The Glannau Ynys Gybi / Holy Island Coast SSSI, SPA and SAC and Tre Wilmot SSSI are located within 200 m of roads to be used by vehicles associated with the construction and operational phases of the Project, as shown in **Figure 22-1** (**Volume II**). Human receptors (residential properties) are also located along these road links.

22.6. IMPACT ASSESSMENT

22.6.1. Overview of Potential Impacts

61. The following potential impacts were considered:

- Construction phase dust and particulate matter emissions;

- Construction phase road traffic emissions; and
- Decommissioning phase dust, particulate matter and road traffic emissions.

22.6.2. Mitigation

22.6.2.1. Embedded Mitigation

62. During the development of the detailed engineering design, a number of embedded mitigation measures have been included to reduce the potential impacts of the project. Full details of these are included in **Chapter 4, Project Description**. There are no embedded mitigation measures specific to Air Quality impacts.

22.6.2.2. Additional Mitigation

63. Where significant adverse impacts have been identified as a result of the Project, additional site specific mitigation measures are proposed to seek to reduce residual impacts to acceptable (non-significant) levels. These are described where required within **Section 22.6.4** and follow IAQM guidance in identifying the appropriate good practice mitigation measures required based on the findings of the initial impact assessment.

22.6.3. Worst Case Scenario

64. The worst-case scenario with regard to potential air quality impacts associated with the Project relate to the construction phase and was determined as follows:

- It was assumed that construction methods with the greatest dust-generation potential would be utilised (i.e. open trenching at landfall rather than Horizontal Directional Drilling (HDD);
- The greatest volume of material to be excavated from the cable trenches was considered (trenches up to 1.5 m wide and 1.7 m deep);
- It was assumed that joint bays (15 m x 3 m x 1.5 m) would be included every 200 m along the route; and
- Worst-case assumptions were used in the derivation of construction and operational phase-generated traffic flows, as described in **Chapter 23, Traffic and Transport**.

22.6.4. Potential Impacts During Construction

22.6.4.1. Construction Phase Dust and Particulate Matter Emissions

65. A qualitative assessment of construction phase dust and PM_{10} emissions was carried out in accordance with IAQM guidance (IAQM, 2016). Full details of the methodology and dust assessment undertaken are provided in **Appendix 22.1** (**Volume III**).

66. The construction works associated with the Project have the potential to impact on local air quality conditions:

- Dust emissions generated by excavation, construction and earthwork activities associated with the construction of the proposed Project have the potential to cause nuisance to, and soiling of, sensitive receptors;

- Combustion emissions (especially NO_2, but also $PM_{2.5}$ and PM_{10}) generated by construction traffic travelling on the local road network have the potential to adversely impact local air quality at sensitive receptors situated adjacent to the routes utilised by construction vehicles; and
- Emissions of NO_2, $PM_{2.5}$ and PM_{10} from non-road mobile machinery (NRMM) operating within the proposed onshore development area have the potential to adversely impact local air quality at sensitive receptors in close proximity to the works.

67. The potential for sensitive receptors to be affected will depend on where the dust-generating activity takes place within the application site, the nature of the activity and mitigation measures in place (controls), the meteorological dispersion conditions and the distance of the receptor from the dust emission source.

68. As described in **Paragraph 39**, emissions from NRMM have not been considered in the assessment, but the relevant control and management measures are included below.

22.6.4.2. Step 1: Screen the Need for a Detailed Assessment

69. The IAQM guidance states that a detailed assessment is required if there are human receptors located within 350 m and ecological sites within 50 m of the site boundary. As human and ecological receptors are present within 350 m of the site boundary, a more detailed assessment was undertaken.

22.6.4.3. Step 2A: Define the Potential Dust Emission Magnitude

70. The IAQM guidance recommends that the dust emission magnitude is determined for earthworks, construction and trackout.

71. The potential dust emission magnitude for the onshore development area was determined using the criteria detailed in **Table A22.1** of **Appendix 22.1** (**Volume III**). The dust emission magnitudes were determined from the worst-case scenarios identified in **Section 22.6.2**.

72. Kingsland, approximately 2 km north-west of the grid connection substation, was identified as the area with the most human receptors within 350 m of the onshore cable route. The works closest to the designated ecological site are at a different location, at landfall. The worst-case assessment was therefore undertaken based on the construction works to be carried out in the vicinity of each type of receptor (**Table 22-9**).

Table 22-9 Dust Emission Magnitudes for Each Activity

Construction Activity	Dust Emission Magnitude Assessment – Human Receptors	Dust Emission Magnitude Assessment – Ecological Receptors
Earthworks	It was assumed that the onshore cable route would be constructed using open trenches 1.4 m wide, and that joint boxes of 12.5 m x 2 m would be required every 200 m, and therefore there would be up to three joint bays within 350m of receptors.	It was assumed that the cables at landfall would be installed by open trenching as a worst-case scenario, using the largest potential trench dimensions (nine trenches 740 m long x 6 m wide) The total area of earthworks in the cliff face would therefore be >10,000 m^2 and the dust emission magnitude would be classified as **large.**

Construction Activity	Dust Emission Magnitude Assessment – Human Receptors	Dust Emission Magnitude Assessment – Ecological Receptors
	Total earthworks area is less than 2,500 m^2. The dust emission magnitude is therefore **small**.	
Construction	No buildings will be constructed as part of the works associated with the onshore cable route. Concrete will be poured into the base of jointing pits, but this will arrive pre-mixed in pumped concrete trucks and therefore there will be no concrete batching on site. Therefore, there are not anticipated to be any relevant construction works relating to the onshore cable route.	At the landfall substation area, there will be three buildings constructed of approximately 62 m by 22.5 m by 7 m, 28 m by 10 m by 7 m, and 8 m by 8 m by 7 m, which is a total volume less than 25,000 m^3. The dust emission magnitude is therefore **small**.
Trackout	There will be 10 - 50 outward daily HGV movements during the construction phase on Lon Towyn Capel. The dust emission magnitude is therefore **medium**.	There will be 10 - 50 outward daily HGV movements on South Stack Road during the construction phase. The dust emission magnitude is therefore **medium**.

73. The dust emission magnitudes for construction, earthworks and trackout are summarised for each worst-case area in **Table 22-10**.

Table 22-10 Summary of Calculated Dust Emission Magnitudes

Activity	Dust Emission Magnitude for Worst Case Scenario	
	Human Receptors	**Ecological Receptors**
Earthworks	Small	Large
Construction	N/A	Small
Trackout	Medium	Medium

22.6.4.4. Step 2B: Define the Sensitivity of the Area

74. The sensitivity of the area to dust soiling and impacts on human health was determined using the criteria in **Table A22.3** and **Table A22.4** of **Appendix 22.1** (**Volume III**). **Figure 22-2** (**Volume II**) details the distance bands from the site boundary used in determining the sensitivity of the area. The sensitivity of the area is defined as:

- Sensitivity of people to dust soiling
  - Earthworks: There are between 1 and 10 high-sensitivity residential receptors within 20 m of the onshore development area. The sensitivity is therefore **Medium**; and
  - Trackout: There are between 10 and 100 receptors within 20 m of roads used by construction vehicles up to 500 m from the onshore development area. The sensitivity is therefore **High**.
- Sensitivity of people to health effects of PM_{10}

- Earthworks: The highest annual mean background PM_{10} concentration across the study area is less than 24 µg.m^{-3} and there 1 - 10 receptors within 20 m of the onshore development area. The sensitivity is therefore **Low**; and
- Trackout: The highest annual mean background PM_{10} concentration across the study area is less than 24 µg.m^{-3} and there are between 10 and 100 receptors within 20 m of roads used by construction vehicles, up to 500 m from the onshore development area. The sensitivity is therefore **Low**.

- Sensitivity of the area to ecological impacts
  - Construction and Earthworks: the Glannau Ynys Gybi / Holy Island Coast SSSI, SPA and SAC is an internationally designated site and is thus a high sensitivity receptor, located within the landfall works area. The sensitivity is therefore **High**.
  - Trackout: South Stack Road will be used to access the landfall area, which is within 20 m of the designated site, therefore the sensitivity is **High**.

75. The sensitivity of the area to dust soiling, human health and ecological impacts for each activity is summarised in **Table 22-11**.

Table 22-11 Sensitivity of the Area to Each Activity

Activity	Sensitivity of the Area		
	Earthworks	Construction	Trackout
Dust Soiling	Medium	N/A	High
Human Health	Low	N/A	Low
Ecological impacts	High	High	High

22.6.4.5. Step 2C: Define the Risk of Impacts

76. The dust emission magnitude and sensitivity of the area are combined, and the risk of impacts determined using **Table A22.1** – **Table A22.7** in **Appendix 22.1** (**Volume III**). The risks for dust soiling, human health and ecological impacts are shown in **Table 22-12** below.

Table 22-12 Risk of Dust Impacts

Potential Impact	Dust Risk		
	Earthworks	Construction	Trackout
Dust Soiling	Low Risk	N/A	Medium Risk
Human Health	Negligible Risk	N/A	Low Risk
Ecological Impacts	High Risk	Low Risk	Medium Risk

22.6.4.6. Step 3: Site-Specific Mitigation

77. Step 3 of the IAQM guidance identifies the appropriate good practice mitigation measures required based on the findings of Step 2 of the assessment methodology. Step 2 of the dust assessment determined that the greatest risk of impacts was ‘high risk’ resulting from construction activities without the implementation of mitigation measures.

78. The recommendations detailed in IAQM guidance document and are considered to be ‘highly recommended’ by the IAQM for sites with a high risk of dust impacts and were tailored to the

requirements and nature of the Project. The measures in **Table 22-13** will be considered and where appropriate incorporated into a construction phase management plan, to be agreed with the local planning authority prior to construction commencing.

Table 22-13 Site Specific Air Quality Mitigation

Activity	Mitigation Measures
Communications	▪ Develop and implement a stakeholder communications plan that includes community engagement before work commences on site. ▪ Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary and the head or regional office contact information. This may be the environment manager/engineer or the site manager.
Dust management	▪ Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by IoACC; ▪ Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken; ▪ Make the complaints log available to IoACC when asked; ▪ Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book; ▪ Liaise with any other high-risk construction sites within 500 m of the onshore development area, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes; ▪ Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to note any dust deposition, record inspection results, and make the log available to IoACC when asked; ▪ Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions; ▪ Plan the working area so that machinery and dust causing activities are located away from receptors, as far as is practicable; ▪ Erect solid screens or barriers around dusty activities, or the works boundary, that are at least as high as any stockpiles on site; ▪ Take measures to control site runoff of water or mud; ▪ Keep fencing, barriers and scaffolding clean using wet methods; ▪ Remove materials that have a potential to produce dust from site as soon as possible; ▪ Cover, seed or fence stockpiles to prevent wind whipping; ▪ Ensure all vehicles switch off engines when stationary - no idling vehicles; ▪ Minimise the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable; ▪ Impose and signpost a maximum-speed-limit of 15 mph on surfaced, and 10 mph on unsurfaced, haul roads and work areas;

Activity	Mitigation Measures
	▪ Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials; ▪ Implement the Travel Plan that has been produced for the proposed scheme, which supports and encourages sustainable travel for contractor operatives and staff (public transport, cycling, walking, and car-sharing); ▪ Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems; ▪ Use enclosed chutes and conveyors and covered skips; and ▪ Bonfires and burning of waste materials should not be permitted.
Earthworks	▪ Re-vegetate or cover earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable; and ▪ Only remove the cover in small areas during work and not all at once.
Construction	▪ Ensure sand and other aggregates are stored in a controlled and well-managed manner; ▪ Avoid scabbling (roughening of concrete surfaces) if possible; ▪ Ensure bulk cement and other fine powder materials are delivered in enclosed tankers to prevent escape of material; and ▪ For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust release
Trackout	▪ Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site; ▪ Ensure vehicles loaded with dusty materials entering and leaving sites are covered to prevent escape of materials during transport; ▪ Record all inspections of haul routes and any subsequent action in a site log book; ▪ Install hard surfaced haul routes, where practicable and appropriate, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned; ▪ If required as a result of visual inspection, install a wheel washing system (with rumble grids to dislodge accumulated dust and mud) prior to leaving the site where reasonably practicable; and, ▪ Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
Non-Road Mobile Machinery	NRMM and plant would be well maintained. If any emissions of dark smoke occur then the relevant machinery should stop immediately and any problem rectified. In addition, the following controls would apply to NRMM: ▪ All NRMM should use fuel equivalent to ultralow sulphur diesel (fuel meeting the specification within EN590:2004); ▪ All NRMM will comply with regulation (EU) 2016/1628 of the European Parliament and of the European Council; ▪ All NRMM should be fitted with Diesel Particulate Filters (DPF) conforming to defined and demonstrated filtration efficiency (load/duty cycle permitting); ▪ The ongoing conformity of plant retrofitted with DPF, to a defined performance standard, should be ensured through a programme of onsite checks; and

Activity	Mitigation Measures
	▪ Implementation of energy conservation measures including instructions to throttle down or switch off idle construction equipment, switch off the engines of trucks while they are waiting to access the site and while they are being loaded or unloaded, and ensure equipment is properly maintained to ensure efficient energy consumption.

79. The implementation of the appropriate mitigation measures will reduce the magnitude of dust emissions and the likelihood of their occurrence. The residual impacts from construction are considered to be **not significant**, in accordance with IAQM guidance.

22.6.5. Construction Phase Road Traffic Emissions

80. The number of daily vehicle movements expected to be generated during the construction phase of the Project was calculated by the transport consultants, as described in **Chapter 23, Traffic and Transport**, using a number of worst-case assumptions.

81. The expected number of daily vehicle movements on each road link that will be used during the construction phase is detailed in **Table 22-14**.

Table 22-14 Number of Daily Traffic Movements Generated During Construction

Road Link	24-Hour AADT Flow Total Vehicles	24-Hour AADT Flow HDVs
A5 London Road	98	40
A55 North Wales Expressway	180	40
A55 North Wales Expressway / Victoria Road	108	20
A5154	108	20
Market Street / Thomas Street / S Stack Road	108	20
Unnamed Road from Ty Mawr in South Stack to Penrhos Feilw	32	8
Longford Road / Plas Road	0	0
Unnamed Road from Penrhos Feilw to Porthdafarch Road	32	8
Lon Isalit	0	0
Lon Towyn Capel	58	28
Longford Road / Plas Road	32	8
A5153	130	48
B4545 Kingsland Road / Lon St Ffraid	0	0

82. As detailed in **Table 22-14**, traffic flows generated during the construction phase on each road links are below the IAQM and EPUK (IAQM and EPUK, 2017) and DMRB (Highways Agency, 2007) screening criteria detailed in **Table 22-7**.

83. As such, it is considered that air quality impacts associated with this number of additional movements would be insignificant at both human and ecological receptors. Further detailed assessment was therefore not required, in accordance with the above guidance, and impacts can be considered to be **not significant**.

22.6.6. Potential Impacts During Operation

84. During the operational phase of the Project, there will be vehicle trips associated with maintenance visits to the Project infrastructure. There are expected to be a maximum of 10 two-way traffic movements per day by employees accessing either the landfall substation, switchgear building or the grid connection substation for maintenance.

85. Given the low number of operational phase traffic movements, air quality impacts are not considered to be significant in accordance with IAQM and EPUK (IAQM and EPUK, 2017) and DMRB (Highways Agency, 2007) guidance. Impacts are therefore considered to be **not significant**.

86. The maintenance activities are not expected to involve any potential for dust generation as they will be limited to the electrical infrastructure at the landfall substation, switchgear building and grid connection substations. As such, there is not anticipated to be any potential for dust impacts during the operational phase.

22.6.7. Potential Impacts During Decommissioning

87. Decommissioning of the onshore infrastructure is likely to be limited to the removal of the landfall substation, switchgear building and grid connection substation. At this stage, it is expected that any cables laid on the surface would be terminated and left in situ. As such, the potential for dust generation and vehicle movements is considered to be markedly less than during the construction phase. Construction phase vehicle movements were considered to have an insignificant effect on air quality at human and ecological receptors; therefore, the same conclusion can be drawn for the decommissioning phase.

88. The best-practice mitigation measures identified to minimise dust impacts during the construction phase will be applied during decommissioning and would be incorporated into a Decommissioning Management Plan. Potential impacts are therefore expected to be suitably controlled such that adverse effects would be **not significant**.

22.6.8. Cumulative Impacts

89. The potential for cumulative impacts to occur as a result of the interaction between the Project and other plans, projects and activities was considered. Firstly, the potential for impacts identified in the air quality assessment to act cumulatively with other projects was identified, as summarised in **Table 22-15**.

Table 22-15 Potential for Cumulative Impacts

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Construction			
Construction phase dust emissions	Yes	High	Multiple projects could lead to increases in dust soiling, human health and ecological impacts at receptors.

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Construction phase road traffic emissions	Yes	High	Multiple projects could lead to increases in traffic flows which may lead to impacts at human and ecological receptors.
Operation			
Operational phase dust emissions	No	High	There are not anticipated to be any substantial dust emission sources or traffic movements generated during the operational phase that would give rise to significant cumulative impacts at human or ecological receptors.
Operational phase road traffic emissions	No	High	
Decommissioning			
Decommissioning phase dust emissions	No	High	There are not anticipated to be any substantial dust emission sources or traffic movements generated during the decommissioning phase that would give rise to significant cumulative impacts at human or ecological receptors.
Decommissioning phase road traffic emissions	No	High	

90. The next stage of the CIA is to identify other plans or projects which have a spatial or temporal overlap with the potential effects considered in this assessment.

91. All offshore cumulative projects were scoped out of the air quality CIA, as it was assumed that the potential for significant impacts to occur in combination with the onshore aspects considered in this assessment was minimal.

92. The projects considered in the CIA included those on Holy Island only, as due to the geography of the area is it not considered that traffic associated with projects elsewhere in North Wales would impact upon roads on Holy Island. Cumulative road traffic emission impacts may occur where the same road network will be used for multiple projects, plans or activities.

93. Traffic flow data for a base year (2019) and peak construction year of the Project (2021) are detailed in **Table 22-16**. The uplift in traffic flows between the 2019 and 2021 scenarios includes additional traffic associated with smaller-scale committed developments within the Holy Island area.

Table 22-16 Traffic Flow Data

Road Link	2019 AADT Flow (All Vehicles)	2019 AADT HDV Flow	Including Project			
			2021 AADT Flow	2021 AADT HDVs	Cumulative increase in AADT Flows from 2019	Cumulative increase in HDVs from 2019
A5 London Road	6,661	148	6,888	191	227	43
A55 North Wales Expressway	11,905	1,032	12,316	1,092	411	60

Road Link	2019 AADT Flow (All Vehicles)	2019 AADT HDV Flow	Including Project			
			2021 AADT Flow	2021 AADT HDVs	Cumulative increase in AADT Flows from 2019	Cumulative increase in HDVs from 2019
A55 North Wales Expressway / Victoria Road	13,214	1,146	13,579	1,188	364	42
A5154	3,331	74	3,504	96	173	21
Market Street / Thomas Street / South Stack Road	3,167	85	3,336	106	169	22
Unnamed Road from Ty Mawr in South Stack to Penrhos Feilw	443	8	484	16	41	8
Longford Road / Plas Road	470	7	479	7	9	0
Unnamed Road from Penrhos Feilw to Porthdafarch Road	443	8	484	16	41	8
Lon Isalit	1,015	15	1,035	15	20	0
Lon Towyn Capel	1,255	415	1,338	451	82	36
Longford Road / Plas Road	1,665	100	1,730	110	64	10
A5153	8,649	200	8,947	252	298	52
B4545 Kingsland Road / Lon St Ffraid	4,040	118	4,118	120	78	2

94. The cumulative increase in traffic flows as a result of small-scale committed developments and the Project is below the screening criteria for detailed assessment, as per **Table 22-7**. Significant impacts as a result of these small-scale cumulative projects are therefore not anticipated.

95. There are several larger-scale projects on Holy Island which are principally located in the vicinity of Holyhead Port. It is anticipated that increases in road traffic emissions associated with these projects would primarily occur on the A55 and A5, as these are the main routes on to Holy Island.

96. Given that the predicted traffic flows associated with the construction of the Project were well below the relevant screening criteria, and the relatively low baseline (background) air pollution concentrations in the area, it is not anticipated that additional traffic associated with cumulative projects would give rise to a significant air quality impact at receptors. Furthermore, the Project will generate the largest amount of traffic during the construction phase, which is temporary in nature, and therefore the potential for any significant impacts to occur would be limited to a relatively short duration.

97. Given the above, cumulative impacts associated with road traffic emissions are not anticipated to be significant and have therefore not been considered further in this assessment.

98. Dust impacts during construction may occur within 350 m of a project boundary; therefore, cumulative impacts may occur where two or more projects are within 700 m of each other, and

where there is a temporal overlap between construction phases. All projects greater than 700 m from the project were scoped out of the assessment.

99. A summary of the potential for cumulative impacts to occur with relevant projects within 700 m is detailed in **Table 22-17**.

Table 22-17 Potential for Cumulative Impacts to Occur

Project	Status	Distance from the Project (km)	Included in CIA	Rationale
Extensions to dwelling	Consented 13/03/19, construction status unknown	0	No	Due to the small scale of this project it is not anticipated that significant construction dust impacts would occur cumulatively with the Project.
Parc Cybi	Consented, construction status unknown	0	No	If a temporal overlap of the construction phases were to occur, it is anticipated that the cumulative project would employ best-practice methods to minimise dust generated during construction, as recommended for the Project. With the implementation of these measures, significant cumulative dust impacts have limited potential to occur.
Roadking Parc Cybi	Consented, construction status unknown	0	No	If a temporal overlap of the construction phases were to occur, it is anticipated that the cumulative project would employ best-practice methods to minimise dust generated during construction, as recommended for the Project. With the implementation of these measures, significant cumulative dust impacts have limited potential to occur.
Penrhos Coastal Park	Consented, construction status unknown	0.35	No	If a temporal overlap of the construction phases were to occur, it is anticipated that the cumulative project would employ best-practice methods to minimise dust generated during construction, as recommended for the Project. With the implementation of these measures, significant cumulative dust impacts have limited potential to occur.
Conversion of outbuilding	Consented, construction status unknown	0.4	No	Due to the small scale of this project it is not anticipated that significant impacts would occur cumulatively with the Project.
Penrhos Industrial Estate	Application validated: 06/03/2019	0.5	No	If a temporal overlap of the construction phases were to occur, it is anticipated that the cumulative project would employ best-practice methods to minimise dust generated during construction, as recommended for the Project. With the implementation of these measures, significant cumulative dust impacts have limited potential to occur.

22.6.9. Inter-relationships

100. **Table 22-18** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 22-18 Inter-Topic Relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Traffic and Transport	Chapter 23, Traffic and Transport	**Section 22.6.4** (construction phase); **Section 22.6.5** (operational phase); Section 22.6.6 (decommissioning phase) and **Section 22.6.7** (cumulative impacts)	Project-generated traffic flows were used in the assessment of impacts on air quality, as a result of road vehicle exhaust emissions
Onshore Ecology	Chapter 19, Onshore Ecology	**Section 22.6.3.1** (construction phase dust) and **Section 22.6.4**, **22.6.5** and **22.6.6** (construction, operational and decommissioning phase traffic)	The potential for impacts on designated ecological sites as a result of construction phase dust and road traffic emissions was considered in the air quality assessment.

22.6.10. Interactions

101. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 22-19**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 22-19 Potential Interactions Between Impacts

Construction	Construction phase dust emissions	Construction phase road traffic emissions
Construction phase dust emissions	-	Yes
Construction phase road traffic emissions	Yes	-

22.7. SUMMARY

102. This assessment considered the potential air quality impacts at both human and ecological receptor locations during the construction, operation and decommissioning phases of the Project. The approach to the assessment was informed by the Scoping Opinion and through

additional consultation with IoACC. A summary of the impact assessment is detailed in **Table 22-20**.

103. Impacts associated with offshore aspects of the Project were scoped out of the assessment, as it was considered that there was limited potential for effects at receptors onshore.

104. A cumulative impact assessment was carried out to identify the potential for significant impacts through the interaction of the Project with other plans and projects. No significant cumulative effects were identified.

Table 22-20 Summary of Air Quality Impact Assessment

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction phase dust emissions	Human receptors within 350 m	High	Medium	The IAQM guidance does not require consideration of significance prior to mitigation	Best practice dust minimisation and suppression methods as recommended by the IAQM	Not significant
	Ecological receptors within 50 m	High	Large			Not significant
Construction, operational and decommissioning phase road traffic emissions	Human receptors within 200 m of road network	High	Negligible	Not significant	Not required	Not significant
	Ecological receptors within 200 m of road network	High	Negligible	Not significant		Not significant

22.8. REFERENCES

Department of Energy and Climate Change (DECC) (2011a) Draft Overarching National Policy Statement for Energy (EN-1) London: The Stationery Office

Department of Energy and Climate Change (DECC) (2011b) National Policy Statement for Renewable Energy Infrastructure (EN-3) London: The Stationery Office

Department of Energy and Climate Change (DECC) (2011c) National Policy Statement for Electricity Networks Infrastructure (EN-1) London: The Stationery Office

Department of the Environment (DoE) (1997) 'The UK National Air Quality Strategy'. HMSO, London.

Department of the Environment, Transport & the Regions (DETR) (2000) 'UK Air Quality Strategy'. HMSO, London.

DETR (2003) 'UK Air Quality Strategy- Addendum'. HMSO, London.

Department for Environment, Food and Rural Affairs (Defra) (2007) 'The Air Quality Strategy for England, Scotland, Wales and Northern Ireland'. HMSO, London.

Defra (2019). Magic Map. Available at: https://magic.defra.gov.uk/MagicMap.aspx [Accessed: 09/04/2019].

Department for the Environment Food and Rural Affairs (Defra) (2017) Local Air Quality Management 1km x 1km grid background pollutant maps. Available at: https://uk-air.defra.gov.uk/data/laqm-background-home [Accessed: 25/02/2019].

Department for the Environment Food and Rural Affairs (Defra) (2018). Local Air Quality Management Technical Guidance Document Local Air Quality Management.TG (16). Defra, London.

European Parliament (2008). Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.

Her Majesty's Stationary Office (HMSO) (2000). 'Statutory Instrument 2000 No. 928, The Air Quality (Wales) Regulations 2000'. London: HMSO.

HMSO (2002). 'Statutory Instrument 2002 No. 3043, The Air Quality (Wales) (Amendment) Regulations 2002'. London: HMSO

HMSO (2010). 'Statutory Instrument 2010 No. 1001, Air Quality Standards (Wales) Regulations, 2010'. London: HMSO.

Highways Agency (2007). Design Manual for Roads and Bridges Volume 11 Environmental Assessment Section 3 Environmental Assessment Techniques Part 1 HA207/07 Air Quality

Institute of Air Quality Management (IAQM) (2016). Guidance on the assessment of dust from demolition and construction. Version 1.1.

IAQM, Environmental Protection UK (EPUK) (2017). Land-Use Planning & Development Control: Planning for Air Quality. January 2017.

Isle of Anglesey County Council (IACC), Gwynedd Council (2017). Anglesey and Gwynedd Joint Local Development Plan 2011 - 2026 Written Statement 31 July 2017.

MHCLG (2019). National Planning Policy Framework.

North Wales Combined Authority (NWCA) (2018). North Wales Combined Authority 2018 Air Quality Progress Report.

Vallack, HW & Shillito, DE (1998) 'Suggested guidelines for deposited ambient dust', Atmospheric Environment, vol. 32, no. 16, pp. 2737-2744.

Welsh Government (2018) Planning Policy Wales

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Morlais Project
Environmental Statement

Chapter 23: Traffic and Transport

Volume I

Applicant: Menter Môn Morlais Limited Document Reference: PB5034-ES-023 Chapter 23: Traffic and Transport Author: Royal HaskoningDHV	

Morlais Document No.: MOR/RHDHV/DOC/0051	Status: Final	Version No: F3.0	Date: July 2019

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GLOSSARY OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
AILs	Abnormal Indivisible Loads
ATC	Automated Traffic Counts
CIA	Cumulative Impact Assessment
CTMP	Construction Traffic Management Plan
DCO	Development Consent Order
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
EIA	Environment Impact Assessment
ES	Environmental Statement
GEART	Guidelines for the Environmental Assessment of Road Traffic
HDD	Horizontal Directional Drilling
HGV	Heavy Goods Vehicle
NPS	National Policy Statements
NSIP	Nationally Significant Infrastructure Project
PIC	Personal Injury Collision
PPG	Planning Practice Guidance
PPW	Planning Policy Wales
RSPB	Royal Society for the Protection of Birds
TAN	Technical Advice Note
TEMPro	Trip End Model Presentation Programme

GLOSSARY OF TERMINOLOGY

Two-way movement	A movement is the process of transporting goods from a source location to a predefined destination. A two-way movement represents the inbound (laden trip from source) and the outbound unladen trip (back to source).

23. TRAFFIC AND TRANSPORT

23.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) considers the potential impacts of the Morlais Project (the Project) on traffic and transport. This Chapter provides an overview of the existing conditions and environment with regard to traffic and transport matters and assesses potential impacts and associated mitigation on sensitive receptors during the construction, operation and decommissioning phases of the Project. This chapter has been prepared by Royal HaskoningDHV.

2. The assessment considers the potential impacts of the onshore infrastructure and also considers cumulative impacts of other proposed projects. The proposed methodology adhered to for the Environmental Impact Assessment (EIA) and Cumulative Impact Assessment (CIA) is discussed in **Section 23.6.6**.

3. No announcement has yet been made regarding a preferred base port for the offshore construction and operation of the Project. Such facilities would be provided or brought into operation by means of one or more planning applications or as port operations enjoying permitted development rights. This Chapter therefore considers the impacts of constructing and operating the onshore infrastructure only.

4. It should be noted that the Project's traffic and transport effects have the potential to impact on environmental receptors discussed in other chapters within the ES. The relevant chapters to consider are:

- Chapter 21, Noise and Vibration; and
- Chapter 22, Air Quality.

23.2. POLICY, LEGISLATION AND GUIDANCE

5. There are a number of pieces of legislation, policy and guidance applicable to traffic and transport. The following sections provide detail on key pieces of UK legislation, policy and guidance. Further detail is provided in **Chapter 2, Policy and Legislation.**

23.2.1. Legislation and Policy

23.2.1.1. National Policy Statements

6. The Project is seeking consent for a Transport and Works Act Order from the Welsh Ministers and a Marine Licence from Natural Resources Wales (NRW). Although this Project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP), therefore guidance relevant to NSIPs is considered appropriate to use for this Project. Guidance that is relevant to assessing impacts on traffic and transport for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to traffic and transport include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3), July 2011 (DECC, 2011b).

7. The NPS for Renewable Energy Infrastructure (EN-3) does not include specific reference to air quality.

8. EN-1 outlines that if a project is likely to have significant transport implications, the Applicant's ES should include a transport assessment and where appropriate, the applicant should prepare a travel plan including demand management measures to mitigate transport impacts.

9. This traffic and transport chapter provides the requisite level of information required by the current transport assessment guidance (referenced in **Section 23.2.2**) and this is evidenced throughout this document. With regards to travel planning, it is considered that the promotion of sustainable travel would be best managed through the development of a post consent Construction Traffic Management Plan (CTMP) once a contractor is appointed and greater certainty is available regarding workforce origins.

10. Details of specific policies used to inform this assessment are provided in **Table 23-1** below. The specific assessment requirements for traffic and transport are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 23-1 NPS EN-1 and EN-3 Assessment Requirements Relevant to Traffic and Transport

NPS Requirement	NPS Reference	ES Reference
If a project is likely to have significant transport implications, the applicant's ES should include a Transport Assessment, using the NATA/ WebTAG methodology stipulated in Department for Transport (DfT) guidance, or any successor to such methodology.	EN-1 Section 5.13.3	The chapter has been produced in accordance with current transport guidance and this is evidenced throughout this document.
Where appropriate, the applicant should prepare a Travel Plan including demand management measures to mitigate transport impacts. The applicant should also provide details of proposed measures to improve access by public transport, walking and cycling, to reduce the need for car parking associated with the proposal and to mitigate transport impacts.	EN-1 Section 5.13.4	The impact assessment and proposed mitigation measures are set out in **Section 23.6** and are summarised in **Table 23-24**.

23.2.1.2. National Planning Policy

11. For development in Wales, a principle strategic policy document is the Planning Policy Wales (PPW) and the associated Technical Advice Note (TAN) suite of documents.

12. The PPW was published in November 2016 and sets out the land use planning policies of the Welsh Government. Chapter 8 of the PPW sets out the transport related planning policies.

13. The TAN is a series of documents that supplement the PPW by providing detailed planning advice. TAN 18: Transport (2007) gives a description of how to integrate land use, transport planning and details how transport impacts should be assessed and mitigated.

14. The salient requirements of the PPW and associated TAN are summarised in **Table 23-2**.

Table 23-2 National Planning Policies

Policy Description	Reference	ES Reference
Land use and transport planning must be integrated. The planning system must ensure it enables integration: • within and between different types of transport; • between transport measures and land use planning; • between transport measures and policies to protect and improve the environment; and • between transport measures and policies for education, health, social inclusion and wealth creation.	4.1.4	**Section 23.6** provides details of the traffic generation and worst-case assumptions that have informed the impact assessment
Development proposals must seek to maximise accessibility by walking, cycling and public transport, by prioritising the provision of appropriate on-site infrastructure and, where necessary, mitigating transport impacts through the provision of off-site measures, such as the development of active travel routes, bus priority infrastructure and financial support for public transport services.	4.1.10	A package of mitigation to reduce risks to the travelling public is included in **Section 23.6.3.5.1**.
It is Welsh Government policy to require the use of a sustainable transport hierarchy in relation to new development, which prioritises walking, cycling and public transport ahead of the private motor vehicles. The transport hierarchy recognises that Ultra Low Emission Vehicles also have an important role to play in the decarbonisation of transport, particularly in rural areas with limited public transport services.	4.1.11	As above
Development plans must identify and safeguard active travel routes and networks, including those identified in the Integrated Network Maps required by the Active Travel Act, and support their delivery. As part of the selection of future development sites, priority should be given to sites which can be readily connected to existing active travel routes or future networks. New development should be integrated with active travel networks and contribute to their expansion and improvement, through the inclusion of well-designed routes and facilities as part of the schemes and financial contributions to pay for off-site connections.	4.1.32	As above
Planning authorities must direct development to locations most accessible by public transport. They should ensure that development sites which are well served by public transport are used for travel intensive uses, such as housing, jobs, shopping, leisure and services, reallocating their use if necessary. In rural areas, planning authorities should designate local service centres, or clusters of settlements where a sustainable functional linkage can be demonstrated, as the preferred locations for new development.	4.1.36	The Project is not considered to be one of the developments listed.
Transport Assessments are an important mechanism for setting out the scale of anticipated impacts a proposed development, or redevelopment, is likely to have. They assist in helping to anticipate the impacts of development	4.1.56	The Transport Assessment has been undertaken in line with DCLG Planning

Policy Description	Reference	ES Reference
so that they can be understood and catered for appropriately.		Practice Guidance. (**Section 23.2.2.1**)
When developing strategies, proposing or assessing development proposals it will be essential to understand the implications of the transport demand associated with the proposal and the effect this may have now and in the foreseeable future.	6.7.13	The Existing Environment with regard to traffic and transport is set out in **Section 23.5**.

15. The TAN18 in conjunction with the PPW is taken account by local planning authorities in the preparation of development plans. They may be material to decisions on individual planning applications and will be taken into account by the Assembly Government and Planning Inspectors where relevant to the determination of called-in planning applications and appeals.

16. The note provides guidance on:

- Integration between land use planning and transport;
- Location of development;
- Parking;
- Design of development;
- Walking and cycling;
- Public transport;
- Planning for transport infrastructure; and
- Assessing impacts and managing implementation.

23.2.1.3. Regional Planning Policy

17. The traffic and transport study area (**Section 23.4.1**) falls under the jurisdiction of North Wales and the Isle of Anglesey County Council local planning authority.

18. A Local Transport Plan was jointly prepared by all six local authorities including the Isle of Anglesey in 2015. The Plan is aimed at improving connections to key destinations, enhancing access to employment and services, increasing levels of walking and cycling, bringing improved safety and security and at the same time bringing benefits and minimised impacts on the environment.

19. The Anglesey and Gwynedd have produced a Joint Local Development Plan which provides context on the majority of decisions on planning applications within the regions.

20. A summary of the requirements of the regional policies are summarised in **Table 23-3**, together with an indication of where each stipulation is addressed.

Table 23-3 National and Regional Policy Requirements Relevant to Traffic and Transport

Policy Description	Reference	ES Reference
North Wales Joint Local Transport Plan (2015)		
Improved safety and security benefits of both actual and perceived safety of travel by all modes.	N/A	Section 23.5.17 provides a review of existing road safety baseline
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
Development will be located so as to minimise the need to travel. The Councils will support improvements that maximise accessibility for all modes of transport, but particularly by foot, cycle and public transport. This will be achieved by securing convenient access via footways, cycle infrastructure and public transport where appropriate, thereby encouraging the use of these modes of travel for local journeys and reducing the need to travel by private car.	Strategic Policy PS 4: Sustainable Transport, Development and Accessibility	The Project will not impact on existing public transport infrastructure. (**Section 23.6**)
3. Transport Assessments Proposals for large-scale development or developments in sensitive areas that substantially increase the number of journeys made by private vehicles will be refused unless they include measures as part of a Transport Assessment and/or a Travel Plan. Where the Transport Assessment reveals the need for a Transport Implementation Strategy this will need to be secured through a planning obligation.	Policy TRA 1: Transport Network Developments	The impact assessment and proposed mitigation measures are set out in **Section 23.6** and are summarised in **Table 23-24.**
Parking provision for all modes of transport should be in accordance with the Councils' Parking Standards.	Policy TRA 2: Parking Standards	Providing parking is included within proposed mitigation measures (**Section 23.6.3.7.1**).
Development will be located so as to minimise the need to travel. The Councils will support improvements that maximise accessibility for all modes of transport, but particularly by foot, cycle and public transport. This will be achieved by securing convenient access via footways, cycle infrastructure and public transport where appropriate, thereby encouraging the use of these modes of travel for local journeys and reducing the need to travel by private car. The Council will endeavour to improve accessibility and seek to change travel behaviour. The Councils will also require appropriate transport infrastructure elements to be delivered as part of major infrastructure development schemes either in kind or through section 106 obligations.	Strategic Policy PS 4	It is recognised that due to the nature of the proposed development, the locations represent a compromise in terms of accessibility by sustainable modes of transport. It is considered that the promotion of sustainable travel would be best managed through the development of a post consent Construction Traffic Management Plan (CTMP) once a contractor is appointed and greater certainty is available regarding workforce origins.
Where appropriate, proposals should be planned and designed in a manner that promotes the most sustainable modes of transport	Policy TRA 4: Managing Transport Impacts	The impact assessment and proposed mitigation measures are set out in **Section 23.6** and are summarised in **Table 23-24**.
1. All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape,	Policy ADN 3: Other Renewable Energy and Low	These assessments are considered in **Chapter 18, Ground Conditions and Contamination, Chapter 19,**

Policy Description	Reference	ES Reference
biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced; 3. That the proposal is mitigated to ensure that there aren't any significant unacceptable effects on sensitive uses located nearby;	Carbon Technologies	**Onshore Ecology, Chapter 20, Onshore Archaeology, Chapter 22, Air Quality and Chapter 24, SLVIA**.
Wellbeing of Future Generations (Wales) Act 2015		
A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).	A resilient Wales	The impact assessment and proposed mitigation measures are set out in **Section 23.6** and are summarised in **Table 23-24.**

23.2.2. Guidance

23.2.2.1. Guidelines for the Environmental Assessment of Road Traffic

21. The Guidelines for the Environmental Assessment of Road Traffic (GEART) (Institute of Environmental Assessment, 1993) relate to the assessment of the environmental impacts of road traffic associated with new developments, irrespective of whether the developments are to be subject to EIA.

22. The purpose of the guidelines is to provide the basis for systematic, consistent and comprehensive coverage for the appraisal of traffic impacts arising from development projects. Impacts that may arise include: pedestrian severance and amenity, driver delay, accidents and safety and noise, vibration and air quality. Further details on the assessment methodology undertaken for the Project in relation to traffic and transport can be found in **Section 23.4.3**.

23.2.2.2. DfT Transport Assessment Guidance

23. The DfT Transport Assessment guidance referred to in NPS EN-1, was withdrawn in October 2014 and was replaced with DCLG Planning Practice Guidance (PPG). For the purpose of assessing the impact of the Project, the relevant PPG is 'Travel Plans, Transport Assessment and Statements' (henceforth referred to as the Transport PPG).

24. The Transport PPG sets out the key principles to be adopted when developing a Transport Assessment as follows:

- Proportionate to the size and scope of the proposed development to which they relate and build on existing information wherever possible;
- Established at the earliest practicable possible stage of a development proposal;
- Be tailored to particular local circumstances (other locally-determined factors and information beyond those which are set out in this guidance may need to be considered in these studies provided there is robust evidence for doing so locally); and
- Be brought forward through collaborative ongoing working between the Local Planning Authority / transport authority, transport operators, rail network operators, Highways Agency (now Highways England) where there may be implications for the strategic road network and other relevant bodies.

25. The Transport PPG key principles have shaped the development of this ES and can be seen throughout this chapter.

23.3. CONSULTATION

26. Consultation undertaken throughout the pre-application phase has informed the approach taken and the information provided in this Chapter. A summary of the comments received from the Environmental Scoping Opinion (Planning Inspectorate, 2018) of particular relevance to traffic and transport is detailed in **Table 23-4** below.

Table 23-4 Consultation Responses

Consultee	Date/Document	Comment	Response
Planning Inspectorate	Scoping Opinion 2018	Potential Impacts: Table 9-12 of the Scoping Report refers to disruption to local traffic and driver delay. The assessment should also assess severance, pedestrian and cycle amenity and road safety."	The effects of severance, pedestrian and cycle amenity and road safety are considered within this ES.
	Scoping Opinion 2018	Potential Impacts: Table 9-12 of the Scoping Report states that the nature, duration and magnitude of effects will be dependent on transportation methods and crossing methods. It is therefore imperative for the ES to define the project as far as is possible, and to ensure that a worst-case scenario is assessed if flexibility is sought.	**Section 23.6** provides details of the traffic generation and worst-case assumptions that have informed the impact assessment.
	Scoping Opinion 2018	Traffic movements: The ES should detail the anticipated vehicle movements during all phases of the Proposed Works. The assumptions made in deriving the traffic demand should be clearly explained within the ES and should represent a worst-case scenario.	
	Scoping Opinion 2018	Affected Road Network (ARN): The ARN should be identified and justified within the ES. This should include roads and transport links likely to be used to transport construction materials and should inform study areas for other aspects (e.g. air quality, noise and vibration).	**Section 23.4.1** includes details of the proposed traffic and transport study area.
	Scoping Opinion 2018	Decommissioning: The ES should assess the potential impacts from decommissioning.	**Section 23.6.5** presents a consideration of the potential decommissioning impacts.
	Scoping Opinion 2018	Traffic Surveys: It is recommended that effort is made to agree the baseline survey with the relevant consultees including the local highways authority and should take into account seasonal traffic fluctuations.	**Section 23.5.15** sets out detail of the baseline traffic flows.

Consultee	Date/Document	Comment	Response
	Scoping Opinion 2018	Sensitive Receptors: The ES should identify any specific receptors which would be sensitive to traffic impacts e.g. schools, recreational facilities. Ecological receptors should also be identified, including any protected sites within 200m of the ARN.	**Section 23.5.16** presents a consideration of the sensitive receptors within the traffic and transport study area. The assessment of ecological receptors is contained within **Chapter 19, Onshore Ecology**.
Isle of Anglesey County Council	4 July 2019 / Consultation	A meeting was held on Thursday 4th July, where Royal HaskoningDHV, on behalf of Menter Mon, presented an outline of the Traffic and Transport EIA to IoACC. IoACC made enquiries on the source of data and content of assessments however raised no concerns during the meeting.	Full details of the baseline data collection and impact assessment are provided in **Section 23.5.** and **Section 23.6.**, respectively

23.4. METHODOLOGY

27. This section describes the assessment methodology, including data collation, impacts and impact assessment criteria that were used in this traffic and transport assessment.

23.4.1. Study Area

28. The traffic and transport study area has been informed by determining the most probable routes for traffic, for both the movement of materials and employees, during construction, operational and decommissioning phases of the Project. In addition, the traffic and transport study area has been extended to include potential diversion routes whilst roads are closed to install the Project's cables in or adjacent to the highway.

29. Routes that extend outside of the traffic and transport study area are routes where construction traffic has dissipated and/ or include roads with negligible sensitive receptors. These parameters combine and do not represent significant impacts on the highway network.

30. The traffic and transport study area is illustrated in **Figure 23-1** (**Volume II**) and covers the majority of western region of the Isle of Anglesey. The traffic and transport study area is divided into 13 separate highway sections known as links, which can be defined as sections of road with similar characteristics and traffic flows.

23.4.2. Data Sources

31. The data sources that have been used to inform the traffic and transport baseline are listed in **Table 23-5**.

Table 23-5 Data Sources

Data	Date	Coverage	Confidence	Notes
Classified Annual Average Daily Traffic (AADT) counts	2017	Links 1,2,3,4,12	High	Data sourced from the DfT which provides classified AADT traffic count data.
Classified Automatic Traffic Counts (ATC)	March 2019	Links 5,6,7,8,9,10,11,13	High	Traffic counts commissioned by Royal HaskoningDHV which provide classified hourly and daily traffic count data.
Personal Injury Collision (PIC) Data	2014 - 2019	All links	High	Open source data sourced from Crashmap.co.uk

32. In addition to the data sources listed in **Table 23-5**, a desk-based assessment was undertaken to provide information with regard to the existing baseline highway network.

23.4.3. Impact Assessment Methodology

33. The overarching methodologies used for EIA are outlined in **Chapter 5, EIA Methodology**. This section describes the assessment methodology, including data collation, impacts and impact assessment criteria that were used in the traffic and transport assessment.

23.4.4. Scale of Assessment

34. The following rules, taken from the GEART, have informed the screening process and thereby defined the extent and scale of this assessment:

- Rule 1: Include highway links where traffic flows are predicted to increase by more than 30% (or where the number of HGVs is predicted to increase by more than 30%); and
- Rule 2: Include any other specifically sensitive areas where traffic flows (or HGV component) are predicted to increase by 10% or more.

35. In justifying these rules GEART examines the science of traffic forecasting and states:

"It is generally accepted that accuracies greater than 10% are not achievable. It should also be noted that the day to day variation of traffic on a road is frequently at least some + or -10%. At a basic level, it should therefore be assumed that projected changes in traffic of less than 10% create no discernible environmental impact.

…a 30% change in traffic flow represents a reasonable threshold for including a highway link within the assessment."

36. Changes in traffic flows below the GEART rules (thresholds) are assumed to result in no discernible or negligible environmental effects and have therefore not been assessed further as part of this study.

37. The exception to the GEART Rule 1 and 2 is the consideration of the effects of driver delay and road safety. These effects can be potentially significant when high baseline traffic flows are evident, and a lower change in traffic flow can be potentially significant. Full details of the methodology adopted for these effects is set out in **Section 23.4**.

38. Following initial screening, GEART sets out consideration and, in some cases, thresholds in respect of changes in the volume and composition of traffic to facilitate a subjective judgement of traffic impact and significance.

39. The following environmental effects have been identified as being susceptible to changes in traffic flow and are appropriate to the local area.

23.4.5. Severance

40. Severance is the perceived division that can occur within a community when it becomes separated by a major traffic artery. The term is used to describe a complex series of factors that separate people from both places and other people. Severance may result from the difficulty of crossing a heavily trafficked road or a physical barrier created by the road itself. It can also relate to relatively minor traffic flows if they impede pedestrian access to essential facilities. Severance effects could equally be applied to residents, motorists, cyclists or pedestrians.

41. GEART suggests that changes in total traffic flow of 30%, 60% and 90% are considered to be ‘slight’, ‘moderate’ and ‘substantial’ respectively.

23.4.6. Pedestrian / Cycle Amenity

42. Pedestrian amenity is broadly defined as the relative pleasantness of a journey and is considered to be affected by traffic flow, traffic composition and pavement width and separation from traffic. The definition of amenity also takes into consideration pedestrian fear and intimidation, consideration of the exposure to noise and air pollution, and the overall relationship between pedestrians and traffic.

43. GEART suggests that a threshold of a doubling of total traffic flow or the HGV component may lead to a negative impact upon pedestrian amenity.

23.4.7. Road Safety

44. The salient GEART guidance on road safety is as follows:

> “Where a development is expected to produce a change in the character of traffic (e.g. HGV movements on rural roads), then data on existing accidents levels may not be sufficient. Professional judgement will be needed to assess the implications of local circumstances, or factors which may elevate or lessen the risk of accidents, e.g. junction conflicts.”

45. In this context, an examination of the existing collisions occurring within the traffic and transport study area will be undertaken to identify any areas of the highway with concentrations of collisions with similar patterns. These sites are considered to be sensitive to changes in traffic flows (sensitive receptors) and could therefore warrant more detailed analysis of significance in the context of the Project.

46. In addition to considering existing patterns of collisions that could be exacerbated by the development proposals, the road safety assessment also considers the potential for introduction of new risks associated with the formation of new junctions.

23.4.8. Driver Delay

47. GEART recommends the use of proprietary software packages to model junction delay and hence increased vehicle delays. However, it is noted that vehicle delays are only likely to be significant when the surrounding highway network is at, or close to, capacity.

48. The assessment therefore seeks to disaggregate the peak hour traffic movements across the traffic and transport study area to inform a judgement upon the potential significance of the driver delay effects.

49. In addition to considering the potential for delays associated with increases in traffic, the potential for delays associated with the temporary road closures will also be considered.

23.4.9. Abnormal Indivisible Loads

50. The importing of large Abnormal Indivisible Loads (AILs) may lead to delays on the highway network. The construction of the landfall substation is likely to require the delivery of three transformers. An AIL access study has been undertaken by abnormal load consultants Wynns to inform the management measures required to deliver AILs to the landfall substation.

51. The AIL study considered three trailer arrangements for transporting the transformer as at the time of drafting the final transformer configuration had not been selected. It has since been confirmed that the final transformer will be of such a size that it can be accommodated upon the smallest of the three trailer arrangements (overall 20m length) and as such the AIL study identifies no significant issues. The AIL study is provided within **Appendix 23-1** (**Volume III**) and details the management measures to be employed to minimise the disruption to baseline traffic.

23.4.10. Other Impacts

52. Traffic-borne noise and vibration effects and air quality effects will be informed by the traffic data outlined in this chapter. These impacts are assessed in **Chapter 21, Noise and Vibration** and **Chapter 22, Air Quality**, respectively.

23.4.11. Sensitivity

53. The sensitivity of a road (link) can be defined by the type of user groups who may use it, e.g. elderly people or children. A sensitive area may be a village environment or where pedestrian or cyclist activity may be high, for example in the vicinity of a school. **Table 23-6** provides broad definitions of the different sensitivity levels which have been applied to the assessment.

Table 23-6 Example Definitions of the Different Sensitivity Levels for a Highway Link

Sensitivity	Definition
High	High concentrations of sensitive receptors (e.g. hospitals, schools, areas with high tourist footfall etc.) and limited separation provided by the highway environment.

Sensitivity	Definition
Medium	A low concentration of sensitive receptors (e.g. residential dwellings, pedestrian desire lines, etc.) and limited separation from traffic provided by the highway environment.
Low	Few sensitive receptors and / or highway environment can accommodate changes in volumes of traffic.
Negligible	Links that fall below GEART Rule 1 and 2 screening thresholds.
* High sensitivity links are considered to be 'specifically sensitive areas' for the purpose of GEART Rule 2	

23.4.12. Other receptors

54. In addition to the consideration of the sensitivity of highway links, areas with existing road safety issues and congested junctions have also been assigned a degree of sensitivity.

55. With regards to road safety areas with existing road safety concerns are considered to be highly sensitive to changes in traffic and are outlined further in **Section 23.5.17**.

56. With regards to driver delay, key junctions on the main 'A' roads within the traffic and transport study area have been identified as potentially highly sensitive to changes in traffic. These locations are discussed further in **Section 23.6.3.6**.

23.4.13. Magnitude

57. **Table 23-7** details the assessment framework for magnitude thresholds adapted from GEART. These thresholds are guidance only and provide a starting point by which transport data will inform a local analysis of the impact magnitude.

Table 23-7 Traffic and Transport Assessment Framework

Effect	Magnitude of Effect			
	Negligible	**Low**	**Medium**	**High**
Severance	Changes in total traffic flows of less than 30%	Changes in total traffic flows of 30 to 60%	Changes in total traffic flows of 60 to 90%	Changes in total traffic flows of over 90%
Pedestrian Amenity	Change in traffic flows (or HGV component) less than 100%	Greater than 100% increase in traffic (or HGV component) and a review based upon the quantum of vehicles, vehicle speed and pedestrian footfall		
Road Safety	Informed by a review of existing collisions patterns and trends based upon the existing personal injury collision records and the forecast increase in traffic			
Driver Delay (Capacity)	Informed by projected traffic increases through sensitive junctions within the traffic and transport study area			
Driver Delay (Road Closures)	Informed by a review of the likely delays associated with road closures			

23.4.14. Impact Significance

58. **Table 23-8** sets out the significance matrix which combines the initial impact assessment derived from the assessment framework presented in **Table 23-7** with the sensitive receptor value for the purpose of determining the 'magnitude of impact'.

Table 23-8 Impact Significance Matrix

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

*Beneficial magnitude matrix has been included for completeness, although it is not anticipated for traffic and transport impacts.

59. Note that for the purposes of this ES, major and moderate impacts are deemed to be 'significant'. In addition, whilst minor impacts are not significant in their own right, it is important to distinguish these from other non-significant impacts as they may contribute to significant impacts cumulatively or through interactions.

23.5. EXISTING ENVIRONMENT

60. Characterisation of the existing environment has been informed through a number of sources, including:

- Desktop studies;
- Traffic count data from the DfT;
- Traffic surveys commissioned by Royal HaskoningDHV on behalf of Menter Môn (**Table 23-5**); and
- Personal injury collision data sourced utilising open source data.

23.5.1. Existing Highway Network

61. The highway network in the vicinity of the traffic and transport study area is illustrated on **Figure 23-1**(**Volume II**). **Figure 23-2** (**Volume II**) illustrates the traffic and transport study area and is divided up into 13 separate links which are described below.

23.5.2. Link 1 – A5 London Road

62. Link 1, the A5 London Road is a major road which runs for approximately 443km in England and Wales. The A5 provides one of the three crossings between Holyhead and the Isle of Anglesey and one of two crossings from the mainland to the Isle of Anglesey.

63. Within the traffic and transport study area, the A5 London Road is a two-lane single carriageway road. The eastern part of the link provides access to an out of town retail park and is subject to a 30mph speed limit with street lighting, to the east of the junction with the Holyhead Eco Park the speed limit increases to the national speed limit. A shared use footway/ cycleway is provided along the northern side of link 1.

23.5.3. Link 2 - A55 North Wales Expressway

64. Link 2, the A55 (North Wales Expressway) forms a direct link from Holyhead Port to Chester. The A55 is the second crossing between the mainland and the Isle of Anglesey. The A55 forms part of the European Route E22 which routes from the United Kingdom to Russia.

65. Within the traffic and transport study area, the A55 North Wales Expressway (link 2) is a two-lane dual carriageway road that runs from junction 2 with the A5153 east to junction 3 with the A5. The road is subject to a 70 mph speed limit, before reducing to 50mph on the approach to junction 2. This reduction in speed limit also corresponds with the provision of street lighting.

23.5.4. Link 3 - A55 North Wales Expressway / Victoria Road / A5154 Victoria Road

66. Link 3, the A55 (North Wales Expressway / Victoria Road) continues north east from junction 2 with A5153 to a signalised junction with the A5154. The link consists a of two-lane dual carriageway road subject to a 30 mph speed limit with street lighting present.

23.5.5. Link 4 - A5154 Victoria Road / Prince of Wales Road

67. Link 4, the A5154 Victoria Road provides a link from the A5 to the northern coastline and residential areas of Holyhead and consists of a two-lane single carriageway road.

68. The road is subject to a 30 mph speed limit with continuous footways and street lighting present along both sides of the road. A number of controlled and uncontrolled pedestrian crossing points are provided along its length. Upon turning west on to Prince of Wales Road / Beach Road traffic calming is provided along the road.

23.5.6. Link 5 – Walthew Avenue / New Park Road / South Stack Road

69. Link 5 comprises of Walthew Avenue, New Park Road and South Stack Road. The link runs south from the roundabout junction with Beach Road and intersects with South Stack Road.

70. Walthew Avenue and New Park Road are predominantly residential roads subject to a 30 mph speed limit with street lighting and footways along both sides of the road. Upon turning on to South Stack Road the link continues as a predominantly residential road subject to a 30 mph speed limit with street lighting and footways along both sides of the road until the junction with Hirfron. From this junction South Stack Road continues south as a rural single carriageway road subject to the national speed limit. Along this section of South Stack Road, there are no footways or street lighting.

23.5.7. Link 6 – Unnamed Road from South Stack Road to Plas Road

71. The unnamed road is a single-lane single carriageway road that runs from its junction with South Stack (link 5) to Plas Road (link 7). The width of the link varies along its length with some sections where vehicles are required to give-way to one another and wider sections where two vehicles can pass. Typically, where the road width prevents two vehicles from passing, informal passing places are provided at the bends in the road.

72. Typical of a rural road, the road is subject to the national speed limit with no footways or street lighting present.

23.5.8. Link 7 – Plas Road

73. Plas Road is a single-lane single carriageway road that runs southwest from Hollyhead. Within the built up areas of Hollyhead the Plas Road is subject to a 30 mph speed limit with a footway along the southern side of the road.

74. The road is also traffic calmed and street lighting present. To the south of the junction with Bryn Gwyn Road the road becomes more rural in character and is subject to the national speed limit with no footway or street lighting present. This section of road is only wide enough for a single vehicle and as such regular passing palaces are provided.

23.5.9. Link 8 – Unnamed Road from Plas Road to Porthdafarch Road

75. Link 8 is an unnamed road that runs south east from its junction with Plas Road (link 7) to its junction with Porthdafarch Road (link 11). The link is a single carriageway road subject to the national speed limit with no footpaths or street lighting present.

23.5.10. Link 9 - Lon Isallt

76. Link 9 (Lon Isallt) is a single-lane single carriageway road that runs east from its junction with Porthdafarch Road (link 9) to its junction with the B454 at Trearddur Bay.

77. Within the built-up area of Trearddur Bay, the link is subject to a 30 mph speed limit within the with footways and street lighting present. Upon leave the built-up area at Trearddur Bay (to the west of the junction with Isallt Back) the link is subject to the national speed limit with no footpaths or street lighting present.

23.5.11. Link 10 – Parc Cybi

78. Link 10 Parc Cybi runs east from its roundabout junction with the A5153 into Trearddur Bay. Parc Cybi is a modern single-lane single carriageway road subject to a 30 mph speed limit with segregated footway/cycleway to the north and is street lit.

23.5.12. Link 11 – Porthdafarch Road

79. Porthdafarch Road is a single-lane single carriageway road that runs southwest from its junction with the B4545 Kingsland Road to its junction with Lon Isallt. To the north, within the built up areas, the road is predominantly residential in character and subject to a 30 mph speed limit with a footway along at least one side of the road. This section of Porthdafarch Road is also traffic calmed and street lit.

80. To the south of the junction Cae Rhos the road becomes more rural in character and is subject to the national speed limit. A continue footway is however provide along the northern side of the road to the junction with link 8.

23.5.13. Link 12 – A5153

81. The A5153 is a modern a single-lane single carriageway road that runs west from its roundabout junction with the A5 through the A55 to its roundabout junction with the B4545.

82. The road is subject to a speed limit of 30 mph with footways and street lights provided on both sides of the road.

23.5.14. Link 13 – B4545 Kingsland Road / Lon St Ffraid

83. The B4545 is a single carriageway road to provides a link from A5153 (link 12) south to Trearddur Bay. To the south of the junction with the A5153 the link is subject to a speed limit of 30 mph and footways are provided along both sides of the road. The speed limit then increases to 40 mph and a footway is provided along the western side of the road until entering the built-up area of Trearddur Bay. At this point the speed limit reduces to 30 mph and there are generally footways along both sides of the road with street lighting.

23.5.15. Traffic Flow Data

84. Baseline traffic flow data including details of the data source for all the key links within the traffic and transport study area are summarised in **Table 23-9**.

85. **Table 23-9** provides details of the total Annual Average Daily Traffic Flows (AADT) and the HGV component. This assessment uses the term HGV as a proxy for HGVs and buses / coaches recognising the similar size and environmental characteristics of the respective vehicle types.

Table 23-9 Existing Annual Average Daily Traffic Flows

Link ID	Link Description	Total Vehicles (24hr AADT)	Total HGVs (24hr AADT)	Data Source, Type and Date
1	A5 London Road	6,527	145	2017 DfT data
2	A55 North Wales Expressway	11,666	1,012	2017 DfT data
3	A55 North Wales Expressway / Victoria Road / A5154 Victoria Road	12,949	1,123	2017 DfT data
4	A5154 Victoria Road / Prince of Wales Road	3,264	73	2017 DfT data
5	Walthew Avenue / New Park Road / South Stack Road	3,167	85	March 2019 commissioned ATC
6	Unnamed Road from South Stack Road to Plas Road	443	8	March 2019 commissioned ATC
7	Plas Road	470	7	March 2019 commissioned ATC
8	Unnamed Road from Plas Road to Porthdafarch Road	443	8	March 2019 commissioned ATC
9	Lon Isallt	1,015	15	March 2019 commissioned ATC
10	Parc Cybi	1,255	415	March 2019 commissioned ATC
11	Porthdafarch Road	1,665	100	March 2019 commissioned ATC
12	A5153	8,475	196	2017 DfT data
13	B4545 Kingsland Road / Lon St Ffraid	4,040	118	March 2019 commissioned ATC

23.5.16. Link Based Sensitive Receptors

86. A desktop exercise has been undertaken to identify the sensitive receptors in the traffic and transport study area utilising the definitions outlined in **Table 23-6**. All 13 links within the traffic and transport study area have been assessed and assigned a sensitivity.

87. Recognising that the characteristics of a link may change along its length, the 13 links have been sub-divided to reflect the varying concentration of receptors. For example, a road passing through a village providing access to a school could be considered highly sensitive, whilst the same road passing between the villages where there is no frontage development could be considered a low sensitive receptor.

88. **Table 23-10** details the routes and the rationale for the applied link sensitivity and **Figure 23-3** (**Volume II**) illustrates these routes graphically.

Table 23-10 Link Based Sensitive Receptors

Link ID	Link Description	Link Sensitivity	Rationale
1	A5 London Road	Low	The links are main A roads that can accommodate a high volume of traffic and have limited sensitive receptors
2	A55 North Wales Expressway	Low	
3	A55 North Wales Expressway / Victoria Road / A5154 Victoria Road	Low	
4	A5154 Victoria Road / Prince of Wales Road	High	The link is an A-road that passes through built up areas. These built up areas have significant frontage developments including residential properties, shops, restaurants and public houses.
5a	Walthew Avenue / New Park Road / South Stack Road	High	The link passes through built up areas with significant frontage developments including residential properties, parks and schools.
5b	South Stack Road	Low	The link has no frontage developments present
6	Unnamed Road from South Stack Road to Plas Road	Low	The link has no frontage developments present
7a	Plas Road south to junction with Bryn Gwyn Road	High	The link passes through built up areas with significant frontage developments including a school, church, and doctor's surgery
7b	Plas Road south from with Bryn Gwyn Road	Low	The link has minimal frontage development present
8	Unnamed Road from Plas Road to Porthdafarch Road	Low	The link has minimal frontage development present
9a	Lon Isallt	Medium	The link has minimal frontage development present, however it does provide direct vehicular access to Porth Dafarch beach
9b	Lon Isallt within the built-up area of Trearddur Bay	High	The link passes through built up areas with residential frontage development and also provides direct access to Trearddur Bay Beach
10	Parc Cybi	Low	The link is predominantly a modern road with wide footways setback from the road, dropped kerb

Link ID	Link Description	Link Sensitivity	Rationale
			crossings and minimal frontage development present
11a	Porthdafarch Road	High	The link passes through built up areas with residential frontage development
11b	Porthdafarch Road	Medium	The link has minimal frontage development present, however, the does provide a pedestrian route to access attractions including such as Anglesey Outdoors and Porth Dafarch beach
12	A5153	Low	The link is a modern A-road with wide footways and signalised pedestrian crossings present. There is also minimal frontage development present in the form of retail shops which are setback from the road and served by the footways
13a	B4545 south to the built-up area of Trearddur Bay	Medium	The link has some residential frontage development and provides access to Holyhead Golf Club
13b	B4545 within Trearddur Bay	High	The road is a B-road that passes through built up areas with significant frontage developments including, residential properties and shops

23.5.17. Road Safety

89. To understand whether the Project would have a significant road safety impact, it is necessary to establish a baseline and identify any inherent road safety issues within the traffic and transport study area.

90. In order to establish whether there are any inherent safety issues a high-level search of the traffic and transport study area utilising open source data (Crashmap.co.uk) has been undertaken to identify any Personal Injury Collision (PIC) clusters.

91. Attempts were made by Royal HaskoningDHV to obtain more detail of the collisions (known as STATS19 data) from the Isle of Anglesey County Council, however, to date no response has been received.

92. Within the traffic and transport study area a total of 22 collisions occurred within the most recent five-year period available (January 2014 to December 2018), of these 15 were regarded as slight, six were serious, and one was fatal. **Table 23-11** provides a summary of the collisions and their locations in respect to the links.

Table 23-11 Summary of Collision Data

Link ID	Link Description	No. of Collisions			Summary
		Fatal	Serious	Slight	
1	A5 London Road	0	0	2	Two slight collision identified. None of two the collisions occurred within the proximity of each other.
2	A55 North Wales Expressway	0	1	1	One slight and one serious collision identified. None of two the collisions occurred within the proximity of each other.

Link ID	Link Description	No. of Collisions			Summary
		Fatal	Serious	Slight	
3	A55 North Wales Expressway / Victoria Road / A5154 Victoria Road	0	2	3	One collision occurred at the A55 junction 2, two collisions occurred at the A55 roundabout junction with Kingsland Road and two at the signalised junction with the A5154.
4	A5154 Victoria Road / Prince of Wales Road	0	1	4	One collision serious collision occurred close to the junction with Market Street. Three slight collisions occurred south of Station Street close to The Dublin Packet Public House and one slight collision occurred close to the H.M. Coastguard building.
5	Walthew Avenue / New Park Road / South Stack Road	0	0	0	No recorded collisions within assessment period
6	Unnamed Road from South Stack Road to Plas Road	0	0	1	One slight collision identified.
7	Plas Road	0	0	0	No recorded collisions within assessment period
8	Unnamed Road from Plas Road to Porthdafarch Road	0	0	0	No recorded collisions within assessment period
9	Lon Isallt	0	1	1	One serious and one slight collision identified. Neither of two the collisions occurred within the proximity of each other
10	Parc Cybi	0	0	0	No recorded collisions within assessment period
11	Porthdafarch Road	0	0	0	No recorded collisions within assessment period
12	A5153	0	1	2	Two slight and one serious collision identified at different roundabouts
13	B4545 Kingsland Road / Lon St Ffraid	1	0	1	One fatal and one slight collision identified. Neither of two the collisions occurred within the proximity of each other
Total		**1**	**6**	**15**	

93. **Table 23-11** identifies that no collision clusters were identifies on any of the links within the traffic and transport study area. It is therefore considered that there are not any inherent safety issues in the traffic and transport study area.

94. Therefore, from a road safety perspective, the study area is considered to be of negligible sensitivity and the addition of development traffic is unlikely to result in significant impact. As such, no further assessment of road safety is presented.

23.5.18. Anticipated Trends in Baseline Condition

95. It is considered that the earliest date that construction could commence would be 2021; as such a baseline year for background traffic of 2021 has been derived for the purpose of this assessment.

96. To take account of sub-regional growth in housing and employment, the baseline flows have been factored to the future year baseline traffic using the Department for Transport Trip End Model Presentation Programme (TEMPro) Version 7.0, for the Isle of Anglesey and adjusted with National Trip End Model dataset AF15.

23.6. IMPACT ASSESSMENT

23.6.1. Mitigation

23.6.1.1. Embedded Mitigation

97. During the development of the detailed engineering design, a number of embedded mitigation measures have been included to reduce the potential impacts of the project. Full details of these are included in **Chapter 4, Project Description**. There are no embedded mitigation measures specific to Traffic and Transport impacts.

23.6.1.2. Additional Mitigation

98. Where significant adverse impacts have been identified as a result of the Project, additional site specific mitigation measures are proposed to seek to reduce residual impacts to acceptable (non-significant) levels. These are described where required within **Section 23.6.3**.

23.6.2. Worst Case Scenario

99. **Table 23-12** identifies the realistic worst-case parameters of the onshore infrastructure that are relevant to potential impacts on traffic and transport during construction, operation and decommissioning phases of the Project.

Table 23-12 Realistic Worst-Case Scenarios

Parameter	Notes
Construction	
Full overlap of the peak period for all onshore infrastructure, namely: ▪ Landfall substation; ▪ Landfall Horizontal Directional Drilling (HDD); ▪ Grid connection substation; ▪ A55 and North Wales Coast Railway HDD; and ▪ Cable installation.	Represents maximum possible intensity of activities resulting in peak traffic generation.
Earliest start of construction 2021	2021 has been used as the realistic construction start date for the purpose of the assessment of environmental impacts.
No allowance for construction workers to car-share or be able to travel by non-car modes (bus, rail, walking and cycling) has been applied to the traffic demand	Represents a worst case, as the adoption of car-sharing, or use of non-car modes would reduce the assessed vehicle movements.
HGVs deliveries profiled over a 10-hour window.	A 7am to 7pm (12hr) ‘delivery window’ has been assumed with ten hours delivery time allocated. This results in higher hourly HGV flows (than 12hrs) but allows for breaks in deliveries (to allow deliveries to be suspended during particularly sensitive periods, e.g. school start and finish times).

Parameter	Notes
Workers departing for home are assumed to overlap with the evening network peak hour (17:00 – 18:00).	The nature of construction works typically requires that employees work longer hours in the summer and shorter hours in the winter to take advantage of the available daylight. Therefore, as a worst case, peak construction worker movements are assumed to overlap with peak background traffic.
Operation	
It anticipated that the landfall and grid connection substations would not normally be staffed. During the operational phase, vehicle movements would therefore be limited to occasional repair, maintenance and inspection visits at the substations.	
Decommissioning	
HGV and Light Commercial Vehicle (LCV) traffic demand as per construction, assuming minimal opportunities to leave components in-situ or recycle materials on site.	Represents peak decommissioning traffic impacts.

23.6.3. Potential Impacts During Construction

23.6.3.1. Trip Generation and Assignment

100. This section forecasts the traffic generated by the Project and distributes vehicle trips to the highway network to establish a basis for assessing the potential transport impacts.

101. The traffic generation that has informed this assessment has been derived by way of a 'first principles' approach. The first principles approach generates traffic volumes from an understanding of material quantities and personnel numbers required for the Project and converts these metrics into vehicle movements.

102. Construction consultants (Black and Veatch Ltd.) have been commissioned to provide industry expertise and to develop the methodologies and quantities that underpin the traffic demand assumptions for the Project.

103. The construction workforce would consist primarily of specialist workers who travel to work on similar projects throughout the UK. To supplement this, local workers would be used where possible, subject to required skills being available. The peak number of construction employees required has been estimated at up to 70 per day, further details regarding the likely split between the various construction activities is provided within **Table 23-13**.

104. The following **Table 23-13** also provides a summary of the forecast HGV movements for the respective construction activities. The numbers presented within **Table 23-13** represent the peak periods for each construction activity.

Table 23-13 Peak Two-Way Vehicle Movements

Construction Activities	Peak two-way * daily HGV movements	Peak two-way * LCV ** movements	Peak all vehicle movements (two-way *)
Onshore cable installation	6	24	30
Landfall substation and HDD	20	64	84

Construction Activities	Peak two-way * daily HGV movements	Peak two-way * LCV ** movements	Peak all vehicle movements (two-way *)
Inland substation and HDD	20	52	72
Total	**46**	**140**	**186**
Notes			
*	*A two-way movement represents the inbound (laden trip from source/home) and the outbound trip (back to source/home). For example, 20 two-way HGV movements comprise 10 laden trips from source and 10 outbound unladen trips back to source.*		
**	*LCV (Light Commercial Vehicles) includes a range of vehicles, such as cars, vans, pickups, etc.*		

105. It is proposed that vehicles associated with the landfall substation, landfall HDD and cable installation activities would first travel to the proposed site compound at that landfall substation. From this point, vehicles associated with the cable installation would then travel onwards to their respective work fronts. Vehicles associated with the inland substation and inland HDD would however, travel direct to these sites.

106. In order to consider a worst case, it is assumed that work on the all construction activities would occur simultaneously. It can therefore be calculated that as a worst case there could be up to 140 employee movements and 46 two-way HGV movements per day.

107. At the time of submission, the supply chain for materials cannot be informed by early contractor involvement as the procurement process has not commenced. Therefore, for the purpose of the assessment, traffic distribution assumes that HGVs would all be distributed to the A55 to an origin/ destination outside the study area. Furthermore, the types of specialist skills required for projects such as the Project means that construction personnel often have to be drawn from across the country and not necessarily from local labour sources, as such it has also been assumed that as a worst case all employees would travel to the area from the A55.

23.6.3.2. Traffic Impact Screening

108. In accordance with the GEART (Rule 1 and Rule 2), a screening process has been undertaken for the onshore highway study area to identify routes that are likely to have sufficient changes in traffic flows and therefore require further impact assessment.

109. **Table 23-14** summarise the assigned daily peak two-way vehicle movements (i.e. arrivals and departures) of all materials, personnel and plant during the peak in-combination month when distributed across the highway network.

110. **Table 23-14** also provide a comparison of the peak daily construction flows with the forecast background daily traffic flows in 2021 and identifies the links exceeding the GEART screening thresholds.

Table 23-14 Existing Annual Average Daily Traffic Flows

Link ID	Link Description	Link sensitivity	Background 2021 flows		Forecast Construction Vehicle Movements (two-way)		Percentage Increase	
			All Vehicles	HGVs	All Vehicles	HGVs	All Vehicles	HGVs
1	A5 London Road	Low	6,790	151	98	40	1.4%	26.5%
2	A55 North Wales Expressway	Low	12,136	1,052	180	40	1.5%	3.8%
3	A55 North Wales Expressway / Victoria Road / A5154 Victoria Road	Low	13,471	1,168	108	20	0.8%	1.7%
4	A5154 Victoria Road / Prince of Wales Road	High	3,396	76	108	20	3.2%	26.3%
5	Walthew Avenue / New Park Road / South Stack Road	Low - High	3,228	86	108	20	3.3%	23.2%
6	Unnamed Road from South Stack Road to Plas Road	Low	452	8	32	8	7.1%	100%
7	Plas Road	Low - High	479	7	0	0	0.0%	0.0%
8	Unnamed Road from Plas Road to Porthdafarch Road	Low	452	8	32	8	7.1%	100%
9	Lon Isallt	Medium - High	1,035	15	0	0	0.0%	0.0%
10	Parc Cybi	Low	1,280	423	58	28	4.5%	6.6%
11	Porthdafarch Road	Medium - High	1,698	102	32	8	1.9%	7.8%
12	A5153	Low	8,817	204	130	48	1.5%	23.5%
13	B4545 Kingsland Road / Lon St Ffraid	Medium - High	4,118	120	0	0	0.0%	0.0%
	Links above GEART screening thresholds							

111. In accordance with GEART only those links that are showing greater than 10% increase in total traffic flows (or HGV component) for sensitive links, or greater than 30% increase in total traffic or HGV component for all other links, are considered when assessing the traffic impact upon receptors.

112. It is noted from **Table 23-14** that links 1, 2, 3, 7 and 9 to 13 are below the GEART screening thresholds and are therefore not considered further in the impact assessment are negligible. The remaining links (highlighted within **Table 23-14**) are all above the GEART screening thresholds and are therefore considered further.

113. The following paragraphs summarise the assessment of construction traffic impacts on the effects identified as being susceptible to changes in flow.

23.6.3.3. Impact 1: Severance

114. The peak daily change in total traffic flow for all screened links is significantly less than a 30% change in total traffic, therefore, applying the GEART severance threshold (**Table 23-7**) the magnitude of effect is assessed as negligible on low to high sensitivity links giving a maximum impact of **negligible to minor adverse**.

23.6.3.4. Impact 2: Pedestrian Amenity

115. The peak daily change in total flows or HGV component for links 6 and 8 is greater than the 100 % GEART impact threshold, which suggests adverse amenity impacts may be experienced.

116. Link 6 and 8 comprises of an unnamed road from between South Stack Road and Porthdafarch Road, the links are assessed as low value sensitivity noting there is no frontage development, and no footways along the road, suggesting limited pedestrian demand. The links are subject to a 100 % increase in HGVs, however, it is noteworthy that there is a very low baseline of HGV traffic (8 HGVs a day), as such the addition of 8 two-way HGV movements per day associated with the Project results in a significant percentage increase.

117. The proposed HGV movements would be associated with HGVs departing from the site compound at the landfall substation and travelling to work on installing the Project’s cables along the roads between South Stack Road and Mill Road. These HGVs would typically depart from the site compound at the start of the day within one hour and return at the end of the shift within an hour, as such for the majority of the day no additional HGV traffic would be observed.

118. The magnitude of effect is therefore assessed as medium on a low sensitivity link resulting in a **minor adverse** impact.

23.6.3.5. Impact 3: Road Safety

119. **Table 23-11** identifies that no collision clusters were identifies on any of the links within the traffic and transport study area. It is therefore considered that there are no inherent safety issues within the traffic and transport study area. Therefore, from a road safety perspective, the study area is considered to be of negligible sensitivity and the addition of development traffic is likely to result in a negligible impact upon existing road safety issues.

120. It is considered however, that at new points of access to the highway network, the intensification of slow-moving construction traffic aligned to high speed rural roads could potentially to lead to significant adverse road safety impacts. Therefore, a package of mitigation measures has been developed to reduce the risk to the travelling public and construction employees at these locations.

23.6.3.5.1. Mitigation

121. The following additional measures would be applied to reduce the road safety impacts associated with the intensification of slow-moving construction traffic at new and existing points of access.

122. A new access is proposed to the landfall substation off South Stack Road, an access concept design is detailed within **Appendix 23-2** (**Volume III**). The concept presented minimises the visual impact upon the existing landscape character, this has however resulted in a reduced carriageway width that would not accommodate two-way HGV movements.

123. To manage the potential for conflicting HGV movements at the access, it is proposed that measures would be agreed with the local highway authority post consent once a Contractor has been appointed through the development of a detailed CTMP, the measures could include:

- Advanced scheduling of deliveries and assigning of delivery slots to reduce the potential for two vehicles to meet at the access;
- Requiring drivers to call ahead to confirm their expected arrival time; and
- Controlling all departing HGV traffic through the use of a banksman.

124. In addition to the proposed CTMP measures, the access designs incorporate the following mitigation measures:

- The access would be provided with appropriate visibility splays to allow vehicles to safely access and exit, these would be maintained by the appointed Contractor;
- The access would incorporate a bound (concrete or asphalt) surface to prevent dust and dirt being tracked on to the highway, reducing the potential for vehicles to lose control on loose material;
- Temporary direction and warning signs to advise of turning vehicles would be provided for the construction phase. This signage would highlight the proposed access to drivers to avoid late breaking manoeuvres and highlight to the travelling public the potential for turning vehicles; and
- A temporary reduction in the existing speed limit in the vicinity of the access would be implemented during the construction phase to reduce the speed of vehicles in the vicinity of the access.

125. Access to the grid connection substation and HDD under the A55 and North Wales Coast Railway line would be from the existing Orthios Eco Park access from the A5. The corresponding reception pit for the HDD on the southern side of the A5 and North Wales Coast Railway line would be provided from an existing access with Parc Cybi. Therefore, in order to make the public aware of the potential for constriction traffic to be using these accesses, temporary direction and warning signs to advise of turning vehicles would be provided. This signage would highlight the proposed accesses to drivers to avoid late breaking manoeuvres and highlight to the travelling public the potential for turning vehicles.

23.6.3.5.2. Residual Impact

126. Following the implementation of these additional mitigation measures, the potential for road safety impacts associated with the intensification of slow-moving construction traffic at new and existing points of access, the magnitude is assessed as negligible on high value receptors resulting in a **minor adverse** residual impact.

23.6.3.6. Impact 4: Driver Delay (Capacity)

127. The GEART screening thresholds do not apply to this effect as the potential impact is defined as significant when the highway network surrounding the development under consideration is at or close to capacity.

128. The most sensitive time for Driver Delay would be when the daytime construction shift finishes at the same time as the evening network peak. During this period, construction employees would be departing their place of work and HGVs would be returning from making deliveries.

129. To assess if this has the potential for significant impacts the traffic generation associated with all construction employees departing work and peak hourly HGV demand (daily HGV demand profiled across ten hours) has been considered.

130. This peak hour demand has been assigned to the main junctions within the traffic and transport study area. **Table 23-15** details the resultant traffic flows arriving at the junctions during the peak hour.

Table 23-15 Peak Hour Construction Traffic Flows Through Junctions

Junction	Entry arms	All vehicles	HGVs
Junction 1: A55 junction with the A5153	A55 westbound off-slip	1	1
	A55 eastbound off-slip	0	0
	A5153 north of A55	43	2
	A5153 south of A55	16	1
Junction 2: A55 junction with Kingsland Road	A55 North Wales Expressway	1	1
	Kingland Road (south)	0	0
	Kingsland Road (north)	0	0
	A55 Victoria Road	45	1
Junction 3: A55 signalised junction with A5154	A55 Victoria Road	1	1
	A55 London Road	0	0
	A5154 Victoria Road	45	1

131. **Table 23-15** identifies that the peak construction traffic total flows through any arm is 45 vehicle per hour.

132. It is considered that the forecast increase in all vehicle movements through the junctions would not be significant in the context of the existing traffic levels. The magnitude of effect is therefore assessed as negligible on a potentially high value receptor resulting in a **minor adverse** impact.

23.6.3.7. Impact 5: Driver Delay (Road Closures)

133. **Chapter 4, Project Description** sets out that the Project cables would need to be installed in the highway between the proposed landfall substation and the grid connection substation, the cables would follow the route detailed below:

- South from the landfall substation via South Stack Road (link 5);

- East along link 6 and 8 from South Stack Road to Porthdafarch Road (link 11);
- North on Porthdafarch Road (link 11) to its junction with Mill Road;
- East on Mill Road for approximately 600 m before heading across fields to the Holyhead Leisure Centre;
- North through the Holyhead Leisure Centre car park and access road to link up with the A5153;
- North at the roundabout junction with the A5153 (link 12) to the junction with Parc Cybi (link 10); and
- East along Parc Cybi before passing under the A55 and North Wales Coast Railway line (by HDD) to reach the grid connection substation.

134. **Chapter 4, Project Description** sets out that the preferred option to bring the offshore cables onshore would be via HDD, with the cables installed under South Stack Road. However, an alternative option may be required where the cables would need to be installed by open trenching across South Stack Road. This open trenching option is therefore considered further as a worst case.

135. To ensure the safety of existing highway users and employees installing the cables, there would be a requirement to maintain a safe working distance between the cable installation works and live traffic.

136. The construction consultant for the Project (Black and Veatch Ltd.) have undertaken an initial review of the available highway width along each link and identified the preferred traffic management strategy. The final traffic management strategy and working practices may however need to be refined once a Contractor is appointed and final working practices are established. It is proposed that the final traffic management strategy would be agreed with the local highway authority post consent through the development of a detailed CTMP.

137. **Table 23-16** sets out details of the initial the traffic management strategy and details of the existing highway conditions via each link.

Table 23-16 Cable Installation Traffic Management Proposals

Link	Peak hour traffic flows	Footway/ Cycleway	Bus Route	Proposed traffic management
5	273	No	No	Single lane closure
6	54	No	No	Full road closure
8	54	No	No	Single lane closure
11	150	Yes	No	Full road closure
Mill Road	< 150	Yes	No	Full road closure
12	792 *	Yes	Yes	Single lane closure
10	115	Yes	Yes	Single lane closure
South Stack Road (west of link 6)	54	No	No	Single lane closure **
Notes * peak hour flow derived from annual average daily traffic flows				

Link	Peak hour traffic flows	Footway/ Cycleway	Bus Route	Proposed traffic management
** facilitated through temporary road widening				

138. It can be noted from **Table 23-16** that due to the narrowness of the existing highway, a full road closure would be required for three sections to allow the Contractor to safely install the Project's cables in the road whilst the five sections could be undertaken under single lane working, i.e. one lane of traffic remains operational.

139. With regards to managing the traffic through the single lane closure following measures would be applied to reduce the potentially adverse impacts. These measures would be agreed with the local highway authority post consent once a Contractor has been appointed through the development of a detailed CTMP, the measures would include:

- Controlling traffic through temporary traffic signals/ stop go boards;
- Maintaining a safe route for pedestrians through the works area; and
- Working with the local highway authority and local stakeholders to agree an appropriate time to undertake the works.

140. In addition to the measures outline above, to manage traffic through the single lane closure of South Stack Road (west of link 6) it would also be necessary to temporarily widen the highway into the adjoining verges. This temporary widening would maintain single lane traffic flow at all times, thus avoiding the need to close the road.

141. The Traffic Signs Manual (DfT, 2009) identifies that on roads with two-way flows of more than 1,300 vehicles per hour, overload of the controlled area is possible and exceptional delays may occur. It can be noted from **Table 23-16** that the flows on all roads are significantly less than 1,300 vehicles. It is therefore considered that the impact of a single lane closure upon links 5, 8, 10, 12 and South Stack Road (west of link 6) would be **negligible**.

142. With regards to links 6, 11 and Mill Road a full road closure would be required whilst the cables are installed. This could potentially lead to significant impacts as access to local businesses and properties along the routes as well as delays between people travelling along the link.

143. To reduce the impact upon local receptors along the links that require closing, further consideration has been given to the staging the cable route works to ensure that where possible local access is maintained. **Figure 23-4** (**Volume II**) demonstrates that through staging of the works, local access can be maintained to all but three properties. The delivery contractor will schedule work to minimise the impact on these properties such that any closure is temporary in nature and limited to several days, with alternative access arrangements made.

144. The impact upon those local properties and businesses where access can be maintained is assessed as negligible on high sensitive receptors resulting in a **minor adverse** impact. The impact upon those three local properties where direct access cannot be maintained is assessed as high on high sensitive receptors resulting in a **major adverse** impact. Therefore, a package of mitigation measures has been developed to reduce the impact upon residents of these three properties.

145. A review of the destinations along links 6 and 11 that could be impacted by a closure of the road has been undertaken, this has identified the following particularly sensitive trip attractors:

- South Stack Cliffs Nature Reserve and South Stack Light House;
- South Stack cliffs Nature Reserve and Royal Society for the Protection of Birds (RSPB) The Range;
- Porth Dafarch Beach; and
- Anglesey Outdoors.

146. The following tables (**Table 23-18** to **Table 23-20**) therefore set out a comparison of the time taken to reach each of these key trip attractors without a closure from within Anglesey and also approaching Anglesey on the A55. The tables also then provide details of the likely diversion routes and the additional time taken if link 6 or 11 were closed. The journey times presented have been taken from the google maps route planner for a weekday at midday.

Table 23-17 South Stack Cliffs Nature Reserve and South Stack Light House (LL65 1YH)

	North West of Holyhead (LL65 1AG)		South West of Holyhead (LL65 2AP)		South East of Holyhead (A55 Junction 2)		North East of Holyhead (LL65 2DU)		Trearddur (LL65 2LJ)	
Current route	Link 5		Link 5		Link 2, 3, 5		Link 4, 5		Link 9, 8, 6	
Journey time via current route	10 minutes		12 minutes		13 minutes		15 minutes		16 minutes	
Closure	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11
Proposed diversion	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Link 13, 3, 4, 5	n/a
Journey time via proposed diversion	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	16 minutes	n/a
Additional journey time	0 minutes	0 minutes	0 minutes	0 minutes	0 minutes	0 minutes	0 minutes	0 minutes	0 minutes	0 minutes

Table 23-18 South Stack cliffs Nature Reserve and RSPB The Range (LL65 2NA)

	North West of Holyhead (LL65 1AG)		South West of Holyhead (LL65 2AP)		South East of Holyhead (A55 Junction 2)		North East of Holyhead (LL65 2DU)		Trearddur (LL65 2LJ)	
Current route	Link 5, 6		Link 7, 6		Link 2, 3, 11, 8, 6		Link 3, 11, 8, 6		Link 9, 8, 6	
Journey time via current route	9 minutes		12 minutes		12 minutes		14 minutes		12 minutes	
Closure	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11
Proposed diversion	Link 7, 6	n/a	Link 11, 8, 6	n/a	Link 2, 3, 4, 5, 6	Link 2, 3, 4, 7, 6	Link 3, 4, 5, 6	Link 3, 4, 5, 6	Link 13, 3, 4, 5, 6	n/a
Journey time via proposed diversion	12 minutes	n/a	12 minutes	n/a	12 minutes	12 minutes	14 minutes	14 minutes	16 minutes	n/a
Additional journey time	3 minutes	0 minutes	0 minutes	0 minutes	0 minutes	0 minute	0 minute	0 minute	4 minutes	0 minutes

Table 23-19 Porth Dafarch (LL65 2LS)

	North West of Holyhead (LL65 1AG)		South West of Holyhead (LL65 2AP)		South East of Holyhead (A55 Junction 2)		North East of Holyhead (LL65 2DU)		Trearddur (LL65 2LJ)	
Current route	Link 5, 6, 8		Link 11		Link 2, 3, 11		Link 3, 11		Link 9	
Journey time via current route	12 minutes		9 minutes		8 minutes		10 minutes		7 minutes	
Closure	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11
Proposed diversion	Link 7, 8	n/a	n/a	Link 7, 8	n/a	Link 2, 12, 13, 9	n/a	Link 3, 7, 9	n/a	n/a
Journey time via proposed diversion	12 minutes	n/a	n/a	12 minutes	n/a	12 minutes	n/a	14 minutes	n/a	n/a
Additional journey time	0 minutes	0 minutes	0 minutes	3 minutes	0 minutes	4 minutes	0 minutes	4 minutes	0 minutes	0 minutes

Table 23-20 Anglesey Outdoors (LL65 2LP)

	North West of Holyhead (LL65 1AG)		South West of Holyhead (LL65 2AP)		South East of Holyhead (A55 Junction 2)		North East of Holyhead (LL65 2DU)		Trearddur (LL65 2LJ)	
Current route	Link 4, 3, 11		Link 11		Link 2, 3, 11		Link 3, 11		Link 9, 11	
Journey time via current route	12 minutes		7 minutes		5 minutes		8 minutes		8 minutes	
Closure	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11	Link 6	Link 11
Proposed diversion	n/a	Link 7, 8, 11	n/a	Link 7, 8, 11	n/a	Link 2, 12, 13, 9, 11	n/a	Link 3, 4, 7, 8, 11	n/a	Link 13, 11
Journey time via proposed diversion	n/a	14 minutes	n/a	14 minutes	n/a	12 minutes	n/a	14 minutes	n/a	9 minutes
Additional journey time	0 minutes	2 minutes	0 minutes	7 minutes	0 minutes	7 minutes	0 minutes	6 minutes	0 minutes	1 minute

147. It can be noted from **Table 23-18** to **Table 23-20** that where the road closure introduce delays, these delays would range between one and seven minutes. There are no commonly agreed thresholds for where delays from road works would be significant, however Chapter 8 of the Traffic Signs Manual (DfT, 2009) does advise that advanced signing of road works should be considered for shorter duration works where the temporary traffic management design indicates that there are likely to be moderate or severe delays of 10 minutes or more.

148. It is therefore reasoned that as delays are likely to less than 10 minutes and would be short term in duration, the delays would not be considered severe. It is therefore concluded that the magnitude of effect would be low on receptors of low sensitivity resulting in a **minor adverse** impact.

149. Prior to the commencement of construction, a CTMP would be submitted to the local highway authority, this CTMP would include details of:

- Proposed traffic management measures;
- Staging of the construction activities;
- The proposed diversion routes and advanced signing;
- Details of the measure to manage impacts upon local residents; and
- Details of measures to escort pedestrians and cyclists through the works.

23.6.3.7.1. Mitigation

150. With regards driver delay impacts upon the three properties that would be within the road closures, the following additional mitigation measures are proposed:

- Establishing a direct line of communication with residents to discuss the proposed timing of the works;
- Providing temporary parking within the closed section of highway as close to the properties as possible;
- Ensure that a banksman is available to guide residents safely through the works area; and
- Provide assistance with carrying heavy items (shopping, bins, etc.) between the resident’s vehicles and home.

23.6.3.7.2. Residual Impact

151. Following the implementation of these additional mitigation measures, the potential for driver delay impacts associated with the delay impacts upon the three properties that would be within the road closures, the magnitude is assessed as low on high value receptors resulting in a **moderate adverse** residual impact.

23.6.4. Potential Impacts During Operation

152. It is anticipated that the Project would not be permanently staffed. During the operational phase, vehicle movements would therefore be limited to periodic maintenance visits at the landfall and grid connection substations.

153. It is anticipated that maintenance visits could result in a peak of 10 employees (20 two-way movements) per day to either the landfall or grid connection substations.

154. During the operational phase access to the landfall substation would be via the new construction access from South Stack Road (detailed within **Appendix 23-2, Volume III**). This access would be constructed during the construction phase and remain in place for the life of the Project. Operational access to the grid connection substation would be from the existing Holyhead Eco Park access with the A5.

155. Considering the activities listed above, **no discernible impacts** are anticipated during the operational phase.

23.6.5. Potential Impacts During Decommissioning

156. No decision has been made regarding the final decommissioning policy for the Project as it is recognised that industry best practice, rules and legislation change over time. However, the substation equipment would likely be removed and reused or recycled and it is expected the onshore cables would be left in situ.

157. Intuitively, the decommissioning of the onshore cable would require less demand for HGV and personnel movements that that of the construction phase, whilst the decommissioning of the substation would potentially result in similar levels of HGV demand. Therefore, the overall magnitude of effects would be lower.

158. It is therefore expected that the traffic impacts are likely to be less than those presented for the construction phase and similar mitigation strategies would be valid for decommissioning.

159. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with Isle of Anglesey County Council. A decommissioning plan would be provided.

23.6.6. Cumulative Impacts

160. The potential for cumulative impacts to occur as a result of the interaction between the Project and other plans, projects and activities was considered. Firstly, the potential for impacts identified in the traffic and transport assessment to act cumulatively with other projects was identified, as summarised in **Table 23-21**.

Table 23-21 Potential for Cumulative Impacts

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Construction			
Impact 1: Severance	Yes	High	Multiple projects could lead to increases in traffic flows which may lead to cumulative impacts upon receptors.
Impact 2: Pedestrian/ Cycle Amenity	Yes	High	
Impact 3: Road Safety	No	High	It has been demonstrated that there are no inherent safety issues within the traffic and transport study area.
Impact 4: Driver Delay (capacity)	Yes	High	Multiple projects could lead to increases in traffic flows which may lead to cumulative impacts upon receptors.
Impact 5: Driver Delay (road closures)	Yes	High	
Operation			
There are not anticipated to be any disenable traffic and transport impacts during the operational phase that would give rise to significant cumulative impacts.			
Decommissioning			
It is anticipated that the decommissioning impacts would be no worse than those of construction.			

161. The next stage of the CIA is to identify other plans or projects where the same road network will be used for multiple projects, plans or activities.

162. All offshore cumulative projects were scoped out of the traffic and transport CIA, as it was assumed that the potential for significant impacts to occur in combination with the onshore aspects considered in this assessment was minimal.

163. It can be noted from **Table 23-14** that the proposed traffic flows via the road links to Holy Island (the A5 and A55) are below GEART screening thresholds and are therefore, assessed to result in no discernible or negligible environmental impacts. Therefore, all projects elsewhere in North Wales offshore are scoped out of the traffic and transport CIA

164. The projects considered in the CIA therefore included those on Holy Island only. No projects were taken forward for CIA. A summary of the potential for cumulative impacts to occur is detailed in **Table 23-22**.

Table 23-22 Potential for Cumulative Impacts to Occur

Project	Status	Distance from the Project (km)	Included in CIA	Rationale
Extensions to dwelling	Consented 13/03/19, construction status unknown	0	No	Sub-regional growth in housing and employment has been captured within TEMPro future year growth factors for 2021. Therefore, the cumulative effect of these
Holyhead	Application validated: 03/01/2019	1.8	No	
Parc Cybi	Consented, construction status unknown	0	No	

Project	Status	Distance from the Project (km)	Included in CIA	Rationale
Conversion of outbuilding	Consented, construction status unknown	0.4	No	housing and employment projects is inherent in the traffic and transport impact assessments.
Penrhos Industrial Estate	Application validated: 06/03/2019	0.5	No	
Trearddur Bay Hotel	Consented, construction status unknown	1.3	No	
Tyn Towyn Caravan Park	Consented, construction status unknown Date valid: 26/03/2019	1.8	No	
Porth Diana Boat Yard	Application validated: 28/02/2019, awaiting decision	2.4	No	
Penrhos Coastal Park	Consented, construction status unknown	0.35	No	At the time of writing, the Isle of Anglesey Council note that they are transferring planning information to a new planning portal, as such no information is available enable a full CIA to be undertaken.
Roadking Parc Cybi	Consented, construction status unknown	0	No	
Holyhead Port	Application validated: 23/11/2018	1.3	No	
Breakwater Country Park	Application validated: 04/03/2019, awaiting decision	1.6	No	
Tyn Towyn Caravan Park	Consented, construction status unknown Date valid: 26/03/2019	1.8	No	
Holy Island Resort	Planning permission granted.	2.5	No	
Holyhead Deep Phase I	In April 2017, a Marine Licence was granted for the first 0.5MW installation.	2.0	No	The ES for the Holyhead Deep Project does not present any information regarding onshore traffic and transport impacts.
Reclamation adjacent to Terminal 4 of the Port of Holyhead	Scoping Report submitted 28/04/17	2.0	No	At the time of writing, the only information available is provided within a Scoping Report. The Scoping Report does not however provide details of likely traffic increases, as such it is considered that there is insufficient information to allow a full CIA to be undertaken.
Holyhead Waterfront Redevelopment	Pre-application	2.0	No	At the time of writing, the ES was not available online and as such there is insufficient information to allow a full CIA to be undertaken.

23.6.7. Inter-relationships

165. **Table 23-25** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 23-23 Inter-topic relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Noise and Vibration	Chapter 21	Section 21.10.4 Construction Road Traffic Noise Emissions	The forecast construction traffic numbers contained within this chapter have been used to inform an assessment of traffic borne noise and vibration impacts. No significant residual noise and vibration effects have been identified.
Air Quality	Chapter 22	Section 22.6.4 Construction Phase road Traffic Emissions	The forecast construction traffic numbers contained within this chapter have been used to inform an assessment of traffic borne air quality impacts. No significant residual air quality effects have been identified.

23.6.8. Interactions

166. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 23-24**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 23-24 Potential Interaction Between Impacts

Potential interaction between impacts					
Construction	1 Severance	2 Pedestrian Amenity	3 Road Safety	4 Driver Delay (Capacity)	5 Drive Delay (Road Closures)
1 Severance	-	Yes	Yes	No	No
2 Pedestrian Amenity	Yes	-	Yes	Yes	No
3 Road Safety	Yes	Yes	-	No	No
4 Driver Delay (Capacity)	No	Yes	No	-	No
5 Drive Delay (Road Closures)	Yes	Yes	Yes	Yes	-
Operation					
No significant impacts					

23.7. SUMMARY

167. This chapter of the ES has assessed the potential impacts of the onshore elements of the Project on the surrounding traffic sensitive receptors.

168. This chapter has been developed with regard to the legislative and policy framework outlined in **Section 23.2**. In accordance with national guidance, a traffic and transport study area has been identified, baseline conditions established and sensitive receptors within the study identified. The traffic and transport study area was screened to identify routes that could be potentially adversely impacted by the Project's traffic generation.

169. A total of 13 links within the traffic and transport study area have been assessed for the effects of severance, pedestrian/ cycle amenity, road safety and driver delay. This detailed assessment concluded that here will therefore be no impacts resulting from the proposed Project that are considered to be significant in EIA terms (i.e. moderate or major adverse) as shown in **Table 23-25**.

Table 23-25 Potential Impacts Identified for Traffic and Transport

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction						
Impact 1: Severance	Links 4, 5, 6, 8	Low – High	Negligible	Negligible to Minor	n/a	Negligible to Minor
Impact 2: Pedestrian/ Cycle Amenity	Links 4 and 5	Low – High	Negligible	Negligible to Minor	n/a	Negligible to Minor
	Link 6 and 8	Low	Medium	Minor	n/a	Minor
Impact 3: Road Safety	All links	Negligible	Negligible	Negligible	n/a	Negligible
Impact 4: Driver Delay (capacity)	Junction 1, 2, 3	High	Negligible	Minor	n/a	Minor
	Landfall substation access	High	Medium	Major	CTMP management measures to prevent two HGVs meeting at the new access Provision of a new access to include a bound surface, advanced warning signs and a temporary speed limit.	Minor
Impact 5: Driver delay (road closures)	Links 5, 8, 10 12 and South Stack Road (west of link 6)	Low	Low	Minor	CTMP measures including: temporary traffic signals/ stop go boards; safe pedestrian routes; agreeing timing of works; and temporary road widening.	Minor
	Links 6, 11 and Mill Road	High	Negligible where direct access can be maintained	Minor	n/a	Minor
			High where direct access cannot be maintained	Major	Direct communication between the Contractor and residents; Temporary parking facilities; and Banksman to guide and assist residents through the works.	Moderate

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
	Links 6, 11	Low	Low	Minor	CTMP measures including: Detail of traffic management measures including proposed diversion signing; Staging of construction activities; and Details of measures to escort pedestrians and cyclists through the works.	Minor
Operation						
No discernible impacts						
Decommissioning						
It is anticipated that the decommissioning impacts would be no worse than those of construction.						

23.8. REFERENCES

Conwy County Borough Council, Denbighshire County Council, Flintshire County Council, Gwynedd Council, Isle of Anglesey County Council and Wrexham County Borough Council (30 January 2015). North Wales Joint Local Transport Plan 2015.

Department of Energy and Climate Change (DECC) (2011a). Overarching National Policy Statement for Energy (EN-1), London: (DECC).

Department of Energy and Climate Change (DECC) (2011b). National Policy Statement for Renewable Energy Infrastructure (EN-3), London: (DECC).

Department of Energy and Climate Change (DECC) (2011c). National Policy Statement for Electricity Network Infrastructure (EN-5), London: (DECC).

Department for Transport (DfT) (2009). Traffic Signs Manual, Chapter 8. Traffic Safety Measures and Signs for Road Works and Temporary Situations, Part 1: Design, London: (DfT).

Highways England (January 1995). Geometric Design of Major/Minor Priority Junctions TD 42/95

Institute of Environmental Assessment (IEA) (1993). Guidelines for the Environmental Assessment of Road Traffic, Horncastle: (IEA).

Isle of Anglesey County Council and Gwynedd Council (31 July 2017). Anglesey and Gwynedd Joint Local Development Plan (2011 - 2026)

Ministry for Housing, Communities and the Local Government (2014). Planning Practice Guidance, Travel Plans, Transport Assessments and Statements, London: communities.gov.uk.

Welsh Assembly Government (December 2018). Planning Policy Wales, Edition 10

Welsh Assembly Government (March 2007). Planning Policy Wales - Technical Advice Note 18: Transport

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Morlais Project
Environmental Statement

Chapter 24: Seascape, Landscape and Visual Impact Assessment

Volume I

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-024

Chapter 24: Seascape, Landscape and Visual Impact Assessment

Author: SLR Consulting Limited

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GLOSSARY OF ABBREVIATIONS

AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
DP	Dynamic Positioning
DSLR	Digital Single Lens Reflex
EIA	Environmental Impact Assessment
ES	Environmental Statement
GPS	Global Positioning System
HDD	Horizontal Directional Drilling
HEPLA	Hermitage Environmental Planning and Landscape Architecture Limited
IoACC	Isle of Anglesey County Council
JLDP	Joint Local Development Plan
KI	Key Issues
LAT	Lowest Astronomical Tide
LCA	Landscape Character Area
MDZ	Morlais Demonstration Zone
NCN	National Cycle Network
NPS	National Policy Statement
NRW	Natural Resources Wales
O&M	Operation and Maintenance
PDE	Project Design Envelope
PPW	Planning Policy Wales
PRoW	Public Rights of Way
SCA	Seascape Character Area
SLA	Special Landscape Area
SLR	SLR Consulting Limited
SLVIA	Seascape, Landscape and Visual Impact Assessment
SM	Scheduled Monument
SoCG	Statement of Common Ground
TAN	Technical Advice Note
TWG	Technical Working Group
ZTV	Zone of Theoretical Visibility

GLOSSARY OF TERMINOLOGY

Characteristics	Elements or combinations of elements which make a contribution to landscape character.
Cloddiau	Vegetated hedge bank.
Horizontal Directional Drilling	A trenchless method of installing underground cables through boring.
Landscape	An area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors.

Landscape receptors	Aspects of the landscape resource that have to potential to be affected by a proposal.
Open Access Land	Land where the public have access either by legal right or by informal agreement.
Photomontage	A visualisation which superimposes an image of a proposed development upon a photograph.
Scoping	The process of identifying the issues to be addressed by the environmental impact assessment process.
Seascape	An area of sea, coastline and land, as perceived by people, whose character results from the actions and interactions of land with sea, by natural and/or human factors.
Study Area	15 km area from the outer edge of the Morlais Demonstration Zone.
Visually prominent	A tidal device where the large proportion of the support structure is visible above the water to the extent it is visually prominent, together with ancillary elements such as navigation lights, railings and mast.
Visual receptors	Individuals and/or groups of people who have the potential to be affected by a proposal.

24. SEASCAPE, LANDSCAPE AND VISUAL IMPACT ASSESSMENT

24.1. INTRODUCTION

1. This section of the Environmental Statement (ES) provides an assessment of the potential effects on seascape and landscape resources and visual amenity that would be likely to result from the construction, operation and maintenance (O&M) and decommissioning of the offshore and onshore elements of the Morlais Project (the Project). The seascape, landscape and visual impact assessment (SLVIA) has been prepared and reviewed by landscape architects at SLR Consulting Limited (SLR). The work undertaken by SLR follows on from initial SLVIA work done by HEPLA in relation to the Project.

2. The Project is being developed by Menter Môn Morlais Limited (Menter Môn) and will have a tidal generating capacity of up to 240 MW within the Morlais Demonstration Zone (MDZ).

3. The development of the Project will provide a consented tidal technology demonstration zone, specifically designed for the installation and commercial demonstration of multiple arrays of tidal energy devices. The Project will include permanent communal infrastructure for tidal technology developers which provides a shared route to a local grid connection. This proposed onshore infrastructure includes a Landfall Substation at Ty-Mawr (hereafter referred to as Landfall Substation), a Grid Connection Substation at Orthios (hereafter referred to as Grid Connection Substation), and a Switchgear Building at Parc Cybi (hereafter referred to as Switchgear Building).

4. The chapter describes the baseline seascape, landscape and visual context to the Project, including the features and elements within the Offshore Development Area (OfDA) and Onshore Development Area (ODA) and the surrounding Study Area. It identifies the potential effects on seascape, landscape and visual receptors, concentrating on the likely significant effects, which are anticipated to occur within a maximum 15 km distance from the MDZ and has therefore defined the Study Area. It also describes the measures included to prevent, reduce or offset adverse effects (mitigation measures). The assessment has been undertaken using an iterative process, meaning that mitigation measures have been incorporated in the Project and the assessment presents the potential effects of the proposed Project taking account of these measures.

5. The Project will install multiple technology types within the MDZ, and so the consent application is based on a Project Design Envelope (PDE), determined through knowledge of existing technology and the direction of future developments. This approach reflects the emerging nature of tidal energy developments and the potential for the components of the development to change or evolve between the preparation of this assessment and implementation of the Project. The PDE is based on a potential realistic ‘worst case’ scenario; however, in relation to the SLVIA, the seascape/landscape and visual sensitivity of the local context is recognised and therefore the incorporated mitigation described above has influenced the PDE and set more specific design parameters for the components of the Project, which are described in more detail in **Section 24.6.2** of this chapter. In addition, recognising that the implementation of the Project would take place incrementally, a concise appraisal of a theoretical 40MW array of tidal energy

devices is included in **Appendix 24.5** (**Volume III**). The approach to this appraisal of a 40MW array is explained in the appendix.

6. The SLVIA concentrates on the key seascape, landscape and visual issues identified during the scoping stage and through continued dialogue with Natural Resources Wales (NRW) and The Isle of Anglesey County Council (IoACC), including the County Council's Area of Outstanding Natural Beauty (AONB) service. Consultation undertaken with NRW and IoACC is described in more detail in **Section 24.3** Consultation. Seascape, landscape and visual effects are defined as follows:

- Seascape/landscape effects – both physical changes to constituent elements of the seascape/landscape fabric, and how changes in the character and qualities of the seascape/landscape and designated areas are perceived by people, as a result of the Project; and
- Visual effects – changes to views or visual amenity, as experienced by people, from key viewpoints, the surrounding sea, settlements, roads, footpaths and cycle routes, as a result of the Project.

7. The location of the Project and the extent of their respective application boundaries are shown in **Figure 1-1 and 1-2** (**Volume II**). This is also detailed in **Chapter 4, Project Description**.

24.1.1. SLVIA Contents

8. This SLVIA is organised into the following main sections, with additional written data also included in appendices, as described below:

- Introduction;
- Project Description;
    - A description of the aspects of the Project with the potential to influence seascape/landscape and visual amenity within the Study Area;
- Design Optimisation and Mitigation Measures;
    - A description of how the PDE has evolved in response to potential seascape, landscape and visual effects identified during pre-application part of the Environmental Impact Assessment (EIA) process, and a description of mitigation measures incorporated at the design stage, aimed at reducing or minimising potentially adverse seascape/landscape and visual effects;
- Policy and Legislation;
    - A review of policy context relevant to seascape, landscape and visual matters;
- Consultation;
    - A summary of the consultation completed to agree the scope of the assessment;
- Methodology;
    - An explanation of how the SLVIA has been carried out, with reference to recommended methodologies and guidelines;

- Existing Environment;
  - A description of the existing seascape, landscape and visual amenity and receptors identified within the Study Area;
- Impact Assessment;
  - Assessment of effects during the construction phase;
    - An assessment of the likely effects arising during the construction phase of the Project;
  - Assessment of residual seascape, landscape and visual effects during the O&M phase;
    - A detailed assessment of the residual effects arising from the operation of the Project on the seascape and landscape resources and the perception of seascape/landscape character and designated areas within the Study Area;
    - An assessment of residual effects on visual amenity arising from the operation of the Project, including an assessment from a range of viewpoints identified and agreed through consultation with NRW, IoACC and the AONB service;
  - Assessment of cumulative and in-combination landscape and visual effects;
    - An assessment of the potential effects arising from the operation of the Project in conjunction with other relevant proposed developments within the Study Area;
  - Assessment of effects during the decommissioning phase;
    - An assessment of the likely effects arising during the decommissioning phase; and
- Summary
  - A summary of the key seascape, landscape and visual effects arising from the Project, and conclusion on the significance of effects.

24.1.2. Supporting Graphics and Appendices

9. The SLVIA is supported by several appendices. These contain detailed information about the approach to the assessment and specific elements that have been considered in detail. The SLVIA chapter should be read alongside the plans, photographs and visualisations, included in **Volume II**, and night time photomontages in **Appendix 24.4**, **Volume III**.

24.1.2.1. SLVIA Figures for the Offshore Development

10. The baseline seascape, landscape and visual context is illustrated in: **Figure 24-1-1a** (**Volume II**), SLVIA Study Area; **Figure 24-1-2a** (**Volume II**), Seascape/Landscape Designations; **Figure 24-1-2b** (**Volume II**), Walking/Cycling Routes; and **Figure 24-1-3** (**Volume II**), Seascape/Landscape Character Areas. Viewpoint locations are shown in **Figures 24-1-4 and 24-1-4a to d** (**Volume II**).

11. The assessment of seascape, landscape and visual effects is supported by the Zone of Theoretical Visibility (ZTV) maps in **Figures 24-2-1** to **24-2-2** (**Volume II**), viewpoint

photographs and wireframes in **Figures 24-3-1 to 24-3-20** (**Volume II**) and photomontages in **Figures 24-4-1 to 24-4-3 (Volume II)**. Night time photomontages are included in **Appendix 24.4** (**Volume III**).

12. The wireframes and photomontages that have been prepared as part of the SLIVA show the appearance of the full deployment of tidal energy devices included in the 240MW scenario that form the Project Design Envelope (PDE) for the SLVIA. The PDE is described in **Section 24.6.2**.

24.1.2.2. SLVIA Figures for the Onshore Development

13. The baseline seascape, landscape and visual context is illustrated in: **Figure 24-1-1** (**Volume II**), SLVIA Study Area; **Figure 24-1-2a** (**Volume II**), Seascape/Landscape Designations, **Figure 24-1-2b** (**Volume II**) Long Distance Walking Routes and Cycle Routes; and **Figure 24-1-3** (**Volume II**), Seascape/Landscape Character Areas. Viewpoint locations are shown in **Figure 24-1-4, Figure 24-1-4e and Figure 24-1-4f** (**Volume II**).

14. The assessment of seascape/landscape and visual effects is supported by the ZTV maps in **Figures 24-2-3 to 24-2-5** (**Volume II**), viewpoint photographs and wireframes in **Figures 24-3-21 to 24-3-31** (**Volume II**), and photomontage in **Figures 24-4-4** (**Volume II**).

24.1.2.3. Appendices

15. This chapter is accompanied by **Appendices 24.1 to 24.5** in **Volume III**. These provide greater detail and background information on:

- **Appendix 24.1** Method used in Assessing Seascape, Landscape and Visual Effects: provides a detailed explanation of the approach to the assessment and how judgements have been made;
- **Appendix 24.2** Seascape and Landscape Character Areas within the 15 km Study Area: contains baseline information regarding the Study Area from relevant character assessments published by Natural Resources Wales and Isle of Anglesey Council;
- **Appendix 24.3** Viewpoint Assessment: contains the detailed assessment of all viewpoints included in the SLVIA.
- **Appendix 24.4** Night Time Photomontages: contains night time photomontages for selected viewpoints; and
- **Appendix 24.5** Appraisal of 40MW Array: contains a concise appraisal of an initial deployment of tidal energy devices within the MDZ.

24.2. POLICY AND LEGISLATION

16. Planning policies and guidance are covered in detail in **Chapter 2, Policy and Legislation**. The policies, legislation and guidance relevant to the SLVIA are set out below, **Figure 24-1-2a,** (**Volume II**), identifies the location and extent of the landscape policy designations. At present the application for the Project, with regard to landscape and visual matters, would be considered under national, regional and local policy, as reviewed below.

24.2.1. Key Designations

There are several designations within the Study Area that have relevance to the SLVIA, including:

- The Isle of Anglesey AONB;
- Sections of Heritage Coast;
- One Special Landscape Area (SLA);
- One Registered Park and Garden; and
- Conservation Areas.

24.2.1.1. Isle of Anglesey AONB

17. The Isle of Anglesey AONB was designated in 1996 and covers an area of approximately 221 km^2 (approximately one third of the island). It is almost continuous around the coastline, with only occasional breaks including Holyhead and Trearddur Bay. The AONB is predominantly a coastal designation, but also encompasses Holyhead Mountain (220 m Above Ordnance Datum (AOD)) and Mynydd Bodafon. Further areas of other land protected by the AONB designation form the backdrop to the coast. The AONB is characterised by sea cliffs/coastal edge and islands. Inland it is primarily a working landscape, with agriculture being the predominant land use. Tourism is a key employer on the island, with people attracted to the beaches and coastal landscape. The AONB also includes areas that are designated at a national and international level for their ecological value. The land is mainly managed by farmers, however there are also areas managed by other organisations including NRW, the Wildlife Trust and The National Trust. The primary objective of the AONB designation is the protection and preservation of landscape character, quality and features from inappropriate development. The location and extent of the AONB in relation to the Project is shown in **Figure 24-1-2a** (**Volume II**).

18. The Isle of Anglesey AONB Management Plan Review 2015-2020 (Isle of Anglesey AONB and NRW) sets out the vision and strategy for the AONB, as well as highlighting its sensitivities and special qualities for which it has been designated. This document identifies the objectives relating to energy development on the Isle of Anglesey, also noting the potential influence this could have on the AONB. This Management Plan is reviewed in more detail as part of the policy context set out below (**Section 24.2.4**), including the special qualities of the AONB.

24.2.1.2. Heritage Coast

19. Heritage Coasts are special coastlines that are managed so that their natural beauty is conserved and, where appropriate, the accessibility for visitors is improved. Heritage Coasts are a non-statutory landscape definition and are defined by agreement between the relevant local authorities and government agencies. Most Heritage Coasts are associated with areas that form part of a National Park or AONB (as is the case with the Isle of Anglesey).

20. There are three sections of the Anglesey coastline that are designated as Heritage Coast, two of which lie within the Study Area. These comprise the north west coast of Holy Island (the

closest coastline to the MDZ) and the north west part of mainland Anglesey, between Swtan and Wylfa Head. Both these sections of Heritage Coast are also designated as AONB. As set out in Planning Policy Wales Edition 10 (Welsh Government, December 2018), the overall aim of this designation is to preserve the character of the coastline. Part of the reason for the Heritage Coast designation is to protect the undeveloped character of these locations. The designation of this section of coast as Heritage Coast reinforces the AONB and reflects the special qualities of this landscape. The location and extent of the sections of Heritage Coast in relation the Project are shown in **Figure 24-1-2a**, (**Volume II**).

24.2.1.3. Special Landscape Areas

21. In December 2012 the Anglesey and Gwynedd Joint Planning Policy Unit published the Review of Special Landscape Areas in Gwynedd and Anglesey. This document reviewed the existing local landscape designations, Special Landscape Areas (SLAs), as part of their Joint Local Development Plan preparation. Planning Policy Wales (2012) sets out that SLAs are applied by local planning authorities where there is good reason to believe that normal planning policies cannot provide the necessary protection.

22. Six SLAs were identified within Anglesey and of these only one SLA lies within the Study Area, the Mynydd Mechell SLA. This SLA lies in the north western part of mainland Anglesey, approximately 4.5 km from the western coast and 3 km from the northern coast. It comprises a distinctive pattern of dispersed rural properties set within a small scale field pattern and craggy, strongly undulating landform. Although relatively low lying it possesses an upland quality and contrasts with the smoothly rolling drumlin landscape that surrounds the SLA. The location and extent of the Mynydd Mechell SLA in relation the Project is shown in **Figure 24-1-2a** (**Volume II**).

24.2.1.4. Register of Historic Landscapes

23. The Register of Historic Landscapes/Historic Parks and Gardens in Wales has been consulted during the preparation of this assessment. This has identified that there are no Landscapes of Special or Outstanding Historic Interest within the Study Area. However, one Registered Park and Garden lies within the Study Area, Carreglwyd, positioned towards the north western edge of the Isle of Anglesey. It lies to the north west of Llanfaethlu and is approximately 1 km from the coastline. The location of Carreglwyd is shown in **Figure 24-1-2a** (**Volume II**).

24. Careglwyd is a largely eighteenth century mansion with earlier origins. There is good survival of the grounds, which mainly comprise a nineteenth-century layout of ornamental wooded grounds focused on an informal lake, incorporating earlier elements. The park and garden also includes woodlands, which were planted for practical and aesthetic reasons.

24.2.1.5. Conservation Areas

25. There are four Conservation Areas within the Study Area, including Holyhead Mountain, Holyhead Beach Holyhead Central and Bodedern.

24.2.2. National Planning Policy

24.2.2.1. Planning Policy Wales

26. Relevant national planning policy context is set out in Planning Policy Wales (PPW), Edition 10 (Welsh Government, December 2018). Figure 3, Key Planning Principles of PPW sets out that the planning system should protect natural, historic and cultural assets and negative environmental impacts impact should be avoided in the wider public interest. Chapter 6; Distinctive and Natural Places, of PPW, includes a strong emphasis on the landscape of Wales and its characteristics.

27. PPW identifies that the landscapes of Wales are rich and varied, highlighting that the character and special qualities of urban and rural landscape can make contributions to sense of place, inspiration and belonging, as well as to the distinctive cultural identity of Wales. Particular emphasis is made in relation to the protection of nationally designated landscapes, including National Parks and AONBs, identifying (in paragraph 6.3.8 of PPW) that these designations *"must both be afforded the highest status of protection from inappropriate developments"*.

28. PPW also identifies the importance of local landscapes and how, where appropriate, local authorities should make provision for their conservation and enhancement. Also of direct relevance to the SLVIA are references to designated or protected sites on the coast. Paragraph 6.5.12 of PPW states *"Development proposals should aim to protect or enhance the natural or historic character and landscape of undeveloped coastlines. The particular landscapes of the coastline should be recognised and protected where they represent significant characteristics of place. Designation as a heritage coast does not directly affect the status of the area in planning terms, however, the features which contributed to the designation of such areas will be important considerations in development plans and in making development management decisions.*"

29. Chapter 3; Strategic and Spatial Choices of PPW highlights the importance of good design for new developments, identifying that landscape and green infrastructure considerations are an integral part this process. It also sets out that the *"special characteristics of an area should be central to the design of a development"*, with an emphasis placed on the *"layout, form, scale and visual appearance of a proposed development and its relationship to its surroundings"*. The importance of areas that are recognised for their landscape, townscape, cultural or historic character and value is also identified, noting the particular importance of design considerations in such locations.

30. Chapter 5; Productive and Enterprising Places, of PPW includes energy, and specifically renewable and low carbon energy. This sets out the importance of the Welsh Government's targets to increase renewable and low carbon energy generation. Paragraph 5.9.17 of PPW states that "*in circumstances where protected landscape, biodiversity and historical designations and buildings are considered in the decision making process, only the direct irreversible impacts on statutorily protected sites and buildings and their settings (where appropriate) should be considered"*.

31. Relevant National planning guidance is also provided in Planning Policy Technical Advice Notes (TANs). TAN12: Design (Welsh Government, March 2016) places importance on the appreciation of context and how a development should respond to this, including local character. TAN12 also place an emphasis on landscape design and the contribution this can make to a proposed development. TAN8: Planning for Renewable Energy (Welsh Assembly Government, July 2005) does not provide any guidance that specifically relates to tidal energy development. TAN8 also provides little specific policy or guidance in relation to landscape and visual issues, although there is general recognition of the need for landscape protection.

24.2.2.2. National Policy Statements

32. The Project is seeking consent for a Transport and Works Act Order from the Welsh Ministers and a Marine Licence from Natural Resources Wales (NRW). Although this Project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP), therefore guidance relevant to NSIPs is considered appropriate to use for this Project. Guidance that is relevant to assessing impacts on SLVIA for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs.

33. At a national level, policy is set out in the National Policy Statements (NPS) for energy infrastructure. The NPSs that are relevant to the Project include; EN-1 – Overarching National Policy Statement for Energy (Department of Energy and Climate Change, July 2011), and EN-3 – National Policy Statement for Renewable Energy Infrastructure (Department of Energy and Climate Change, July 2011). While the focus of the NPSs relates to applications for energy infrastructure that falls under the Planning Act 2008, EN-1 also states (paragraph 1.2.1 of EN-1) that "*In England and Wales this NPS is likely to be a material consideration in decision making on applications that fall under the Town and Country Planning Act 1990 (as amended)*". It is also likely that this policy is applicable to the consenting route that has been adopted for the Project.

34. EN-1 Overarching Energy NPS makes numerous references to landscape and visual impacts. It identifies that the development of new energy infrastructure is likely to have some negative impacts on landscape and visual amenity and cultural heritage. It also states that *"in general, it should be possible to mitigate satisfactorily the most significant potential negative effects"*, also reflecting that *"the impacts on landscape/visual amenity in particular will sometimes be hard to mitigate"*. In paragraph 1.7.11 it reinforces this, stating that *"the principal area in which consenting new energy infrastructure...is likely to lead to adverse effects which cannot always be satisfactorily mitigated is in respect of landscape and visual effects"*. It goes on to outline that potential for such development in the most attractive landscapes and townscapes is already severely limited and further restriction would make consents much harder to gain.

35. Section 5.9 (Landscape and Visual) of EN-1, provides general advice on the assessment of impacts as well as providing general advice in relation to mitigation of potential impacts through siting, layout, design and landscaping schemes.

36. Section 5.8 (Historic Environment) and 5.10 (Land Use Including Open Space, Green Infrastructure and Green Belts) of EN-1 are also relevant to this assessment. These aspects

are also covered by other assessments, but there is some overlap where relevant designations e.g. Conservation Areas and Registered Parks and Gardens can be reflective of landscape or townscape character and the associated policies protect certain characteristics of such designations.

37. EN-3 NPS for Renewable Energy Infrastructure reiterates some aspects covered by EN-1 e.g. good design. There is no specific guidance that relates to tidal energy developments. However, Section 2.6 (Offshore Wind) of EN-3 contains some relevant guidance on the assessment of potential seascape and visual effects.

38. The above considerations are an integral part of this SLVIA and the method used. The NPSs also provide some explanation of the key considerations that should be applied to decisions for proposed developments, including projects within and outside nationally designated landscape and also considering potential visual impacts.

39. Details of specific policies within EN-1 and EN-3 used to inform this assessment are provided in **Table 24-1** below. The specific assessment requirements for SLVIA are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 24-1 NPS EN-1 and EN-3 Assessment Requirements Relevant to SLVIA

NPS Requirement	NPS Reference	ES Reference
An emphasis on good design is placed. It reflects that high quality design goes beyond aesthetic considerations, but still places importance on the appearance of proposed developments. It also sets out that there may be opportunities to “demonstrate good design in terms of siting relative to landscape character, landform and vegetation”.	EN-1 Section 4.5	**Section 24.6.2** sets out the design optimisation and embedded mitigation measures of the project.
The applicant should carry out a landscape and visual assessment and report it in the ES…The landscape visual assessment should include reference to any landscape character assessment and associated studies as a means of assessing landscape impacts relevant to the proposed project…The applicants assessment should also take account of any relevant policies based on these assessments in…local development plans in Wales	EN-1 Paragraph 5.9.5	**Sections 24.4.6** and 24.4.7 set out the data sources used for this assessment. **Section 24.2** outlines the policy and legislation relevant to this assessment.
The applicant’s assessment should include the effects during construction of the project and the effects of the completed development and its operation on landscape components and landscape character	EN-1 Paragraph 5.9.6	**Sections 24.6.4** and **24.6.5** set out the potential impacts that have been assessed within this chapter for both construction and operation respectively.
The assessment should include the visibility and conspicuousness of the project during construction and of the presence and operation of the project and potential impacts on views and visual amenity. This should include light pollution effects, including on local amenity, and nature conservation	EN-1 Paragraph 5.9.7	As above.

NPS Requirement	NPS Reference	ES Reference
An emphasis is placed on the protection that is afforded to national landscape designations (including AONBs), confirming the policy set out in PPW; that *"National Parks, the Broads and AONBs have been confirmed by the Government as having the highest status of protection in relation to landscape and scenic beauty"*. It also establishes that conservation of the natural beauty of the landscape and countryside should be given substantial weight in decisions for development in such areas.	EN-1 Paragraph 5.9.9	**Section 24.6.5.3** details the assessment of effects on landscape designations and **Section 24.6.5.2** sets out the assessment of effects on seascape and landscape character.
Where proposed development will affect the setting of a heritage asset, representative visualisations may be necessary to explain the impact.	EN-1 Section 5.9.8	**Sections 24.5.2.3**, **24.5.2.4** and **24.5.2.15** outlines the baseline archaeological features which have been assessed within this chapter (**Section 24.6.5**).
There is a requirement to protect open space and green infrastructure, reflecting on the contribution such assets make to local communities.	EN-1 Section 5.10	**Section 24.5.3** and **24.5.2.12** set out the seascape and landscape designations and the overall character which has been assessed within this chapter (**Section 24.6.5**).
It sets out that an appropriate seascape and visual assessment should be carried out, based on recognised methodologies.	EN-3 Section 2.6	The methodology follows good-practice guidance and advice, key sources of guidance are detailed in **Section 24.4.1** and **Appendix 24.1 (Volume III)**.

24.2.2.3. The Well Being of Future Generations (Wales) Act 2015

40. The Well Being of Future Generations (Wales) Act 2015 does not specifically relate to seascape, landscape and visual amenity. However, it does relate clearly to environmental, social, economic and cultural themes. It places the importance of sustainable development at the centre of the goals set out by this Act. Therefore, it forms part of the considerations for balancing the predicted effects of the Project identified in the SLVIA against the positive contributions it would make to both the local community and wider region and country.

24.2.3. Local Planning Policy

24.2.3.1. Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026

41. The current planning policy framework for Anglesey is set out in the Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026 (adopted 31st July 2017). The Joint Local Development Plan (JLDP) sets out a number of "Key Issues" (KI), with KI 34 and 35 having direct relevance to this assessment. KI 34 identifies the need to *"maintain the positive features that contribute towards creating a unique character in various parts of the area"*. KI 35 states the need to protect and improve place, landscape and buildings of historic, cultural and archaeological importance and their setting.

42. The JLDP also sets out a clear vision for the Plan area. This includes reference to the need to value, protect and enhance the unique character of the built and cultural heritage, its countryside and landscape and its environment.

43. Theme 5: Protect and Enhance the Natural and Built Environment includes, within Strategic Objective 17, an outline of the need to protect, enhance and manage the natural and heritage assets of the Plan area, including landscape character. Similar principles are reinforced in Strategic Policy PS 5: Sustainable Development, which sets out (amongst numerous other criteria) that development proposals should "*protect and improve the quality of the natural environment*", including its landscapes.

44. The JLDP also includes a number of specific landscape policies that are relevant to the SLVIA.

45. Policy PCYFF 3: Design and Place Shaping sets out that all proposals will be expected to demonstrate high quality design, including taking account of the natural, built and environmental context.

46. Policy PCYFF 4: Design and Landscaping has particular relevance to the SLVIA. It states that: *"All proposals should integrate into their surroundings. Proposals that fail to show (in a manner appropriate to the nature, scale and location of the proposed development) how landscaping has been considered from the outset as part of the design proposal will be refused. A landscape scheme should, where relevant:*

1. *Demonstrate how the proposed development has given due consideration to the Landscape Character Area Assessment or Seascape Character Area Assessment;*
2. *Demonstrate how the proposed development respects the natural contours of the landscape;*
3. *Demonstrate how the proposed development respects and protects local and strategic views;*
4. *Respect, retain and complement any existing positive natural features, landscapes, or other features on site;*
5. *Identify trees, hedgerows, water courses and topographical features to be retained;*
6. *Provide justification for circumstances where the removal/loss of existing trees, hedgerows, water courses and topographical features cannot be avoided and provides details of replacements;*
7. *Provide details of any proposed new landscaping together with a phased programme of planting;*
8. *Demonstrate that any proposed new planting includes plants and trees of mainly native species of local provenance and does not include any non-native invasive species;*
9. *Ensure that selection of species and planting position of any trees allows for them to grow to their mature height without detriment to nearby buildings, services and other planting; and*
10. *Provide permeable hard surface landscaping."*

47. Strategic Policy PS 9: Renewable Energy Technology seeks to promote such initiatives, but also recognises the need to consider potential landscape and visual impacts, overlapping with the objectives of Strategic Policy PS 19 (set out below). With specific relevance to this assessment, it places an emphasis on designated landscapes and the amenity of residential and holiday accommodation.

48. Policy ADN 3: Other Renewable Energy and Low Carbon Technologies identifies that such proposals will be permitted providing impacts, including those on designated landscapes, can be adequately mitigated and where the proposal does not have a significant unacceptable effect on visual amenities. It also highlights that, *"where necessary, proposals should be informed by the landscape and visual impact assessment"*.

49. Strategic Policy PS 14: The Visitor Economy includes a specific criterion associated with preventing development that is considered to have an unacceptable adverse impact on tourist facilities, including accommodation and areas of visitor interest (or their setting).

50. Chapter 6 of the JLDP relates directly to the natural and built environment. There are several policies within Chapter 6 of the JLDP that are of particular relevance to this SLVIA. Strategic Policy PS 19: Conserving and Where Appropriate Enhancing the Natural Environment states that *"The Councils will manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline, and proposals that have a significant adverse effect on them will be refused unless the need for and benefits of the development in that location clearly outweighs the value of the site or area and national policy protection for that site and area in question. When determining a planning application, consideration will need to be given to the following:*

1. *Safeguard the Plan area's habitats and species, geology, history, the coastline and landscapes;*

2. *Protect or where appropriate enhance sites of international, national, regional and local importance and, where appropriate, their settings in line with National Policy;*

3. *Have appropriate regard to the relative significance of international, national or local designations in considering the weight to be attached to acknowledged interests, ensuring that any international or national responsibilities and obligations are fully met in accordance with National Policy;*

4. *Protect or enhance biodiversity within the Plan area and enhance and/or restore networks of natural habitats in accordance with the Local Biodiversity Action Plans and Policy AMG 5;*

5. *Protect or enhance biodiversity through networks of green/ blue infrastructure;*

6. *Safeguard internationally, nationally and locally protected species;*

7. *Protect, retain or enhance the local character and distinctiveness of the individual Landscape Character Areas (in line with Policy AMG 2) and Seascape Character Areas (in line with Policy AMG 4);*

8. *Protect, retain or enhance trees, hedgerows or woodland of visual, ecological, historic cultural or amenity value."*

51. In cognisance of Chapter 5 of PPW, the IoACC includes a summary within **Policy PS 19** of relevant designations, including landscape designations, and sets out its obligation in respect of each type of designation. The following extract refers to AONB designations which are relevant to the Proposed Development:

52. "The primary objective for designating AONBs is to conserve and enhance the natural beauty of the landscape. It is crucial that any development schemes that affect the AONB or its setting favours the safeguarding of an area's natural beauty.

Proposals for major development would have to satisfy 3 tests, which are:

- *The need for the development, in terms of national considerations, and the impact of permitting it or refusing it upon the local economy;*
- *The cost of and scope for providing the development outside the designated area or meeting the need for it in some other way;*
- *Any detrimental effect on the environment and the landscape, and the extent to which that could be moderated."*

53. Policy AMG1: AONB Management Plans states further that: *"Proposals within or affecting the setting and/ or significant views into and out of the Areas of Outstanding Natural Beauty must, where appropriate, have regard to the relevant AONB Management Plan."*

54. The relevant extracts from the Anglesey AONB Management Plan are reviewed below.

55. Policy AMG 2: Special Landscape Areas protects locally designated landscapes. Whilst the Proposed Development will not be located within a Special Landscape Area cognisance will be given to Policy AMG2 which states that: "*When considering a proposal within Special Landscape Areas (SLA), as identified by the Proposals Map…there will be a need to* [give] *appropriate consideration to the scale and nature of the development ensuring that there is no significant adverse detrimental impact on the landscape."*

56. Policy AMG 3: Protecting and Enhancing Features and Qualities That Are Distinctive to The Local Landscape Character sets out specific criteria that are applicable to sites and their local context. Particular consideration has been given to the design of the onshore infrastructure associated with the Proposed Development in respect of the requirements of Policy AMG 3 which states that: *"A proposal will be granted provided it doesn't have significant adverse impact upon features and qualities which are unique to the local landscape in terms of visual, historic, geological, ecological or cultural aspects. Measures should be taken to ensure that the development does not:*

1. Cause significant adverse impact to the character of the built or natural landscape;

2. Fail to harmonise with, or enhance the landform and landscape;

3. Lose or fails to incorporate traditional features, patterns, structures and layout of settlements and landscape of both the built and natural environment.

Particular emphasis will be given to the landscapes identified by the Landscape Character Areas as being of high and outstanding quality because of a certain landscape quality or a combination of qualities. Additional consideration will also be given to development [s] *that directly affect the landscape character and setting of the AONBs or the National Park."*

57. Policy AMG 4: Coastal Protection is directly relevant to areas designated as Heritage Coast setting out that *"In considering a proposal on the coast, including the Heritage Coast, there will be a need to ensure that the proposal conforms to the following criteria:*

1. The development due to its nature must be located on the coast, or in open estuaries, or nearby, and that there is an overriding economic and social benefit from the development

2. It does not cause unacceptable harm to:

i. Water quality

ii. Public access considerations

iii. The built environment, or the landscape, or seascape character

iv. The area's biodiversity interests (including European Protected Areas such as marine Special Areas of Conservation and Special Protected Areas) due to their location, scale, form, appearance, materials, noise, or emissions or due to an unacceptable increase in traffic.

3. Priority is given to locations with a close visual connection to current buildings or existing structures.

4. There are no suitable alternative locations on the coast that have been developed.

5. That the development is consistent with other policies within the Plan including Policy ARNA1."

24.2.4. Isle of Anglesey AONB Management Plan Review 2015 – 2020

58. The Isle of Anglesey AONB Management Plan Review 2015 – 2020 also includes a number of Management Objectives and associated policies. The following text sets out those that are directly relevant to the Proposed Development and landscape/seascape character within the Study Area. These all relate to the overall aim for enhancing countryside and coastal character; *"the natural beauty, special qualities and distinctiveness of the landscape of the Isle of Anglesey AONB, including its natural, cultural and historical features, will be conserved and enhanced for the benefit of present and future generations"*.

Management Objective 1: Landscape/Seascape

- *The coastal landscape/seascape will be actively conserved through appropriate management.*

Policies

CCC 1.1 LANDMAP is used as the process by which the landscape character of the AONB is valued and assessed.

CCC 1.2 The Anglesey Seascape Character Assessment is used to help determine the likely impacts of marine developments on the special qualities and features of the AONB.

CCC 1.3 There is a need to maintain the accessibility and conservation interest of sites of geological and geomorphological importance.

CCC 1.4 Elements of the landscape that have been degraded and lost their character will be restored and enhanced to safeguard the quality of the landscape.

Management Objective 2: Historic Landscape and Culture

- *Historic, archaeological and cultural sites are important features of the Isle of Anglesey AONB. Strong planning policies will protect such sites from development that degrades the special qualities of the AONB.*

Policies

CCC 2.1 Identify, protect and actively conserve the historic, archaeological and cultural resources of the AONB with relevant agencies.

CCC 2.2 Support the use of traditional skills and practices during restoration of the AONB's special qualities.

CCC 2.3 Ensure that high quality, co-ordinated and consistent interpretation material is provided to inform people about the rich history of the AONB.

Management Objective 3: Development

- *Planning Policies will ensure that all development within and adjacent to the boundary of the AONB is compatible with the aims and objectives of the designation and that new developments enhance local character.*

Policies

CCC 3.1 All development proposals within and up to 2 km adjacent to the AONB will be rigorously assessed to minimise inappropriate development which might damage the special qualities and features of the AONB or the integrity of European designated sites.

CCC 3.2 All new developments and re-developments within and up to 2 km adjacent to the AONB will be expected to adopt the highest standard of design, materials and landscaping in *order to enhance the special qualities and features of the AONB. Proposals of an appropriate scale and nature, embodying the principles of sustainable development, will be supported.*

CCC 3.3 Ensure that planning policies reflect the statutory duty of the Council to conserve and enhance the special qualities and features of the AONB.

CCC 3.4 Continue to encourage the under grounding of existing and proposed power and telephone lines.

CCC 3.5 Continue to encourage the highest standards of equipment design for telecommunication masts to minimise their visual impact on the special qualities and features of the AONB.

Management Objective 4: Peace and Tranquillity

- Unspoilt panoramic views and tranquil atmosphere are safeguarded from improvement that would degrade the special quality of the AONB.

Policies

CCC 4.1 Work to maintain the solitude and natural beauty of the AONB.

CCC 4.2 Work towards securing Dark Skies status for Anglesey.

CCC 4.3 Ensure noise intrusion into the AONB is within acceptable limits."

59. In addition to the above, the Management Plan recognises the focus on Anglesey becoming an Energy development island, with this relating to both nuclear and renewable energy. The Energy Island Programme is a partnership between public and private sector organisations. Through this programme it is intended to put Anglesey at the forefront of energy related technology developments with the potential associated economic benefits. It sets out that renewable energy may include offshore wind farms, marine turbines and solar farms. At the same time the Management Plan recognises the potential for these to influence the landscape and seascape of the AONB, resulting from the potential proximity of such development and the need to bring the power that is generated ashore.

60. The AONB Management Plan also sets out the features and special qualities of the AONB. The features of the Anglesey AONB are defined as:

- Coastal landscape/seascape features;
- Traditional agricultural landscape features; and
- Geological and geomorphological features.

61. The special qualities of the Anglesey AONB are identified as comprising the following:

- Expansive views/seascapes;
- Peace and tranquillity;
- Islands around Anglesey;

- Broadleaved woodlands;
- Lowland coastal heath;
- Species rich roadside verges;
- Ecologically important coastal and wetland habitats (including rocky shores, mudflats and estuaries, saltmarshes, beaches and dunes);
- Built environment including conservation areas and listed buildings;
- Archaeology and ancient monuments/ historic landscapes, parks and gardens;
- Rural agricultural/coastal communities;
- Welsh language;
- Soil, air and water quality;
- Public rights of way network; and
- Accessible land and water.

24.2.5. Summary

62. **Table 24-2** summarises the national and regional policy of relevance to SLVIA.

Table 24-2 National and Regional Policy Requirements Relevant to SLVIA

Policy Description	Reference	ES Reference
MPS		
The effects of activities and developments in the marine and coastal area on the landscape, including seascape, will vary on a case-by-case basis according to the type of activity, its location and its setting. There is no legal definition for seascape in the UK but the European Landscape Convention (ELC) defines landscape as “an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors”. In the context of this document, references to seascape should be taken as meaning landscapes with views of the coast or seas, and coasts and the adjacent marine environment with cultural, historical and archaeological links with each other.	2.6.5.1	The potential seascape, landscape and visual effects associated with all land-based components of the Project are assessed throughout **Section 24.6.**
Draft WNMP		
Designated landscapes Proposals that demonstrate that they are compatible with the purposes and special qualities for which National Parks or Areas of Outstanding Natural Beauty have been designated are encouraged.	SOC_06	Impacts to Anglesey AONB are considered throughout the impact assessment (**Section 24.6**)
Seascapes Proposals should demonstrate how potential impacts on seascapes have been taken into consideration at an early stage and should, in order of preference: a) avoid adverse impacts on seascapes; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be adequately addressed, proposals should present a clear and convincing	SOC_07	The SLVIA considers offshore effects associated with offshore tidal energy devices. This has comprised the analysis of numerous viewpoints along the coastline,

Policy Description	Reference	ES Reference
justification for proceeding. Opportunities to enhance seascapes are encouraged.		including elevated locations. (**Section 24.6.4** and **24.6.5**)
Cumulative effects Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01	Cumulative impacts are considered in **Section 24.6.7** and within **Chapter 26, Cumulative and In-combination**
Planning Policy Wales		
All the landscapes of Wales are valued for their intrinsic contribution to a sense of place, and local authorities should protect and enhance their special characteristics, whilst paying due regard to the social, economic, environmental and cultural benefits they provide, and to their role in creating valued places.	6.3.3	The sensitivity of seascapes and landscapes are discussed within **Section 24.5.2**.
The statutory landscape designations that apply in Wales are National Parks, and AONBs. Planning authorities have a statutory duty to have regard to National Parks and AONB purposes.	6.3.5	Impacts to Anglesey AONB are considered throughout the impact assessment (**Section 24.6**)
In National Parks, planning authorities should give great weight to the statutory purposes of National Parks, which are to conserve and enhance their natural beauty, wildlife and cultural heritage, and to promote opportunities for public understanding and enjoyment of their special qualities. Planning authorities should also seek to foster the social, economic and cultural well-being of their local communities.	6.3.6	As above
In National Parks or AONBs, special considerations apply to major development proposals which are more national than local in character. Major developments should not take place in National Parks or AONBs except in exceptional circumstances. This may arise where, after rigorous examination, there is demonstrated to be an overriding public need, refusal would be severely detrimental to the local economy and there is no potential for locating the development elsewhere or meeting the need in some other way. Any construction and restoration must be carried out to high environmental standards. Consideration of applications for major developments should therefore include an assessment of: • the need for the development, in terms of national considerations and the impact of permitting it or refusing it upon the local economy; • the cost of and scope for providing the development outside the designated area or meeting the need for it in some other way; and	6.3.10	As above

Policy Description	Reference	ES Reference
• any detrimental effect on the environment and the landscape, and the extent to which that could be moderated and/or mitigated.		
Planning authorities should protect the features and utilities for which Geoparks and RIGS have been designated, and are encouraged to promote opportunities for the incorporation of geological features within the design of development, particularly where relevant evidence is provided by Green Infrastructure Assessments.	6.3.15	The geology of landscape features is considered in **Section 24.5.2.1**and **24.5.2.2**. Impacts to designated sites for geology are assessed in **Chapter 18, Ground Conditions and Contamination**.
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
All proposals will be expected to demonstrate high quality design which fully takes into account the natural, historic and built environmental context and contributes to the creation of attractive, sustainable places. Innovative and energy efficient design will be particularly encouraged.	Policy PCYFF 3: Design and Place Shaping	Embedded mitigation measures are discussed in **Section 24.6.2.**
All proposals should integrate into their surroundings. Proposals that fail to show (in a manner appropriate to the nature, scale and location of the proposed development) how landscaping has been considered from the outset as part of the design proposal will be refused.	Policy PCYFF 4: Design and Landscaping	As above.
1. All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced; 2. That the proposal does not have a significant unacceptable effect on visual amenities; 3. That the proposal is mitigated to ensure that there aren't any significant unacceptable effects on sensitive uses located nearby; 6. That the development does not have cumulative unacceptable effect with any prominent features in the landscape or townscape;	Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	As above
Whilst ensuring compatibility with the local economy and communities and ensuring the protection of the natural, built and historic environment the Councils will support the development of a year-round local tourism industry	Strategic Policy PS 14: The Visitor Economy	The inter-relationship between SLVIA and Tourism and Recreation is discussed in **Section 24.6.8**.
The Councils will manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline, and proposals that have a significant adverse effect on them will be refused unless the need for and benefits of the development in that location clearly outweighs the value of the site or area and national policy protection for that site and area in question.	Strategic Policy PS 19: Conserving and Where Appropriate Enhancing the Natural Environment	The potential seascape, landscape and visual effects associated with all land-based components of the Project are assessed throughout **Section 24.6.**

Policy Description	Reference	ES Reference
Proposals within or affecting the setting and/ or significant views into and out of the AONB must, where appropriate, have regard to the relevant Area of Outstanding Natural Beauty Management Plan.	Policy AMG1: Area of Outstanding Natural Beauty (AONB) Management Plans	Impacts to Anglesey AONB are considered throughout the impact assessment (**Section 24.6**)
Proposals that would have significant adverse impact upon landscape character as defined by the Landscape Character Areas included within the current Landscape Strategy for the relevant authority, must demonstrate through a landscape assessment how landscape character has influenced the design, scale, nature and site selection of the development.	Policy AMG 3: Protecting and Enhancing Features and Qualities that are Distinctive to the Local Landscape Character	Impacts to LCAs, SCAs and the Heritage Coast are considered throughout the Impact Assessment (**Section 24.6**)
It is important that heritage assets - encompassing archaeology and ancient monuments, listed buildings, conservation areas and historic parks, gardens and landscapes are preserved	Policy PS 20: Preserving and Where Appropriate Enhancing Heritage Assets	
Wellbeing of Future Generations (Wales) Act 2015		
A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).	A resilient Wales	See **Section 24.6** for the impact assessment results.

24.3. CONSULTATION

63. SLVIA scoping was carried out in October 2018 as part of the formal scoping exercise described in **Chapter 6, Consultation**. In addition, considerable consultation has taken place with IoACC and NRW during the preparation of this SLVIA. This has taken place through three specific technical working group (TWG) meetings that have focussed on the issues associated with the SLVIA, including the scope of the assessment and the PDE. **Table 24-3** provides a summary of the comments received during the scoping exercise and the TWG meetings. The TWG discussions have been extensive and are described in detail in the Statement of Common Ground (SoCG) included in **Document MOR/RHDHV/DOC/0071**, with a concise summary provided below. An overall description of consultation undertaken as part of the Project, including the SLVIA, is provided in **Document MOR/RHDHV/DOC/0066, Consultation Report**.

Table 24-3 Summary of Scoping Consultation

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Scoping Comments	The ES should confirm how long the drilling rig would be required at the landfall and this should be factored into the assessment.	The duration of construction activities is described in **Chapter 4: Project Description**. Construction activities are considered in the SLVIA, **Section 24.6.4**
		Table 9-2 of the Scoping Report has not referred to the potential impacts of any works that would	The potential seascape, landscape and visual effects associated with all land based

Consultee	Date/Document	Comment	Response
		be required at the grid connection site (i.e. a substation or switching facility). The ES should assess the potential impacts of all elements of the Proposed Works, including any elements that would be temporary.	components of the Project are assessed throughout **Section 24.6 Impact Assessment**.
		Details of any proposed landscaping should be provided within the ES. Consideration should be given to the length of time for foliage to develop and whether planting could be commenced in advance of construction to maximise the growth period before structures are in place.	There is a commitment to restore land that is disturbed during the construction phase of the Project. No specific planting proposals are incorporated in the Project at present and the mitigation of land based elements of the Project concentrate on site selection and design of the substations. It is envisaged that the detail of any specific additional requirements for planting and restoration would be agreed the future in response to a condition.
		The Scoping Report has not made reference to the selection of viewpoints. However, it is recommended that these are discussed and effort is made to agree them with the local authority and NRW.	Consultation has taken place and the viewpoints included in the SLVIA have been agreed with IoACC and NRW.
		It is recommended that wireframes and photomontages are produced for the offshore and onshore works respectively, in order to aid the reader in understanding the visually prominent characteristics of the Proposed Works. In producing visualisations, including photomontages and wireframes, views should be verified and visualisations should accord with industry standards.	A combination of Wireframes and photomontages have been prepared for the viewpoints included in the SLVIA. These have informed the judgements in **Section 24.6 Impact Assessment**.
NRW	2015 Scoping Comments	The scoping report is brief in setting out the proposal in the seascape and landscape context. It acknowledges the AONB statutory landscape designation and outlines the Seascape Character Area baseline context for the development proposal. We recommend that you utilise	Regional and local seascape units have been referred to in the preparation of the SLVIA, with the focus being on the Seascape Character Assessment Published by IoACC (2013). Further consultation has taken place with NRW and IoACC to inform the SLVIA.

Consultee	Date/Document	Comment	Response
		Regional Seascape Units and Local Seascape Units information. The latter includes a sensitivity assessment to tidal stream development. We recommend that additional advice is sought from NRW advisory in this matter.	
	2015 Scoping Comments	In regard to sensitive viewpoints – the AONB is referred to and distinctiveness of South Stack in particular. Sea views towards the Anglesey coastline as well as views of the sea from the coast are relevant to the assessment. In the case of the former, views from the Ireland to Holyhead Ferry contribute to an important gateway to Wales.	These points have been factored into the SLVIA, including viewpoints that reflect offshore visual receptors (**Viewpoints 13 and 14**).
	2015 Scoping Comments	Section 8.2 land use and quality does not mention that part of Penrhos Beach and all of Penrhos Coast Park which lies within the AONB. The routing of the cable, construction disturbance, location of the substation and potential effects upon the visual amenity of visitors to this part of the AONB need to be considered within the scope of the EIA.	Changes to the design of the Project mean that Penrhos Beach and Coast Park would not be directly affected. The revised deign for the Project includes onshore infrastructure within the AONB and this is assessed in **Section 24.6**.
	2015 Scoping Comments	The list of developments included within the cumulative effects assessment appear to include the relevant consented, operational and in planning development within the vicinity but we recommend Anglesey County Council planning department and NRW MLT are contacted to provide definitive comment on this matter prior to submission of any application.	Up to date information on potential cumulative developments in the Study Area have been reviewed and are considered in **Section 24.6.7**.
	2018 Scoping Comments	The EIA scoping report covers the seascape and landscape baseline context appropriately. As a minor point of clarification, paragraph 2 on page 113 notes that 'construction activity and surface piercing infrastructure would be visible from receptors in areas of offshore SCAs 30, 31 and 32'. We advise that SCA32 therefore needs to be included in table 9-1. Marine Character Area	All SCAs within the Study Area have been considered in the SLVIA, including SCA32. The descriptions of the SCA have been incorporated in the baseline description (**Appendix 24.2**).

Consultee	Date/Document	Comment	Response
		descriptions may also be relevant and should be incorporated within the baseline description where appropriate.	
	2018 Scoping Comments	Visual receptors have been described in general terms. As the project develops we would wish to be consulted on viewpoints that will be used to assess change to visual amenity and change to character. A viewpoint schedule, reason for inclusion, receptor sensitivity and viewpoint location plan would be useful. Photomontage images to help explain the visual aspects of the project will be required.	Viewpoints included in the assessment have been agreed through consultation with NRW and IoACC. Viewpoint location plans were provided as part of this process. The details of all viewpoints that form part of the SLIVA are included in **Appendix 24.3** and are summarised in **Section 24.6.5.4**. A combination of photomontages and wireframes have been prepared as part of the SLVIA.
	2018 Scoping Comments	To help clarify how effects upon natural beauty of the AONB can be addressed, in our experience the visual and character aspects of the assessment need to be brought together when assessing effects upon special qualities and people's perceptions. We recommend that it would be helpful to set this assessment out in the visual effects tables that accompany the photo viewpoint images.	The potential effects on seascape and landscape character are described in **Section 24.6.5.2** and specific consideration of potential effects on the special qualities of the AONB are included in **Section 24.6.5.3.1**.
	2018 Scoping Comments	The potential impacts upon Seascape and Landscape are set out generically at this stage but cover the key themes of the assessment topic appropriately. The category 'changes' to visual amenity is described within the framework of potential impacts on the amenity of the offshore area. We assume, however, that both onshore and offshore visual receptors will be assessed.	Effects on visual amenity for both onshore and offshore visual receptor are considered in relation to all components of the Project.
	2018 Scoping Comments	The project will be informed by a range of constraints and impacts to be avoided or minimised. Imbedded and iterative design are important components of EIA towards impact avoidance, and we would welcome design input imbedded to positively benefit the scheme's visual integration and influence any options being considered.	Iterative design has been an integral part of the design process for both the offshore and onshore components of the Project. The feedback received from NRW and IoACC has also influenced this process. The Project Design Envelope and the mitigation that has been incorporated in this is set out in **Section 24.6.2**.

Consultee	Date/Document	Comment	Response
	2018 Scoping Comments	Wireframe modelling of the development for key sensitive viewpoints, panoramas and sequential views (where they exist) will help identify and look to resolve the potential issues of the offshore development component. A colour assessment for the sub-station and its landscape context is recommended, to identify a palette of integrating colours, given the open and wind-swept nature of much of the AONB. Limited use of lighting is recommended to avoid night time effects upon dark skies/ dark seascapes and tranquillity of the AONB.	Wireframe modelling has been undertaken for all viewpoints included in the SLVIA. The layout and design of the Landfall Substation, including materials and colours, and how these relate to the AONB have been key considerations.
	2018 Scoping Comments	There is no published guidance for the planning and design of tidal arrays in relation to seascape, landscape and visual amenity contexts, however established guidance for wind farm planning and seascapes, seascape sensitivity and assessment methodologies are relevant; for example: ▪ LI and EIMA Guidelines for landscape and visual impact assessment 3rd edition 2013; ▪ Dti Guidance on the assessment of the impact of offshore wind farms 2012; ▪ SNH Offshore renewables - guidance on assessing the impact of coastal landscape and seascape 2012; and ▪ SNH Visual representation of wind farms guidance 2017.	Relevant guidance, including documents stated, has informed the approach to the assessment. This is summarised in **Section 24.4**, with a more detailed assessment methodology included in **Appendix 24.1**.
	2018 Scoping Comments	Due to a lack of detailed drawings, it is difficult to gauge the potential visual impact of the proposed development. From a landscape perspective, it is encouraging to note that comments made earlier scoping opinion have been taken into consideration and incorporated	The potential impacts of all components of the Project have been considered within the 15 km Study Area. The assessment of the onshore components has concentrated on an area extending to 3 km. This has included locations on the Anglesey Coastal Path and

Consultee	Date/Document	Comment	Response
		into the scoping report. However, one particular issue which appears to have been overlooked is that of the 500 m study area for quantifying the offshore effects of the development, particularly when such development is viewed from elevated locations. The Anglesey Coastal Path and the environs of Holyhead Mountain afford such elevated viewing positions and there needs to be an adjustment of the study area in order to increase coverage in this regard. The offshore effects the study area should be extended/adjusted where elevated views may be affected – this should be determined by any Zones of Theoretical Visibility (ZTVs).	the environs of Holyhead Mountain.
	2018 Scoping Comments	Viewpoints for the Landscape and Visual Impact Assessment (LVIA) should be agreed with the local planning authority (LPA) and NRW TE. Given the extent of potential visual impacts, viewpoints should cover the following receptors: ▪ AONB; ▪ Heritage Coast; ▪ Landscape Character Areas; ▪ Seascape Character Areas; ▪ Wales Coast Path; ▪ Onshore recreation and leisure activities within the study area; ▪ Tourist Traffic using the Port of Holyhead; and ▪ Conservation Areas.	Viewpoints included in the SLVIA have been agreed with NRW and IoACC and the majority of the receptors listed are covered. The exception to this is Conservation Areas, but these have been considered within the SLVIA through desk-based analysis, including review of the ZTVs, and fieldwork.
	2018 Scoping Comments	It is unclear if or how the onshore assessment considers properly off-shore effects, for example, some of the generating equipment demonstrated include above water elements. These may well be visible from several viewpoints, particularly elevated ones thereby dictating that viewpoints selected for assessing visual impacts need	The SLVIA considers offshore effects associated with offshore tidal energy devices. This has comprised the analysis of numerous viewpoints along the coastline, including elevated locations.

Consultee	Date/Document	Comment	Response
		to consider effects on expansive sea views.	
	2018 Scoping Comments	Whilst the Isle of Anglesey County Council (IoACC) has not made a formal application to the International Dark-Sky Association (IDA) to attain Dark Sky Community Status for Anglesey, a number of sky quality assessments have been completed. IoACC are currently scoping the most effective approach for preparing and submitting an application to the IDA. The proposed development will need to be assessed against Policy AMG1: (AONB) Management Plans of the Joint LDP 2011 -2026, where 'Proposals within or affecting the setting and / or significant views into and out of the AONB must, where appropriate, have regard to the relevant AONB Management Plan'. Any form of lighting, therefore, will need to consider how it impacts on the AONB aligned to the special qualities within the AONB Management Plan. In this particular case, the two special qualities of the AONB which could be affected are the expansive views / seascapes and; peace and tranquillity. The potential impact on the non-statutory, Holyhead Mountain Heritage Coast designation will need to be considered within the context of the AONB Management Plan. Given the lifespan of the proposed development, the ES should address the onshore facility's decommissioning and site restoration proposals.	The potential lighting associated with the Project has been considered in the SLVIA, including through the inclusion of five specific night time viewpoints. The effects on seascape and landscape character, including the AONB and Heritage Coast are included in the SLVIA. Decommissioning of the Project has been considered at a high level in the SLVIA. It is envisaged that the detail of decommissioning and restoration would be agreed the future in response to a condition.
IoACC	2018 Scoping Comments	The 500 m study area for quantifying the offshore effects of the development should be extended to take into account elevated viewing positions.	A 15 km study area has been used for the assessment of potential effects and takes account of elevated viewing positions.
		Viewpoints and receptors for the Landscape and Visual Impact Assessment (LVIA) should be	Viewpoint and receptors included in the SLVIA have been agreed with both NRW and IoACC.

Consultee	Date/Document	Comment	Response
		agreed with the local planning authority (LPA).	
		The potential for impacts beyond the 500 m study area proposed will be relevant for development within the designated Area of Outstanding Natural Beauty and coastal edge. The following components are identified as the physical components of the proposal: ▪ Export cable to shore and landfall area; and ▪ Onshore cable and substation location; Effects should be considered at the construction; maintenance and decommissioning phases. Section 3.2 notes the parameters that would be defined with a Rochdale Design Envelope. The detail should be adequate in order to assess significance.	The potential impacts of all components of the Project have been considered within the 15 km Study Area. The assessment of the onshore components has concentrated on an area extending to 3 km. This has included locations on the Anglesey Coastal Path and the environs of Holyhead Mountain. The design envelope that forms the basis of the assessment is described in **Section 24.6.2**.
		The number and location of viewpoints should be agreed with the LPA as part of the LVIA. These should encompass the main receptors listed below: ▪ AONB; ▪ Heritage Coast; ▪ Landscape Character Areas; ▪ Seascape Character Areas; ▪ Wales Coast Path; ▪ Onshore recreation and leisure activities within the study area; ▪ Tourist traffic using the port of Holyhead; and ▪ Conservation Areas.	Viewpoints included in the SLVIA have been agreed with NRW and IoACC and the majority of the receptors listed are covered. The exception to this is Conservation Areas, but these have been considered within the SLVIA through desk-based analysis, including review of the ZTVs, and fieldwork.
		The LVIA should also have regard to the possible cumulative effects within the study area of the proposed development with other, particularly energy related development whether existing; permitted or live applications, together with reasonably foreseeable proposals.	Potential cumulative developments in the Study Area have been reviewed and are considered in **Section 24.6.7**.

Consultee	Date/Document	Comment	Response
		We advise that a CLVIA cut-off date be agreed with the LPA. This should be at a date close to the preparation of the applicants Cumulative Assessment. A record of live and determined applications is held by, and available from the Planning Service free of charge.	Up to date information on potential cumulative developments in the Study Area, including planning applications for proposed development submitted to IoACC, have been reviewed and are considered in **Section 24.6.7**.
		Due to a lack of detailed drawings, it is difficult to gauge the potential visual impact of the proposed development. From a landscape perspective, it is encouraging to note that comments made in our earlier scoping opinion have been taken into consideration and incorporated into the scoping report. However, one particular issue which appears to have been overlooked is that of the 500 m study area for quantifying the offshore effects of the development, particularly when such development is viewed from elevated locations.	The potential impacts of all components of the Project have been considered within the 15 km Study Area. The assessment of the onshore components has concentrated on an area extending to 3 km. This has included locations on the Anglesey Coastal Path and the environs of Holyhead Mountain.
		The Anglesey Coastal Path and the environs of Holyhead Mountain afford such elevated viewing positions and there needs to be an adjustment of the study area in order to increase coverage in this regard.	The Anglesey Coast Path and environs of Holyhead Mountain are included within the Study Areas and considered as part of the SLVIA.
		It is unclear if or how the onshore assessment considers properly off-shore effects, for example, some of the generating equipment demonstrated include above water elements. These may well be visible from several viewpoints, particularly elevated ones thereby dictating that viewpoints selected for assessing visual impacts need to consider effects on expansive sea views.	The SLVIA considers offshore effects associated with offshore tidal energy devices. This has comprised the analysis of numerous viewpoints along the coastline, including elevated locations.
		The 500 m study area, will be too narrow to consider off-shore effects. This issue was raised in our earlier scoping report. Given this, the study area needs to be extended/adjusted where elevated views may be affected – this will be determined by any	The potential impacts of all components of the Project have been considered within the 15 km Study Area. The assessment of the onshore components has concentrated on an area extending to 3 km. This has included locations on

Consultee	Date/Document	Comment	Response
		Zones of Theoretical Visibility (ZTVs). Viewpoints for the Landscape and Visual Impact Assessment (LVIA) should be agreed with the local planning authority (LPA). Given the extent of potential visual impacts, viewpoints should cover the following receptors: ▪ AONB; ▪ Heritage Coast; ▪ Landscape Character Areas; ▪ Seascape Character Areas; ▪ Wales Coast Path; ▪ Onshore recreation and leisure activities within the study area; ▪ Tourist Traffic using the Port of Holyhead; and ▪ Conservation Areas.	the Anglesey Coastal Path and the environs of Holyhead Mountain. ZTVs for the components of the Project have been prepared and have influenced the scope of the SLVIA, including the Study Area. Viewpoints included in the SLVIA have been agreed with NRW and IoACC and the majority of the receptors listed are covered. The exception to this is Conservation Areas, but these have been considered within the SLVIA through desk-based analysis, including review of the ZTVs, and fieldwork.
NRW/IoACC	TWG meetings – 30th October 2018, 12th March 2019, 17th April 2019	Discussions relating to the approach to the SLVIA including the extent of the study area, the viewpoint selection for all Project components, the preparation/ presentation of viewpoint photography and related visualisations and the scope of the cumulative assessment.	The SLVIA has taken account of the comments and requests that have been made, as described in the **Statement of Common Ground** in **Document MOR/RHDHV/DOC/0071**.
NRW/IoACC	TWG meeting, 12th March 2019	Concern expressed about the PDE for the MDZ, particularly in relation to the value and sensitivity associated with the local context. It was identified that the closest coastline is highly valued and sensitive to new development. The wild and undeveloped character of Holyhead Mountain was highlighted, with specific reference to Gogarth Bay.	In response to the concerns raised, the PDE was revisited and an alternative approach was presented at the third TWG meeting. This included a range of measures that reduced the extent of the PDE and have been adopted for the proposed development. These embedded mitigation measures are set out in **Section 24.6.2**.
	TWG meeting, 12th March 2019	NRW/IoACC expressed the need for potential effects of the Landfall Substation to be considered carefully and set out that the SLVIA process should inform the approach that is taken. They identified that this was particularly important in the context of the baseline landscape, which comprises an open, exposed coastal	This request has been responded to in the design process. The SLVIA has proactively influenced the design of the Landfall Substation from the selection of the site to the layout of the buildings and the proposed materials. These measures are explained in **Section 24.6.2**.

Consultee	Date/Document	Comment	Response
		landscape that is designated as an AONB.	
NRW/IoACC	Conference call 25th March 2019 and letter from NRW 2nd April 2019	Conference call specifically discussed the Landfall Substation location and design. Subsequent letter from NRW followed up points made during the second TWG meeting (12th March) and the conference call. The points made in relation to the sensitivity of the landscape particularly in relation to potential development in the northern part of the MDZ were confirmed. The two substation locations presented during the conference call are referred to (one near Tŷ Mawr Farm and a second, the proposed site, adjacent to South Stack Road). A general preference is stated in relation to the second of these options i.e. the proposed Landfall Substation location, although residual issues are also stated. A suggestion is made in relation to placing the Landfall Substation in the field to the north east of option two.	Continued consideration has been given to the design and layout of the substation based on the comments from NRW and IoACC. Option two is the location proposed for the substation. Consideration has been given to the field to the north east of option two. However, this has not been taken forward due to the increased project infrastructure that would be required, potential for buried utilities/pipes linked with the nearby reservoir and greater potential for loss of landscape features e.g. potential removal of existing field boundaries.
NRW/IoACC	TWG meeting, 17th April 2019	NRW/IoACC acknowledged the progress that had been made, specifically in relation to the PDE for the offshore components of the Project and the Landfall Substation. It was recognised that this evolution in the Project was positive. However, it was also noted that the Project would still have the potential to result in adverse seascape, landscape and visual effects.	The potential effects of the revised PDE have been assessed in the SLVIA.

24.4. METHODOLOGY

64. The chapter is supported by **Appendix 24.1** (**Volume III**), which contains a detailed description of the method of assessment used to carry out the SLVIA.

24.4.1. Guidance

65. The SLVIA methodology follows good-practice guidance and advice on the assessment of the impacts of development on seascape, landscape and visual resources. A key source of guidance is the Guidelines for Landscape and Visual Impact Assessment (Third Edition, 2013) (GLVIA 3). Other guidance documents, including those specific to photography and visualisation techniques, have also been referred to. These are detailed in **Appendix 24.1** (**Volume III**).

24.4.2. General Methodology

66. The general approach to the SLVIA includes the following key tasks:

- Desk study and preliminary site survey;
- Consultation and confirmation of scope and approach with the NRW and IoACC;
- Baseline assessment of seascape, landscape and visual resources (consisting of desk study, field survey and reporting);
- Layout and design optimisation;
- Assessment of potential seascape, landscape and visual effects (construction, decommissioning and, in particular, residual operational effects); and
- Assessment of potential cumulative seascape, landscape and visual effects.

67. Defining the baseline involved reviewing the existing seascape, landscape and visual resource of the Study Area in terms of its character, value, susceptibility and sensitivity. The baseline assessment forms the basis against which to assess the magnitude and significance of the predicted landscape and visual impacts arising from the Project.

68. The baseline assessment comprises three main stages; desk study; field survey; and analysis. The methods for these three stages are described below.

69. The first stage of the assessment reviewed the existing seascape, landscape and visual resource of the Study Area in terms of its character, value and sensitivity and with reference to existing published sources. The baseline assessment forms the basis against which to assess the magnitude and significance of the predicted landscape and visual impacts arising from the Project.

70. The baseline assessment involved three elements:

- Description – the process of collecting and presenting information about seascape, landscape and visual resources in a systematic manner;
- Classification – the more analytical activity whereby seascape/landscape in particular is refined into units of distinct and recognisable character; and

- Evaluation – the process of attributing a value to a given landscape or visual resource, by reference to specified criteria.

71. Once the baseline context in relation to seascape, landscape and visual receptors has been reviewed, this information is combined with an understanding of the proposed change or development that would be introduced in order to identify and describe the seascape, landscape and visual effects. The assessment process determines whether the level of an effect would be significant or not through methodical consideration of, firstly the sensitivity of seascape, landscape and visual receptors relative to changes as a result of the Project and, secondly, the magnitude of change that they would experience. The relationship between sensitivity and magnitude of change is evaluated to reach a judgement in relation to the level of effect that would occur and whether this would be considered to be significant.

72. Where the seascape, landscape or visual effect has been classified as major or major/moderate, this is considered to be a significant effect in terms of the EIA Regulations. Moderate effects are considered individually to determine whether each effect is significant or not significant. It should be noted that significant effects need not be adverse and may be either negative or positive. The assumption is that effects are negative unless stated.

73. The correlation between receptor sensitivity and the predicted magnitude of change (as set out in **Appendix 24.1**) is not prescriptive. The methodology and analysis of potential effects at any particular location must make allowance for the exercise of professional judgement. Thus, in some instances, a particular parameter may be considered as having a determining effect on the analysis.

24.4.3. Zones of Theoretical Visibility

74. Zones of theoretical visibility (ZTV) have been prepared for the different components of the Project to identify the parts of the Study Area with potential visibility of the Project. Separate ZTVs have been prepared for the offshore development within the MDZ and for each of the onshore substations. The ZTVs have been prepared using Ordnance Survey Terrain 5 and Terrain 50 data. All the ZTVs are based on bare earth terrain data and therefore do not take account of the influence of surface features, such as buildings and vegetation, on potential visibility.

75. Two ZTVs have been prepared for the offshore components. The first of these (**Figure 24-2-1**, **Volume II**) shows the theoretical maximum visibility of the proposed offshore components within the MDZ. This is based on the height of the tallest structure (the electrical hub) and assumes structures of this height are placed around the perimeter of the MDZ. The height of the electrical hub (for the PDE) is 18 m above lowest astronomical tide (LAT). As LAT is 3.05 m below Ordnance Datum (based on data for Holyhead[1]) a height of 14.95 m has been used to calculate the ZTV. This ZTV is considered to represent a likely worst case for the Project.

76. The second ZTV (presented at two different scales in **Figures 24-2-2a** and **24-2-2b**, **Volume II**) is based more specifically on the PDE. It is based on the various heights and positions of the tidal energy devices and electrical devices that make up the PDE. The floating tidal energy devices are not fixed in position but would be moored/anchored to the seabed using cables or chains. This is necessary to allow for varying tide heights and means there would be some movement in the positions of the devices. Therefore, the pattern of visibility would vary with tide heights and flows. However, this ZTV provides a more realistic pattern of theoretical visibility based on the PDE.

77. ZTVs for the three substations are presented in **Figures 24-2-3**, **24-2-4** and **24-2-5** (**Volume II**). These ZTVs are based on the maximum height of proposed structures within each substation: 7 m for the Landfall Substation; 9 m for the Grid Connection Substation and 4 m for the Switchgear Building. For the purposes of these ZTVs it is assumed that a building of these heights would occupy the entire footprint of the substation footprint.

24.4.4. Supporting Visualisations

78. The SLVIA is supported by a range of figures including viewpoint photography. The viewpoint assessment has been carried out to identify and evaluate potential effects on seascape/landscape and visual amenity arising from the Project at specific and representative locations in the Study Area. This concentrates on publicly accessible areas such as the road and public footpath network, residential and outdoor recreational areas. Viewpoints have been selected in consultation with NRW and IoACC. The viewpoints are considered to be representative of the spectrum of receptors in the Study Area, located at different distances, directions and heights relative to the Project and accord with best practice guidance. The viewpoint locations are shown in **Figures 24-1-4** (**Volume II**), with more detailed locations shown in **Figures 24-1-4a** to **24-1-4f** (**Volume II**).

79. The assessment has involved the production of computer generated wireframes and photography. Photography was obtained using a full frame digital Single Lens Reflex (DSLR) camera mounted with a 50 mm 'fixed' lens (predominately Nikon D600). The camera was mounted on a tripod with a panoramic head in order to obtain a stable platform and the single frame and panoramic views. The position of the tripod was recorded with a handheld GPS

[1] - https://www.ntslf.org

device. In addition to recording the location of the viewpoint, observations relating to time of day, weather, cloud cover, and visibility were recorded.

80. Following completion of the fieldwork, the photography was reviewed and the clearest images selected for the production of panoramic images. In some cases, small adjustments were made to the images through the use of Adobe Photoshop software in order to improve clarity. The panoramas were then prepared through the joining of individual frames in Photoshop to generate 360 degree panoramas.

81. The visualisations supporting the SLVIA have been presented in order to provide a view of the elements of the Project within its seascape/landscape context and assist the assessor in determining the change and resultant effect on the viewpoint location.

82. The photomontages have been prepared through the use of Adobe Photoshop CC (2019), 3D Studio Max (2019) and Vray (3.6) software. This allows the devices to be accurately positioned in the photograph/panorama and rendered so as to account for cloud cover, sun position and colour of the device. While every effort is undertaken to render the devices to account for the prevailing lighting conditions, where the devices may appear indistinct to the background, manipulation of the rendering has been applied in order to make the structures appear more distinct for the purposes of clarity within the assessment.

83. The presentation of graphics material requires careful consideration in order to prepare a visualisation that provides an accurately scaled depiction of the Project for use at the viewpoint location. The presentation of the visualisations is based on principles included in the guidance provided in Photography and Photomontage in Landscape and Visual Impact Assessment (Landscape Institute Advice Note 01/11) and Visual Representation of Wind Farms (Scottish Natural Heritage, February 2017). The visualisations should be used in the field at the viewpoint location. Instructions for viewing the visualisations are provided on the figures for each viewpoint. It should be noted that in reality neither photographs nor visualisations can convey a view exactly as it would be seen by the human eye.

24.4.5. Study Area

84. The Study Area for the SLVIA extends to a 15 km radius from the MDZ. The terrestrial elements of the Project are all located within this overall Study Area. However, the assessment relating more specifically to the substations concentrates on a more focussed area around each site, up to approximately 3 km. The 15 km radius Study Area has been used for the assessment of effects upon seascape and landscape character, landscape designations, visual receptors and the cumulative assessment. The extents of the Study Area are based on professional judgement and experience and is considered to be appropriate for the identification of the potentially significant effects associated with the nature and location of the different elements of the Project, and consistent with accepted industry best practice. The extent of the Study Area has been agreed in consultation with NRW and IoACC.

24.4.6. Data Sources – Desk Study

85. Baseline sources for information about the Study Area which have been reviewed in the preparation of this SLVIA include the following:

- Current and Historical Ordnance Survey (OS) Maps;
- Admiralty Charts;
- Aerial Photography;
- Published Landscape Character Assessments;
- Published Seascape Character Assessments;
- Inventories of Designated Landscapes;
- National Planning Guidance;
- Development Plans;
- Non-Statutory Planning Documents;
- Historic and cultural guides and interpretation boards in the local landscape; and
- Conservation information relating to archaeology, cultural heritage, buildings and other conservation interests.

24.4.7. Data Sources – Site-specific Surveys, Reports and Guidance

86. The following documents have been referred to in the preparation of the SLVIA:

- Landscape Institute and Institute of Environmental Management and Assessment (2013) *Guidelines for Landscape and Visual Impact Assessment (GLVIA 3)*, Third Edition;
- The Countryside Agency and Scottish Natural Heritage (2002), *Landscape Character Assessment: Guidance for England and Scotland*;
- Countryside Council for Wales, Brady Shipman Martin, University College Dublin, (March 2001) Report No. 5 *Guide to Best Practice in Seascape Assessment*; Maritime Ireland/Wales INTERREG 1994-1999;
- LDA (2012) *An Approach to Seascape Character Assessment*, Natural England;
- Enviros Consulting (2005) *Seascape and Visual Impact Assessment Guidance for Offshore Wind Farm Developers*, DTI;
- Landscape Institute (2011) *Photography and Photomontage in Landscape and Visual Impact Assessment*, Landscape Institute Advice Note 01/11;
- Scottish Natural Heritage (2017) *Visual Representation of Wind Farms*, Version 2.2
- LUC (2015) *National Seascape Assessment for Wales*, Natural Resources Wales;
- Natural Resources Wales (dates vary for different character area profiles) National Landscape Character Areas;
- Natural Resources Wales. LANDMAP Information.
- Fiona Fyfe Associates with Countryscape and Bangor University (SEACAMS), (2013) *Anglesey Seascape Character Assessment*, Isle of Anglesey County Council;
- TACP (2011) *Anglesey Landscape Strategy update,* Isle of Anglesey County Council;

- Isle of Anglesey County Council and Natural Resources Wales. The Isle of Anglesey Areas of Outstanding Natural Beauty; Management Plan Review 2015 to 2020;
- International Association of Marine Aids to Navigation and Lighthouse Authorities (December 2013). IALA Recommendation O-139 on The Marking of Man-Made Offshore Structures, Edition 2; and
- International Association of Marine Aids to Navigation and Lighthouse Authorities (May 2013). IALA Recommendation E-108 on The Surface Colours used as Visual Signals on Aids to Navigation, Edition 3.

24.5. EXISTING ENVIRONMENT

87. This section provides a general description of the seascape, landscape and visual context of the RLB and Study Area. It briefly describes the historical and cultural context within the Study Area, identifying both sensitive locations and receptors to be addressed in the subsequent impact assessment. Elements of this information is presented in greater detail in other relevant sections of this ES (e.g. **Chapter 20, Onshore Archaeology and Cultural Heritage**), but a review of the local coastal area in relation to its amenity use and conservation designation status is briefly summarised below in order to provide a more accessible context for the baseline description of the seascape and landscape.

24.5.1. Regional Context

88. The MDZ lies off the west coast of Holy Island, Anglesey. Inshore to the east is Holyhead Mountain, and to the south the lower lying coast of Rhoscolyn and Rhosneigr, and further to the south Caernarfon Bay. To the north is the open sea to the north of Anglesey and to the north east Holyhead Bay opens, beyond Holyhead Mountain, framed by the distant headland at Carmel Head. Holyhead Mountain, 220 m AOD, is a prominent landmark onshore, and gives a strong sense of place and orientation throughout the Study Area. In wider views from the Study Area the mountains of Snowdonia frame views to the east and the distant profile of the Llyn peninsula frames the southern edge of Caernarfon Bay.

89. There is a long and continuing tradition of maritime communications, particularly with Ireland, and the area is well used by commercial shipping, passenger ferries, cruise ships, fishing vessels and recreational vessels.

90. The MDZ forms a seven-sided polygon, indented on its eastern side reflecting the shape of the coastline. The zone is focussed on the area of strong tidal flow around the north west part of Holy Island. It lies between approximately 500 m and 1.5 km from the closest part of the west coast of Holy Island, with the closest section of the coast to the MDZ being between South Stack and Penrhyn Mawr. It extends north into the south western edge of Holyhead Bay and 1 km to the south of Ravens Point at its southern extent. The MDZ measures approximately 4 km from east to west in the north, 5.5 km from east to west in the south and is approximately 8.5 km from north to south. The MDZ is shown in the figures that support the SLVIA e.g. **Figure 24-1-1** (**Volume II**).

24.5.2. General Characteristics and Features of the Study Area

24.5.2.1. Topographical Features

91. The topography of the Isle of Anglesey is generally subdued with a rolling, undulating pattern interspersed by harder, rocky outcrops such as Holyhead Mountain. The landform falls from east to west, with a number of low-lying areas along the western coast. This general character belies a complex, underlying geology and effects of geomorphological processes such as glaciation.

92. Holyhead Mountain forms the highest point on Anglesey, rising up to 220 m AOD. It has a distinctive rounded profile which reflects the underlying geology of metamorphic Cambrian age rocks and includes the well-known South and North Stacks on its rocky northern coastline. The landscape is wild and untamed and provides a vantage point for expansive views to the west and provides relative containment to the inland areas to its east.

93. The northern and middle portion of Holy Island is relatively low lying but is interspersed with frequent craggy outcrops which give rise to an undulating terrain. Further south around Rhoscolyn where glacial clay cover is more widespread, the landscape is softer and more rolling, interspersed with occasional rocky outcrops.

94. To the east, the inland sea between Holy Island and Anglesey lies at a low level, a discrete enclosed landscape.

95. To the north west of the Study Area the rocky coastline along the north west coast of Anglesey forms a sequence of rocky cliffs and headlands between Alaw Bay in the south to Carmel Head in the north. To the east of this coastline the inland areas are characterised by extensive drumlin fields, orientated with a south west to north west striation, formed by the deposition of boulder clay during the glacial retreat of the last Ice Age. Interspersed with this landform are a number of hard rocky features such as Mynydd y Garn and Mynydd Mechell.

96. At the south western extent of the Study Area the rural area of west central Anglesey is underlain with granite giving rise to an area of undulating topography with occasional outcrops.

24.5.2.2. Natural Heritage Features

97. The Study Area covers a diverse range of landscapes, encompassing both lowland and upland areas that support a variety of flora and fauna. In addition, the geology of the region provides a broad range of sites of geological and geomorphological interest. The key natural heritage attributes can be broadly summarised as follows:

- Upland/moorland habitats;
- Rock outcrops;
- Dry heaths and scrub;
- Areas of acid grassland;
- Marshland;

- Littoral;
- Intertidal; and
- Maritime.

98. Extensive tree cover is generally scarce with the exception of the area around Penrhos and the edge of the inland sea where there are areas of estate plantation and semi-natural woodlands. Generally, the land cover is dominated by improved grassland within a mosaic of fenced/walled and hedged pastures.

24.5.2.3. Archaeological Features

99. The Study Area has a rich cultural history with evidence of man's actions extending over some 8000 years. There are over 200 Scheduled Ancient Monuments within Anglesey ranging from Bronze Age burial chambers to later medieval features. Locally, the following are important sites:

- Holyhead Mountain has three scheduled monuments: Caer Y Twr Iron-Age hillfort; Cytiau'r Gwyddelod prehistoric hut circles; and a Roman watchtower;
- To the south of Holyhead are the adjacent scheduled monuments sites of Tŷ-Mawr Standing Stone and Trefignath Burial chamber;
- Penrhos Feilw standing stones to the east of Abraham's Bosom;
- The early medieval chapel at Towyn-y-capel and the associated burial ground at Trearddur Bay have been lost through coastal erosion. Stone axes and Roman coffins have been found on the beach at Trearddur Bay confirming a long history of use of the foreshore;
- Further south within Rhosneigr there are further Scheduled Ancient Monuments at Barclodiad y Gawres Burial Chamber on the headland above Porth Trecastell and the Ty Newydd Burial Chamber on elevated land to the north west of Rhosneigr; and
- Numerous features associated with the long-term settlement at Holyhead including the Caer Gybi Roman Fort scheduled monument site.

24.5.2.4. Built and Other Heritage Features

100. More recent features include the planned landscapes of large estates, such as Plas Newydd, major transportation routes and industrial features including nuclear power and windfarms.

101. At Holyhead Mountain there is an old signal station (part of Holyhead-Liverpool Telegraph); Cliff top cannon (and magazine) fired to warn vessels which were too close to the shore; South Stack lighthouse (established 1809) and footbridge connecting the stack to the shore; as well as numerous shipwrecks in the seaward component of the Study Area. The quarry on the north coast was used as a source of stone for construction of Holyhead harbour breakwater (now part of Breakwater Country Park). The industrial landscape also includes the quarry tramway, two large limekilns and a powder magazine.

102. There are numerous defensive sites associated with Holyhead Harbour including the Napoleonic War battery at Penrhos, Soldiers Point, and WW2 pillbox defences. Central Holyhead has Conservation Area status reflecting its long history, covering the old harbour and many buildings in the town. Modern industrial heritage includes the former industrial site of Anglesey Aluminium located to the east of Holyhead, with its tall chimney stack which forms a major landmark feature in views.

103. The north west coast of Anglesey though now tranquil, includes areas of former quarries, brickworks and lime kilns. The former copper mine at Parys Mountain and former brickworks at Porthwen are distinctive remnants of this past. The nuclear power station at Wylfa to the west of Cemaes forms a notable industrial landmark on the coastline.

24.5.2.5. Settlement

104. Holyhead and Trearddur form the main settlements on Holy Island. Holyhead to the north of the island is centred on a Roman town and has become a major port through trading with Ireland. In more recent years the arrival of the A55 has increased traffic to and through to town. Holyhead is the main centre of population in the Study Area with dense urban development, industry and infrastructure.

105. In contrast, Trearddur to the south of Holy Island is a settlement focussed on tourism. The hotels, second homes, camping and caravan sites, together with the golf course all contribute to its character.

106. Similarly, Rhosneigr a coastal village in the south of the Study Area has expanded in recent years under the influence of tourism.

107. Other key centres of population within the 15 km Study Area include: Valley; Bodedern; Caergeiliog; Llanfihangel yn Nhowyn; Aberffraw; Llanfaethlu; and Rhydwyn.

108. A number of smaller settlements lie within 10 km of the Project and those settlements with expansive coastal views have also been considered in the assessment. These include: scattered settlement at Rhoscolyn; scattered settlement at Penrhosfeilw to the west of Trearddur; and at Swtan to the south of Carmel Head.

24.5.2.6. Main Roads

109. The A5 corridor, and its modern neighbour the A55, form key elements within the historic and cultural development of the island. The construction of the A5 by Telford, as a response to the need to improve links with Ireland, cemented the development of Holyhead as a major port. The A55 now forms the principal road connection in the Study Area. Other main roads within the Study Area include the A4080 which connects between the A55/A5 and Rhosneigr/Llanfaelog and the A5025 which connects the A55/A5 to settlement within the north west of Anglesey.

110. A key coastal route within the Study Area is the B4545, linking between Valley and Holyhead via Trearddur and the network of minor roads which lead from it including Lon Isallt, Porthdafarch Road, Plas Road, South Stack Road and Ravenspoint Road.

24.5.2.7. Railway Lines

111. The North Wales Coast Line connects services from the north west and in particular Crewe as the main junction with the West Coast Line, through to the port of Holyhead. The route closely follows the A55 corridor between Holyhead and Valley, at which point it arcs to the south through to Rhosneigr before re-joining with the A55 alignment at the crossing of the Menai Strait to the east.

24.5.2.8. Ferry

112. Stena Line and Irish Ferries sail from Holyhead to Dublin in Ireland, forming the principal link for surface transport from north Wales and central and northern England to Ireland. There are currently nine sailings departing and arriving Holyhead daily, with eighteen daily ferry transits beyond the northern edge of the MDZ.

24.5.2.9. Cycle Network

113. The National Cycle Network (NCN) is co-ordinated by the charity Sustrans and forms a comprehensive network of signed cycling routes (NCN Routes) across the UK. Two sections of the NCN pass through the Study Area:

- NCN Route 5 connects Reading and Holyhead, passing through the Study Area on minor roads from Llanddeusant, Bodedern and Valley before joining the A5 to Holyhead; and
- NCN Route 8, known as the Lôn Las Cymru, connects Cardiff and Holyhead, passing through the Study Area on minor roads from Llanfairyneubwll before joining the A5 to Holyhead.

114. Four interconnected local cycle routes are promoted across Holy Island by Cybi Bikes which follow the network of minor roads:

- Porth Darfach Loop;
- Trearddur Loop;
- Four Mile Bridge Loop; and
- Rhoscolyn Loop.

115. NCN Routes and key local routes within the Study Area are shown in **Figure 24-1-2b** (**Volume II**).

24.5.2.10. National Trails

116. The Isle of Anglesey Coastal Path runs for 200 km (120 miles) along the coast and follows the coastline of the Study Area. Highlights include Holyhead Mountain, South Stack lighthouse and sea cliffs, the sea arches at Rhoscolyn, and the headland at Carmel Head. The route is part of the Wales Coast Path, with the two routes being almost identical through the Study Area. The route of the Anglesey Coastal Path/Wales Coast Path within the Study Area is shown on **Figure 24-1-2b** (**Volume II**).

24.5.2.11. Tourism and Recreation

117. Typically, opportunities for tourism and recreation within the Study Area focus on outdoor pursuits such as walking, cycling and horse riding, enjoying the large range of landscape features, archaeological sites, and other landmarks present throughout the area. These activities tend to take place in the coastal areas towards the west of the Study Area. The Anglesey AONB and Heritage Coast provide extensive opportunities for walking. Within the lowland areas there are opportunities for angling, walking, bird watching and golf.

118. The coast also provides a huge resource and focus for local tourism with Holyhead Mountain, Trearddur Bay to the west of Holy Island and Rhoscolyn to the south providing many opportunities for informal recreation whilst resort towns such as Trearddur and Rhosneigr offer formal tourist facilities.

119. Specific visitor attractions include South Stack Seabird Centre, Holyhead Breakwater Country Park and Penrhos Country Park. The beaches at Porth Dafarch, Trearddur Bay, Borthwen, Silver Bay, Rhosneigr are notable destinations for recreation.

24.5.2.12. Seascape and Landscape Character

120. Seascape is defined by Natural England in its position statement on All Landscapes Matter (2010) as: *"An area of sea, coastline and land, as perceived by people, whose character results from the actions and interactions of land with sea, by natural and/or human factors".*

121. An approach to Seascape Character Assessment, (Natural England, 2012) confirms that: *"A Seascape Character Assessment can provide a baseline against which the effects of change can be judged…and can help determine mechanisms that can be deployed to guide positive decision-making and action to protect, manage, plan and promote seascape character in the future". "Characterisation concentrates on making clear what makes one area different or distinctive from another."*

122. The Guide to Best Practice in Seascape Assessment (Countryside Council for Wales, Brady Shipman Martin and University College Dublin, 2001) sets out the elements of seascape assessment which differ from landscape assessment. Of those listed it refers to the sea's variability and dynamism, stating that a *"feature of seascape is its variability. The most important variables in determining the character of the sea are wind, light, tidal movements and the clarity or otherwise of the atmosphere. It is this play of light and shade, the noise of the waves breaking on the shore and the promise of change that gives the sea a special quality in any view…altered hugely by the weather to a far greater extent than any terrestrial, rural or urban environment."*

123. The baseline assessment has reviewed the existing seascape character assessments prepared for the Study Area. The key documents referred to are the Anglesey and Snowdonia Seascape Character Assessment, 2013 and the National Seascape Assessment for Wales, 2015. Whilst both documents have been referred to, the former document provides a finer grain of detail and is considered appropriate to inform decision making for the Project. In this regard the baseline seascape assessment adopts the seascape units described in the Anglesey Seascape Character Assessment, 2013.

124. Analysis of this character assessment identifies that the following 10 seascape character areas (SCA) are located within the Study Area:

- SCA 9 - Cemlyn Bay;
- SCA 10 - Carmel Head to Penrhyn;
- SCA 11 - Holyhead
- SCA 12 - Inland Sea;
- SCA 13 - Holyhead Mountain;
- SCA 14 - Rhoscolyn;
- SCA 15 - Rhosneigr;
- SCA 30 – North West of Anglesey;
- SCA 31 – West of Anglesey; and
- SCA 32 – Caernafon Bay;

125. In addition to the SCAs defined in the Anglesey and Snowdonia Seascape Character Assessment, 2013 the IoACC have published the Anglesey Landscape Strategy 2011 (update) which provides an updated landscape characterisation of the Anglesey landscape. The Anglesey Landscape Strategy 2011 divides the landscape into separate sets of landscape character areas (LCAs) which have a degree of overlap with the SCAs. The use of these published character assessments in the SLVIA has been agreed with IoACC and NRW at the technical working group meetings.

126. To avoid a duplicate assessment of areas where the SCAs and LCAs overlap, a rationalisation of the character areas has been undertaken. For much of the Study Area the SCAs have been used, but for the onshore areas beyond the boundary of the SCAs, the LCAs defined within the Anglesey Landscape Strategy 2011 have been used. These rationalised character areas retain their SCA and LCA suffixes, in line with the terminology used in the two sets of landscape character information. The LCAs included from the Anglesey Landscape Strategy 2011 falling within the Study Area are as follows:

- LCA 5 – North West Anglesey;
- LCA 16 - Aberffraw;
- LCA 17 – West Central Anglesey; and
- LCA 18 – Valley Airfield Environs;

127. The studies noted above provide an assessment of the seascape and landscape character of the area and consider the likely pressures and opportunities for change in the landscape. The characteristics of these SCAs and LCAs, together with their associated value, susceptibility and sensitivity are described in **Appendix 24.2** (**Volume III**). The 10 SCAs and 4 LCAs that fall within the 15 km Study Area are illustrated in **Figure 24-1-3** (**Volume II**).

128. The MDZ is almost entirely situated within SCA 31, West of Anglesey. The onshore components of the Project are located within SCA 11, Holyhead (Grid Connection Substation and part of the

onshore cable route) and SCA 14, Rhoscolyn (Landfall Substation, Switchgear Building and part of the onshore cable route).

129. In undertaking the preliminary assessment and review of baseline material against the visibility mapping of the Project, and through subsequent fieldwork, it is considered that a 15 km radius is more than sufficient to identify the likely significant seascape, landscape and visual effects associated with the Project. Beyond this, even if visible, the components of the Project would be seen as very distant elements with a very limited influence on the characteristics, defining features and/or special qualities of the SCAs/LCAs. The SCAs/LCAs within a 15 km radius of the Project, as defined within the documents identified above, have been reviewed in detail, and are considered to provide an appropriate basis to describe the seascape/landscape character of the Study Area surrounding the Project.

130. Review of the SCAs and LCAs in relation to the ZTV immediately identifies that very limited visibility of the MDZ would occur in relation to LCA 18 – Valley Airfield. In addition, this LCA is relatively remote from the other components of the Project, with the closest being the Grid Connection Substation (approximately 4.5 km to the north west). Therefore, the potential effects of the Project are predicted to be minimal, and not significant, and this LCA has not been considered further in the assessment. As identified by the ZTV, the remaining SCAs/LCAs would potentially be affected by the Project and are listed in **Table 24-4**.

Table 24-4 SCAs / LCAs within the 15 km Study Area within the Zone of Theoretical Visibility

Seascape / Landscape Character Type / Area	Source	Seascape / Landscape Value	Susceptibility to the Project	Sensitivity to Change Associated with the Proposed Development
SCA 9 - Cemlyn Bay	Anglesey SCA 2013	National	High	High
SCA 10 - Carmel Head to Penrhyn	Anglesey SCA 2013	National	Medium	High/medium
SCA 11 – Holyhead	Anglesey SCA 2013	National to community	Medium	Medium
SCA 12 – Inland Sea	Anglesey SCA 2013	National	Medium	High/medium
SCA 13 - Holyhead Mountain	Anglesey SCA 2013	National	High	High
SCA 14 - Rhoscolyn	Anglesey SCA 2013	National to community	High/medium	High/medium
SCA 15 - Rhosneigr	Anglesey SCA 2013	National to low	High/medium	High/medium
SCA 30 – North West of Anglesey	Anglesey SCA 2013	Local authority	Medium	Medium
SCA 31 – West of Anglesey	Anglesey SCA 2013	Local authority	Medium	Medium
SCA 32 – Caernafon Bay	Anglesey SCA 2013	Local authority	High/medium	High/medium
LCA 5 – North West Anglesey	Anglesey Landscape Strategy 2011	National to community	Medium	Medium
LCA 16 - Aberffraw	Anglesey Landscape Strategy 2011	National to community	High	High

Seascape / Landscape Character Type / Area	Source	Seascape / Landscape Value	Susceptibility to the Project	Sensitivity to Change Associated with the Proposed Development
LCA 17 – West Central Anglesey	Anglesey Landscape Strategy 2011	Community	Medium	Medium

24.5.2.12.1. LANDMAP Aspect Areas

131. The published seascape and landscape character assessments take account of LANDMAP. The SLVIA concentrates on these published character assessments and this approach was agreed at the technical working group meetings. However, to gain deeper understanding of the potential sensitivities the LANDMAP Aspect Areas applicable to the context of the Project have also been reviewed.

24.5.2.13. Cultural Landscape

132. The majority of Cultural Landscape Aspect Areas close to the Project are evaluated as being outstanding. The key Aspect Area that lies in the local context is Holyhead Mountain. This extends beyond Holyhead Mountain itself and applies to much of the north-western part of Holy Island. The outstanding evaluation relates to the way this landscape forms a backdrop to Holyhead and how it comprises the first sight of Wales for people travelling to Wales from Ireland by sea. Other Cultural Heritage Aspect Areas within the Study Area are typically evaluated as being outstanding due to the settlement pattern and tourism value attached.

24.5.2.14. Geological Landscape

133. The local context of the Project comprises a mosaic of different Aspect Areas. Those evaluated as outstanding and high include South Stack-Holyhead Coast, South Stack (east of South Stack itself) and Holyhead Mountain.

24.5.2.15. Historic Landscape

134. Almost the entire local context of the Project is evaluated as being outstanding. This comprises two aspect areas; Holy Island/South Stack and Holyhead. The evaluation for Holy Island/South Stack relates to the historic settlement and agricultural uses, also including relic pre-historic ceremonial sites. Holyhead is recognised for its historical and recent settlement, with the description outlining how this Aspect Area has evolved from pre-historic to current times.

24.5.2.16. Landscape Habitats

135. There is a wide range of Aspect Areas within the north-western part of Holy Island. The evaluation of these habitats varies from outstanding to low. Those evaluated as outstanding typically comprise the unimproved habitats, including heath and coastal habitats. Aspect Areas with lower evaluation comprise improved agricultural landscape and settlement.

24.5.2.17. Visual and Sensory

136. The majority of the north-west part of Holy Island is evaluated as outstanding and high. Those assessed as outstanding comprise Holyhead Mountain and the coastline in the vicinity of South Stack and North Stack, with the analysis focussing on the dramatic and relatively remote character, the relationship with the coastline sea and associated expansive views are key elements. The land south and south-west of Holyhead is evaluated as high, whilst this landscape is less dramatic than further north-west it still comprises an attractive rural landscape, with coastal views noted as a particular component.

24.5.3. Seascape and Landscape Designations

137. Seascape and Landscape designations are important in the context of the SLVIA with regard to the potential effects of the Project on the seascape/landscape value and visual amenity of designated areas within the Study Area.

138. Seascapes and Landscapes designated at the national level in Wales include AONBs and Heritage Coasts. SLAs are designated by local authorities. The location and extent of these designations as they occur within the Study Area are shown on **Figure 24-1-2a** (**Volume II**). The details of these designations are set out in **Section 24.2.1** and include:

- The Isle of Anglesey AONB;
- Two sections of Heritage Coast;
- One SLA;
- One Registered Park and Garden; and
- Four Conservation Areas within Holyhead and Bodedern.

24.5.4. Baseline Visual Resources

139. A key component of the assessment is the appraisal of effects on visual amenity from key locations within the Study Area. This assessment is undertaken through analysis of visibility mapping and confirmation of the extent of visibility, through the preparation of wireframes and use of these in the field in combination with photomontages.

24.5.4.1. Viewpoint Selection

140. Viewpoints for the visual assessment for both the offshore and onshore components of the Project were identified following production of the ZTV plans. A preliminary list of viewpoints was compiled and discussed with consultees as part of the scoping exercise, as summarised in **Section 24.3**. Additional viewpoints were added following meetings between HEPLA, IoACC, and NRW in November 2018. The types of receptors considered includes the following:

- Different SCAs/LCAs;
- Designated and other sensitive landscapes;
- Settlements (towns and villages, as well as smaller groups of residential properties);
- Roads (main and minor);

- Public footpaths and cycle routes including National Trails, marked footpaths, NCN Routes, and Public Rights of Way (PRoWs);
- Marked/popular viewpoints;
- Other outdoor recreational resources;
- Scheduled Monuments; and
- Visitor/tourist facilities such as camp sites, hotels and visitor attractions.

141. In order to confirm the appropriateness of the viewpoint selection, field survey verification was carried out. This involved checking the viewpoint grid references on the ground, to ensure that there would be potential views of the Project from these locations, noting that some changes to the PDE have influenced the level of visibility as the assessment work has progressed.

142. The viewpoints taken forward for full assessment include 20 viewpoints (including those use to assess night time effects) that cover a range of representative seascape, landscape and visual receptors, distances from the offshore component of the Project, as well as varying altitudes and directions, with the aim of achieving a reasonable distribution at compass points around the application site. In addition, 11 viewpoints have been selected for the visual assessment of the Landfall Substation, Grid Connection Substation and Switchgear Building. Viewpoints were visited as part of the baseline visual assessment, and panoramic photographs of the existing views have been taken.

143. The final list of the agreed viewpoints for the offshore component of the proposed development, is shown in **Table 24-5** to **Table 24-9** and their locations are illustrated in **Figure 24-1-4** (**Volume II**). Photographs of the existing views from these viewpoints are shown in **Figures 24-3-1** to **24-3-19** (**Volume II**). The final list of the agreed viewpoints for the Landfall Substation, Grid Connection Substation and Switchgear Building components of the proposed development, are shown in **Table 24-7, Table 24-8** and **Table 24-9**, and their locations are illustrated in **Figures 24-1-4e** and **24-1-4f** (**Volume II**). Photographs of the existing views from these viewpoints are shown in **Figures 24-3-21** to **24-3-31** (**Volume II**). Night time photomontages are included in **Appendix 24.4**.

Table 24-5 Viewpoints for the Assessment of Offshore Components

No.	Viewpoint Location	Distance from and Direction to MDZ	Receptors	Grid Ref.
01	Summit of Holyhead Mountain	1.7 km to the west.	Walkers visiting summit	221847 382943
02	Near Parliament House, North Stack	1 km to the west.	Residents, walkers (including people walking the Wales Coast Path/Isle of Anglesey Coast Path)	221557 383887
03	Car park at South Stack Light House	900 m to the west	Tourists/visitors to the car park, walkers (including people walking the Wales Coast Path/Isle of Anglesey Coast Path)	220578 382277

No.	Viewpoint Location	Distance from and Direction to MDZ	Receptors	Grid Ref.
04	Ellin's Tower, South Stack	900 m to the west.	Visitors to South Stack RSPB visitor centre, walkers (including people walking the Wales Coast Path/Isle of Anglesey Coast Path)	220637 382001
05	Cytiau'r Gwyddelod Scheduled Monument	1.4 km to the west	Visitors to heritage asset (promoted site with interpretation)	221151 381951
06	South Stack Cliffs Nature Reserve/Penrhyn Mawr	600 m to the west.	Visitors to nature reserve, walkers (including people walking the Wales Coast Path/Isle of Anglesey Coast Path)	221108 379715
07	Porth Dafarch, Wales Coast Path	2.8 km to the west	Visitors to Porth Dafarch, walkers (including people walking the Wales Coast Path/Isle of Anglesey Coast Path)	223378 379696
08	Ravens Point Road, Trearddur	4 km to the west.	Residents of/visitors to Trearddur, walkers (including people walking the Wales Coast Path/Isle of Anglesey Coast Path), road users	225220 378097
09	Rhoscolyn Head	5 km to the north west.	Residents, walkers (including people walking the Wales Coast Path/Isle of Anglesey Coast Path)	225784 375512
10	High Street Rhosneigr	11.5 km to the north west.	Residents of Rhosneigr, walkers (including people walking the Wales Coast Path/Isle of Anglesey Coast Path), road users	231644 372749
11	Barclodiad y Gawres Scheduled Monument	13.6 km to the north west	Walkers (including people walking the Wales Coast Path/Isle of Anglesey Coast Path), visitors to heritage asset (promoted site with interpretation)	232899 370729
12	Coast Path beneath Penbrynyreglwys	10.5 km to the south west.	Walkers (including people walking the Wales Coast Path/Isle of Anglesey Coast Path)	229211 392011
13	Route of Holyhead To Dublin Ferry	1.9 km to the south.	Offshore visual receptors, particularly ferry passengers	222222 386886
14	South West Extent of Project Area	2.4 km to the north east.	Offshore visual receptors, particularly people on recreational vessels	213800 375607

Table 24-6 Night Time Viewpoints for the Assessment of Offshore Components

No.	Viewpoint Location	Distance from and Direction to MDZ	Receptors	Grid Ref.
15	Car Park at South Stack Light House	900 m to the west	Tourists/visitors to the car park	220578 382277
16	Ellin's Tower South Stack	900 m to the west.	Visitors to South Stack RSPB visitor centre.	220637 382001
17	Promenade Trearddur Bay	4.7 km to the west.	Residents of/visitors to Trearddur	225696 378816
18	Ravens Point Rd, Trearddur	4 km to the west.	Residents of/visitors to Trearddur, road users	225220 378097
19	Swtan	9.6 km to the south west.	Residents of Swtan	230027 389188
20	Holyhead Breakwater	4.5 km to the west	Offshore visual receptors, particularly ferry passengers	225673 384755

Table 24-7 Viewpoints for the Assessment of the Landfall Substation

No.	Viewpoint Location	Distance from and Direction to Landfall Substation	Receptors	Grid Ref.
S01	South Stack Road nr. Tŷ-mawr Farm	90 m to the west	Road users	222060 381905
S02	Junction between South Stack Road and road to Trearddur	390 m to the north east	Road users, walkers following the Wales Coast Path/Isle of Anglesey Coast Path	221702 381500
S03	Henborth, South Stack Road	360 m to the north east	Road users, walkers following the Wales Coast Path/Isle of Anglesey Coast Path	221559 381641
S04	Wales Coast Path/Isle of Anglesey Coast Path, adjacent to the road to Trearddur	600 m to the north east	Road users, walkers following the Wales Coast Path/Isle of Anglesey Coast Path	221746 381264
S05	Southern slopes of Holyhead Mountain	640 m to the south east	Walkers, Open Access Land close to Public Rights of Way	221675 382536

Table 24-8 Viewpoints for the Assessment of the Grid Connection Substation

No.	Viewpoint Location	Distance from and Direction to Grid Connection Substation	Receptors	Grid Ref.
S06	A55 south of Orthios site	150 m to the north east	Road users travelling along A55	226860 380520

S07	Industrial access road south west of Orthios site	20 m to the north	Employees – industrial site	227041 380610

Table 24-9 Viewpoints for the Assessment of the Switchgear Building

No.	Viewpoint Location	Distance from and Direction to Switchgear Building	Receptors	Grid Ref.
S08	Parc Cybi Spine Road	200 m to the north west	Road users within Parc Cybi allocated employment site	225718 380671
S09	Trefignath Burial Chamber, Parc Cybi	350 m to the north west	Visitors to heritage asset (promoted site with access permitted)	225844 380559
S10	Parc Cybi allocated employment site, between the A55 and footpath/ cyclepath	230 m to the south east	Walkers/cyclists using the route through Parc Cybi allocated employment site, Road users travelling along A55	225482 381030
S11	Tŷ-Mawr Standing Stone, Parc Cybi	270 m to the south east	Visitors to heritage asset (promoted site with access permitted)	225399 380963

24.5.5. Other Developments in the Baseline Environment

144. At the time of writing, there was one other operational tidal development within the 15 km Study Area, the Minesto Holyhead Deep tidal turbine. As present this comprises a pre-commercial demonstration project (i.e. testing the operation of the tidal energy device prior to larger scale commercial deployment), with a single tidal energy device. This device operates below the water but is linked to a floating buoy. It is positioned approximately 6.5 km from the closest part of the coastline, to the west of the MDZ. At the time of undertaking the fieldwork this device was not in operation and therefore no components of the Minesto project are present in the baseline photography. As this project is already part of the current seascape, landscape and visual baseline resource it has been considered as an integral part of the baseline within the main assessment of seascape, landscape and visual effects in **Section 24.6**. Other tidal developments or other similar proposals within the Study Area that are within the planning system but yet to be determined have been considered separately when gauging the cumulative impact of the Project in addition to these as-yet-undetermined applications, in the assessment of cumulative effects in **Section 24.6.7**.

145. The location of the Minesto Holyhead Deep tidal device relative to the Project is illustrated in **Figure 26-4-1** (**Volume II**).

24.6. IMPACT ASSESSMENT

24.6.1. Overview of Potential Impacts

146. Following the methodology described in **Section 24.4** above, the Project has the potential to affect a wide range of seascape, landscape and visual receptors identified in the baseline assessment. These include the perception of seascape and landscape character and changes to views, with resultant effects on visual amenity. The Project incorporates a range of measures

to reduce these potential effects where practicable and these are described below. In addition, a number of additional mitigation measures could be considered that would also help to reduce potential effects on seascape, landscape and visual receptors. The realistic worst case scenario, on which the impact assessment is based, is set out in **Section 24.6.3**.

24.6.2. Mitigation

24.6.2.1. Embedded Mitigation Measures

147. Consideration of seascape, landscape and visual effects of the proposed Project have been one of several technical aspects considered as part of the design evolution, which is described in detail in **Chapter 3, Site Selection and Consideration of Alternatives**. The design of the Project has been developed to reduce effects on landscape and visual receptors where possible. This approach has been informed by the consultation with IoACC and NRW. The mitigation measures applicable to potential seascape, landscape and visual effects are also included in **Document MOR/RHDHV/DOC/0074, Landscape Management Plan**. The following provides a summary of the measures that have been applied as result of the design iteration to the key components of the Project:

- Offshore elements within the MDZ:
  - No visually prominent tidal energy devices would be placed in the northern part of the MDZ (as indicated in **Figures 4-2, 4-3 and 4-4, Volume II**) to reduce potential landscape and visual effects in relation to seascape/landscape and visual receptors to the north west of Holyhead Mountain;
  - A minimum separation distance of 1 km would be applied from the coastline for visually prominent devices, helping to increase the separation distance between such structures from the coastline;
  - Minimising floating elements elsewhere within sub-zones to help ensure the composition of offshore elements is as simple as possible.
- Landfall Substation:
  - Selecting a recessive location in the landscape, in a relatively low lying position and using the landform to help integrate the substation (cutting into the valley side rather than building a platform out);
  - Arrangement of plant and equipment within three buildings, resulting in a collection of buildings that break up the scale of the development and create a form and massing that is comparable with local agricultural buildings;
  - Using colours and materials (including natural materials) that are consistent with the vernacular associated with agricultural buildings, and are recessive in the local context;
  - Using the buildings to define the boundaries of the substation, reducing the requirement for security fencing;
  - Using stone walls and stock proof fencing as part of new boundaries;

- Considering limited application of planting to help integrate the substation, acknowledging the limitations associated with this in the open and exposed coastal landscape; and
- Minimising the use of external lighting in this rural location.

- Grid Connection Substation:
    - Positioning of the substation in a location where industrial structures form an established part of the baseline context, and where established vegetation surrounding the site provides effective visual enclosure.
- Switchgear Building:
    - Positioning of this element within an allocated employment site, adjacent to an existing substation and where surrounding development will be comparable in form, massing and appearance.
- Cable connections:
    - Use of underground cabling to provide the connections between all Project elements, avoiding the need for overhead cables;
    - Routing the underground cable within the local road corridors to minimise potential disruption to field boundaries; and
    - Reinstatement of the ground and landscape features following construction (also described below).

148. After construction has been completed, all temporary structures, machinery and equipment would be removed from the compounds. Construction compounds and the onshore cable corridor would be restored as close as possible to a condition and land use that is consistent with the immediate context. Any disruption to field boundaries would be restored.

149. Site restoration would be programmed, managed and carried out to allow restoration of disturbed areas as early as possible and in a progressive manner. A restoration plan would be agreed with IoACC and NRW.

24.6.2.2. Additional Mitigation Measures

150. The principal means of mitigation with regard to the offshore development is through the careful consideration of the siting, design and layout of the devices, and ancillary infrastructure, in relation to seascape, landscape and visual receptors as described in **Section 24.6.2**.

151. In addition to the above measures, further consideration could be given to mitigation at the detailed design stage, through consultation with IoACC and NRW in relation to the discharge of appropriate conditions on the consent. Such measures could include:

- The colour of the tidal devices;
- The navigational lighting that is required;
- The layout configurations of tidal devices within arrays e.g. curved rows of devices or irregular placement;

- Detailed design and materials selection for the substations;
- Planting proposals around the substation sites; and
- Detailed agreements over the types/design of field boundaries to be instated following the construction phase e.g. stone walls, cloddiau (hedge banks) or hedgerows.

152. Note that measures that would have the potential to affect navigational safety (such as colouring and lighting) would also require consultation and agreement with the relevant navigation authorities and consultees.

24.6.3. Worst Case Scenario

153. The assessment covers the construction, operational and decommissioning phases of the Project, as described in **Chapter 4, Project Description**.

154. The PDE has been influenced through the assessment process and consultation with NRW and IoACC. This approach means that the PDE being assessed within the SLVIA does not reflect a theoretical worst case, but incorporates specific measures that would reduce potential seascape, landscape and visual effects. Such measures are particularly applicable to the offshore components of the Project and the Landfall Substation. The approach to the PDE, together with further detail on the Project components are described in **Chapter 4, Project Description**.

155. In addition, a concise appraisal of a 40MW array of tidal energy devices is included in **Appendix 24.5**. This has been prepared recognising that the implementation of the Project would take place incrementally and therefore the seascape, landscape and visual effects would change over time. The approach to this appraisal is set out in the appendix.

156. The main operational elements of the Project, with the potential to affect seascape, landscape and visual receptors are summarised as follows:

- Tidal devices, deployed in multiple arrays within the MDZ, to a maximum installed capacity of 240 MW;
- Up to eight surface emergent electrical hubs;
- Cardinal and special marker buoys;
- Potential for up to five environmental monitoring platforms within the MDZ
- Inter-array cables within the MDZ;
- Export cables and export cable tails to the transition pits/bays;
- Landfall Substation;
- Grid Connection Substation;
- Switchgear Building; and
- Onshore buried cable installed between the Landfall and Grid Connection Substations.

157. There are different potential options for hubs that connect a number of individual devices. As set out in **Chapter 4, Project Description** the anticipated scenarios include up to 120 seabed

mounted electrical hubs, up to 93 floating surface emergent electrical hubs or up to eight seabed mounted, surface emergent electrical hubs. The eight seabed mounted, surface emergent hubs would comprise the largest and tallest of these structures, and most likely to be visible across the study area. Therefore, this scenario forms the worst case scenario for the SLVIA.

158. As worst case it is assumed that the tidal energy devices, electrical hubs and marker buoys will be lit at night, in conformance with guidance from Trinity House and the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) (IALA Recommendation O-139 on The Marking of Man-Made Offshore Structures, Edition 2, December 2013) to ensure that they are conspicuous to marine traffic. It is likely that yellow colouring will be a worst case in terms of the appearance of any surface emergent elements and the colours used in the photomontages included in the assessment reflect the guidance provided in IALA Recommendation E-108 on The Surface Colours used as Visual Signals on Aids to Navigation, Edition 3, May 2013. This colouring may be varied and agreed through consultation, but for the purpose of the SLVIA it is assumed that all above water elements of structures would be yellow.

159. The overall programmed life of the Project is 37 years, which includes construction, commissioning, operation, repowering and decommissioning. The assessment concentrates on the operational phase of the development, which will be between 25 and 35 years. During the operational phase, maintenance periods are expected to be frequent and short in duration (with a worst case of five hours per month assumed per device). The maintenance vessels may be relatively large but are expected to be limited in number at any one time. Given that the PDE being assessed incorporates numerous surface emergent tidal devices across the MDZ, in a seascape context where marine vessels are frequently seen, it is anticipated that such maintenance activities will be comparable with the visual effects associated with the arrays of devices. Therefore, the focus is on the appearance of the operational structures. The assessment will also consider the construction, repowering and decommissioning phases, although these will be temporary, and the focus will be on operational elements.

160. The wireframes and photomontages show the appearance of the full deployment of tidal energy devices included in the 240MW scenario that form the PDE for the SLVIA.

161. The cable landfall will be located within the bay on the western side of Holy Island known as Abraham's Bosom. The preferred method for installing the landfall cable is through the use of horizontal directional drilling (HDD), meaning there would be no visible disturbance to the landscape during construction, or visible infrastructure during the operational phase. However, should HDD not be feasible an alternative approach (and in the context of the SLVIA a likely worst case) would be open cut trenching, i.e. cutting shallow trenches across the beach and pinning and/or ducting the subsea cable, within a split-pipe to the cliff face. The cables crossing the intertidal area may require protection using rock bags, concrete mattresses or similar. For the purpose of the SLVIA, the worst case option of open cut trenching is assumed.

162. From the cliff top the cables would be buried to the transition pits/bays. The nine transition pits/bays would all be buried, with the only surface elements comprising nine manhole covers. There would be physical disturbance to the field (currently grassland). This would be a visible change in the landscape during the construction phase, but it would relate to short term activities and the field would be restored to the pre-existing condition post construction. The presence of

the transition pits/bays is likely to influence the long-term use of the land, in that the buried infrastructure is likely to restrict or prevent cultivation. However, pasture/grassland is the prevalent agricultural land use in the local landscape and therefore use of this field for pasture would be consistent with this context.

163. The Landfall Substation would be positioned within a single field to the adjacent to South Stack Road to the west of Tŷ-Mawr Farm (see **Figure 1-2, Volume II**). It would comprise three separate buildings of differing footprints, all up to approximately 7 m high. There would also be a separate transformer compound and external working areas and parking. A temporary construction compound would also be created to the south west of the Landfall Substation.

164. The Grid Connection Substation would be located within the land that forms part of the former Anglesey Aluminium works to the north east of Holy Island, south east of Holyhead (see **Figure 1-2, Volume II**). The operational substation would have an overall footprint of approximately 104 m by 62 m. It would contain a range of external plant and equipment, together with four buildings. The maximum height of the proposed structures within the Grid Connection Substation would be 9 m.

165. The Switchgear Building would comprise a single building approximately 9.4 m by 5 m, with a maximum height of 4 m. It would be positioned to the north east of the existing substation within the Parc Cybi allocated employment site (allocated in the Anglesey and Gwynedd Joint Local Development Pan 2011 – 2026, 31st July 2017), separated from this existing infrastructure by part of the internal road layout (see **Figure 1-2, Volume II**).

166. All onshore cables would be buried. Between the landfall point and the transition pits/bays the cables would cross the fields adjacent to South Stack Road. Between the Landfall Substation and the Grid Connection Substation the cable route predominately follows the local road network. It is expected that the buried cable would generally be positioned within the road corridor. In certain circumstances it may be necessary to deviate from this approach by placing he cable within adjacent fields. The need to place specific sections of cable within fields would be identified and discussed with IoACC, including any necessary reinstatement of vegetation and boundary features, prior to construction. The key exceptions to this are where it would cross the land around Holyhead Leisure Centre and alongside the A55 where the cable route would cross the A55.

24.6.4. Potential Impacts During Construction

24.6.4.1. Offshore Project Components

167. Within the MDZ there would be changes to the seabed through the construction of foundations associated with the tidal devices. In addition, cables would be laid on the seabed both within the MDZ and the offshore export cable corridor. However, these changes would not be visible from above the sea surface and would not have a significant impact on features that conspicuously contribute to character or visual amenity. The potential effects on the marine environment are considered in the relevant detailed assessment chapters within this ES.

168. During installation it is anticipated that a range of vessels may be required. The uncertainty around the types of tidal devices that may be installed means the installation techniques and

equipment are not known. However, it is expected that installation would require the use of vessels such as dynamic positioning (DP) and heavy lift vessels. It is also anticipated that during installation the vessels would need to work 24 hours a day and would require flood lighting to permit safe night time working. These activities are anticipated to take place over a minimum period of ten years, although not continuously. Such impacts would be temporary, overlap with the operational phase of the Project and be reversible on completion of the installation.

169. There are no measures proposed to mitigate the potential seascape, landscape and visual effects associated with the construction phase for offshore elements. Direct effects on the seascape fabric and character as a result of the offshore site are predicted to be very limited.

170. The nature of disturbance to the seascape as a consequence of the offshore components, together with the relatively short duration of the effects and would ensure that the effects of the construction phase on the seascape fabric, character and visual amenity of the locality would be limited. Due to the temporary nature of the offshore construction activities and the overlap with the operational phase, this phase has not been considered in any further detail in this assessment. The impacts of the development components likely to give rise to significant effects during the operational phase are considered in **Section 24.6.5**.

24.6.4.2. Onshore Project Components

171. The onshore cable routing has potential to have a direct/physical temporary effect on seascape/landscape features. As outlined in **Chapter 4, Project Description**, the landfall cables would either be installed in a trench across the beach then pinned to the cliff face within a split pipe or horizontally directionally drilled through the underlying rock. As worst case for the SLVIA, is it assumed the former of these approaches would be adopted. This work would require temporary construction/laydown areas within the field at the top of the cliffs.

172. From the top of the cliffs to the transition pits/bays the cables would be buried in trenches that cross the fields and South Stack Road. The key physical temporary landscape impacts associated with the cable route are likely to arise as result of the trenching work across agricultural land (grassland), including potential disruption to stone wall field boundaries. There is also some scrub cover within the fields and adjacent to the surrounding stone walls, which would also be removed during the construction activities. The construction of the transition pits/bays would require excavation of the field (agricultural grassland) to the east of South Stack Road. Subsequently the cables to the Landfall Substation would be buried within the fields, again with removal of agricultural grassland and potential disruption to the field boundaries. The land affected would be reinstated afterwards and stone walls would be reconstructed on the same alignment. No notable landscape features or elements are expected to be lost following the construction phase due to the reinstatement work that would take place.

173. The construction of the Landfall Substation would require excavation of the field in which it would be located, to the east of Tŷ Mawr Farm, to create a level platform for development. This would result in some vegetation loss and alteration of the landform within the footprint, which would continue into the operational phase. There would also be a temporary construction compound created within the field to the south west of the Landfall Substation site. This land would be reinstated to agricultural uses following the construction of the substation.

174. The cable route between the proposed Landfall Substation and the proposed Grid Connection Substations would be positioned within the local road network wherever possible. There would be temporary disruption to existing road surface during the construction phase. However, this would be reinstated following construction and this approach would limit disruption to surrounding fields and the associated boundary features. In certain circumstances it may be necessary to deviate from this approach by placing he cable within adjacent fields. The need to place specific sections of cable within fields would be identified and discussed with IoACC, including any necessary reinstatement of vegetation and boundary features, prior to construction. The key exceptions to this are where it would cross the land around Holyhead Leisure Centre and alongside the A55 where the cable route would cross the A55. To the west and south west of Holyhead Leisure Centre the cable would cross agricultural land, including potential disruption to existing field boundaries before entering the land occupied by the leisure centre and following the internal road layout.

175. Between the Switchgear Building and the Grid Connection Substation there would be potential loss of grassland and scrub along the cable route and at the position of the working areas for horizontal directional drilling under the A55 and railway line. No notable landscape features or elements are expected to be lost as result of this work and the land would be reinstated following the construction phase.

176. The Switchgear Building would occupy former agricultural land (grassland) within the Parc Cybi allocated employment site. There would be localised loss of vegetation as a result of this component of the Project. However, this loss is within a wider allocated employment site which is undergoing incremental development and no notable landscape features or elements would be lost.

177. The Grid Connection Substation would occupy a combination of previously developed land and grassland within an existing industrial development. There would be localised loss of vegetation as a result of this component of the Project. However, no notable landscape features or elements would be lost.

178. The key mitigation of effects associated with the construction phase relate to the effective restoration of disturbed land and reinstatement of landscape features, particularly field boundaries, following this work. Other mitigation measures, associated with the design of the substations are more applicable to the longer-term effects during the operational phase, and are described in **Section 24.6.2** of this chapter.

179. The relatively small extent of the disturbance, the short duration of the effects and the reinstatement of working areas would ensure that the effects of the construction phase on the landscape fabric, character and visual amenity of the locality would be limited. Due to the temporary nature and limited extent of the actual construction activities, the construction phase has not been considered in any further detail in this assessment. The impacts of the Project components likely to give rise to significant effects during the operational phase are considered in detail in the following sections. The predicted impacts on landscape fabric that would occur as a consequence of the Project are also assessed in relation to the operational phase of the Project.

24.6.5. Potential Impacts During Operation (including Repowering)

180. This section comprises the assessment of the effects on the landscape resource and visual amenity arising from offshore and onshore components of the Project, focussing on the operational phase. Repowering of devices or arrays may occur during the operational phase of the Project. This would comprise the removal of a tidal energy device or devices and associated elements, followed by potential installation of a new device or devices. A more detailed description of repowering is provided in **Chapter 4, Project Description**. In relation to the SLVIA it is anticipated that repowering activities would be intermittent and seen in the context of the tidal energy devices that form part of the PDE. Repowering activities are also likely to take place in specific parts of the MDZ rather than throughout it at any one time. The predicted effects are based on the realistic PDE, as set out in **Section 24.6.2**.

181. The following assessment of landscape effects addresses:

- Effects on landscape character (including designations); and
- Effects on visual amenity.

182. Seascape/landscape character and designations can be affected physically by a development. This will normally occur where it lies within and causes changes to the fabric of the landscape through the introduction of new features or the removal of existing ones. In addition, changes to the seascape/landscape from development also occur in relation to how the existing character and designations are perceived, through people's visual experience of them being affected. These changes in perception of character, quality or value can affect both the areas and designations that a development may lie within, as well as those surrounding it within the Study Area.

24.6.5.1. General Appraisal of Visibility within the Study Area

183. People's perceptions of the effects of a development on seascape/landscape character and designated areas, together with potential effects on visual amenity are closely related to the potential extent and nature of visibility of the key elements. Whilst effects on seascape/landscape character do not directly relate to visibility, it is typically the case that if the predicted visibility of a proposed development is very restricted it is likely that the corresponding effects on the perception of landscape character will also be limited. An overview of the predicted visibility of the development site (including potential tidal devices) is provided below.

184. The basis on which the ZTVs for the various components of the Project have been generated is explained in **Section 24.4.3** of this chapter.

185. Analysis of the ZTVs for the MDZ (**Figures 24-2-1**, **24-2-2a** and **24-2-2b**, **Volume II**) identifies that theoretical visibility of the offshore elements within the MDZ is focussed along the western edges of Holy Island and the Isle of Anglesey. This concentration of visibility on the coastline is more apparent in **Figures 24-2-2a** and **24-2-2b** (**Volume II**). However, the coastline does not truncate potential views and these do extend to locations further inland. Key themes identified include:

- Around Holy Island theoretical visibility generally extend up to 2 km inland from the coastline, becoming increasingly fragmented with distance from the coastline. Coastal and onshore visibility occurs from north of Holyhead, Holyhead Mountain and west facing slopes and coastline in the vicinity of Rhoscolyn Head.
- To the south of Holy Island there is a notable difference between the more general ZTV for the MDZ and the ZTV for the PDE. Whilst the ZTV for the MDZ suggests theoretical visibility from Rhosneigr to Ynys Meibion (further south), the ZTV for the PDE identifies almost no visibility (the exception being at Barclodiad y Gawres).
- In relation to north west Anglesey theoretical visibility generally extends along the coastline from Valley to Carmel Head and The Skerries. However, again there is a notable difference between the ZTV for the MDZ and the ZTV for the PDE, with the latter showing much more limited visibility, particularly from inland areas.
- The ZTV demonstrates that the offshore components of the Project would be visible from vessels on the sea in all directions.

186. The ZTV for the Landfall Substation shows theoretical visibility would be concentrated within the valley between the southern slopes of Holyhead Mountain and Penrhosfeilw. The ZTV suggests there would be visibility of the Landfall Substation from Holyhead, however the built form of the settlement would typically prevent such views. The pattern of visibility extends across the Irish Sea to the south west and also part of the Isle of Anglesey to the north east. However, from such locations the intervening distance, relative scale of the change and context of views means any potential change and related effects would be very limited.

187. The ZTV for the Grid Connection Substation shows extensive theoretical visibility based on bare ground. However, this is considered to be unrepresentative of likely actual visibility. The site is surrounded to the north, north east and south west by woodland and industrial buildings lie to the north west. The aluminium works is no longer operational, but it is proposed to retain this site for employment uses, meaning any changes to these buildings are still likely to provide restrictions to the visibility of this substation. The main direction from which this substation is likely to be seen is to the south, but vegetation alongside the railway and A55, together with vegetation in the wider landscape is predicted to restrict or prevent such views.

188. The ZTV for the Switchgear Building is much less extensive compared with the Grid Connection Substation, which is a reflection of the small size of this Project component. The ZTV shows theoretical visibility would be concentrated to the south of Holyhead, but there are fragmented areas of potential visibility beyond this, including from Holyhead Mountain. However, in reality the small size of this structure and its location within the Parc Cybi allocated employment site, mean the visual prominence of this substation would be very limited.

24.6.5.2. Assessment of Potential Effects on Seascape/Landscape Character

189. This section assesses effects upon seascape/landscape character within the Study Area. The key characteristics, value, susceptibility and sensitivity of the LCAs identified as having potential to be affected by the Project are set out in **Appendix 24.2** (**Volume III**). The sensitivity of each LCA is derived by considering its susceptibility to change of the nature associated with the Project and its value as set out in the methodology included in **Appendix 24.1** (**Volume III**). The

findings of the viewpoint assessment set out in **Appendix 24.3** (**Volume III**) have been used to inform the assessment of potential effects on SCAs/LCAs.

190. Early evaluation of the potential effects on seascape/landscape character, together with the viewpoint assessment identified that character areas beyond approximately 5 km of the Project would experience limited change. This is largely as a result of the relatively low height of the structures that form part of the Project. In order to ensure the SLVIA is concise the **Table 24-10** below summarises the character areas where the potential effects are predicted to be very limited, including justification for this. LCA 18 Valley Airfield Environs has been excluded from further assessment due to the limited predicted visibility of the offshore components and the separation distance from the onshore components of the Project.

Table 24-10 SCAs and LCAs where the Effects of the Project are Predicted to be Limited

SCA/LCA	Sensitivity to Change	Predicted Magnitude of Change and Justification	Potential Effect and Significance
SCA 9 – Cemlyn Bay	High	Negligible. The ZTVs indicate limited to no visibility from the land based part of this SCA. The separation distance from the MDZ is over 11 km and analysis of the closest viewpoint identifies that offshore components of the Project would result in a negligible change. The SCA is also over 11 km from any onshore components of the Project.	Minor/negligible (adverse) and not significant
SCA 12 – Inland Sea	High/medium	Negligible. This SCA is separated from the MDZ by Holy Island, resulting in very limited or no visibility in the ZTVs for the offshore elements. The SCA is much closer to the Grid Connection Substation and Switchgear Building (400 m to the Grid Connection Substation and 1.3 km to the Switchgear Building). However, intervening woodland between the SCA and these Project components would restrict or prevent potential visibility.	Negligible (adverse) and not significant
SCA 15 - Rhosneigr	High/medium	Negligible. The ZTVs indicate limited visibility from the land based part of this SCA, with the ZTV for the PDE showing almost no visibility. There would be some theoretical visibility from the seaward part of this SCA, but this would be at a distance of approximately 9.5 km. Two viewpoints are located within this SCE (Viewpoints 09 and 10), with the analysis of both these identifying a negligible magnitude of change. The SCA is also remote from any onshore components of the Project.	Minor/negligible (adverse) and not significant

SCA/LCA	Sensitivity to Change	Predicted Magnitude of Change and Justification	Potential Effect and Significance
SCA 30 – North West of Anglesey	High/medium	Slight. The SCA lies immediately to the north of the MDZ. The ZTV shows visibility of the offshore components throughout the SCA. However, the offshore viewpoints that provide an indication of how these offshore Project components would be perceived demonstrate that their relative scale would quickly diminish, meaning for much of this SCA they would form small components in an expansive seascape. The onshore components of the Project are remote from this SCA and separated by Holyhead Mountain or the town of Holyhead.	Moderate/minor (adverse) and not significant
SCA 32 – Caernafon Bay	High/medium	Slight/Negligible. This SCA is entirely offshore. The ZTV suggests considerable theoretical visibility, although this is likely to diminish towards the edge of the Study Area due to curvature of the earth. The intervening distance is approximately 6.5 km and review of the closest viewpoints, including Viewpoint 14 (selected to represent offshore receptors) identifies limited change.	Minor (adverse) and not significant
LCA 5 – North West Anglesey	Medium	Slight/negligible. This LCA covers a large part of north west Anglesey. Review of the ZTVs highlights a fragmented pattern of visibility, with a very limited pattern in the PDE specific ZTV, and a separation distance of over 8 km. There are no viewpoints within this LCA, but analysis of the closest locations assessed identifies that limited change is predicted to occur. The onshore components of the Project are closer, approximately 2.5 km to the Grid Connection Substation, but visibility of these would be restricted or prevented by intervening woodland.	Minor/negligible (adverse) and not significant
LCA 16 – Aberffraw	High	Negligible. This LCA lies towards the south eastern edge of the Study Area. Review of the ZTVs highlights a fragmented pattern of visibility for the MDZ, but no visibility for the PDE specific ZTV, and a separation distance of approximately 13.5 km. There are no viewpoints within this LCA, but analysis of the closest locations assessed identifies that very limited change is predicted to occur. The onshore components of the Project are also remote from this LCA (over 10 km).	Negligible (adverse) and not significant

SCA/LCA	Sensitivity to Change	Predicted Magnitude of Change and Justification	Potential Effect and Significance
LCA 17 – West Central Anglesey	Medium	Negligible. This LCA lies towards the eastern edge of the Study Area. Review of the ZTVs highlights a fragmented pattern of visibility for the MDZ, but no visibility for the PDE specific ZTV, and a separation distance of approximately 11 km. There are no viewpoints within this LCA, but analysis of the closest locations assessed identifies that very limited change is predicted to occur. The onshore components of the Project are also remote from this LCA (approximately 6 km).	Negligible (adverse) and not significant

24.6.5.2.1. SCA 10 – Carmel Head to Penrhyn

191. This SCA comprises the outer part of Holyhead Bay and the north west coastline of the Isle of Anglesey. It relates to the expansive Irish Sea to the west. The town and port of Holyhead, together with Holyhead mountain form a distinctive backdrop to the south. The landward part of this SCA lies within the Isle of Anglesey AONB, and the more northerly section of the coastline is also designated as Heritage Coast. The northern part of Holyhead Bay relates closely to these designations meaning this SCA is considered to be of national value.

192. The MDZ lies to the south west of the SCA, with the most north eastern edge of the MDZ lying within the SCA. Analysis of the ZTVs identifies that the offshore components of the Project would be seen, with increasing numbers of offshore structures visible further north within the SCA. From the landward part of the SCA, theoretical visibility would be limited in extent and the pattern of visibility is also likely to be quite fragmented (based on the PDE ZTV).

193. The tidal devices and other structures would comprise new man-made features in the sea to the west of Holy Island. They would be positioned to the right of Holyhead Mountain, which would provide a scaling comparison that would diminish the prominence of the proposed structures. In addition, the continual movement of the water would also serve to reduce their prominence. Human influences within Holyhead Bay, including Holyhead itself, would reduce the change associated with the introduction of new man-made structures. Whilst some of the navigation lighting associated with the Project would be seen the change associated with this would be very limited due to the existing sources of light that form the baseline in the SCA. Reviewing the daytime and night time viewpoints positioned within this SCA identifies that the predicted magnitude of visual change would be negligible or slight/negligible, helping to illustrate these points relating to scale and prominence. Parts of the SCA that are closer to the MDZ would experience greater change, but this would reduce quickly with increasing separation distance.

194. It is therefore considered that the overall change from the Project would be **slight/negligible**. As the sensitivity of this SCA is **high/medium**, the resulting overall effect would be **minor**, and **not significant**.

24.6.5.2.2. SCA 11 – Holyhead

195. This SCA comprises the inner part of Holyhead Bay and the land to the east, together with the port and town of Holyhead, including the harbour. It is strongly influenced by urbanising elements and is a complex and dynamic area both onshore and offshore. It is a visually enclosed SCA as a result of the surrounding landscape and headlands, with Holyhead Mountain forming a distinctive backdrop to the west. It is partly located within the Isle of Anglesey AONB, placing national value on part of this SCA. The sensitivity of the SCA to the Project is considered to be medium.

196. The MDZ lies to the west of the SCA and is largely separated from it by Holy Island. Analysis of the ZTVs identifies offshore components of the Project would be seen, however the number of structure visible would be limited in number and the pattern of visibility is likely to be quite fragmented (based on the PDE ZTV). The shortest distance between the SCA and the MDZ is approximately 2.5 km, although the closest part is the eastern lower slopes of Holyhead Mountain.

197. Based on the PDE ZTV the structures that would be discernible from this SCA would be the northern most electrical hubs, which would comprise new man-made features in the sea beyond Holyhead. Their scale would be diminished by the relative height of Holyhead Mountain, and importantly it is a location where human influences and activities are a prevalent part of the baseline character. Whilst some of the navigation lighting associated with the Project would be seen the change associated with this would be limited due to the existing sources of light that form the baseline.

198. The Grid Connection Substation would be located within this SCA and the Switchgear Building would be almost adjacent to the west. The Grid Connection Substation would be located adjacent to existing industrial development which, together with woodland to the north and east would provide both a high degree of enclosure and a context that would greatly limit the scale of the change and also the extent of this change. The Switchgear Building would be a relatively small-scale element in the context of an emerging employment area and adjacent to an existing, much larger, substation.

199. It is therefore considered that the overall change from the Project in this SCA would be **slight**. As the sensitivity of this SCA is **medium**, the resulting overall effect would be **minor** (adverse), and **not significant**.

24.6.5.2.3. SCA 13 – Holyhead Mountain

200. The Holyhead Mountain SCA comprises the north west part of Holy Island and the adjacent coastal wasters to the north and north west. The land-based part of the SCA includes the rugged, elevated landform of Holyhead Mountain, the highest point on Holy Island and Anglesey, together with the distinctive coastal landforms of South Stack and Gogarth Bay. The nature of the land cover and limited development gives rise to a relatively remote and wild character, despite the relative proximity of Holyhead. The SCA is almost entirely within the Isle of Anglesey AONB and is largely designated as Heritage Coast, both of which place national value on this SCA. The sensitivity of the SCA to the Project is considered to be high.

201. The MDZ lies to the west of the SCA, with the shortest separation distance being approximately 500 m at South Stack. The ZTVs show theoretical visibility from a large proportion of the SCA, with the greatest number of structures visible from the slopes of Holyhead Mountain and coastal waters near South Stack.

202. The tidal devices and associated structures would introduce man-made features in the wider seascape. However, the prominence of the structures would be variable throughout this SCA. The main visible structures in the northern part of the MDZ would be three electrical hubs (together with navigation buoys and potentially monitoring platforms), which would relate more closely to Gogarth Bay. However, from other locations, particularly the south west facing slopes of Holyhead Mountain and near South Stack, a greater proportion of structures within the MDZ would be more prominent. Navigation lighting would also introduce new elements into a seascape with a largely dark baseline context. For the majority of the SCA the change associated with lighting and how this would alter the perception of seascape character would be experienced by few people.

203. The relative scale of this SCA, with particular reference to Holyhead Mountain, would help to restrict the change associated with proposed structures in the sea. However, this elevation also means that the composition of the arrays of devices and their extent would be readily discernible. The introduction of the tidal energy devices would not fundamentally alter the character of the SCA, but they would detract from certain perceptual qualities including wildness and remoteness. They would not prevent the expansive panoramic views over the Irish Sea that are experienced from this SCA but would clearly introduce new low level man-made structures within such views.

204. The substations that form part of the Project would also be seen from this SCA. However, these would all comprise small scale recessive elements due to their low-lying position, intervening distance, and the open expansive views in which they will be seen as well as, in the case of the Switchgear Building and Grid Connection Substation, the industrial and urban context in which they will be seen.

205. It is therefore considered that the overall change from the Project would be **medium**. The sensitivity of this SCA is **high**, therefore the resulting effect would be **major/moderate** (adverse) and **significant**.

24.6.5.2.4. SCA 14 – Rhoscolyn

206. The Rhoscolyn SCA comprises the majority of Holy Island and the adjacent coastal waters to the west and south (to the south of Holyhead Mountain and Holyhead. The land-based part of the SCA is a rural landscape with a predominately sparse and dispersed settlement pattern, the exception to this being at Trearddur. The landform is an open, rugged and low-lying, with a crenelated coastline of low cliffs. It is partly located within the Isle of Anglesey AONB and the more northerly section of the coastline is also designated as Heritage Coast, both of which place national value on part of this SCA. The sensitivity of the SCA to the Project is considered to be high/medium.

207. The MDZ lies to the west of the SCA, with the shortest separation distance being approximately 500 m at Penrhyn Mawr. The tidal devices would be seen as man-made features in the wider seascape. However, the prominence of the structures would be variable throughout this SCA. From a small area in the northern part of the SCA (between Penrhyn Mawr and Pen-las Rock, west and north west of Penrhosfeilw) the arrays of tidal energy devices and associated structures would form prominent elements. This would also be applicable at night when the navigation lighting would introduce new elements into a seascape with dark baseline context.

208. South of Penrhyn Mawr the relative scale of the offshore structures would diminish, partly due to increasing distance and also the way in which the proposed structures would be seen from this generally low lying SCA. Typically, the tidal devices would be seen as a small part of the large-scale, open character of the seascape and would be viewed as a minor addition in views in a westerly or north westerly direction. In addition, the navigation lighting would become less conspicuous further south within the SCA due to the increasing distance and the greater influence of existing light sources that form part of the baseline seascape character. This is particularly the case in the vicinity of Trearddur where the multiple sources of artificial light would reduce the change that would occur.

209. The structures within the MDZ would be theoretically visible from much of the coastal waters and coastline within the SCA. This pattern of visibility would become increasingly fragmented inland, which would limit the overall geographic extent of the effects. The crenelated character of the coastline would also limit theoretical visibility in places, e.g. at Porth Dafarch.

210. The Landfall Substation, Switchgear Building and the majority of the onshore cable route would be located within this SCA. For the most part the underground cable would be buried under the local road network. Following construction there would be no discernible change to the SCA, with the road surface being reinstated and any disturbance to landscape features or elements being restored (e.g. field surfaces and boundaries). The exception to this is potentially the landfall cables at the cliffs, which may be placed in shallow trenches (protected by rock bags, concrete mattresses or similar) and pinning the cables to the cliff face. Such changes would be perceived at a local scale within the SCA due to the enclosed nature of the bay. However, these elements would be discernible from locations in South Stack Cliffs Nature Reserve to the south (The Range), from locations offshore and more prominently from the beach itself. The scale of this specific change would be limited and similar would be the case for the extent of this change, but it would contrast with the natural state of the beach and cliffs.

211. The Switchgear Building would form a small-scale element within an area that forms part of an allocated employment site. It would be positioned adjacent to an existing substation and it is likely that the that surrounding land would be developed for employment uses over time. Overall the change that would be associated with this specific Project component in the context of both the current and emerging baseline means it would have very limited influence on the SCA.

212. The Landfall Substation would be a more prominent change in the landscape. The scale and configuration of the buildings would be comparable with local agricultural buildings. The various mitigation measures that have been incorporated into the design, including boundary treatments, lowering the base level and cutting the platform into the slope, and the proposed materials, would help to reduce the relative change. It would be located on relatively low lying

ground, limiting the extent of the potential effects and the prominence of the substation. It would result in a noticeable change at a very localised level, but beyond a distance of approximately 400 m it would form a relatively recessive element in the landscape.

213. The Project would result in some noticeable changes, but these would be localised and within many parts of the SCA the components of the Project would not be discernible. The most prominent components of the Project would be the offshore structures within the MDZ, with these contrasting with the undeveloped character of the northern most part of the SCA.

214. It is therefore considered that the overall change from the Project would be **medium**. The sensitivity of this SCA is **high/medium**, therefore the resulting effect would be **moderate** (adverse). As set out in the methodology (**Appendix 24.1**, **Volume III**), moderate effects can be either significant or not significant based on the judgements that lead to the predicted magnitude of change. In this instance it is considered this would constitute a **significant** effect, primarily due the scale of the changes associated with the tidal energy devices in the northern most part of the SCA.

24.6.5.2.5. SCA 31 – West of Anglesey

215. Almost the entire MDZ is located within this SCA. It lies to the west of Holy Island and comprises open sea. It is characterised by high energy water due to the strong tidal currents and wave activity. Primary uses of the SCA include fishing and recreation. Holyhead Mountain forms a distinctive backdrop and the entire coastline to the east forms part of the Isle of Anglesey AONB, and part of it is also designated at Heritage Coast. However, the SCA is not within the AONB. The sensitivity of the SCA to the Project is considered to be medium.

216. Analysis of the ZTVs identifies that offshore components of the Project would be seen throughout this SCA which entirely comprises open water.

217. The tidal devices and other structures would comprise and introduce distinctive man-made features in the sea. The lighting of the structures would be visible in the eastern part of the SCA, which is currently devoid of fixed light sources, although does have more distant visibility of land-based sources of night time lighting, notably South Stack lighthouse. The proposed structures would be positioned to the left of or in front of the landscape to the east (including Holyhead Mountain). This would provide a scaling comparison that would diminish the prominence of the proposed structures. In addition, the continual movement of the water would also serve to reduce their prominence. One viewpoint (Viewpoint 14) is positioned within this SCA, with a predicted magnitude of change of slight/negligible, helping to illustrate these points relating to scale and prominence. This viewpoint is relatively close to the MDZ (approximately 2.5 km) and the potential change would reduce considerably with greater separation distance. Conversely the change would increase closer to the MDZ, also acknowledging that the tidal energy devices would be located within this SCA.

218. There would be potential for localised significant effect on this SCA but overall it is considered that the change from the Project would be **medium/slight**. As the sensitivity of this SCA is **medium**, the resulting effect would be **moderate**. In this instance it is considered this effect be **not significant**. This primarily due to the size of the SCA and the scale of the changes

associated with the tidal energy devices, which would occupy a relatively small proportion of the SCA. The tidal energy devices would form prominent structures within the eastern part of the SCA. However, beyond this the change would quickly diminish.

Table 24-11 Summary of Effects on SCAs most likely to be Adversely Affected by the Project

SCA/LCA	Sensitivity to Change	Predicted Magnitude of Change	Potential Effect and Significance
SCA 10 – Carmel Head to Penrhyn	High/medium	Slight/negligible	Minor (adverse) and not significant
SCA 11 – Holyhead	Medium	Slight	Minor (adverse) and not significant
SCA 13 – Holyhead Mountain	High	Medium	Major/moderate (adverse) and significant
SCA 14 – Rhoscolyn	High/medium	Slight	Moderate (adverse) and significant
SCA 31 – West of Anglesey	Medium	Medium/slight	Moderate (adverse) and not significant

24.6.5.3. Assessment of Effects on Landscape Designations

219. The following sections provide further analysis of the potential effects of the Project on designations that are relevant to the SLVIA. The above analysis in relation to seascape/landscape character has included consideration of designations in the evaluation of sensitivity. However, this analysis revisits the specific qualities of the designations, as identified in the relevant publications, to further analyse how the Project would influence these.

24.6.5.3.1. Isle Anglesey AONB and Heritage Coast

220. Much of the coastline within the Study Area lies within the Isle of Anglesey AONB. As set out in the evaluation of the relevant policy and legislation The Isle of Anglesey Area of Outstanding Natural Beauty Management Plan 2015 to 2020 identifies the special qualities of the AONB. In addition, there are two sections of Heritage Coast within the Study Area, both of which are coincidental with the AONB designation. There are no defined special qualities for the Heritage Coast although as they relate to the same areas of coastline some of the special qualities of the AONB are frequently common to both designations. The following sections set out how the Project would influence these special qualities.

24.6.5.3.1.1. Special Quality; Expansive Views/Seascapes – Evaluation:

221. The offshore elements of the Project would be visible in expansive views and seascapes, particularly from the west coastline of Holy Island. The open character of the coastline and, in the case of Holyhead Mountain, relative elevation frequently affords open, long distance views both along the coastline and over the Irish Sea.

222. The tidal devices would not prevent these views but would introduce a series of man-made elements to the seaward component. They would be seen in the context of other human elements (land and sea based) and as a part of an overall panorama.

223. The viewpoint assessment has considered a wide range of locations from which open and expansive views can be obtained within the AONB. Whist some significant visual effects have been identified from the closest part of the coastline (e.g. viewpoints 3, 4 and 6), in many instances the effects on visual amenity not predicted to be significant (e.g. viewpoints 7 to 12).

24.6.5.3.1.2. Special Quality; Peace and Tranquillity – Evaluation:

224. The settled character and tourism use of much of the coastline within the Study Area affects peace and tranquillity of part of the AONB. It is acknowledged that areas of seascape/landscape are peaceful, tranquil and dark skies also contribute to the AONB. This quality is generally more prevalent along the north west coastline of Holy Island (with the exception of the area around Trearddur) and the north west coast of the Isle of Anglesey.

225. The key potential effects of the Project would be through the introduction of new human elements in seaward views. Construction, repowering and decommissioning activities would be visible. The tidal devices potentially affect views from the AONB and the analysis of local character has identified the potential for significant effects from SCAs associated with the western side of Holy Island.

226. The assessment of potential effects in relation to **Noise and Vibration** is detailed in **Chapter 21** and provides an analysis of potential effects in relation to the construction, operation, repowering and decommissioning. This concludes that there are no significant adverse noise impacts, once embedded mitigation such as use of temporary hoarding during construction, is in place.

227. To comply with navigation and safety requirements, the offshore development area would be lit at night. The baseline environment at night varies along the coastline. In the vicinity of Holyhead and Trearddur there is a considerable amount of existing lighting, which collectively results in a degree of sky glow. Away from these settlements, light sources decrease considerably as population density reduces. Existing light sources still form part of the night time onshore context and offshore lights associated with shipping as well as South Stack Lighthouse, also contribute to this baseline. While shipping lanes are positioned some distance from the coastline, the associated lights are still visible from the coastline and contribute to the baseline character within the AONB.

228. Lighting would be required during construction, operation, repowering and decommissioning. Lighting associated with construction, repowering and decommissioning will be intermittent and reversible. Therefore, the potential effects associated with construction and decommissioning phases will be relatively ephemeral, which would limit the potential effects. The operational structures would be lit at night as would the cardinal or special mark buoys. The required specification for the lighting is expected to comprise flashing yellow and white lights with a visibility of not less than five nautical miles.

229. The navigation lights would be positioned within the sea, where there are relatively few existing sources, and these are typically transitory and further offshore than the MDZ (shipping). The key purpose of the lighting will be to ensure suitable horizontal illumination in order to highlight the presence of the MDZ to marine traffic. The number and intensity of the lights would make a

limited overall contribution in the night sky, but they would be more prominent in localised areas within 5km of the MDZ. As set out in the assessment of seascape character the lighting would contribute to the significant effects identified.

24.6.5.3.1.3. Islands Around Anglesey – Evaluation:

230. The key effects resulting from the Project relate to Holy Island. However, it is assumed that this special quality relates to smaller islands and islets around the coastline. The Project would not have any effects on these smaller islands and islets due to a combination of the predicted visibility of the Project and the intervening distance.

24.6.5.3.1.4. Broadleaved Woodlands – Evaluation:

231. No component of the Project would be positioned within or cross areas of broadleaved woodland within the AONB. Therefore, there would be no effect on this special quality.

24.6.5.3.1.5. Lowland Coastal Heath – Evaluation:

232. No elements of the Project would directly affect areas of lowland coastal heath. Therefore, there would be no effect on this on this special quality.

24.6.5.3.1.6. Species Rich Roadside Verges – Evaluation:

233. The onshore cable route would have direct, localised effects on road verges, where they are crossed. As the majority of the onshore cable would be buried beneath the road itself the disturbance to the roadside verges would be very limited. In certain circumstances it may be necessary to deviate from this approach by placing he cable within adjacent fields. The need to place specific sections of cable within fields would be identified and discussed with IoACC. Following completion of the construction phase all areas of disturbed ground, including roadside verges, would be restored. The verges would be seeded with an appropriate species mix agreed with the IoACC and NRW to ensure that this special quality is not adversely affected.

24.6.5.3.1.7. Ecologically Important Coastal and Wetland Habitats (including Rocky Shores, Mudflats and Estuaries, Saltmarshes, Beaches and Dunes) – Evaluation:

234. The benthic and intertidal ecological assessment, included in Chapter 9 identifies that the majority of potential impacts to the benthic and intertidal ecology throughout the various phases of the development are likely to be of minor adverse significance, even when assessed against the worse-case scenario.

24.6.5.3.1.8. Built Environment including Conservation Areas and Listed Buildings – Evaluation:

235. The SLVIA has evaluated the potential effects on Conservation Areas in the Study Area, which include three parts of Holyhead and part of Bodedern village. The assessment of potential effects on the character of these settlements has identified that none of the components of the Project would have a significant effect on any of the Conservation Areas. Such effects are described in more detail below.

236. **Chapter 20, Onshore Archaeology and Cultural Heritage** has assessed the potential effects of the Project on heritage assets within the area surrounding the Project. This concludes that the residual effects on heritage assets would not be significant. There is potential for buried heritage assets to be disturbed or removed during the construction phase of the Project. This would be managed through appropriate mitigation including fieldwork, geophysical surveys and trial trenching.

24.6.5.3.1.9. Archaeology and Ancient Monuments/ Historic Landscapes, Parks and Gardens – Evaluation:

237. As set out above Chapter 20 has assessed the potential effects of the Project on key heritage assets. This concludes the effects on heritage assets are predicted to be limited. In addition, the potential for effects on buried archaeology during the construction phase would be managed through the implementation of appropriate mitigation measures.

238. In addition, the SLVIA has evaluated the potential effects on registered parks and gardens in the Study Area. One registered park and garden has been identified within the Study Area: Carreglwyd, near Llanfaethlu, positioned towards the north west edge of the Isle of Anglesey. The assessment of potential effects has identified that the Project would not have a significant effect on this Registered Park and Garden and this is described in more detail below.

24.6.5.3.1.10. Rural Agricultural/Coastal Communities – Evaluation:

239. **Chapter 25, Socio-Economics, Tourism and Recreation** concludes that the Project would bring benefits to the local communities through the investment and employment opportunities it would create. The socio-economic assessment also highlights the potential positive effects that would result from the energy generated by the Project, including energy security and the opportunities for reducing carbon emissions.

24.6.5.3.1.11. Welsh Language – Evaluation:

240. The Project would not affect this special quality. Potential effects of the Project on the Welsh Language are described in **Chapter 25, Socio-Economics, Tourism and Recreation**.

24.6.5.3.1.12. Soil, Air and Water Quality – Evaluation:

241. The Project is not predicted to have any significant adverse effects on soil, air or water quality. Therefore, there would be no effect on this special quality. A detailed evaluation of potential effects of the Project is set out in **Chapter 17, Water Resources and Flood Risk**, **Chapter 18, Ground Conditions and Contamination**, and **Chapter 22, Air Quality**.

24.6.5.3.1.13. Public Rights of Way Network – Evaluation:

242. The Project would not have any permanent direct effects on any Public Right of Way (PRoW), i.e. following the construction phase. No temporary or permanent closures to PRoW are proposed by the Project, as described in **Chapter 25, Socio-Economics, Tourism and Recreation**. It would be seen from numerous paths along the coastline, but the visibility and relative prominence would vary due to landform, vegetation and built form. The viewpoint

assessment identifies that there are certain locations where significant effects are predicted e.g. from the coastline between Penrhyn Mawr and South Stack. However, in the wider Study Area, the potential visual effects associated with the development site are not predicted to be significant, with the key contributory factors being the distance to the development site and the relative scale of the tidal devices compared with existing elements of the seascape/landscape.

24.6.5.3.1.14. Accessible Land and Water – Evaluation:

243. The Project would have no adverse effects on this special quality. Potential elements of improvement such as improved access to the shore at landfall would be subject to the detail of the works associated with the landfall cable and the restoration following the construction phase. It is envisaged this detail would be addressed through conditions should the Project be consented.

24.6.5.3.1.15. Summary of Potential Effects on the Isle of Anglesey AONB and Heritage Coast

244. The offshore elements of the Project would not have any physical effects on the AONB. There would be some direct effects within a small part of the AONB and on one section of Heritage Coast as result of the onshore components of the Project, the most notable being the Landfall Substation and potential for trenched cables across the beach and pinning of cable to the cliff face at the landfall point.

245. The overall pattern of visibility of the Project in the context of the AONB as a whole would be limited, and any changes would be associated with a relatively small part of the designation.

246. The potential impacts in relation to the perception of the AONB and Heritage Coast are consistent with the analysis of impacts on landscape character. The offshore elements of the Project would contrast with the relatively remote parts of the AONB and section of Heritage Coast and the greatest potential effects would occur around Holyhead Mountain and the coastline between South Stack and Penrhyn Mawr.

247. The greatest effects would be in relation to views to and from the coastline and the influence of the tidal devices on these, with the offshore elements of the Project introducing new man-made elements positioned off the coastline. The appearance of these structures, their colouring and lighting would have an adverse impact on these designations. However, the scale of the receiving seascape/landscape and the associated views are large and would help to accommodate the Project. Following the operational period all readily visible elements would be removed and the effects would be reversed.

248. While some localised significant effects are predicted in relation to the AONB, overall it is anticipated that these impacts will not be significant in relation to this designation as a whole.

249. The Heritage Coast designations apply to shorter sections of coastline. The Heritage Coast that relates to north west Anglesey is more remote from all Project components. The closest part of this Heritage Coast is over 9.5 km from the Project. This separation distance means the relative scale of the tidal energy devices would be limited and the potential effects on seascape character are not predicted to be significant. This is described in more detail in relation to SCA 10 – Carmel Had to Penrhyn, **Section 24.6.5.2.1** above. However, the section of Heritage Coast

that is associated with north west Holy Island is immediately to east of the MDZ. This proximity and the extent of the Heritage Coast that would be affected means the Project would result in significant effects, and the nature of these effects are described in more detail in relation to the applicable SCAs (SCA 13 – Holyhead Mountain and SCA 14 – Rhoscolyn), as detailed earlier in **Sections 24.6.5.2.3** and **24.6.5.2.4** above.

24.6.5.3.2. Special Landscape Areas

There is one SLA within the Study Area. This relates to Mynydd Mechell in the north west part of mainland Anglesey. The SLA is positioned inland from the coastline (4.5 km from the west coast and 3 km from the north coast). The shortest distance between the MDZ and the SLA is approximately 14 km, and the closest substation component is over 11 km. Review of the ZTVs shows very limited relationship between the Project and this SLA, with the PDE ZTV for the offshore elements showing no theoretical visibility. Therefore, it is predicted that the Project would have no adverse effects on this landscape designation.

24.6.5.3.3. Conservation Areas

250. There are four Conservation Areas within the Study Area. Three of these relate to separate parts of Holyhead and a further Conservation Area lies within the village of Bodedern. There is very limited predicted visibility of the offshore components of the Project shown on the ZTVs and the onshore components would be relatively remote from these designations. Whilst the Grid Connection Substation and Switchgear Building would be theoretically visible from the Holyhead Mountain Conservation Area, the intervening distance would be over 3 km. In addition, these substations would be located in the context of urban development within Holyhead, including industrial structures on the Orthios site and the allocated employment site around the proposed Switchgear Building. Overall it is predicted that any effects on these Conservation Areas as a result of the Project would be very limited.

24.6.5.3.4. Registered Parks and Gardens

251. The only Registered Park and Garden within the Study Area is Carreglwyd (Llanfaethlu), positioned towards the north west edge of the Isle of Anglesey, approximately 1 km from the coastline. This lies approximately 10 km from the MDZ and 7.5 km from the closest onshore components of the Project. Given the separation distances from the Project it is predicted that there would be limited potential for adverse effects to occur in relation to this Registered Park and Garden.

24.6.5.4. Assessment of Potential Visual Effects

252. The following sections provide an assessment of the predicted visual effects that would be likely to arise from the Project during the operational phase. The visual effects of the Project within the Study Area are considered in respect of the main visual receptor groups identified, namely:

- Residents of settlements;
- Users of transport routes (including promoted cycle routes);
- Walkers on long distance routes, PRoW and Open Access Land; and

- Users of other recreational resources/visitor attractions.

253. Visual impacts have been assessed through review of the ZTVs (**Figures 24-2-1**, **24-2-2a**, **24-2-2b**, **24-2-3**, **24-2-4** and **24-2-5**, **Volume II**), field survey and the assessment of effects at the 31 agreed viewpoints.

254. **Appendix 24.3** (**Volume III**) contains the detailed viewpoint assessment for the Project. The viewpoints were selected to be representative of the main landscape and visual receptors in the Study Area. There are several viewpoints in close proximity to the Project and therefore the predicted effects at these locations should not be considered as indicative of the same level of effect across the whole Study Area. **Table 24-12** to **Table 24-16** below provides an overview of the viewpoint assessment.

Table 24-12 Visual Effects and Significance – Offshore Development Viewpoints

No	Viewpoint Name	Sensitivity	Magnitude of Change`	Visual effect	Nature of Effect (Adverse, Beneficial, Neutral	Significant/Not Significant
01	Summit of Holyhead Mountain	High	Medium	Major/Moderate	Adverse	Significant
02	Near Parliament House, North Stack	High	Medium to slight	Moderate	Adverse	Not significant
03	Car park at South Stack Light House	High	Substantial	Major	Adverse	Significant
04	Ellin's Tower, South Stack	High	Substantial	Major	Adverse	Significant
05	Cytiau'r Gwyddelod Scheduled Monument	High	Medium	Major/moderate	Adverse	Significant
06	South Stack Cliffs Nature Reserve/Penrhyn Mawr	High	Substantial	Major	Adverse	Significant
07	Porth Dafarch, Wales Coast Path	High	Slight to negligible	Moderate/minor	Adverse	Not significant
08	Ravens Point Road, Trearddur	High	Slight to negligible	Moderate/minor	Adverse	Not significant
		High/medium		Moderate/minor		
09	Rhoscolyn Head	High	Negligible	Minor	Adverse	Not significant
10	High Street Rhosneigr	High	Negligible	Minor	Adverse	Not significant
		High/medium		Minor		
11	Barclodiad y Gawres Scheduled Monument	High	Negligible	Minor	Adverse	Not significant
12	Coast Path beneath Penbrynyreglwys	High	Negligible	Minor	Adverse	Not significant
13	Route of Holyhead To Dublin Ferry	Medium	Slight	Moderate/minor	Adverse	Not significant
14	South West Extent of Project Area	High/medium	Slight to negligible	Moderate	Adverse	Not significant
		Medium		Minor		

Table 24-13 Visual Effects and Significance – Night Time Viewpoints

No	Viewpoint Name	Sensitivity	Magnitude of Change`	Visual effect	Nature of Effect (Adverse, Beneficial, Neutral	Significant/Not Significant
15	Car Park at South Stack Light House (night)	High	Substantial	Major	Adverse	Significant
16	Ellin's Tower South Stack (night)	High	Substantial	Major	Adverse	Significant
17	Promenade Trearddur Bay (night)	High	Slight to negligible	Moderate/minor	Adverse	Not significant
18	Ravens Point Rd, Trearddur (night)	High	Slight	Moderate	Adverse	Not significant
19	Swtan (night)	High	Negligible	Minor	Adverse	Not significant
20	Holyhead Breakwater (night)	Medium	Negligible	Minor	Adverse	Not significant

Table 24-14 Visual Effects and Significance – Landfall Substation Viewpoints

No	Viewpoint Name	Sensitivity	Magnitude of Change`	Visual effect	Nature of Effect (Adverse, Beneficial, Neutral	Significant/Not Significant
S01	South Stack Road nr. Tŷ-mawr Farm	High/medium	Medium	Moderate	Adverse	Not significant
S02	Junction between South Stack Road and road to Trearddur	High	Slight	Moderate	Adverse	Not significant
		High/medium		Moderate/minor		
S03	Henborth, South Stack Road	High	Negligible	Minor	Adverse	Not significant
		High/medium		Minor		
S04	Wales Coast Path/Isle of Anglesey Coast Path, adjacent to the road to Trearddur	High	Negligible	Minor	Adverse	Not significant
		High/medium		Minor		
S05	Southern slopes of Holyhead Mountain	High	Negligible	Minor	Adverse	Not significant

Table 24-15 Visual Effects and Significance –Grid Connection Substation Viewpoints

No	Viewpoint Name	Sensitivity	Magnitude of Change`	Visual effect	Nature of Effect (Adverse, Beneficial, Neutral	Significant/Not Significant
S06	A55 south of Orthios site	Medium/low	Slight	Negligible	Adverse	Not significant
S07	Industrial access road south west of Orthios site	Medium/low	Moderate to slight	Minor	Adverse	Not significant

Table 24-16 Visual Effects and Significance –Switchgear Building Viewpoints

No	Viewpoint Name	Sensitivity	Magnitude of Change`	Visual effect	Nature of Effect (Adverse, Beneficial, Neutral	Significant/Not Significant
S08	Parc Cybi Spine Road	Medium/low	Negligible	Minor	Adverse	Not significant
S09	Trefignath Burial Chamber Parc Cybi	Medium	Negligible	Minor	Adverse	Not significant
S10	Parc Cybi allocated employment site, between the A55 and footpath/ cycle path	Medium/low	Slight to negligible	Minor	Adverse	Not significant
		Medium/low		Minor		
S11	Tŷ-Mawr Standing Stone Parc Cybi	Medium	Negligible	Minor	Adverse	Not significant

24.6.5.5. Potential Effects on Settlements

255. The following section provides an assessment of the predicted effects of the Project on the visual amenity that would be experienced by residents of key settlements within the Study Area. The assessment has been undertaken through field survey and the analysis of mapping ZTV and wireframe views, in order to confirm the likely nature of visibility.

256. In accordance with the criteria outlined in the methodology residential receptors, within settlements in the Study Area, typically have a high susceptibility to change as views are experienced regularly for prolonged periods and are generally considered to have a high sensitivity overall to the Project. In addition, particular visual characteristics within a settlement, such as views relating to the setting of a Conservation Area or visual influences from a designated landscape that the town or village may sit within or overlook – can be important with regard to the value of specific views in and around a town or village.

257. An indication of the predicted extents of visibility of the Project across the settlements is provided in the ZTVs for the MDZ and PDE (see **Figures 24-2-1**, **24-2-2a** and **24-2-2b**, **Volume II**). In addition, separate ZTVs have been prepared for each proposed substation. The ZTVs are based on bare ground conditions, therefore for those settlements where the ZTV indicates theoretical visibility, buildings and vegetation are likely to provide a degree of containment between receptors and the proposed development. Therefore, actual views to the Project will tend to be more restricted or intermittent than the ZTV indicates.

258. There are three key settlements where visual effects are most likely to occur, including:

- Holyhead;
- Trearddur; and
- Rhosneigr.

259. In addition to the above, there are numerous dispersed residential properties in the Study Area. Those that are most relevant to the SLVIA occur to the north west of Trearddur, including the community of Penrhosfeilw.

24.6.5.5.1. Holyhead

260. Holyhead lies to the east of the centre of the Study Area. The closest part of Holyhead lies approximately 2.5 km to the east of the MDZ, 1 km from the Landfall Substation and the Grid Connection Substation and Switchgear Building lie within the industrial and employment sites that lie on the south east edge of the town.

261. The ZTVs illustrate limited theoretical visibility of the offshore components of the Project and the Landfall Substation. The town is also orientated towards Holyhead Bay to the north, and therefore away from the MDZ. Greater theoretical visibility is associated with the Grid Connection Substations and Switchgear Building, particularly the Grid Connection Substation. The magnitude of change associated with the offshore elements would be limited by the pattern of visibility and intervening distance, restricting both the size/scale of the change and also the extent of the settlement affected. Whilst there is greater potential for the Grid Connection

Substation and Switchgear Building to be seen, the built form within the settlement would restrict this. In addition, both the Grid Connection Substation and Switchgear Building would be located within existing industrial and employment sites, meaning the relative change would be limited and structures in the immediate context of both sites would further restrict the potential visibility.

262. It is therefore considered that the Project would have a negligible magnitude of change on visual amenity for the residents within Holyhead. As residents have a high sensitivity, the resulting effect would be minor and not significant.

24.6.5.5.2. Trearddur

263. Trearddur lies to the east of the centre of the Study Area. The MDZ lies to the west, approximately 3.8 km from the closest part of the settlement. The Grid Connection Substation lies approximately 1.4 km to the to the north east of Trearddur. The Landfall Substation would not be visible from this settlement and would therefore not result in any effects on visual amenity. The ZTV for the Switchgear Building shows very limited visibility from the northern edge of Trearddur. Given this is a bare earth ZTV (meaning actual visuality is likely to be less) and the Switchgear Building is located within an employment site, next to an existing larger substation, it is not considered that it would result in any significant effects on this settlement.

264. The offshore elements of the Project would be seen in views to the north west, with the closest part of the MDZ located approximately 4.3 km from the settlement. However, the analysis of Viewpoints 8 (daytime), as well as Viewpoints 17 and 18 (night time) has identified that the predicted visual magnitude of change would be slight or slight to negligible and the potential effects would be moderate or moderate/minor and not significant. These viewpoints, particularly Ravens Point, are also arguably the locations where the offshore elements are likely to be most visible from Trearddur. Accordingly, it is considered that there would not be any significant effects from the offshore component of the Project on visual amenity in Trearddur.

265. The Grid Connection Substation would be theoretically visible from much of Trearddur. However, actual visual visibility would be very limited due to intervening woodland and or buildings, and also restricted to the north eastern edge of the settlement. In addition, the substation would be located in the context of the existing adjacent industrial development.

266. It is therefore considered that the Project would have a slight to negligible magnitude of change on the residents within Trearddur. As residents have a high sensitivity, the resulting effect would be moderate or moderate-minor and not significant.

24.6.5.5.3. Rhosneigr

267. Rhosneigr is located approximately 11.5 km from the MDZ. It is also located over 8 km from all onshore components of the Project and due to this separation distance and drawing on the fieldwork and findings of the Viewpoint Assessment, it is considered that there would not be any significant effects from the onshore components on visual amenity for residents within Rhosneigr.

268. Review of the ZTV for the MDZ shows potential visibility of the offshore elements of the Project. However, the ZTV for the PDE illustrates that no tidal energy devices or electrical hubs would

be seen. In addition, analysis of Viewpoint 10 located in Rhosneigr identifies that negligible change would occur and the visual effect would be minor.

269. It is therefore considered that the Project would have a negligible magnitude of change on the residents within Rhosneigr. As residents have a high sensitivity, the resulting effect on visual amenity would be minor and not significant.

24.6.5.5.4. Dispersed Residential Properties

270. In addition to the above settlements it is acknowledged that the rural character of the Study Area means there are numerous dispersed properties. This assessment does not seek to assess potential effects of the Project on all of these properties, but there are some important observations in relation to key properties. The main dispersed properties where there are likely to be greatest effects on visual amenity are those to the north west of Trearddur, including those within the community of Penrhosfeilw, and these effects are most likely to be associated with the changes resulting from the offshore components of the Project as well as the Landfall Substation.

271. Several locations along this section of coastline are included in the viewpoint assessment (e.g. Viewpoints 02, 03, 04 and 05). Whist none of the viewpoints specifically relate to the dispersed properties, field observations have identified that several properties are positioned to take advantage of the open views over the Irish Sea. Review of the assessment judgements in relation to these viewpoints indicates that there may be major or major/moderate and significant effect on visual amenity at dispersed properties within approximately 400 m of the Landfall Substation and up to approximately 3 km of the MDZ.

24.6.5.5.5. Transport Routes

24.6.5.5.5.1. Primary Roads

272. The three main routes within the Study Area (the A55, A5 and A5025) are all remote from the offshore elements of the Project and also the Landfall Substation. Review of the corresponding ZTVs identifies very limited visibility of the MDZ and Landfall Substation from these primary roads. The proposed Grid Connection Substation and Switchgear Building would be positioned closer to these primary roads, particularly the A55. However, any visibility of these substations would be very localised due to a combination of the size/scale of these components of the Project and the screening effect of existing vegetation and buildings. Any views from these routes would be transitory and short in duration. Therefore, any potential effects on visual amenity for road users would be very limited and not significant. This is also demonstrated by the analysis of Viewpoints S06 and S10, which identifies the potential for minor effects as a result of the Project at both locations.

24.6.5.5.5.2. Secondary Roads

273. The baseline assessment also identifies the B4545 as a key coastal route. As with the primary roads, this route is also relatively remote from the key elements of the Project. The ZTV for the MDZ shows theoretical visibility of the offshore components in Trearddur. However, given this section of road is within the settlement, intervening buildings greatly restrict views to the sea

and therefore would also limit potential visibility of the tidal energy devices. There is no predicted visibility of the Landfall Substation from the B4545. Both the Grid Connection Substations and Switchgear Building would be theoretically visible. However, the relative size/scale of these structures, separation distance from the route, screening influence of intervening buildings and vegetation, and context within which they would be seen means potential effects are predicted to be limited and not significant. No viewpoints have been selected to specifically assess these project components from the B4545, but it is expected that the potential magnitude of change would be no greater than slight, and the visual effect no greater than moderate/minor.

24.6.5.5.5.3. Minor Roads

274. In addition to the above there are multiple minor roads within the Study Area. These are frequently remote from the Project components which would typically limit potential effects. However, there are some important observations in relation to certain minor roads on the north west part of Holy Island. The minor roads where there are likely to be greatest effects on visual amenity are the coastal route between Trearddur and Holyhead (part of which is South Stack Road) and also the section of South Stack Road that terminates at the small car park near South Stack. There is frequent visibility of the Irish Sea from this route, and therefore potential visibility of the offshore components of the Project. In addition, South Stack Road also passes adjacent to the Landfall Substation.

275. Several locations along this section of coastline are included in the viewpoint assessment (e.g. Viewpoints 02, 03, 04 and 05). With the exception of Viewpoint 02, the car park where South Stack Road terminates, these viewpoints are not located on the road and have not been specifically used to assess the effects of the offshore components of the Project on road users. However, field observations have confirmed the potential for views over the Irish Sea and, relating the assessment judgements for these viewpoints, it is likely that there would be major/moderate and significant effects on visual amenity for users of this road.

276. Views to the proposed Landfall Substation have been assessed at a number of Viewpoints (e.g. S01, S02, S03, and S04). However, this process has identified no significant effects resulting from the Landfall Substation, with the proposed structure typically comprising a limited addition to the views.

24.6.5.5.5.4. Ferry Passengers

277. Ferry routes between Holyhead and Ireland cross the seaward part of the Study Area to the north of the MDZ. The Project components relevant to these receptors are the offshore structures within the MDZ. The onshore Project components would be remote from these receptors and unlikely to be visible or distinguishable is landward views.

278. The ferry routes lie to the north of the MDZ and the tidal energy devices would be seen in transitory views from ferries and also cruise ships heading to and from Holyhead Port. Such views to the Project would form a small part of long-distance journeys. Viewpoint 13 has been selected to provide an indication of the magnitude of change and related effects on visual amenity for ferry passengers. The assessment identifies that the potential effects of the Project would be moderate/minor and not significant. It is also recognised that Holyhead Mountain is

noted in published documents as forming a landmark for people arriving at Holyhead. Importantly, whist the offshore structures would be visible, it is considered that their limited height would not diminish the much greater height of Holyhead Mountain.

24.6.5.5.5.5. Recreational Receptors

279. The baseline assessment identifies several recreational receptors relevant to the assessment including:

- The users of long-distance footpaths;
- The users of other PRoW and Open Access Land;
- Promoted cycle routes;
- Visitors to South Stack Royal Society for the Protection of Birds (RSPB) Visitor Centre;
- Visitors to beaches; and
- Offshore recreational receptors.

280. The above recreational receptors are typically considered to be of high susceptibility to change associated with the Project as their attention is focussed on the landscape. The exception to this is cyclists as the nature of the views obtained are more transitory and a greater degree of attention on the route is required. The value of the views experienced by such receptors is also considered to be high in this instance due to the value attached to the landscape, as well as the promotion of these routes. Therefore, the sensitivity of people using these recreational resources, in relation to the Project is high or high/medium (the latter applying to cyclists).

24.6.5.5.5.5.1. The Users of Long-Distance Footpaths

281. The two long distance footpaths within the Study Area comprise the Wales Coast Path and the Isle of Anglesey Coastal Path, both of which follow an almost identical route. The sections of these routes where there are likely to be greatest effects on visual amenity are between Penrhyn Mawr and North Stack (i.e. the closest section of the coastline to the MDZ). There is constant visibility of the Irish Sea from this route, and therefore potential visibility of the offshore components of the Project. There is also potential visibility of Landfall Substation from locations close to the coastline to the south west of this Project component.

282. In addition, there is theoretical visibility of the Grid Connection Substation and Switchgear Building from this route. However, it is expected that any views would be severely restricted or prevented by intervening buildings and vegetation, particularly from the closest sections of this path e.g. at Penrhos Beach. Therefore, it is not anticipated that the Grid Connection Substation and Switchgear Building would result in significant effects on visual amenity for users of the long-distance footpaths.

283. Almost all the viewpoints selected in relation to the offshore components of the Project (located along the western coastlines of Holy Island and the Isle of Anglesey) are on the route of these long-distance paths (i.e. Viewpoints 01, 02, 03, 04, 06, 07, 08, 09, 10, 11 and 12). These viewpoints demonstrate the open, expansive views over the Irish Sea obtained from this path. The viewpoint assessment also identifies that the predicted effects are likely to be major or

major/moderate and significant for the closest parts of this route. At more distant locations the relative size/scale of the structures would quickly diminish and the corresponding effects would not be significant. Therefore, the significant visual effects would be associated with a short section of these routes (within approximately 4 km of the MDZ).

284. Views to the proposed Landfall Substation from these long-distance routes have been assessed at Viewpoints S02, S03, and S04. However, this process has identified no significant effects resulting from the Landfall Substation, with the proposed structure typically comprising a limited addition to the views.

24.6.5.5.5.5.2. The Users of Other Public Rights of Way and Open Access Land

285. In addition to the above there are multiple other PRoW and area of Open Access Land within the Study Area. These are frequently remote from the Project components which would typically limit potential effects. However, there are some important observations in relation to certain routes/areas on the north west part of Holy Island. The routes/areas where there are likely to be greatest effects on visual amenity are between Penrhyn Mawr and South Stack, including South Stack Cliffs Nature Reserve/The Range and the south west slopes of Holy Island. In the majority of instances, the coastal paths forms part of the long distance routes considered above. There is frequent visibility of the Irish Sea from these routes, and therefore potential visibility of the offshore components of the Project.

286. With the exception of Viewpoint 05, which lies within Open Access Land (at Cytiau'r Gwyddelod scheduled monument), these viewpoints are all located on the Anglesey Coastal Path/Wales Coast Path and have not been specifically used to assess the effects of the offshore components of the Project on other PRoW/Open Access Land. However, field observations have confirmed the potential for views over the Irish Sea and, relating these to the assessment judgements for surrounding viewpoints, it is likely that there would be locations within approximately 4km of the MDZ where the predicted effect would be major or major/moderate and significant.

287. Views to the proposed Landfall Substation have also been assessed from Open Access Land on the south west slopes of Holyhead Mountain (viewpoint S05). However, this analysis has identified no significant effects resulting from the Landfall Substation, with the proposed structure typically comprising a limited addition to the view.

24.6.5.5.5.5.3. Promoted Cycle Routes

288. There are two National Cycle Routes within the Study Area, which are shown on **Figure 24-1-2b** (**Volume II**). These routes are remote from the offshore elements of the Project and also the Landfall Substation. Review of the corresponding ZTVs identifies very limited visibility of the MDZ and Landfall Substation from these primary roads. The proposed Grid Connection Substation and Switchgear Building would be positioned closer to these cycle routes. However, any visibility of these substations would be very localised due to a combination of the size/scale of these components of the Project and the screening effect of existing vegetation and buildings. Any views from these routes would there both be transitory and very short in duration. Therefore, any potential effects would be very limited and not significant.

289. In addition to the above there four locally promoted cycle routes within the Study Area (also shown on **Figure 24-1-2b, Volume II**). These typically follow minor roads and therefore the effects are broadly consistent with those stated above for the users of these routes. The parts of these local cycle routes where there are likely to be greatest effects on visual amenity are the coastal route between Trearddur and Holyhead (part of which is South Stack Road). There is frequent visibility of the Irish Sea from this road, and therefore potential visibility of the offshore components of the Project. South Stack Road also passes adjacent to the Landfall Substation.

290. Several locations close to this section of coastline are included in the viewpoint assessment (e.g. Viewpoints 02, 03, 04 and 05). These viewpoints are not located on the cycle routes and have not been specifically used to assess the effects of the offshore components of the Project on these receptors. However, field observations have confirmed the potential for views over the Irish Sea and, relating the assessment judgements for these viewpoints to the cycle routes, it is likely that there would be locations where the predicted effect would be major or major/moderate and significant.

291. Views to the proposed Landfall Substation have been assessed in a number of viewpoints on the minor roads that form part of the cycle routes (i.e. S01, S02, S03, and S04). However, this process has identified no significant effects resulting from the Landfall Substation, with the proposed structure typically comprising a limited addition to the views.

292. The local cycle routes also pass close to the Grid Connection Substation and Switchgear Building, particularly the Trearddur Loop, which follows the cycle path through Parc Cybi allocated employment site. However, the relative scale of these substations, local context (industrial/employment uses) and/or the screening effects of vegetation would limit potential visual effects which are not predicted to be significant at any of the viewpoints specific to these project components.

24.6.5.5.5.5.4. Visitors to South Stack RSPB Visitor Centre

293. The RSPB Visitor Centre is positioned on the coastline near South Stack and is positioned to take advantage of the views along the coastline and across the Irish Sea. This receptor has been specifically included in the viewpoint assessment (Viewpoint 04) and it is predicted that there would be a major or major/moderate and significant effect on visual amenity for people at the Visitor Centre.

24.6.5.5.5.5.5. Visitors to Beaches

294. Key beaches in the Study Area that lie close to the Project include:

- The beach at Abraham’s Bosom;
- Porth Dafarch;
- Trearddur Bay;
- Borthwen;
- Sliver Bay;

- Rhosneigr; and
- Beaches at Penrhos.

295. With the exception of the beach at Abraham's Bosom, it is predicted that there would be limited or no visibility from the above beaches. This broad conclusion is established through analysis of the ZTVs and the viewpoint assessment, which has specifically considered the beaches where visibility of project elements is most likely to occur (Porth Dafarch, Trearddur Bay and Rhosneigr).

296. The cable landfall point would be within the beach at Abraham's Bosom. Fieldwork observations have identified that this beach is not very accessible due to the condition of the route leading to it. However, people visiting the beach are still considered to be of high sensitivity. Assuming the potential worst-case scenario (which comprises cables in shallow trenches, protected by rock bags or similar, and cables pinned to the cliff face) there would be substantial and therefore major adverse effect on visual amenity for visitors to this beach. However, should it be feasible to install the landfall cable using horizontal directional drilling there would be no change to the character or appearance of this beach and potential effects would only be associated with the offshore structures.

24.6.5.5.5.5.6. Offshore Recreational Receptors

297. Offshore recreational receptors such as people travelling on recreational vessels have been specifically considered in respect of Viewpoint 14. This viewpoint is located approximately 2.4 km from the MDZ, where it is predicted that there would be a moderate and not significant effect these receptors. However, it is acknowledged that the level of effect on these receptors, at a given location, would vary with distance and greater (and potentially significant) effects would occur at locations closer to the MDZ. However, such effects would be localised and associated with people travelling within approximately 2 km of the Project and lesser (not significant) effects would occur at greater separation distances.

24.6.5.5.6. Overview of Potential Visual Effects

298. The predicted visual effects vary for the different components of the Project. The greatest magnitude of change and potential effects are associated with the offshore components of the Project. Lesser effects are associated with the onshore components, particularly the Grid Connection Substation and the Switchgear Building.

299. The generally open and exposed character of the Study Area gives rise to frequent and extensive views over the landscape/seascape. Holyhead Mountain forms a prominent and distinctive landmark, frequently forming a key component of views on this part of Holy Island and the Isle of Anglesey. The elevated landform and openness of the slopes also affords long distance views over both the landscape and surrounding sea. The effects associated with the offshore components of the Project would be greatest in the vicinity of Holyhead Mountain and the coastline to the south west of Penrhosfeilw, where a combination of the proximity of the MDZ and elevation of the landscape mean the number and spread of tidal devices and associated structures would form distinctive new man-made elements on the sea surface that contrast with the baseline context.

300. An important factor in the assessment of effects is the value and sensitivity of the landscape/seascape. It is a location of high scenic quality, which is reflected in much of the Study Area being designated as an AONB and Heritage Coast. This in turn means that people living within and visiting locations in the Study Area are frequently assessed as being of high sensitivity.

301. The limited height of the tidal devices means that their relative prominence would diminish quickly with distance. At viewpoints located further than 3 km from the MDZ the potential effect is predicted to be moderate or less. From such locations, and viewpoints towards the peripheral parts of the Study Area it would be difficult to discern the changes resulting from structures within the MDZ. The crenulated form of the coastline will also influence this, with the coastal landform restricting views of the Project.

302. Navigation lighting is also an important consideration in relation to potential effects. The limited artificial lighting within the baseline of part of the Study Area, particularly adjacent to the MDZ means this lighting would contrast with the baseline context of a sea surface largely devoid of fixed sources of light, although noting the presence of South Stack Lighthouse. Again, the key changes associated with lighting would be associated with the viewpoints on the most western parts of Holy Island, e.g. in the vicinity of South Stack. However, from more settled areas, or where settlements form part of the view, including Trearddur, the magnitude of change and predicted effects would be less.

303. The Landfall Substation and sections of the onshore cable route would be located within the AONB, to the west of Holyhead. Again, the open, exposed nature of this landscape means that the Landfall Substation would be visible. In addition, the baseline landscape is sensitive to the changes that would result from such development. However, the sensitive siting and design of this element of the Project has reduced potential adverse effects. It would be positioned in a relatively low lying position to provide visual enclosure and the layout and form of the structures have been designed to reflect local agricultural buildings, reducing the contrast and change in relation to the baseline landscape. There are locations from which close-range views of the Landfall Substation would be seen, but these are typically from South Stack Road and are therefore transient in nature. The predicted visual effects resulting from the Landfall Substation are no greater than moderate, and these quickly reduce to moderate/minor or less with increasing distance.

304. The proposed Grid Connection Substation and the Switchgear Building are considered to result in limited visual effects, with no significant effects predicted. In the case of the Switchgear Building the relative size of the proposed structure, together with the baseline context within the allocated employment site, would limit the predicted magnitude of change and levels of effect. The Grid Connection Substation site is enclosed by vegetation and adjacent to existing industrial structures and land uses. These factors both limit potential visibility and the contrast with the baseline conditions.

24.6.6. Potential Impacts During Repowering and Decommissioning

305. The potential seascape/landscape and visual effects associated with the repowering of berths and decommissioning would be comparable with the construction phase detailed in **Section 24.6.4**.

306. The most conspicuous changes during the decommissioning phase are likely to be associated with the removal of the Landfall Substation.

307. Overall, the potential seascape/landscape and visual effects associated with these phases will be short term, temporary and the changes compared with the baseline limited. In the case of repowering these activities would be intermittent and seen in the context of the tidal energy devices that form part of the PDE. Repowering activities are also likely to take place in specific parts of the MDZ rather than throughout it at any one time. Therefore, no effects greater than those associated with the operational phase are predicted in relation to repowering and decommissioning.

24.6.7. Cumulative Impacts

308. An assessment of the potential for cumulative effects with other proposed developments in the Study Area has been undertaken. This has involved review of information available from IoACC, NRW (in relation to Marine Licences) and National Infrastructure Planning to identify proposed developments with similar characteristics to the Project which could result in cumulative effects. Based on this process, and with consideration of the key characteristics of the various components of the Project, the following are considered to be the proposed developments with which the Project has greatest potential to result in cumulative effects:

- DG Holyhead Deep Array Project;
- Orthios development proposals, including Anglesey Eco Park Power Station;
- Holy Island Resort; and
- Huws Gray builders’ merchant at Parc Cybi.

309. The DG Holyhead Deep Array Project comprises a proposed tidal energy development to the west of the MDZ. A scoping report has been prepared for this proposed development, but a Section 36 application or Marine Licence application has not been submitted at present. It would include the construction, operation and decommissioning of tidal energy devices (Deep Green Utility units) with an area 9.1 km^2 approximately 6.5 km to the west of Holy Island. The Deep Green Utility units operate under the water, with no visible elements above the sea surface, apart from the possible use of floating electrical connection hubs within moored buoys. However, the hubs may be mounted on the seabed. This development would have appropriate required navigation marking and lighting. The scoping report for the DG Holyhead Deep Array Project does not identify any specific onshore grid connection infrastructure.

310. Orthios are proposing a range of developments within the former aluminium works site. A planning application for demolition works within the site has been approved. It is understood

that there are emerging development proposals for the site including a 299 MW biomass power station (the Eco Park Power Station). The emerging proposals for the aluminium works site are not yet the subject of a planning application therefore the associated details are not known at present.

311. The Holy Island Resort proposal comprises the creation of a luxury holiday destination on the Penrhos Estate. It would include 500 lodges, restaurants, a spa and a waterpark. Planning permission for this development has been granted and it is understood that the site for this development includes land to the north and south of the A55 to the east of Holyhead.

312. A high level assessment of the above developments has been undertaken to understand the potential for cumulative effects to occur in combination with the Project, based on the size, location, extent and characteristics of each of these proposed developments. This has identified that the key development that has greatest potential to result in cumulative effects is the DG Holyhead Deep Array Project. As the Agreement for Lease Area for this proposed development is located further offshore, it would typically be seen behind the Project from the terrestrial parts of the Study Area. This proposed development is currently at scoping stage and it is uncertain what, if any, surface emergent elements would be deployed. The elements that could result in combined effects with the Project would comprise vessels used in construction and operation/maintenance, and navigation markers including lighting which could result in a greater magnitude of change during daylight and night hours. Based on the existing level of information, it is difficult to draw any specific conclusions on the potential cumulative effects and these would need further consideration when the application for the Holyhead Deep Array Project is submitted.

313. The Orthios development proposals also have the potential to result in cumulative effects in combination with components of the Project, particularly the Grid Connection Substation and Switchgear Building components. As these proposals are not yet part of a planning application, the details are not available. The potential for cumulative effects with the Project would require assessment when this planning application is submitted. The baseline context of industrial structures within the former aluminium works site is likely to limit the potential level of cumulative effects between the proposed Grid Connection Substation and Switchgear Building components of the Project and the Orthios proposals.

314. The Holy Island Resort development would be located close to the proposed Grid Connection Substation and Switchgear Building. It has been established throughout the SLVIA that the Grid Connection Substation would be located within a visually enclosed site in the context of existing industrial structures, which forms part of the baseline. In addition, the Switchgear Building would form a relatively small structure in the context of an existing development site. It is also unlikely that there would be any inter-visibility between the Holy Island Resort and the offshore components of the Project. Therefore, the potential cumulative seascape, landscape and visual effects of the Project with the Holy Island Resort development are likely to be limited and not significant.

315. The Huws Gray builders' merchant development would be positioned immediately to the north west of the Switchgear Building. The principle of development within this location is established through its allocation for employment uses in the Local Development Plan. Whilst the

Switchgear Building and Grid Connection Substation would contribute to cumulative effects with the Huws Gray development. However, the context of the Project, including both the industrial structures within the Orthios site and the employment land allocation at Parc Cybi, together with the scale and prominence of the Switchgear Building and Grid Connection Substation will restrict its overall contribution to cumulative effects. Overall, is it considered that the potential cumulative seascape, landscape and visual effects of the Project with the Huws Gray development are likely to be limited and not significant.

24.6.8. Inter-relationships

316. **Table 24-17** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 24-17 Inter-topic relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Onshore Archaeology and Cultural Heritage	Chapter 20	Section 24.6 (all impacts); Section 24.6.5.3 (impacts on landscape designations)	Both chapters consider the potential effects of the Project on designated Registered Parks and Gardens and their setting within the landscape.
Socio-Economics, Tourism and Recreation	Chapter 25	Section 24.6 (all impacts).	Both chapters consider the potential effects of the Landfall Substation, Grid Connection Substation and Switchgear Building on the visual amenity of recreational users in the local area.
Onshore Ecology	Chapter 19	Section 24.6.2 (design optimisation and embedded mitigation) Section 24.6.4 (impacts during construction) Section 24.6.5 (impacts during operation)	Both chapters consider the potential effects of vegetation removal, the SLVIA considering the impact of vegetation removal as landscape elements, and the Onshore Ecology assessment considering the impact on vegetation removal as ecological receptors.

24.6.1. Interactions

317. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 24-18**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 24-18 Potential interaction between impacts

Construction				
	1 Loss of agricultural land	2 Loss of hedgerows and scrub	3 Changes to landscape character	4 Changes to landscape designations
1 Loss of agricultural land	-	Yes	Yes	Yes
2 Loss of hedgerows and scrub	Yes	-	Yes	Yes
3 Changes to landscape character	Yes	Yes	-	Yes
4 Changes to landscape designations	Yes	Yes	Yes	-
Operation				
1 Loss of agricultural land	-	Yes	Yes	Yes
2 Loss of hedgerows and scrub	Yes	-	Yes	Yes
3 Changes to landscape character	Yes	Yes	-	Yes
4 Changes to landscape designations	Yes	Yes	Yes	-

24.7. SUMMARY

318. The Project comprises a range of components, with those most likely to have adverse effects on seascape, landscape and visual receptors being:

- The offshore structures within the MDZ, particularly the tidal energy devices, electrical hubs, navigation markers and lighting;
- The landfall cables within Abraham's Bosom;
- The Landfall Substation;
- The Grid Connection Substation; and
- The Switchgear Building

319. Much of Holy Island and the Isle of Anglesey within the 15 km Study Area considered in this assessment form part of the Isle of Anglesey AONB, with sections of the coastline also designated as Heritage Coast. There are other relevant designations within the Study Area (such as a SLA and a Registered Park and Garden), but the Project is not predicted to result in any significant effects on these designations. Therefore, the proposed Project would be located where surrounding landscapes are considered to be of national and local authority value and

the characteristics of the corresponding seascape and landscape areas are sensitive to changes that would occur as a result of tidal energy development.

320. A summary of the effects identified in the SLVIA is included in **Table 24-19** below.

24.7.1. Potential effects associated with construction

321. The relatively small extent of the disturbance, the short duration of the effects and the reinstatement of working areas in relation to the onshore components of the Project would ensure that the effects of the construction phase on the landscape fabric, character and visual amenity of the locality would be limited. In relation to the offshore components of the Project, the construction activities would take place over a longer duration and these works would overlap with the operational phase. Due to the temporary nature, limited extent of the actual construction activities and anticipated overlap with the operational phase, the SLVIA concentrates on the effects resulting from the operational phase of the Project.

24.7.2. Potential Effects on Seascape Resource

322. Physical effects on the fabric of the qualities and characteristics of the seascape and landscape as a result of the offshore elements would be limited in extent and visible changes would be reversible on decommissioning of the Project. The tidal energy devices would be attached to foundations secured to the seabed and all structures that emerge from the surface of the sea would be removed on decommissioning. While it may not be possible to remove all the elements within the development site (e.g. foundations), all visible components would be removed, and the visual characteristics of the seascape would revert to pre-development conditions. This is also expected to be the case for the onshore components of the Project, with all above ground structures proposed to be removed as part of the decommissioning phase.

323. The arrays of tidal energy devices would potentially be seen from parts of the surrounding area and have the potential to affect the perception of seascape and landscape character, both in daylight and at night time. The high value placed on the landscape and coastline of much of the Study Area is reflected in its designation as an AONB and Heritage Coast. The relative sense of remoteness and tranquillity associated with parts of the Study Area (e.g. Holyhead Mountain) also affect its sensitivity.

324. Overall, the SLVIA has identified that there would be some adverse effects as result of the offshore elements of the Project. Of the 14 SCAs and LCAs in the Study Area it is predicted that significant adverse effects on parts of the Holyhead Mountain and Rhoscolyn SCAs. The effects on the Holyhead Mountain and Rhoscolyn Seascape Character Areas would be particularly associated with locations that are more remote and where the composition of the arrays of tidal devices introducing new man-made elements to the seascape would be apparent. In the context of the wider Study Area, the offshore components of the Project would frequently comprise relatively small elements in the context of key components of the character types/units and the potential effects on seascape/landscape character are not predicted to be significant. The tidal energy devices would not become a defining feature of seascape or landscape character and would comprise small components within the open views that can be seen over the Irish Sea.

325. It is predicted that the onshore components of the Project, would not result in significant adverse effects on seascape or landscape character for any of the 14 SCAs and LCAs identified in the baseline assessment, including the Rhoscolyn and Holyhead SCAs in which the substations would be located. In the case of the Landfall Substation this has been located and designed to mitigate potential adverse effects on the Rhoscolyn SCA. The Switchgear Building, also within the Rhoscolyn SCA, would comprise a relatively small scale structure within an allocated employment site. The Grid Connection Substation, within the Holyhead SCA would comprise larger structures, but these would be would be positioned within land that is enclosed by existing vegetation and buildings and in the immediate context of existing industrial structures.

24.7.3. Potential Effects on Designations

326. Potential effects on designated landscapes within the Study Area have been assessed, including the Isle of Anglesey AONB, sections of Heritage Coast, Mynydd Mechell SLA, Conservation Areas and Carreglwyd Registered Park and Garden.

327. Localised significant adverse effects are predicted on the AONB and section of the Heritage Coast closest to the Project, specifically in relation to the Holyhead Mountain and Rhoscolyn seascape character areas. However, no overall significant effect is predicted for the whole of the AONB or the other section of Heritage Coast in the Study Area. Physical effects on the fabric of the seascape/landscape within these designations would be relatively limited and no notable features or elements would be lost. There would be localised significant effects at Abraham's Bosom within the Heritage Coast (and AONB) in relation to the worst-case scenario for the landfall cables.

328. No significant effects are predicted on the Mynydd Mechell SLA Conservation Areas and Carreglwyd Registered Park and Garden due to a combination of the intervening distance, limited inter-visibility and/or context of the Project components.

24.7.4. Potential Effects on Visual Amenity

329. The study has assessed the effects of the Project upon settlements, transport routes and recreational receptors in the Study Area. Potential effects on visual amenity at a range of viewpoints that are representative of the views seen by a range of visual receptors have also been assessed.

330. The nature of the offshore structures associated with the Project and the sensitivity of local visual receptors means that there would be some adverse effects on visual amenity. The extent of these potential effects would be limited to some extent by landform, as well as the relative size/scale of the structures compared with elements of the existing environment and the reversible characteristics of the proposals. In the case of the Grid Connection Substation and Switchgear Building, the restrictions to potential visibility due to vegetation and buildings, together with the nature of land uses and buildings in the immediate vicinity of these Project components would limit the potential visual effects.

331. Significant potential visual effects have been identified in relation to receptors in the closest part of the coastline, between Penrhyn Mawr and South Stack. These receptors include:

- Residents of dispersed properties;
- People walking the Anglesey Coastal Path/Wales Coast Path; and
- People visiting the RSPB reserve and visitor centre.

332. At other locations the degree of change and effect would be less, mitigated by the intervening distance, relative scale of the proposed structures, the context in which they would be seen and/or the scale of the view. The Project has an overall lifespan of 37 years and following decommissioning the devices and structures would be removed, reversing the potential effects identified in the SLVIA.

24.7.5. Potential for Cumulative Effects

333. A high level review of proposed developments within the Study Area has been undertaken as part of the SLVIA. Review of these has identified that the key development that has the potential to result in cumulative effects in combination with the Project is the Holyhead Deep Array Project. However, this proposed development is currently at the scoping stage and insufficient detail is known about its likely design envelope to carry out a meaningful cumulative assessment with the Project. Therefore, further consideration of the potential cumulative effects with the Project would be required in the future.

Table 24-19 Summary of Key Potential Impacts for Seascape, Landscape and Visual Receptors

Receptor	Sensitivity	Magnitude	Effect	Significance
Seascape				
SCA 10 – Carmel Head to Penrhyn	High/medium	Slight/negligible	Minor (adverse)	Not significant
SCA 11 – Holyhead	Medium	Slight	Minor (adverse)	Not significant
SCA 13 – Holyhead Mountain	High	Medium	Major/moderate (adverse)	Significant
SCA 14 – Rhoscolyn	High/medium	Medium	Moderate (adverse)	Significant
SCA 31 – West of Anglesey	Medium	Medium/slight	Moderate (adverse)	Significant
Designations				
Isle of Anglesey AONB	High	Medium	Moderate (adverse)	Locally significant
Heritage Coast (Holy Island)	High	Substantial	Major (adverse)	Significant
Heritage Coast (north west Anglesey)	High/medium	Slight/negligible	Minor (adverse)	Not significant
Mynydd Mechell SLA	Not specifically assessed	None	None	Not significant
Conservation Areas	Not specifically assessed	Not specifically assessed	Predicted to be very limited	Not significant
Carreglwyd Registered Park and Garden	Not specifically assessed	Not specifically assessed	Predicted to be limited	Not significant
Settlements				
Holyhead	High	Negligible	Moderate/minor	Not significant
Trearddur	High	Slight to negligible	Moderate to moderate/minor	Not significant
Rhosneigr	High	Negligible	Minor	Not significant
Dispersed residential properties (north west Holy Island)	High	Substantial to medium	Major to major/moderate	Significant
Transport routes				
Primary roads	Medium/low	Slight to negligible	Minor to negligible	Not significant
Secondary roads	Medium/low	Slight	Moderate/minor	Not significant
Minor roads (north west Holy Island)	High/medium	Substantial to medium	Major/moderate	Significant

Ferry passengers	Medium	Slight	Moderate/minor	Not significant
Recreational Receptors				
Users of long-distance footpaths	High	Substantial to medium	Major to major/moderate (locally)	Significant
Other footpaths and Open Access Land	High	Substantial to medium	Major to major/moderate (locally)	Significant
Promoted cycle routes	High/medium	Substantial to medium	Major to major/moderate (locally)	Significant
Visitors to South Stack RSPB Visitor Centre	High	Substantial to medium	Major to major/moderate (locally)	Significant
Visitors to beaches (Porth Dafarch, Trearddur Bay, Borthwen Sliver Bay, Rhosneigr and Penrhos)	High	Negligible to none	Minor to none	Not significant
Visitors to beach at Abraham’s Bosom	High	Substantial	Major	Significant
Offshore recreational receptors	High/medium	Slight to negligible	Moderate (locally)	Not significant

24.8. REFERENCES

CADW and ICOMOS UK (1998) Register of Landscapes, Parks and Gardens of Special Historic Interest in Wales, CADW

CADW, Countryside Council for Wales and ICOMOS UK (1998) Register of Landscapes of Outstanding Historic Interest in Wales, CADW

CADW, Countryside Council for Wales and ICOMOS UK (2001) Register of Landscapes of Special Historic Interest in Wales, CADW

Countryside Council for Wales, Brady Shipman Martin and University College Dublin (2001) Guide to Best Practice in Seascape Assessment, Maritime Ireland/Wales INTERREG 1994-1999

Department of Energy and Climate Change (July 2011) Overarching National Policy Statement for Energy (EN-1), The Stationary Office, London

Department of Energy and Climate Change (July 2011) National Policy Statement for Renewable Energy Infrastructure (EN-3), The Stationary Office, London

Enviros Consulting (2005) Seascape and Visual Impact Assessment Guidance for Offshore Wind Farm Developers, DTI

Fiona Fyfe Associates with Countryscape and Bangor University (SEACAMS), (2013) Anglesey Seascape Character Assessment, Isle of Anglesey County Council

International Association of Marine Aids to Navigation and Lighthouse Authorities (December 2013) IALA Recommendation O-139 on The Marking of Man-Made Offshore Structures, Edition 2

International Association of Marine Aids to Navigation and Lighthouse Authorities (May 2013) IALA Recommendation E-108 on The Surface Colours used as Visual Signals on Aids to Navigation, Edition 3

Isle of Anglesey County Council and Gwynedd Council, Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026, Written Statement, adopted 31st July 2017

Isle of Anglesey County Council and Gwynedd Council (2012) Review of Special Landscape Areas in Gwynedd and Anglesey

Isle of Anglesey AONB and NRW, The Isle of Anglesey AONB - Management Plan Review 2015-2020

Landscape Institute (2011) Photography and Photomontage in Landscape and Visual Impact Assessment, Landscape Institute Advice Note 01/11

Landscape Institute and Institute of Environmental Management and Assessment, (2013) Guidelines for Landscape and Visual Impact Assessment (GLVIA 3), Third Edition, Routledge, Abingdon

LDA (2012) An Approach to Seascape Character Assessment, Natural England

LUC (2015) National Seascape Assessment for Wales, Natural Resources Wales

Natural England (October 2012) An Approach to Seascape Character Assessment

Natural England (February 2010) Natural England Position Statement: All Landscapes Matter

Natural Resources Wales (dates vary for different character area profiles) National Landscape Character Areas

Natural Resources Wales (undated) LANDMAP Information

Scottish Natural Heritage (February 2017) Visual Representation of Wind Farms

TACP (2011) Anglesey Landscape Strategy update, Isle of Anglesey County Council

The Countryside Agency and Scottish Natural Heritage (2002) Landscape Character Assessment: Guidance for England and Scotland

Welsh Government (December 2018) Planning Policy Wales (PPW), Edition 10

Welsh Government (July 2005) Technical Advice Note 8: Planning for Renewable Energy

Welsh Government (March 2016) Technical Advice Note 12: Design

Welsh Statutory Instruments (2016) Town and County Planning (Environmental Impact Assessment) (Wales) Regulations 2016, The Stationary Office Limited

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Morlais Project
Environmental Statement

Chapter 25: Socio-Economics, Tourism and Recreation

Volume I

Applicant: Menter Môn Morlais Limited
Document Reference: PB5034-ES-025
Chapter 25: Socio-Economics, Tourism and Recreation
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aquatera environmental services and products

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GLOSSARY OF ABBREVIATIONS

AONB	Area of Outstanding Natural Beauty
Bn	Billion (£)
CfD	Contract for Difference
DECC	Department of Energy and Climate Change
EIA	Environmental Impact Assessment
EMEC	European Marine Energy Centre
ES	Environmental Statement
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GVA	Gross Value Added
HIE	Highlands and Islands Enterprise
IoACC	Isle of Anglesey County Council
KPI	Key Performance Indicator
M	Million (£)
MCAA	Marine and Coastal Access Act
MDZ	Morlais Demonstration Zone
MEW	Marine Energy Wales
MPS	Marine Policy Statement
MW	Mega Watts
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
NVQ	National Vocational Qualification
ONS	Office of National Statistics
PRoW	Public Right of Way
PPA	Power Purchase Agreement
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WEFO	Welsh European Funding Office
WNMP	Wales National Marine Plan

GLOSSARY OF TERMINOLOGY

Average gross weekly earning	The average wage rate before any tax or other deductions are taken applied.
Average job density	The average number of people employed within an area based on population.
Brexit	The political term for Britain's plan to leave the European Union.
Employment multiplier	National employment statistic multipliers used to compare employment across different sectors.
Energy Island Programme	Funding programme developed by the European Union specially for energy projects within islands.
European Marine Energy Centre (EMEC)	Marine energy test centre, based in Orkney.

FTE - Full Time Equivalents	A measure used to estimate the amount of full time jobs a project may create.
GVA - Gross Value Added	The measure of the value of goods and services produced in an area, industry or sector of an economy.
HIE - Highlands and Islands Enterprise	Government economic agency that covers the north of Scotland and the northern and western isles.
Indirect jobs	Jobs that are created by a project that are not directly related to the individual developer such as boat crews.
Induced Jobs	Jobs that are created by the presence of a project but not directly or indirectly related to the project. Such as increased hotel staff in a hotel close to project used by people visiting.
Minesto	Tidal developer with an operational site in North Wales.
North Wales Growth Deal	The government funding package for North Wales.
NVQ qualifications	National vocational qualifications which are a work based qualification which recognises the skills and knowledge a person needs to do a job. It is a recognised standard qualification across the UK.
Occupancy rates	The amount of time a tourist accommodation is full.
Person-years	Person-years is a type of measurement which takes into account both the number of people in the project and the amount of time each person spends working on the project.
RSPB	Royal Society for the Protection of Birds.
Socio-economic	The social and economic issues that relate to the project.
UNESCO World Heritage Site	United Nations recognised site of outstanding heritage importance.

25. SOCIO-ECONOMICS, TOURISM AND RECREATION

25.1. INTRODUCTION

1. Menter Môn Morlais Limited (Menter Môn) proposes the development of 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ). The development of the Morlais Project (the Project) will support the development of renewable energy technology objectives of the Anglesey and Gwynedd Joint Local Development Plan (JLDP), providing a consented tidal technology demonstration zone which supports installation, testing and commercial demonstrations of tidal energy devices. The Project will also provide opportunities for the local communities via direct employment and support of the local supply chain.

2. The Project will include permanent communal infrastructure for tidal technology developers which provides a shared route to a local grid connection via nine export cable tails, an onshore landfall substation, and an onshore electrical cable route to a grid connection via a grid connection substation (see **Chapter 4, Project Description**).

3. Menter Môn is a social enterprise which works across North Wales to deliver a range of regeneration, environmental and cultural projects for the benefit of local communities. By working in partnership with government, the third sector, business and individuals, Menter Môn attracts funding from different sources to add value and to contribute to creating a sustainable future. This Project aims to establish Anglesey as a marine energy hub, whilst maximising opportunities for local communities directly through employment and indirectly through the establishment of a local supply chain where possible.

4. This chapter focuses specifically on assessing the impacts of the Project (both beneficial and adverse) on local, regional and national socio-economic conditions, including employment, tourism, recreation, interaction with other sectors e.g. the fishing and shipping industries, as well as energy related issues. Where possible and appropriate, quantitative estimation and analysis has been undertaken to describe and analyse potential outcomes in key topic areas. In other areas it is only possible to offer qualitative description and analysis based on the experience of the chapter authors, which is itself based on over 15 years' experience of the tidal energy sector.

5. Within the overall assessment a number of references are made to experience of tidal energy development to date in the Orkney Islands. Orkney is an island community that has been host to a test and demonstration facility since 2003, the European Marine Energy Centre (EMEC). It therefore offers considerable opportunity for comparison with the proposed Project. The Orkney experience is particularly relevant to Anglesey due the island nature of the two communities. The assessment is further informed by data from other similar projects located in the Anglesey/North Wales regions.

6. This chapter should, where applicable, be considered in conjunction with the following chapters contained within this ES:

   - **Chapter 2, Policy and Legislation**; overview of relevant policy and legislation for the Project;
   - **Chapter 4, Project Description**: describes the key aspects of the Project including location, infrastructure and the methods likely to be adopted for the construction, operation, maintenance and final decommissioning phases of the Project;

- **Chapter 13, Offshore Archaeology and Cultural Heritage**: assesses the impacts of the Project on marine archaeology;
- **Chapter 14, Commercial Fisheries**: assesses the impacts of the Project on commercial fisheries;
- **Chapter 15, Shipping and Navigation**: assesses the effects of the Project on shipping and navigation.
- **Chapter 23, Traffic and Transport**: assesses the effects of the Project on traffic and transport; and
- **Chapter 24, Seascape, Landscape and Visual Impact Assessment**: assesses the effects of the Project on landscapes and seascapes.

7. This chapter should also be read with reference to the Morlais Welsh Language Impact Assessment which is a standalone (non ES) document.

8. All baseline characterisation and impact assessment work carried out as part of this chapter is based on best practice and best available data. The approach is not intended to be wholly prescriptive, with professional judgement and experience being applied where appropriate. It is acknowledged that some data gaps and uncertainties still exist. Where possible necessary measures have been taken to minimise these data gaps and uncertainties, to ensure that they do not compromise the robustness of the impact assessment.

9. This Chapter has been prepared for the Project by Aquatera Ltd on behalf of Menter Môn.

25.2. POLICY, LEGISLATION AND GUIDANCE

10. This section outlines the policy, legislation and guidance materials of particular relevance to the Project. A detailed overview of the all key policy and legislation related to the Project, can be found in **Chapter 2, Policy and Legislation**.

25.2.1. Policy Statements

25.2.1.1. Marine Policy Statement

11. The Marine Policy Statement (MPS) adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made in order to enable sustainable development. The MPS sets out a vision of having ‘clean, healthy, safe, productive and biologically diverse oceans and seas’ by supporting the development of Marine Plans. It also sets out the framework for environmental, social and economic considerations that need to be considered in marine planning.

25.2.1.2. Wales National Marine Plan

12. By adopting the MPS, the Welsh Government committed to the requirement to introduce Marine Plans for Wales.

13. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the Welsh National Marine Plan (WNMP). The Plan is being developed in accordance with the Marine and Coastal Access Act (MCAA) 2009, the MPS and the Maritime Spatial Planning Directive, a draft version has been issued for consultation (discussed further in **Chapter 2, Policy and Legislation**).

14. Objective 10 of the draft WNMP, “to maintain and enhance the resilience of marine ecosystems and the benefits they provide in order to meet the needs of present and future generations”, is of relevance to this chapter. It covers policies and commitments on the wider ecosystem, as set out in the MPS including those relating to the Marine Strategy Framework Directive and the Water Framework Directive, and other environmental, social and economic considerations.

25.2.1.3. National Policy Statements

15. Although this Project is not seeking a Development Consent Order (DCO), its size (up to 240 MW) means it is of equivalent scale and magnitude as a Nationally Significant Infrastructure Project (NSIP). Guidance that is relevant to assessing potential socio-economic impacts for NSIPs are set out within National Policy Statements (NPS) which are the principal decision-making documents for NSIPs.

16. The assessment of potential impacts within this chapter has, therefore, been undertaken with specific reference to the relevant National Policy Statements (NPS). Those NPS relevant to the Project are:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3), (DECC) 2011b).

17. Specific relevant sections of these NPS that detail the focus of impact assessment work on socio-economic impacts and which have been used to inform this assessment are summarised below:

- NPS EN-1 (Para 5.12.3): The assessment should consider the creation of jobs and training opportunities;
- NPS EN-1 (Para 5.12.3): The assessment should consider the provision of additional local services and improvements to local infrastructure, including the provision of educational and visitor facilities;
- NPS EN-1 (Para 5.12.3): The assessment should consider effects on tourism;
- NPS EN-1 (Para 5.12.3): The assessment should consider the impact of a changing influx of workers during the various construction, operations and maintenance (O&M) and decommissioning phases, of the energy infrastructure;
- NPS EN-1 (Para 5.12.3): The assessment should consider cumulative effects;
- NPS EN-1 (Para 5.12.6 to 5.12.7): PINS (Licensing Body) conclude that little weight is to be given to assertions of socio-economic effects that are not supported by appropriate evidence (particularly in view of the need for energy infrastructure as set out in this NPS); and
- NPS EN-1 (Para 5.12.8): The assessment should consider any relevant beneficial provisions the applicant has made or is proposing to make to mitigate impacts (for example through planning obligations) and any legacy benefits that may arise as well as any options for phasing development, in relation to socio-economic impacts.

25.2.1.4. Other Relevant Policy

18. From a policy perspective, the primary documents used to inform this Chapter are as follows:

- North Wales Growth Deal 2017;
- Sustainable Tourism – A Framework for Wales 2007;
- Destination Anglesey Management Plan 2016 – 2020;
- Isle of Anglesey - Single Integrated Plan 2013 – 2025;
- Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026;
- Anglesey Food Tourism Strategy and Action Plan 2011;
- Rights of Way Improvement Plan 2008 – 2018;
- Energy Wales: A Low Carbon Transition Delivery Plan 2014;
- The Welsh Government Strategy for Tourism 2013 – 2020;
- Partnership for Growth 2013;
- The Welsh Government Rural Communities - Rural Development Programme 2015;
- Welsh Language (Wales) Measure 2011; and
- Cymraeg 2050: Welsh Language Strategy.

19. This Project forms a vital part of the Destination Anglesey Management Plan 2016-2020 – Strategic Objective 6 (Isle of Anglesey Council, 2016b). It also dovetails with the Energy Wales's ambition to transition steadily to decarbonise its energy supply, whilst reaping the potentially significant social and economic benefits from doing so.

20. **Table 25-1** sets out a summary of the relevant national and regional policies for Socio-economics, Tourism and Recreation.

Table 25-1 National and Regional Policy Requirements Relevant to Socio-economics, Tourism and Recreation

Policy Description	Reference	ES Reference
MPS		
Properly planned developments in the marine area can provide environmental and social benefits as well as drive economic development, provide opportunities for investment and generate export and tax revenues. The marine planning system will help to promote these benefits in contributing to the achievement of sustainable development. There will therefore be a presumption in favour of sustainable development in the marine planning system.	2.5.2	The impact assessment concludes that the majority of effects arising from the Project will have a beneficial impact on socio-economics, tourism and recreation **Appendix 25.1 (Volume III**)
Marine based activities can provide opportunities for employment in long established industries such as fishing, marine transport, port related storage and processing, oil and gas production and new and developing industries such as the renewable energy sector and associated offshore electricity transmission. This employment provides wide and long term benefits for both national and local economies.	2.5.3	Opportunities for local services arising from the Project are discussed in **Section 25.5.14**

Policy Description	Reference	ES Reference
The marine environment provides national economic and social benefits including for heritage assets, seascape and cultural services of coastal and marine activities, as well as directly contributing to the quality of life and well-being of coastal communities. Marine planning will also therefore make an important contribution towards ensuring vibrant and sustainable coastal communities - helping to build strong local economies - improving quality of life, access to, and enjoyment of, their marine areas.	2.5.4	The impact assessment concludes that the majority of effects arising from the Project will have either insignificant effects such as for tourism and recreation (See **Section 25.5.5.1**) or beneficial impact such as on socio-economics, (See **Section 25.5.5; Section 25.5.6** and **Section 25.5.17**and **Table 25-35**)
Renewable energy offers the potential for significant broad-scale environmental benefits through mitigating greenhouse gas emissions from energy production. In addition there are a number of potentially significant socio-economic benefits from the sector including employment opportunities, export business and energy security. As yet, the potential for benefits such as introduction of artificial reef structures, which can yield biodiversity benefits and fishing opportunities around wind farm sites, have not been fully explored. These should be considered further in the context of marine planning, and for individual developments.	3.3.23	As above and in addition see **Section 25.5.10** regards job creation benefits and **Section 25.5.16** regards the benefits for decarbonisation
Draft WNMP		
Designated landscapes: Proposals that demonstrate that they are compatible with the purposes and special qualities for which National Parks or Areas of Outstanding Natural Beauty have been designated are encouraged.	SOC_06:	Potential impacts to Anglesey AONB are assessed in **Chapter 24, SLVIA**
Seascapes Proposals should demonstrate how potential impacts on seascapes have been taken into consideration at an early stage and should, in order of preference: a) avoid adverse impacts on seascapes; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Opportunities to enhance seascapes are encouraged.	SOC_07	Potential impacts on seascapes are assessed in **Chapter 24, SLVIA**
Cumulative effects Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01	Cumulative effects are assessed in **Section 25.5.17** and in **Chapter 26: Cumulative and In-combination.**

Policy Description	Reference	ES Reference
Planning Policy Wales		
The planning system should identify proactive and preventative measures to reduce health inequalities. This will include enabling opportunities for outdoor activity and recreation, reducing exposure of populations to air and noise pollution, promoting active travel options and seeking environmental and physical improvements, particularly in the built environment.	3.20	Impacts to noise and vibration are assessed in **Chapter 21**, impacts to air quality are assessed in **Chapter 22**
If required, language impact assessments may be carried out in respect of large developments not allocated in a development plan which are proposed in areas of particular sensitivity or importance for the language. Any such areas should be defined clearly in the development plan.	3.29	Potential impacts to the Welsh Language are assessed in the **Morlais Welsh Language Impact Assessment**
Proposed development should be designed wherever possible to prevent adverse effects to amenity, health and the environment but as a minimum to limit or constrain any effects that do occur. In circumstances where impacts are unacceptable, for example where adequate mitigation is unlikely to be sufficient to safeguard local amenity in terms of air quality and the acoustic environment it will be appropriate to refuse permission.	6.7.14	The impact assessment concludes that the effects arising from the Project regards amenity, health and the environment will be insignificant (**Section 25.5** and **Appendix 25-1, Volume III**)
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
1. All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced; 3. That the proposal is mitigated to ensure that there aren't any significant unacceptable effects on sensitive uses located nearby;	Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	The impact assessment concludes that the Project will have insignificant effects on these factors (**Section 25.5** and **Appendix 25-1, Volume III**)
Whilst seeking to protect and enhance the natural and built environment, the Councils will facilitate economic growth in accordance with the spatial strategy of the Plan	Strategic Policy PS 13: Providing Opportunity for a Flourishing Economy	The impact assessment concludes that there will be positive economic benefit (See **Section 25.5.6** and **Section 25.5.17)**
The Councils will promote and support the use of the Welsh language in the Plan area.	Strategic Policy PS1: Welsh Language and Culture	Potential impacts to the Welsh Language are assessed in the Morlais Welsh Language Impact Assessment
Whilst ensuring compatibility with the local economy and communities and ensuring the protection of the natural, built and historic environment the Councils will support the development of a year-round local tourism industry	Strategic Policy PS 14: The Visitor Economy	The Project will not have an adverse effect on tourism (**Section 25.5** and **Appendix 25-1, Volume III**)

Policy Description	Reference	ES Reference
The Councils will manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline, and proposals that have a significant adverse effect on them will be refused unless the need for and benefits of the development in that location clearly outweighs the value of the site or area and national policy protection for that site and area in question.	Strategic Policy PS 19: Conserving and Where Appropriate Enhancing the Natural Environment	Impacts to the natural environment are assessed in **Chapters 9, 10, 11, 12, 18, 19** and **24** of this ES**.**
Proposals within or affecting the setting and/ or significant views into and out of the AONB must, where appropriate, have regard to the relevant Area of Outstanding Natural Beauty Management Plan.	Policy AMG1: Area of Outstanding Natural Beauty (AONB) Management Plans	Potential impacts to Anglesey AONB are assessed in **Chapter 24, SLVIA**
Wellbeing of Future Generations (Wales) Act 2015		
A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).	A resilient Wales	See **Section 25.5 and Appendix 25.1, Volume III** for the impact assessment results

25.2.2. Relevant Legislation

25.2.2.1. EIA Directive

21. The 2014/52/EU Environmental Impact Assessment (EIA) Directive requires consideration of socio-economic effects within the EIA process. The key regulations and guidance that apply to onshore electrical substations and associated infrastructure projects in Wales are listed below:

- Planning (Wales) Act (2015);
- The Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations (2017);
- Marine and Coastal Access Act (2009); and
- The Isle of Anglesey Supplementary Planning Guidance (2018).

25.2.2.2. Well-being of Future Generations (Wales) Act

22. The Well-being of Future Generations (Wales) Act 2015 is intended to improve the social, economic, environmental and cultural well-being of Wales. The Wellbeing of Future Generations (Wales) Act 2015 places a statutory duty on public bodies in relation to sustainable development, based on seven well-being goals. Amongst these goals is "a prosperous Wales", which aims to develop an "innovative, productive and low carbon society which recognises the limits of the global environment and, therefore, uses resources efficiently and proportionately (including acting on climate change); and which develops a skilled and well-educated population in an economy which generates wealth and provides employment opportunities, allowing people to take advantage of the wealth generated through securing decent work".

23. An impact assessment for public health is provided in **Appendix 25.2** (**Volume III**).

25.2.3. Consultation

24. A request for scoping opinion for the Project was issued to the Welsh Government Planning Inspectorate (PINS) under different consenting regimes in 2015 and 2017, with a final scoping opinion requested in April 2018 from Natural Resources Wales (NRW) and the Welsh Government PINS.

25. Via these consultation exercises, queries were raised around the potential risk to navigation, the impact to commercial fisheries, the visual impact on the sea and landscape, as well as the potential impact to sites of archaeological importance and/or cultural heritage value. These potential impacts are assessed in stand-alone topic-specific chapters (**Chapter 14, Commercial Fisheries**; **Chapter 15, Shipping and Navigation**; **Chapter 20, Onshore Archaeology and Cultural Heritage**; and **Chapter 24, Seascape, Landscape and Visual Assessment**). However, the socio-economic, tourism and recreation aspects of these concerns have been assessed within this chapter and are displayed in **Table 25-2**.

26. All scoping comments pertaining to this chapter have been presented in **Table 25-2**. These comments have been addressed fully in this chapter, with the location of the relevant information highlighted in the response column, for ease of location.

Table 25-2 Summary of EIA scoping responses related to socio-economics

Consultee	Comment/Discussion	Response/ where addressed in ES
Planning Inspectorate, 2018	**Public rights of way** The ES should identify any public rights of way which would be temporarily or permanently affected by the Proposed Works. Any necessary diversions or closures should be identified, and the resultant effects assessed.	Results of initial assessment provided in **Appendix 25.1** (**Volume III**), impact screening concluded detailed assessment not required. Also see **Section 24.4.8.3**.
Planning Inspectorate, 2018	**Employment** The Scoping Report states that increased personnel and temporary construction workers may put pressure on tourist accommodation and result in a 'more buoyant' rental market. This potential impact has also been identified within the Socio-economics Section of the Scoping Report. The ES should clearly state how construction and operational workers are anticipated to be accommodated and how this may impact tourism. The ES should state how any mitigation and/ or enhancement measures are to be secured.	Assessed in **Appendix 25.1** (**Volume III**) summarised in **Section 25.4.4 & 25.5.10**. Assessment considers temporal and spatial distribution of likely job opportunities.
Planning Inspectorate, 2018	**New draw for tourists** The Scoping Report states that the Proposed Works may create a new draw for tourists. The ES should clarify if this is due to the existence of the Proposed Works and if other features are proposed as part of the Project, such as tourist education. The ES should explain any assumptions and limitations made in undertaking this assessment.	Assessed in **Appendix 25.1** (**Volume III**), summarised in **Section 25.4.4 & 25.5.5**. Green branding opportunities for the locality are considered.
Planning Inspectorate, 2018	**Visual effect for tourists** The Scoping Report states that the Proposed Works may impact tourist visual amenity onshore and offshore when tourists are arriving from sea. The Applicant is	Briefly assessed within **Appendix 25.1** (**Volume III**) but covered in

Consultee	Comment/Discussion	Response/ where addressed in ES
	advised to include this assessment within the Seascape and Landscape Chapter of the ES, identifying tourists as a receptor of seascape and landscape visual effects, providing clear cross-reference to the Tourism and Recreation aspect of the ES.	greater detail in **Chapter 24, SLVIA**.
Planning Inspectorate, 2018	**Recreational Angling** The ES should assess any likely significant effects associated with the potential impacts to recreational angling and changes to target species.	Assessed in **Appendix 25.1** (**Volume III**). Impact screening concluded detailed assessment not required.
Planning Inspectorate, 2018	**Cross-referencing** The Applicant should consider how to avoid duplication and potential conflict within the ES, specifically between the Socio-economic and Tourism and Recreation aspect Chapters of the ES. Clear cross-referencing should be utilised.	Tourism and recreation, and socioeconomics are both referenced within this chapter. The two topics have been combined to avoid duplication.
Planning Inspectorate, 2018	**Landfall works** The ES should identify whether any beach closures are necessary for the landfall works and if so, the areas and duration for which access would be restricted.	See **Chapter 4, Project Description**. Covered in **Section 24.4.7.3**.
Planning Inspectorate, 2018	**Tourism, housing, worker migration** The impacts from increased worker numbers during construction and operation to other industries, such as tourism has also been identified within Section 9.9 Tourism and Recreation of the Scoping Report.	Further baseline information provided in **Section 25.4.4** and impacts assessed in **Appendix 25.1** (**Volume III**).
Planning Inspectorate, 2018	**Improvements to infrastructure and facilities and local transport services** The Scoping Report identifies a potential beneficial impact from external investment to local infrastructure, including the transport network, Holyhead Harbour and public services. If such investment is not guaranteed and does not form part of the Proposed Works, this should not be taken into account within the ES.	Assessed in **Appendix 25.1** (**Volume III**). Summarised in **Section 25.5.11**. Assessment considers local supply chain and services benefits.
Planning Inspectorate, 2018	**Well-being of Future Generations (Wales) Act 2015** The Applicant's intention to support the Wellbeing of Future Generations (Wales) Act 2015 in its objectives to improve the social, economic, environmental and cultural well-being of Wales is welcomed.	Assessed in **Appendix 25.1** (**Volume III**), summarised in **Section 25.5.6**. Assessment considers project against well-being goals. An impact assessment on public health is provided in **Appendix 25.2** (**Volume III**). The project wide approach in support of the Wellbeing of Future Generations (Wales) Act 2015 is presented in **Chapter 2, Policy and Legislation**.
Planning Inspectorate, 2018	**Qualitative assessment** The Scoping Report states that the Socio-economic aspect Chapter will present a qualitative assessment of potential impacts. The ES should provide clarification regarding the methodology of the assessment, given	Methodology is detailed in in **Section 25.3**. Job estimates assessed in **Section 25.5.10**.

Consultee	Comment/Discussion	Response/ where addressed in ES
	that the Scoping Report later states economic impacts e.g. number of jobs will be calculated within an economic impact assessment. Where appropriate, a qualitative assessment is expected, of potential socio-economic impacts.	
Planning Inspectorate, 2018	**Guidance** The Applicant should take care to ensure that the methodology applied is sufficient to identify and assess the likely significant effects from the Proposed Works.	Methodology is detailed in **Section 25.3**.
Planning Inspectorate, 2018	**Local business survey** The Scoping Report states that survey(s) and discussions will be undertaken with local businesses to gather data and ascertain the capabilities of the local supply chain. The ES should clearly set out the methodology for survey(s) and discussions, such as providing the questions posed in the survey(s) and ensure leading questions are avoided.	A local business survey has not been undertaken as existing information sufficient for EIA. Future targeted surveys may be undertaken as part of the wider Project development.
NRW (for PINS), 2018	Recreational angling - including charter boat trips - are addressed within this section. However, we recommend that consideration should be given to changes in target species, not just the potential to restrict or impair the access to the area.	Assessed in **Appendix 25.1** (**Volume III**). Impact screening concluded detailed assessment not required. Further detail on commercial (including recreational) fisheries is presented in **Chapter 14, Commercial Fisheries**.
IoACC, 2018	A detailed Economic Impact Assessment should be provided.	Detailed throughout this Chapter.
IoACC, 2018	Tourism should be a stand-alone item within the ES.	Tourism is addressed in **Section 25.4.7** and **Appendix 25.1** (**Volume III**).
IoACC, 2018	Consideration should be given to Welsh language impacts.	Potential impacts to the Welsh Language are assessed in the Morlais Welsh Language Impact Assessment.
IoACC, 2017	A detailed Economic Impact Assessment should form part of the EIA. Further information is required regarding jobs (numbers, type, quality, breakdown of skills etc.).	Detailed throughout this Chapter. Assessment regarding jobs detailed in **Section 25.5**.
IoACC, 2017	Full reference should be made to the geology of the Island, given UNESCO status. Soldier's Point is part of a site for a large multi-use development and the tourism and other impacts of a cable route here should be fully referenced. Pressures on temporary accommodation to house workers should be included.	Assessed in **Appendix 25.1** (**Volume III). Note** that project refinement has led to selection of cable landfall at Abraham's Bosom not Soldier's Point. This is covered in **Chapter 3, Site Selection and Alternatives**.
IoACC, 2017	Statistics quoted in the EIA should be the most up-to-date available; e.g. tourism figures presented date back to 2011 whereas more recent 2015 figures are available.	Sources of information detailed in **Section 25.4.7**.

Consultee	Comment/Discussion	Response/ where addressed in ES
IoACC, 2017	Consideration should be given to Welsh language Impacts e.g. during the construction phase, utilising nationally-based workers.	Potential impacts to the Welsh Language are assessed in the Morlais Welsh Language Impact Assessment.
IoACC, 2017	As previously stated in our earlier screening opinion, a detailed Economic Impact Assessment should form part of the EIA. Further information is required regarding jobs (numbers, type, quality, breakdown of skills etc.). Tourism should be a stand-alone item within the ES. Pressures of temporary accommodation to house workers should be included. Statistics quoted in the EIA should be the most up to date available.	Addressed in **Appendix 25.1** (**Volume III**), detailed throughout this Chapter. Full Assessment regarding jobs detailed in **Section 25.5**.
NRW, 2017	Recreational angling including charter boat trips are addressed within this section, however, consideration should be given to changes in target species not just the potential to restrict or impair the access to the area.	Assessed in **Appendix 25.1** (**Volume III**). Impact screening concluded detailed assessment not required. Further detail on commercial (including recreational) fisheries is presented in **Chapter 14, Commercial Fisheries**.
NRW, 2017	A detailed Economic Impact Assessment should form part of the EIA. Further information is required regarding jobs (numbers, type, quality, breakdown of skills etc.). Pressures of temporary accommodation to house workers should be included. Statistics quoted in the EIA should be the most up to date available.	Detailed throughout this Chapter. Full Assessment regarding jobs detailed in **Section 25.5**.
NRW, 2017	Consideration should be given to Welsh language Impacts e.g. during the construction phase utilising nationally-based workers.	Potential impacts to the Welsh Language are assessed in the Morlais Welsh Language Impact Assessment.

25.3. METHODOLOGY

25.3.1. Introduction

27. This section outlines the methodology used to assess the potential socio-economic impacts of the Project. The study area is defined and data sources identified, along with residual data gaps and uncertainties. The approach to describe and assess the sensitivity of the various socio-economic receptors is presented, as well as approaches to assigning levels of magnitude to the various beneficial and adverse impacts.

25.3.2. Study Area

28. This Chapter has considered the potential social and economic impacts of the Project on a local (Anglesey), regional (North Wales – Gwynedd, Anglesey, Conwy, Denbighshire and Wrexham) and national level (Wales). The use of a local, regional and national study area aligns with the definitions in the Isle of Anglesey Topic Papers (2015). These categorisations also reflect the strong locational funding packages that support the Project.

29. In some instances, it has not been necessary to evaluate the impact on a receptor at all these spatial scales since the impact pathway is clearly linked to only one of these study area extents or is clearly so negligible that it cannot reasonably or meaningfully be assessed at larger spatial extents, i.e. National.

25.3.3. Data Sources – Desk Study

30. Given that tidal energy development at the scale proposed by the Project is relatively new and that the underpinning economic basis for the sector is continually under review, there are no references that can be used to provide a definitive prediction of possible socio-economic outcomes for the Project. This differs significantly from, for example, a similar socio-economic assessment of a commercial-scale offshore wind farm where there is now a 20-year track record of costs and benefits.

31. To address this evidence gap, direct anecdotal information from other existing areas of tidal energy development activity have been used, i.e. Orkney.

32. Publicly available data and supporting studies that has been used to inform the assessment include:

- Project-specific consultation responses from local stakeholders;
- Economic overview of the Isle of Anglesey – A data analysis of the Island 2013;
- The Economic Impact of the Development of Marine Energy in Wales. Report for Welsh Government. July 2013. Regeneris Consulting Ltd and Cardiff University (2013);
- Heritage Impact Assessment Wales (Cadw, 2017);
- Wales Tourism Business Barometer Wave 4, Autumn 2018;
- Wylfa Newydd Supplementary Planning Guidance (Wylfa Newydd SPG – 2014);
- Anglesey and Gwynedd Joint Local Development Plan (JLDP) – July 2017 – Including topic papers:
    - Topic Paper 1: Natural Environment – Anglesey County Council;
    - Topic Paper 2: Historic Environment;
    - Topic Paper 3 Population and Housing;
    - Topic Paper 4: Describing Housing and Spatial Growth;
    - Topic Paper 5: Transport;
    - Topic Paper 6 Urban Capacity Study;
    - Topic Paper 7: Retail;
    - Topic Paper 8: Infrastructure;
    - Topic Paper 9: Tourism;
    - Topic 10: Welsh Language and Culture;
    - Topic Paper 14: Open Space Assessment;
    - Topic Paper 17: Local Market Housing;

- North Wales Growth Deal, 2018; and
- Older People and Place in Wales; Demography, Policy and Community, 2013.

25.3.4. Data Gaps and Uncertainties

33. There are three main areas of uncertainty regarding the potential socio-economic impacts of this Project.

- The exact programme/phasing of development that may take place;
- The economic/revenue framework within which tidal energy and wider energy developments may take place; and
- The wider socio-economic context within which the Project could develop. Specifically, the uncertain or un-specified linkages between some socio-economic cause and effect pathways.

34. The first two bullets above relate to the exact nature of development of the MDZ and the economic/revenue framework that would be needed to support it, which are closely related. The tidal and wider marine energy sectors are currently lobbying the UK government to establish a suitable fiscal framework. The outcome of this lobbying process and subsequent fiscal support mechanism will have a major influence upon the type, scale and pace of development that will ultimately be taken forward within the MDZ.

35. To enable this assessment of potential socio-economic impacts to be undertaken, a phased development scenario has been developed for the purposes of this chapter. Four sequential, indicative, interim phases up to the full 240 MW capacity have been mentioned throughout the chapter, however note that if alternative development scenarios emerge post this assessment, particularly if they were slower or at a lesser scale, then significant changes to the socio-economic outcomes predicted in the following sections could arise with a reduction in the predicted beneficial as well as the adverse outcomes outlined. The first of these phases has been determined by the outcomes of assessments outlined in **Chapter 12, Marine Mammals**.

36. This dynamic relationship between the scale and pace of marine energy development and economic and employment effects were illustrated in a study commissioned by Welsh Government to examine the potential economic benefits of wave and tidal energy development in Wales (Regeneris Consulting, 2013). This study considered three illustrative development scenarios of 60MW, 300MW and 1GW. The GVA and person-years of employment for these three scenarios were estimated to be £72m and 2,020 persons years; £303m and 8,510 person-years; and £840m and 23,760 person-years, respectively.

37. The third bullet point in paragraph 33 relates to the uncertain political, economic and energy strategy context for the Project. Issues such as Brexit, decarbonisation imperatives and nuclear energy development strategies could also have a major influence upon the Project that are very difficult to predict.

38. Finally, there is inherent uncertainty associated with predicting socio-economic outcomes and about attributing observed changes to specific stimuli. It is clear that the socio-economic metrics of Anglesey, North Wales and Wales as a whole are dynamic and influenced by many different and interacting factors. Demonstrating a straightforward cause and effect, even where it is clear that such a relationship exists may, therefore, be difficult because of the many other interacting factors in play. Any of the predicted outcomes set out within this chapter may, therefore, be

significantly altered by external factors unrelated to the eventual development scenario that the Project follows.

25.3.5. Impact Assessment Methodology

39. The overarching methodologies used for the EIA are outlined in **Chapter 5, EIA Methodology**. This section sets out the assigned definitions that are used in the assessment process, for both beneficial and adverse socio-economic impacts.

40. The approach to making balanced assessments for the Project has been guided by technical specialists, using available data, experience and expert judgement.

41. The socio-economic assessment initially involved a review of baseline conditions within the study area. This was then compared against the potential impacts (beneficial or adverse) from the Project.

42. This impact assessment considers the potential for impacts during the construction, operations and maintenance (including re-powering) and decommissioning phases of the Project.

43. Impacts have been classified as follows:

- Direct impacts: these may arise from impacts associated with the construction, operations and maintenance, or decommissioning of the Project;
- Indirect impacts: these may be experienced by a receptor that is removed (e.g. in space or time) from the direct impact (e.g. noise impacts upon fish which are a prey resource for fish or mammals); and
- Cumulative impacts: these may occur as a result of the Project, in conjunction with other existing, or planned projects within the study area, for each receptor.

44. The methodology that has been followed is based upon a clear and concise set of definitions for sensitivity of receptor and magnitude of effect, which have then been combined to give an assessment of potential significance.

25.3.5.1. Receptor Sensitivity

45. Sensitivity in the context of socio-economic issues has been taken to comprise the capacity of the receptor in question to deal with change, with specific reference to issues such as adaptability, experience/exposure to change and levels of other existing changes. The qualities addressed in terms of adverse effects include robustness, acceptability, tolerability and threat levels, as well as adaptability, capability and vulnerability.

46. The sensitivity qualities addressed in terms of beneficial effects include: robustness, strength of benefit afforded, any imperative needs, as well as current status regards resilience, favourable positions and any latent threats (see **Table 25-3** below).

Table 25-3 Sensitivity definitions

Sensitivity	Definition
Adverse	
High	Receptor under some threat, vulnerable to change
Medium	Receptor in tolerable, but not favourable state, capable of coping with change

Low	Receptor in an acceptable and less favourable state, but with some resilience and adaptability
Negligible	Receptor in a robust, sub-favourable state which will be little changed, inherent resilience
Beneficial	
High	Receptor with an imperative need for benefit, ready to embrace beneficial change
Medium	Receptor in a tolerable, favourable state, capacity to embrace beneficial influence, limited inertia
Low	Receptor in an acceptably favourable state, some adaptability, some inertia to improvement
Negligible	Receptor in a robust favourable state which, where change may be difficult to measure, inherent inertia

47. The full evaluation of sensitivity for each receptor/issue is presented in **Appendix 25.1** (**Volume III**).

25.3.5.2. Magnitude of Effect

48. The magnitude of effect factors considered, related to the scale of change (effect) that might take place. This was defined in terms of the geographical scale and the intensity of change (effect) as outlined in **Table 25-4**. Definitions are provided for both adverse and beneficial effects.

Table 25-4 Magnitude definitions

Magnitude	**Definition**
Adverse	
High	Change across wider area, affecting multiple sectors of the economy, multiple communities influenced, possible long-term barriers or problems being created
Medium	Change across a region or sub-region, affecting one/few key sectors or one/few key communities, medium term disruption and disturbance
Low	Change across a locality, affecting sub sectors and sub communities, shorter-term effects associated with nuisance and inconvenience
Negligible	Change at a specific place, affecting individual business or individuals, effects which are known and noticed, but not manifestly detrimental
Beneficial	
High	Change across a wider area, affecting multiple sectors of the economy, multiple communities influenced, possible long-term material opportunities and solutions available
Medium	Change across a region or sub-region, affecting one/few key sectors or one/few key communities, medium term direct and indirect benefits
Low	Change across a locality, affecting sub sectors and sub communities, shorter-term effects associated with enablement and support
Negligible	Change at a specific place, affecting individual business or individuals, effects which are known and noticed, but not manifestly beneficial

25.3.5.3. Significance

49. In terms of assigning levels of significance, a standard EIA matrix, comprising (receptor sensitivity x magnitude of effect) was used, with compatible classifications of adverse and beneficial impacts, as shown in **Table 25-5** and **Table 25-6**.

50. Levels of significance classified as moderate or above were considered to be significant and merit further detailed analysis. Classifications of minor and below were considered to be non-significant and were not considered further within the formal EIA process, but have been included in **Appendix 25-1 (Volume III)** for reference.

Table 25-5 Table of impact significance for adverse impacts

	Magnitude			
Sensitivity	High	Medium	Low	Negligible
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

Table 25-6 Table of impact significance for beneficial impacts

	Magnitude			
Sensitivity	**High**	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

25.3.5.4. Mitigation and/or Optimisation

25.3.5.4.1. Embedded Mitigation

51. The current preferred Project Design Envelope (PDE) has been designed to avoid impacts as far as reasonably possible on selected receptors, including seascape and landscape and marine navigation/shipping, via the development of embedded mitigation measures. These have been developed via consultation with selected stakeholders.

52. The Project will avoid the deployment of surface emergent tidal devices in the north of the MDZ which is closer to the coastline and within 1 km of the coastline to reduce seascape impacts. Furthermore, the Landfall Substation has been designed within a recessive location in the landscape, in a relatively low-lying position which using the landform to help integrate the buildings. The Project has also committed to the use of underground cabling to provide the connections between all Project elements, avoiding the need for overhead cables.

53. A full list of the embedded mitigation measures is outlined in **Chapter 4, Project Description**.

25.3.5.4.2. Additional Mitigation/Optimisation Measures

54. Where significant adverse impacts have been identified as a result of the Project, additional mitigation measures are proposed to seek to reduce residual impacts to acceptable (non-significant) levels. Where beneficial impacts have been identified, measures defined as "optimisation measures" are also provided. These are aimed at further enhancing any potential beneficial impacts.

55. These additional measures relevant to socio-economics, recreation and tourism are outlined within each impact assessment, as required.

25.3.5.4.3. Implementation and Monitoring of Proposed Mitigation/Optimisation Measures

56. Menter Môn are committed to the optimisation measures set out in this Chapter. The proposed optimisation measures have been developed in order to localise expenditure and to encourage the local supply chain to invest in opportunities that maximise their ability to take up contracting opportunities.

57. With respect to how Menter Môn actually intend to secure these measures, in particular the optimisation measures, a series of actions are proposed which are intended to form the basis of future discussions with relevant stakeholders, post consent application.

58. These will include, but may not be limited to the following:

- Inclusion of proposed measures within a formal Section 106 agreement(s) between Menter Môn and relevant consenting bodies;
- Development of local/regional/national supply chain action plans that set out the proposed measures and actions that Menter Môn would aim to deliver to ensure full engagement with the supply chain;
- Development of a mitigation/optimisation measure monitoring framework specific to socio-economic elements. This will enable the progress and implementation of all proposed measures to be formally monitored, potentially against an agreed set of Key Performance Indicators (KPIs); and
- Regular meetings with Isle of Anglesey County Council (IoACC) in the period between consent application and potential consent award to further develop the potential mechanisms outlined above, and, where relevant, develop additional ones.

25.3.5.5. Worst Case Scenario

59. In line with the underlying approach within this EIA of ensuring that worst-case impacts are assessed, there is also a more optimistic case presented to highlight the potential if some of the manufacturing activity can be attracted to Wales. This has been justified by the level of turbine manufacturing that has already been undertaken within Wales and the strength of the supply chain around this type of activity within Wales.

60. This socio-economic assessment chapter presents a range of potential values. The "worst case" scenario is used as the basis of any impact significance conclusions.

25.3.5.6. Cumulative effects

61. Details of the approach for assessing the cumulative effects of the Project with other onshore and offshore projects are provided in **Section 25.5.17**.

25.4. Existing Environment

62. The existing socio-economic environment was assessed wherever appropriate at local, regional and national level. Baseline statements have been created for the following:

- Population and Demographics;
- Employment and GVA;
- Skills, Training and Education;
- Housing and Accommodation;
- Commercial Fisheries;
- Shipping and Navigation;
- Tourism;
- Recreation; and
- Cultural Heritage.

25.4.1. Population and Demographics

63. The population numbers and the structure (demographics) of that population provide important insights into (a) the status of communities overall; (b) the possible availability of labour and; (c) present trends associated with age group migration for education and jobs in or out of the regions under consideration. Recent population trends in Anglesey, North Wales and Wales taken from the Office of National Statistics (ONS) are presented in **Table 25-7.**

Table 25-7 Population statistics across study area (2011-2017) (ONS, 2018b)

Year	2011	2012	2013	2014	2015	2016	2017	% increase/ decrease
Anglesey	69,913	70,037	70,073	70,141	69,936	69,665	69,794	-0.1%
North Wales	688,417	689,924	691,180	693,067	693,360	694,826	696,284	1%
Wales	3,074,067	3,082,412	3,092,036	3,099,086	3,113,150	3,125,165	3,125,200	1%

25.4.1.1. Population

64. The population across all three study area scales (Anglesey, North Wales, Wales) has remained relatively constant over the period 2011-2017. Anglesey has experienced a very minor decrease in overall population over the period, in contrast to the regional and national figures which exhibit a 1 % rise over the same period.

25.4.1.2. Demographics

65. Further consideration is provided here with respect to the structure (demographics) of the populations in these three areas, with particular consideration of the numbers of young people staying on the local area of Anglesey and the percentage of working age residents (**Table 25-**

8). These are considered useful metrics with regards to the availability of a suitable workforce and the likely age profile of that workforce.

Table 25-8 Demographic make-up (expressed as %) of different communities by age (Welsh Government, 2019c)

Age group	Wales	Gwynedd	Conwy	Denbigh	Flint	Wrexham	Anglesey
0—14	16.9	15.8	15.2	17	17.3	18.3	16.2
15-29	18.9	21.2	14.7	16.2	16.8	16.9	15.1
30-44	17.2	14.9	14.6	15.1	17.5	18.5	15.4
45-64	26.5	25.5	28.3	27.8	27.6	26.8	27.8
64-75	11.4	12.3	14.1	13.5	12	11	14.3
>75	9.2	10.3	13	10.3	8.8	8.5	11.2

25.4.1.3. National

66. On average, the age of the UK's population is increasing, and Wales mirrors this trend. This trend is more pronounced in rural areas than towns and cities and particularly in geographically peripheral areas. It is predicted that by 2036, only four local authorities in Wales will have populations with an age demographic containing less than 25 % of over 65s (Welsh Government, 2019c). Wales typically has a lower proportion of work age residents in comparison to the rest of the UK, usually being between 1.1 and 1.5 % lower depending on the comparator UK region.

25.4.1.4. Regional

67. Similar figures are seen across North Wales where comparable age group demographics are recorded. Wrexham, however, is an outlier, with approximately 63.14 % of residents being of working age (16-64). This is above both the Welsh national average of 61.5 % and the UK average of 62.9 %. All other local authorities in North Wales had lower working age populations than both the Welsh national average and the UK average in 2017.

25.4.1.5. Local

68. In 2017, the Isle of Anglesey had approximately 40,000 inhabitants of a working age (16-64), which accounted for 57.3 % of the Islands population. This figure is below the Welsh national average of 61.5 % and the UK average of 62.9 %. The percentage of working age residents in Anglesey has declined steadily since 2007.

25.4.2. Employment and GVA

25.4.2.1. National

69. The economy of Wales is estimated to have a gross value of £62 billion (ONS, 2018a). In 2016, all nations and regions of the UK had a lower GVA per head than the UK average except London and the South East of England. Welsh GVA per head as a percentage of the UK average has

been the lowest of all of the UK nations and regions since 2001[1] (72.7 % of UK National average in 2016).

70. Across Wales, the unemployment rate amongst working age residents is estimated at 27.4 %, 2.5 % higher than the UK average (Welsh Government, 2019c). Between 2001 and 2016 the growth of Welsh employment grew slightly less than that of the UK as a whole and Wales was hit harder during the 2008-2010 recession, when Wales saw greater falls relative to the UK; falling 4 % over that two-year period, compared with 1 % for the UK. A Welsh Government study of employment across different sectors in Wales found that since 2010, Wales has seen seven of its key sectors grow over the 15 years from 2001 – 2015 (Welsh Government, 2018a) (see **Table 25-9**).

71. Between 2001 and 2016 the biggest percentage sectoral growth was in the real estate sector, where employment in Wales increased by 92%, representing an additional 4,000 jobs. The greatest growth in job numbers over the same period was within the human health and social services sector, where jobs grew by 38,000 (23 %). Also of note, is the growth of the agriculture, forestry and fishing sector, which grew as an employer by 24 % between 2001 and 2016, despite a fall of 5 % for the UK as a whole (Welsh Government, 2018a).

Table 25-9 Employment by Sector in Wales (source Welsh Government, 2018a)

Area and industry	Jobs (000s)			Change in job numbers		Percentage change in job numbers	
Year	2001	2015	2016	2001 to 2016	2015 to 2016	2001 to 2016	2015 to 2016
Agriculture, Forestry & Fishing	33	41	41	8	-	+24%	-
Mining & Quarrying	3	2	2	-1	1	-33%	+50%
Manufacturing	193	147	142	-51	-5	-26%	-3%
Electricity, Gas, Steam & Air Conditioning	5	10	8	3	-2	+60%	-20
Water supply; Sewage, Waste Management & Remediation activities	8	13	10	2	-2	+25%	-23%
Construction	85	93	103	18	11	+21%	+11%
Wholesale & retail trade; Repair of Motor Vehicles & Motorcycles	210	207	199	-11	-8	-5%	-4%
Transportation & Storage	49	51	41	-7	-9	-16%	-19%
Accommodation & Food Service activities	84	100	117	33	17	+40%	+17%
Information and Communication	25	24	35	10	11	+40%	+45%
Financial and Insurance activities	26	31	31	5	-	+19%	0%
Real Estate activities	12	19	23	11	4	+92%	+21%
Professional, Scientific & Technical activities	43	78	70	27	-8	+62%	-10%
Administration & Support service activities	64	88	90	27	2	+40%	+2%
Public Administration & Defence Compulsory Social Security	74	86	83	9	-2	+12%	-3%

[1] https://seneddresearch.blog/2018/01/04/gross-value-added-in-wales-the-headlines-and-beyond/

Area and industry	**Jobs (000s)**			**Change in job numbers**		**Percentage change in job numbers**	
Year	2001	2015	2016	2001 to 2016	2015 to 2016	2001 to 2016	2015 to 2016
Education	114	132	131	16	16	+15%	-1%
Human Health & Social work activities	167	205	205	38	-	+23%	0%
Arts, Entertainment & Recreation	30	44	41	12	-3	+37%	-7%
Other Industries	29	33	31	3	-1	+7%	-6%
All Industries	**1,253**	**1,403**	**1,404**	**152**	**1**	**+12%**	**0%**

72. Despite growth in some sectors, average job density (defined by the number of jobs in an area, divided by the area's population) within Wales is 0.76, which is lower than the British average of 0.86 (Welsh Government, 2018c). This indicates lower wage levels within Wales than the rest of the UK.

25.4.2.2. Regional

73. The economy of North Wales is worth approximately £12.8 bn per annum (North Wales Economic Ambition Board, 2016) and represents 22 % of the economy of Wales. North Wales represents over 30 % of the manufacturing output of Wales (Mersey Dee Alliance, 2012).

74. The Welsh Government Sector Report, (Welsh Government, 2018a) also presents the economic value of the economy running along the M56/A55 corridor from Manchester Airport to Anglesey, which generates an output of £31 bn; £6 bn more than the M4 corridor from the Vale of Glamorgan to Bristol which represents £25 bn.

75. 75.3 % of the working aged population in North Wales was in Full or Part Time employment in September 2018 (Welsh Government, 2019a). This figure is higher than that of the national average of Wales (72.6 %) and aligns with the British average of 75.1 %.

76. The GVA per head in key sectors of employment, as assessed by Welsh Government in 2012 is outlined in **Table 25-10**.

Table 25-10 Key Sectors of Employment in North Wales (2012)

Employment	**Anglesey**	**Gwynedd**	**Conwy**	**Denbighshire**	**Wrexham**	**Flintshire**	**Total**	**LQ**
Major Manufacturing sectors								
Manufacture of Air, Spacecraft and related machinery							6,200	7.4
Manufacture of Chemicals and Chemical products						1,700	2,700	2.65
Manufacture of Food Products	800	700	100	300	1,900	2,800	6,700	2.10
Manufacture of Computer, Electronic, and Optical Products (ICT)		100		600	600	300	1,700	1.41
Manufacture of Electrical Equipment	100			500	400	200	1,100	1.39
Other significant Manufacturing Sectors								
Manufacture of Paper and Paper Products		100			400	1,400	1,900	3.99

Employment	Anglesey	Gwynedd	Conwy	Denbighshire	Wrexham	Flintshire	Total	LQ
Manufacture of Motor Vehicles, Trailers and Semi-trailers	100	200		300	500	700	1,800	1.42
Manufacture of Wood and of products of Wood and Cork					900	300	1,400	1.84
Manufacture of basic Pharmaceutical products and Pharmaceutical preparations					500		600	1.43
Other disciplines								
Civil Engineering	300	400	400	500	200	300	2,100	1.10
Specialised Construction activities	600	900	1,000	900	1,400	2,400	7,100	1.18
Electricity, Gas, Steam, and Air Conditioning supply	400	200	200		600	300	1,800	1.76

77. The total GVA in North Wales in 2017 was £24.5 bn. This was an increase of 4.4 % from previously recorded values and was 1.3 % higher than that of Wales as a whole, in terms of total GVA. The GVA per head in North Wales in 2017 was £20,800, 1.7 % higher than that of Wales as a whole, equating to an additional £947 per head. Despite this, the average gross weekly earning of a worker in North Wales was £10.20 less than the Welsh average (based on data from Stats Wales).

25.4.2.3. Local

78. While all of the Welsh areas have GVA per head below the UK average, there is variation in economic performance across Wales. The Isle of Anglesey (and Gwent Valleys) have the lowest levels of GVA per head of any regions across the UK, with GVA per head at 51.8 % of the UK average in 2016 for Anglesey[2]. However, it should be noted that commuting affects GVA figures for smaller areas, with areas such as Anglesey having more people commuting out than commuting in this means that their populations will contribute to the GVA of other areas.

79. Despite more growth in some sectors such as forestry and fisheries in Wales compared to the rest of the UK, job density in Anglesey in 2017 was 0.64 which is below the Wales and UK averages, indicating that Anglesey has lower average wage levels across the area. This point is further highlighted by Gross weekly pay for Anglesey, which is also lower than the Welsh average by approximately £250 per month.

80. The top seven employers by sector in Anglesey and the numbers they employ, taken from official labour market statistics provided by the Office of National Statistics[3] are shown in **Table 25-11**.

[2] https://seneddresearch.blog/2018/01/04/gross-value-added-in-wales-the-headlines-and-beyond/
[3] https://www.nomisweb.co.uk/)

Table 25-11 Employment by sector in Anglesey (October 2017 -September 2018) (NOMIS Report)

Sector	Estimated number of jobs
Accommodation and Food Services Activities	3,000
Wholesale and Retail Trade	3,000
Human Health and Social Work Activities	2,500
Education	1,500
Public Administration and Defence	1,000
Construction	1,000
Administration and Support Service Activities	1,000

81. Despite the lower than national average job density (based on population), Anglesey has lower rates of unemployment than both Wales and Great Britain, with 74.9 % of working age adults in employment in October 2017 (0.5% lower than the Wales figure). The size and nature of business activities on Anglesey is broadly representative of the National average, with 89.8 % of enterprises being classed as ‘micro’, compared with the national average of 89.1 %.

82. With respect to educational qualifications, individuals with formal academic (Higher Education) qualifications are 1.2 % lower than the Wales average of 8.7 %. In 2018, earnings (by place of residence) figures for Anglesey, showed that on average, an employee in Anglesey will earn approximately £78 per week less than the average British citizen (NOMIS). In addition to the lack of growth in the population of Anglesey, the percentage of the population that is of working age is some 4.2 % lower than the UK national average.

25.4.3. Skills Training and Education

25.4.3.1. National

83. Nationally, Wales has lower levels of formal educational attainment than the UK in relation to skills, training and education, with only 35.1 % of people holding an NVQ Level 4 qualification or above, as opposed to the UK average of 38.6 %. When compared to the UK as a whole, Wales also has a higher percentage of individuals with no qualifications at all.

25.4.3.2. Regional

84. North Wales performs consistently well regarding the percentage of the population with formal educational qualifications. With the exception of Flintshire, which displays higher rates of residents with no formal qualifications than the rest of North Wales, only 11.8% of the North Wales population have no educational qualifications. North Wales also has a higher percentage of population with NVQ qualifications, compared with the rest of Wales.

25.4.3.3. Local

85. Anglesey has a higher percentage of individuals with an NVQ 4 or higher qualification than is recorded both nationally and in the UK. This percentage has been rising steadily since records began in 2004. In 2011, a wellbeing study conducted in Anglesey (Gwynedd and Môn Public Services Board, 2017) found that 57 % of pupils in Anglesey achieved five A* to C rates in their GCSEs; 1 % lower than the national average. The study also showed that 26 % of the Island’s population have a degree or equivalent qualification, which is 1.5 % higher than the UK national average (NOMIS). Of note, Anglesey also has a high percentage of residents who hold an NVQ

Level 4 qualification or above. This makes it an outlier in North Wales and makes it one of the most highly educated local authorities in Wales.

25.4.4. Housing and Accommodation

86. The housing and accommodation baseline has been established at a local level only. It is not predicted that there will be potential for any direct impacts on regional or national-scale housing and accommodation, as a result of the construction or operation of the Project – see Appendix 25.2. This is due to the current and predicted good levels of availability of housing in Anglesey. The size of the local housing market, as highlighted in Table 25-12 as well as the details that tourism occupancy in Wales is on average 67% (Paragraph 120) back up the assertion that there will be a minimal impact on accommodation. This is further backed up by the phasing described in **Chapter 4, Project Description** suggesting a relatively long build-out process which spreads demand over a longer timescale allowing any capacity adaptations that are needed to take place.

25.4.4.1. Local

87. The Anglesey County Council 2016 Construction Worker Accommodation Base and Assumptions study (IOACC, 2016a) provides useful insights into the type, availability and occupancy rates on Anglesey. These have been used to assess the potential impact of the Project's migratory workforce on privately owned, rented and temporary holiday accommodation on Anglesey. The two main drivers of the housing market are the resident population and the local labour market. The purchase of second homes on Anglesey is also increasingly exerting an influence on the housing market.

88. Analysis conducted by Edge Analytics (Edge, 2014) predicts that between 2015 and 2026, the household population in Anglesey will increase by 2,420, which equates to 220 separate, new households. These predictions, however, suggest that the number of households is set to grow faster than the population. Within the Isle of Anglesey County Council, Construction Worker Accommodation Base 2016 the tenure status of property on Anglesey is shown in **Table 25-12**.

Table 25-12 Tenure of new accommodation required in the Isle of Anglesey over the next 11 years - (dated from 2015)

Tenure	Current Tenure Profile 2015	Tenure Profile 2026	Change required	% of change required
Market	26,636	28,342	1,706	70.5
Shared ownership/help to buy	60	128	68	2.8
Intermediate rent	18	427	409	16.9
Social rented	4,451	4,688	237	9.8
Total	**31,165**	**33,585**	**2,420**	**100**

89. The Local Housing Assessment model was based on predictions that included the continued development of the Wylfa Newydd Nuclear Power Station (currently on hold), which estimated a peak workforce of 9,200 employees. It was assessed that 25 % of the workforce would already be living in the area, 670 workers were likely to purchase accommodation in the area and that 6,230 employees would require temporary accommodation.

90. The workforce estimate for the development and operation of the Project is a fraction of that estimated for the Wylfa Newydd Nuclear Power Station. From a strategic perspective, it should be considered alongside any other smaller developments on Anglesey, as a contributing factor to a more significant, cumulative impact.

91. Continuing trends of increasing house prices (21.7 % between 2011-2015), above that of the national average (10 % between 2011-2015) and greater demand for temporary lets and tourist accommodation, are likely to continue if construction restarts at the Wylfa Newydd Nuclear Power Station.

25.4.5. Commercial Fisheries

92. Commercial fisheries are addressed in detail in **Chapter 14, Commercial Fisheries**. The description below highlights the economic importance of fisheries across the study area, including commercial charter angling vessels, from SeaFish (2019).

25.4.5.1. National/Regional

93. At a national level, the Welsh commercial fishing sector comprises a range of traditional fisheries, plus a number of innovative shellfish aquaculture operations. Over 460 vessels are licensed within Wales, employing 850 Full-Time and Part-Time fishermen. Wales' seafood industry is significant to the local economy and vital for the long-term sustainability of many coastal communities.

94. Approximately 75 % of the Welsh fleet is made up of small fishing vessels <8m, some no larger than dinghies. At the other end of the scale, some of the largest vessels (>15m) operate from the Ports of Milford Haven, Holyhead, and Porth Penrhyn. The most common type of vessels in Welsh waters are vessels <10 m that typically fish in inshore waters, with the most frequent vessel length being between 5 and 6 m. Vessels >10 m fish both within and outside the 12 nm boundary of Welsh waters.

95. Static gear (pot) fishing is the dominant method of fishing in Wales. Crab, lobster, whelk and prawn are high value key target species. Netting is also a key gear type used in Welsh waters, with fish including skate, ray, bass, herring caught in gill, trammel, drift and tangle nets.

96. Scallop fisheries using mobile dredge gear is another key high value fishery off the Welsh coast, with particularly important areas to the south of the MDZ in Cardigan Bay and vessels also targeting this species off the North Wales coast.

97. There are a very small number of trawlers operating from Wales. These trawlers predominantly target mixed, demersal fisheries, landing a range of species such as monkfish (anglerfish), megrim, sole and plaice.

98. Commercial fishing is widely distributed throughout the entire Irish Sea region. The waters around Wales provide an important variety of fishing areas and species for commercial activity. Welsh waters are targeted by both large (>10 m) offshore vessels and smaller (<10 m) inshore vessels, as well as hand gatherers and commercial net fishermen for diadromous (migratory) species, including salmon and sea trout. Fishing ports in this region include Holyhead, Amlwch, and Beaumaris on Anglesey, Pwllheli, Caernarfon and Morfa Nefyn in Gwynedd, and Conwy in Conwy County. A variety of species are landed.

25.4.5.2. Local

99. The closest main fishing port to the MDZ is Holyhead Port, which is one of the most important traditional commercial fisheries hubs in Wales and is one of a network of ports around the North West Wales coastline.

100. A list of vessels likely to fish in or near the area was also compiled as part of the baseline assessment by the Fisheries Liaison Officer (FLO) for the Project – see **Chapter 14, Commercial Fisheries.** This identified a total of 44 vessels that may fish in or near the MDZ area. The most common port of origin was Holyhead, followed by Morfa Nefyn and Caernarfon. There was one vessel from each of Amlwch, Porth Colmon, Pwllheli and Trefor. The majority of vessels (42 of 44) were ≤10 m in length. Of the two vessels >10 m, one originated from Holyhead, and one originated from Pwllheli.

101. In addition to commercial fishing vessels, there are at least 12 registered charter angling vessels that operate in the local area, from ports including Holyhead (i.e. *My Way 2; Bad Boyz IV; Spindrift New Dawn*); Beaumaris (*Maverick; Lander 2; Starida II; Sarah Jane Too*); Amlwch (*Fairway Aqua Star; Kerrykim; Empress & Julieann*) and Cemaes (*Stingray*). All these vessels contribute to the local economy both via direct charter fees but also local accommodation and catering inputs from visiting anglers.

102. A report commissioned by Menter Môn and completed by Aquatera and MarineSpace (Aquatera and MarineSpace, 2015) investigated opportunities for fishermen to diversify into marine renewables. The conclusions of this study highlighted there could be significant opportunities for vessel operators to diversify and provide a range of services across development, construction and operation of marine renewable projects

103. The report suggested that these contracts could be as much as £4 M over 10 years with up to £400,000 in development, approximately £2.5 M in construction phase and up to £350,000 / year during the operational phase.

104. The types of operations that would suit the diversification opportunities for the Anglesey fleet are physical and environmental surveys, deployment of monitoring equipment including Remotely Operated Vehicles and buoys, guard vessel duties and crew transfer services.

25.4.6. Shipping and Navigation

105. Shipping and navigation is addressed in detail in **Chapter 15, Shipping and Navigation**. However, for ease of cross-reference, it has also been addressed in brief in this chapter, in recognition of the potential knock-on social and economic impacts that may be associated with the Project.

25.4.6.1. Regional (Irish Sea)

106. The most notable routes where vessel traffic density is highest were the Holyhead and Liverpool to Dublin routes, the Heysham and Liverpool to the Isle of Man and Belfast routes, and Loch Ryan routes to Belfast and Larne routes (MMO, 2014).

25.4.6.2. Local (Anglesey)

107. Holyhead is the largest commercial Port on Anglesey. Annually, the Port handles approximately 2.7 million passengers, 400,000 cars, 170,000 freight units and 270,000 tonnes of bulk freight. It has a maximum depth of 13.5 m and can accommodate vessels up to 190 m in length, with a

deadweight tonnage of no more than 5,680 (Marine Energy Wales, 2019b). Commercial ferry Ro-Ro services run between Holyhead and Dublin year-round, with the two main commercial operators being Irish Ferries and Stena Line (UK Ports), The Holyhead-Dublin shipping channel intersects a small part of the northern section of the MDZ array. Ferry services can run up to five times a day in peak season.

25.4.7. Tourism

25.4.7.1. National

108. A study conducted by Deloitte and Oxford Economics (2013) estimated the total contribution of tourism to the Welsh economy, as being in the region of £8.7 billion per annum. Tourism is one of Wales' largest employers and since 2005 the Tourism Sector has outperformed other priority sectors (such as: Advanced Materials and Manufacturing, Construction, Creative Industries, Energy and Environment, Finance and Professional Services, Food and Drink, Information Technology and Telecommunications and Life Sciences).

109. In Wales in 2015, over half of 16-24-year olds working in priority sectors, were employed in tourism.

110. The latest tourism statistical release from the Welsh Government (dated 7th March 2019), shows that between the period of January 2018 and September 2018, 784,000 foreign visitors came to Wales. This is on additional to the 8.1 million overnight trips taken by UK residents and the 75 million day trips to Wales during the same period (Welsh Government, 2019a).

111. A Statistics for Wales report (Welsh Government, 2018b) records room occupancy rates of 67 % for hotels in Wales with occupancy rates falling to 48 % in January, peaking at 79 % in July and August. Guesthouses and B & B's have January room occupancy rates of 19 %, peaking at 57 % in August. Statistics for Coastal Touring and Camping Parks are only available for the months May through to October; such sites have an average occupancy rate of 40 % through this period with coastal sites seeing higher occupancy year on year as opposed to inland sites. As is to be expected, occupancy rates peak in the summer months. In 2017, Bunkhouse and Hostel occupancy levels peaked at 73 % in August; however, during the winter months (November through March) occupancy levels were approximately 40 %.

25.4.7.2. Regional

112. A Welsh Government study (Tourism Profile – North Wales 2014-2016), (Welsh Government, 2018c) established that between 2014 and 2016, 37 % of all overnight domestic UK trips to Wales and 28 % of both international and tourist day trips to Wales were to North Wales.

Table 25-13 Volume of Overnight Domestic GB Trips (000s) (Great Britain Tourism Survey, cited in Welsh Government, 2018b)

	Trips (000s)		
	2013-2015	**2014-2016**	**% change**
GB	120,524	119,374	-1
Wales	10,127	9,919	-2
North Wales	**3,713**	**3,626**	**-2**
Mid Wales	1,763	1,750	-1
South East Wales	2,473	2,471	0
South West Wales	2,081	2,014	-3

Table 25-14 Volume of International Visits (000)

	Visits (000s)		
	2013-2015	**2014-2016**	**% change**
GB	34,397	36,037	+5
Wales	924	992	+7
North Wales	**253**	**274**	**+8**
Mid Wales	87	98	+14
South East Wales	467	497	+6
South West Wales	191	205	+7

113. In 2014-2016, the most popular destination for overnight domestic GB trips to North Wales was the seaside (51 %), this compared favourably to a low percentage of only 6 % wishing to visit a city or town. The highest proportion of visitors (22 %) were visiting friends and family, closely followed by those choosing the region for a day out (17 %), to go out for a meal (13 %), or outdoor activities (11 %) (Welsh Government, 2018c).

25.4.7.3. Local

114. Anglesey is highly dependent on the tourism and recreation sectors and attracts 1.71 million visitors per annum, contributing £304 M per annum to the local economy. The latest Isle of Anglesey County Council Tourism Topic Report (Isle of Anglesey County Council, November 2018) showed that the Tourism Sector employs approximately 20 % of the island's population. Tourism forms the bedrock of the island's economy and the industry has been and continues to be, supported by initiatives and funding programs to promote the island's cultural, recreational and environmental assets.

115. The growth in the Tourism Sector in Anglesey, far outstrips that of the rest of Wales with a 63.7 % increase in revenue between 2006 and 2017, representing growth of 7 % (4 % higher than the national average). Although Anglesey predominately attracts tourists from the North West of England, Holyhead has also become a destination of choice for cruise ship operators. 2018 saw 43 cruise ships visit with approximately 32,700 passengers potentially disembarking. With an average spend of between £80 and £100 per head, passengers contribute significantly to the Island's economy (Isle of Anglesey County Council, November 2018).

116. Tourists are attracted to Anglesey for many reasons. A 2003 Survey carried out by Anglesey and Gwynedd Councils as part of the Local Joint Development Plan stated that 41 % of visitors were attracted to the region by the scenery and landscape, 19 % by the beaches and coastlines and 18 % by access to outdoor activities. Other factors included tranquillity, walking, castles and abbeys. Unequivocally, the area's landscape and natural beauty play a significant role in the number of visitors Anglesey receives, as does its rich and diverse cultural heritage. Whilst the cable landfall will be onto one of Anglesey's beaches, at Abrahams Bosom, this is not a busy or popular amenity beach, so effects on tourism are likely to be negligible – see **Appendix 25.2 (Volume III).**

117. The landscape and visual impacts of the Project are assessed separately within **Chapter 24, Seascape, Landscape and Visual Impact Assessment.** This has taken into account embedded mitigation introduced during the project design process to minimise visual impacts of the Project from the coastline. Eight indicative subzones within the MDZ are shown in **Figure 4-1 (Volume II)**, however, these indicative zones may be modified to meet the requirements of tenants and regulators. Within indicative subzones 1 – 3 and northern parts of indicative subzones 4 and 8 (which overlay the yellow and purple shaded areas), no visually prominent devices would be deployed. This mitigation will further reduce any possible negative effects on tourism and recreation arising as a result of the visibility of the Project from the Wales Coastal Path and South Stack RSPB Reserve.

118. Typical holiday accommodation is, in the main, geographically separate from residential accommodation, as a result of broader local and national planning policies. Types of holiday accommodation in Anglesey can be placed into the following categories; Hotels, guest houses and Bed and Breakfasts (B&B), self-catering accommodation, camping and caravanning, glamping (glamourous, high end camping, commonly in purpose built camping pods, yurts or tepees), hostels and bunkhouses. In addition, the purchase of second homes for personal use is increasing on the island.

119. The north west of Holy Island has a range of visitor accommodation including self-catering, bed and breakfast and caravanning and camping accommodation. This includes South Stack Coastal Retreats (a range of self-catering cottages), Ty Mawr Farm Camping and Caravan Club site caravan site and Blackthorn Farm Caravan site. These could all be subject to temporary disruption during construction of onshore infrastructure, including road closures, diversions and highways works, particularly along the South Stack access road. However, Chapter 23 Traffic and Transport identifies that these closures will be very temporary in nature and so not likely to result in significant disruption to access.

120. Occupancy durations for holiday accommodation in Anglesey are capped at ten months per annum; if occupancy rates exceed this, the property would be considered as residential. A Statistics for Wales report (Welsh Government, 2018b) records room occupancy rates of 67 % for hotels in Wales, with occupancy rates falling to 48 % in January and peaking at 79 % in July and August. Guesthouses and B&B's have January room occupancy rates of 19 %, peaking at 57 % in August.

25.4.8. Recreation

25.4.8.1. National

121. In 2014/15 a NRW survey (July 2015) estimated 84 % of the Welsh population participated in recreational activities on a frequent, or infrequent basis. Of this 84 %, 88 % were in the 16-64 age bracket. The survey categorised activities as either being “low input”, “active pursuits” or “traditional activities” (**Table 25-15**).

Table 25-15 Activity Types (in order of popularity/per type) (NRW, July 2015)

Low Input	Active Pursuits	Traditional Activities
1. Walking	1. Running	1. Fishing
2. Sightseeing	2. Swimming	2. Field Sports
3. Playgrounds	3. Road Cycling	3. Horse Riding
4. Picnics	4. Mountain Biking	
5. Informal games	5. Water sports	
6. Wildlife watching	6. Climbing	

122. Of all the low input activities, walking was the most popular, with 85 % of people surveyed having recreationally walked in the past 12 months. This was followed by sightseeing, which was the second most popular activity, with 71 % of people saying they had taken part in sightseeing activities in the preceding 12 months. Playgrounds, picnic, informal games and wildlife watching figures were lower, with approximately 40 % of those surveyed having taken part in these activities in the last 12 months.

123. Active pursuits were less popular, due to accessibility factors such as cost, proximity to resources, health factors etc. The most popular active pursuit was running (28 %) closely followed by swimming and road cycling (26 % and 24 % respectively). Water sports, mountain biking and climbing all had participatory rates of less than 20 %.

124. The NRW (July 2015) survey also asked which outdoor areas people most went to, in order to conduct recreational activities; the results are pictorially represented below in **Plate 25-1**.

125. A more recent Welsh Government Report (National Survey of Wales 2016-17) defined the recreational activities in Wales that adults are most likely to be accessing. In order of popularity the list included; walking, gym or fitness classes, swimming, cycling, jogging, football, rambling or hill walking, road running or cross country, golf and dance.

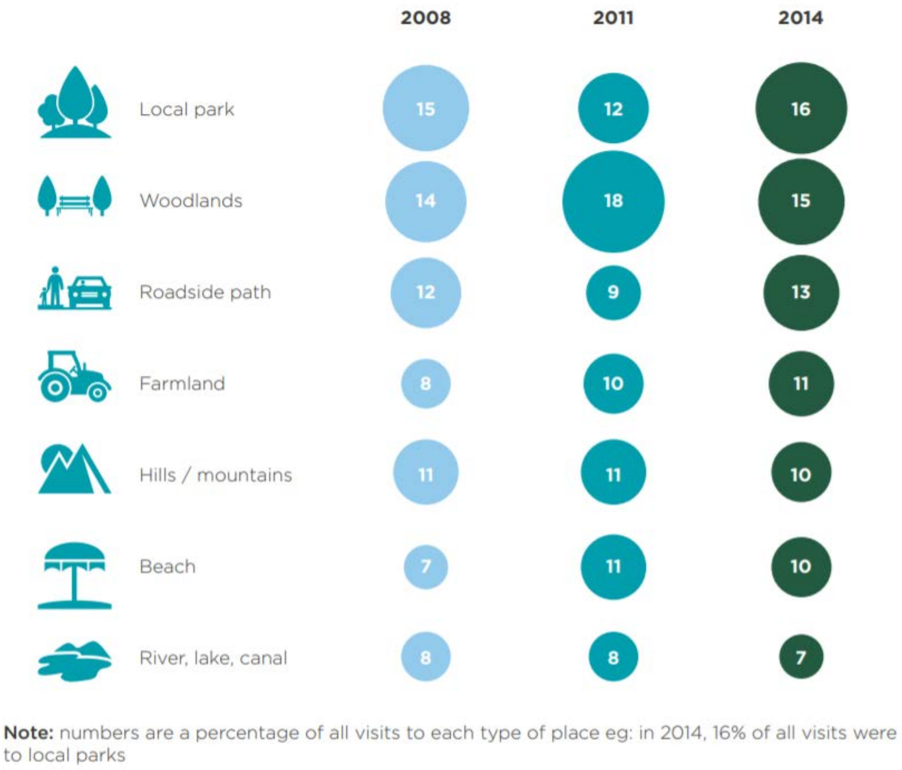

Plate 25-1 Places People Visit (NRW Report, July 2015) (National Survey of Wales 2016-17)

25.4.8.2. Regional

126. The natural environment of North Wales lends itself to outdoor recreation. The region provides outstanding natural beauty and varied terrain, which makes it ideal for walking, cycling, climbing, water sports, wildlife watching etc.

127. North Wales is very popular for road, mountain biking and leisure cyclists. North Wales is home to seven Mountain Biking Centres, as well as seven National Cycle Routes (numbered 556, 8, 5, 41, 13, 12 and 81) (**Plate 25-2**). These routes alone provide hundreds of miles of marked cycle paths, many of which are on traffic free paths or roads with low density traffic.

128. Agreements with the Forestry Commission Wales to use tracks in the Gwydyr forest and Coed y Brenin have enabled dedicated mountain biking routes to be established, which has in turn led to increased investment in the mountain biking sector in North Wales. Government and EU investment led to the first dedicated trail centre at Coed y Brenin, being opened in 1997; this was followed closely by the development of other forestry sites. These established centres attract significant visitor numbers and have become important to their respective local economies.

129. Cycle tourism is growing rapidly in the UK. In 2015 it was estimated that the National Cycle Network in the UK contributed £650 million and supported 15,000 jobs. The National Cycle Route in North Wales is shown in **Plate 25-2**. The National Cycle Network is used by over 4.4 million people a year, and in 2017 an estimated 786 million trips were made on it, with 44 % of these journeys' leisure-based (Sustrans, 2019). Cycling continues to increase in popularity in the UK and Wales is becoming a destination of choice for the British and international cycling community.

Plate 25-2 National Cycle Routes North Wales (Source: Sustrans, 2019)

130. North Wales is also popular with ramblers, hill walkers, road and trail runners alike. North Wales has a wealth of coastal footpaths stretching from the shores of the Irish Sea to the Peaks of the Snowdonia National Park. In 2015 is was estimated that 3.89 million people visited the Snowdonia National Park making it the ninth most visited park in the UK that year. In 2015 it was estimated that nearly 600,000 people visited Snowdon itself, making it the third most visited attraction in Wales (Scarborough Tourism Economic Activity Model (STEAM) Figures, 2015).

131. Other popular recreational activities in North Wales include water sports such as sailing, surfing, kayaking, coasteering, white water rafting and paddle boarding. General sightseeing, wildlife observation and visits to parks and forests for dog walking, picnics and enjoying the natural beauty of the land and seascape are also popular activities.

25.4.8.3. Local

132. Anglesey provides a microcosm of all the recreational activities available in North Wales. Anglesey is home to 125 miles of coastal paths that circumnavigate the island. Menter Môn invested £6 M to improve coastal access around Anglesey, as part of the wider Wales Coast Path project (figure from Menter Môn website). These footpaths travel through areas of both cultural significance and Areas of Outstanding Natural Beauty (AONB) (**Plate 25-3**).

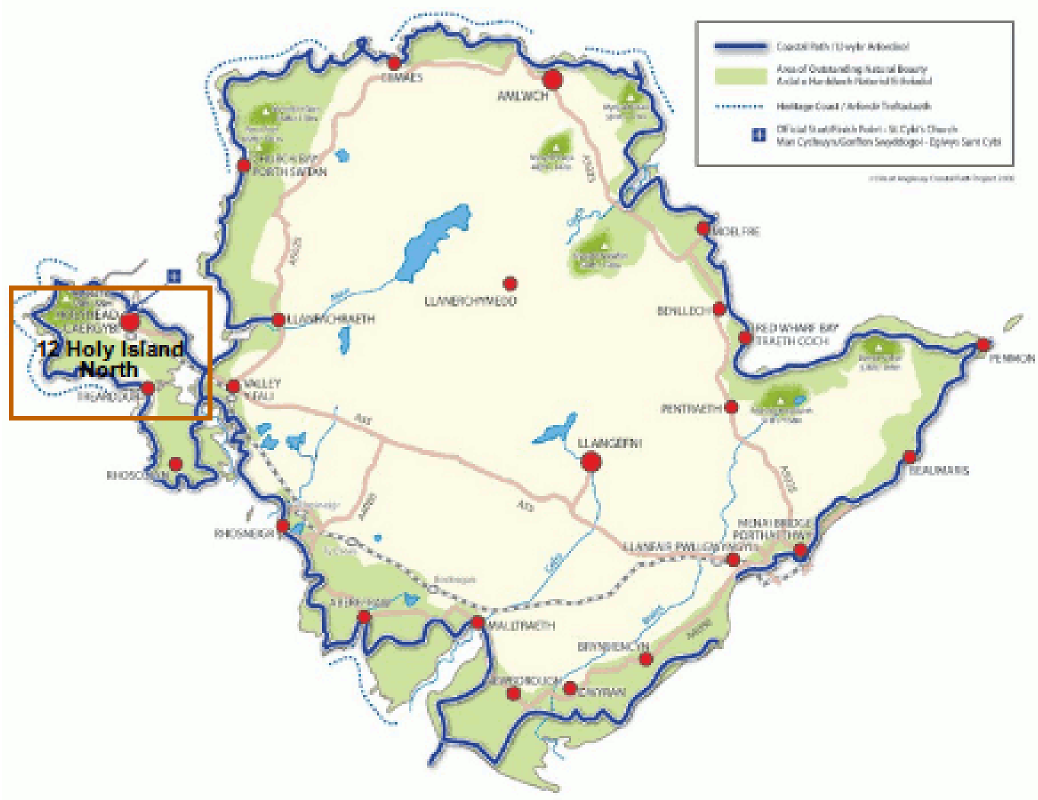

Plate 25-3 Coastal Footpaths -Anglesey

133. The Wales Coast Path closely follows the coastline along the north west of Holy Island. The section around the South Stack area is extremely popular, and part of an important RSPB reserve for active visitor engagement attracting circa 180,000 visitors per year[4]. Landscape and visual impacts from the Wales Coast Path including the South Stack RSPB Reserve has been assessed separately within **Chapter 24, Seascape, Landscape and Visual Impact Assessment**. Potential exists for temporary closures to Public Rights of Way (PRoW), including the Wales Coast Path, during the construction phase of the Project. This potential impact was assessed via the initial impact screening exercise (see **Appendix 25.1 (Volume III)**. A conclusion of minor adverse impact was presented; therefore, this potential impact was not assessed further within the main body of this Chapter.

134. Embedded mitigation has been introduced during the project design process to minimise visual impacts of the Project from the coastline including coastal footpaths. Within indicative subzones 1 – 3 and northern parts of indicative subzones 4 and 8 (which overlay the yellow and purple shaded areas, no visually prominent devices would be deployed. This will further reduce the visibility of the Project from the Wales Coastal Path.

135. Further mitigation in the form of the provision of appropriate signage will also be implemented to ensure all path users (locals and tourists) are notified of any minor diversions and/or temporary restrictions around the construction period. There will also be consultation with local

[4] RSPB 2010 figure from: http://ww2.rspb.org.uk/Images/PEASouthStackJan11_tcm9-268711.pdf

people and organisations about appropriate signage and interpretation boards when the site is commissioned.

136. Anglesey has an extensive rural cycle path network, and two National Cycle Routes including National Route 8 (Lôn Las Cymru) which runs from Cardiff to Holyhead. Menter Môn has invested heavily in creating cycling infrastructure on the island, supporting the creation of five new cycleways on Anglesey. This investment and the variety Anglesey offers the cyclist means that it appeals to both novice and expert cyclists alike. The island also hosts an annual “Tour De Mon” road biking event, where competitors ride over a 42- or 107-mile course. This event alone attracts over 1,000 competitors to Anglesey each year.

137. Anglesey is also improving its existing mountain biking infrastructure and has two dedicated mountain biking trails, the Bike Quest Nature Challenge Trail and the Corsica Bike trail, both located in Anglesey’s Newborough Forest. The beauty of the national environment and the relative quietness of the island’s roads compared to other areas of the UK, make Anglesey a popular destination for cyclists.

138. Anglesey offers a wide range of coastal and offshore recreational activities. Coasteering -the practice of individuals navigating around rocky headlands and jumping into the sea - is a popular and exhilarating activity. Coasteering is accessible in Anglesey and there many outdoor activity centers offering coasteering trips on Anglesey.

139. Anglesey has a thriving sailing community. The island is home to six yacht clubs catering for both coastal dinghy sailing to offshore yachting. During August each year, the Island hosts the Menai Strait Regatta, with the 2018 regatta attracting approximately 100 boats. A highlight of this Regatta is the Round Anglesey race which has taken place since 1966 and which is a non-stop circumnavigation of the Island. Much of Anglesey coastline is the subject of low to moderate amounts of nearshore, recreational boating activity (UK Coastal Access Recreational Boating Atlas) – see **Chapter 15, Shipping and Navigation**.

140. Anglesey is one of the UK's top dive destinations. Dive operators provide trips to offshore dive sites, however many of the sites can be accessed from the shore which increases its popularity with recreational divers, as can be seen from **Plate 25-4**. This shows a number of popular dive spots on Anglesey’s West Coast. The area known as the Fangs to the South Stack Light House is characterised by bare rocky outcrops, volcanic rocks and steep cliffs. The main diving area is around Rip-Tide Rock and the Fangs which together form a series of inlets and submerged reefs. The Fangs are a pair of drying rocks that lie 100-150 m south of Tide Rip Rock. Many vessels have sunk along this coastline.

Plate 25-4 Dive Sites (Holy Island South)

141. Anglesey has a growing surfing community, with both North Wales residents and visitors accessing the island's beaches to surf. The island's surf is inconsistent compared to other regions of Wales and the wider UK and suitable swell for good quality surfing is predominantly confined to the winter months. The island's best surfing locations, where the wave regime and bathymetry produce the best surfing waves, are on the south-westerly facing coastline, for example at Rhosneigr.

142. Anglesey is a popular destination for sea kayaking for novices and experienced paddlers. Sea kayaking takes place all around the island's coastal waters, but the north coast of Anglesey has a challenging combination of steep cliffs, strong tidal streams, offshore islands and sheltered bays. The area of sea around Holy Island including the MDZ is particularly challenging in nature and generally only recommended for experienced kayakers (Krawiecki and Biggs, 2013). The sea kayaking community, including local clubs and local kayaking training providers, will be kept informed of the development of the site particularly during construction period and the cable laying closer to shore. This will be backed up by the introduction of relevant signage.

25.4.9. Cultural Heritage

25.4.9.1. National

143. The 2016 Historic Environment (Wales) Act underlines the country's commitment to the preservation of their historic environment, including: monuments, historic building, landscapes and subterranean archaeology.

144. Wales is home to six UNESCO World Heritage sites; Pontcysyllte Aqueduct and Canal, Caernarfon Castle, Beaumaris Castle, Blaenavon World Heritage Site, Harlech Castle and Conwy Castle. Sites of cultural interest in Wales span millennia from the Palaeolithic to the industrial revolution making Wales rich in cultural heritage.

145. The Welsh language continues to be read, spoken and written in mainstream Welsh society; in 2015 it was estimated that 19 % of the Welsh population could speak Welsh (Welsh Government Statistics, Dec 2018). A full assessment of potential Welsh language impacts of the Project is presented in a stand-alone (non-ES) report – "Morlais Welsh Language Impact Assessment" that has been submitted as part of the consent applications for the Project.

25.4.9.2. Regional

146. Of the six UNESCO world heritage sites detailed above, all but Blaenavon World Heritage Site are in North Wales.

147. North Wales is also of historical and cultural significance as a result of a number of other features. Slate mined in North Wales not only roofs houses across the globe, but it also shapes the unique landscape of North Wales and in particular the Snowdonia National Park. The mining of slate is not only of tangible significance but is also highly significant to the cultural make up of North Wales.

148. This heritage can be viewed across North Wales at sites such as; Chwarel Hên Llanfair Slate Caverns (Llanfair), Corris Mine, Inigo Jones Slateworks (Penygroes), Llechwedd Slate Caverns (Blaenau Ffestiniog) and the National Slate Museum (**Plate 25-5**).

149. Portmeirion, is also situated in North Wales and has become a popular tourist attraction, hosting numerous listed properties. The site was acquired in 1925 by Welsh architect Clough Williams-Ellis who then developed an Italian-style village over the period 1926-1973. Several buildings were salvaged from demolition sites.

150. Over the last decades, development of the site has continued and Portmeirion has, in recent years, hosted a major music festival and a range of other cultural events.

Plate 25-5 Abandoned Slate Quarry, Snowdonia

151. North Wales has the highest percentage of the Welsh speakers in Wales, with approximately 33 % of the population speaking Welsh. These values increase in the western part of the region, with Gwynedd having the highest percentage of Welsh speakers in all Wales. In 2011, 65 % of Gwynedd's population spoke Welsh (Welsh Government Statistics, Dec 2018).

152. A full assessment of potential Welsh language impacts of the Project is presented in a stand-alone (non-ES) report – "Morlais Welsh Language Impact Assessment" that has been submitted as part of the consent applications for the Project.

25.4.10. Local

153. Anglesey is rich in cultural heritage. Alongside Orkney and Salisbury Plain, it is one of the richest prehistoric landscapes in the UK. Early Neolithic settlers, drawn to the island because of its agricultural potential, erected numerous burial chambers and landscape features, which to this day are of global interest and significance – see **Chapter 13, Offshore Archaeology and Cultural Heritage.** Menter Môn has provided significant funding and support since 1997 to promote the unique cultural heritage of Anglesey.

154. The island is home to a UNESCO World Heritage Site, Beaumaris Castle and has UNESCO Geopark status due to the scientific quality, rarity and aesthetic appeal of its geology. Within proximity of the Project's landfall on Holy Island there is a long history of human habitation. This is demonstrated by a significant concentration of prehistoric, iron-age and Roman sites of cultural significance.

155. The Western edge of Holy Island has multiple shipwrecks of cultural heritage significance. Wrecks include the *Missouri*, which wrecked in 1886 and the *Matilda*, which foundered on the rocks of the South Stack in 1853. The coastline is also home to multiple small traditional landing sites that historically provided shelter for small vessels, during periods of inclement sea conditions. The Old South Stack signal station is also culturally significant and is an iconic landmark.

156. **Plate 25-6** highlights the proximity of these sites to the Project location and highlights their proximity to main arterial transport routes on the islands that have the potential to be utilised by the Project.

157. Anglesey also has over 1,000 listed buildings, many of which are of architectural or historical interest (British Listed Buildings, 2019). Of these listed buildings, 39 are listed as Grade I (highest importance). Those within the vicinity of the Onshore Development Area are outlined in **Chapter 20, Onshore Archaeology and Cultural Heritage**.

158. The Welsh language is at the centre of Anglesey's cultural heritage. According to the 2011 Welsh language census carried out by Stats Wales, Anglesey is the county with the second highest proportion of Welsh speakers (57.2 %) in Wales (Stats Wales, 2012). It is anticipated that many of the jobs created by this project will be available to local Welsh speakers, since Menter Môn has a specific initiative, Menter Iaith Môn to provide opportunities to ensure Anglesey continues to be a stronghold of the Welsh language.

159. A 2015 report (Isle of Anglesey and Gwynedd County Councils Joint Planning Policy Unit, 2015) recorded a 1.5 % decline in the number of Welsh speakers in Anglesey between 2001 and 2011. Menter Môn has been very active in this area of promoting use of the Welsh language and cultural heritage.

160. A full assessment of potential Welsh language impacts of the Project is presented in a stand-alone (non-ES) report – "Morlais Welsh Language Impact Assessment" that has been submitted as part of the consent applications for the Project.

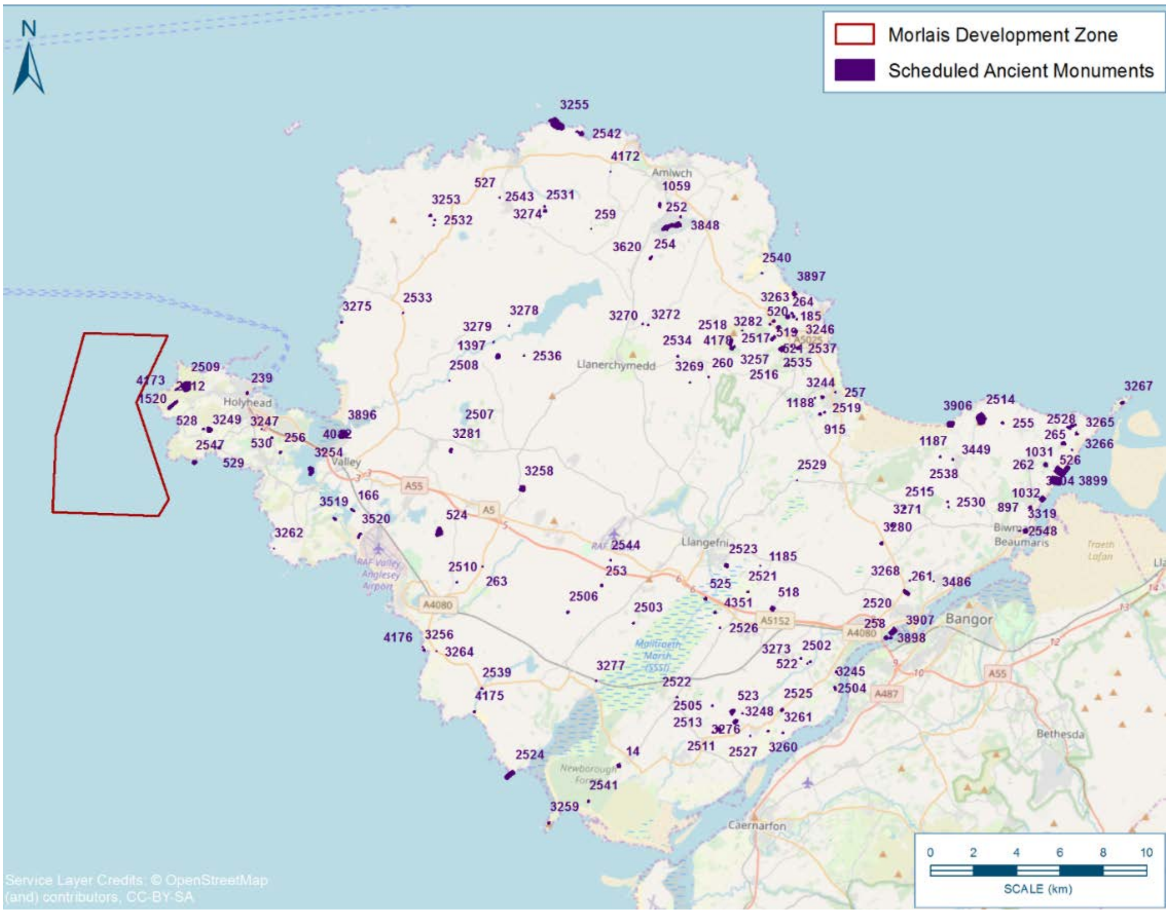

Plate 25-6 Distribution of Scheduled Ancient Monuments

25.5. IMPACT ASSESSMENT

161. This section covers the assessment of potential socio-economic impacts of the Project, using the methodology described in **Section 25.3.5**. The impact assessment is presented as follows:

- Identification of key potential impacts;
- Potential impacts subject to a screening process (see **Section 25.5.2** below); and
- Assessment of impacts.

162. A full assessment of potential Welsh language impacts of the Project is presented in a stand-alone (non-ES) report – "Morlais Welsh Language Impact Assessment" that has been submitted as part of the consent applications for the Project.

163. Reference should also be made to **Chapter 23, Traffic and Transport** which considers the possible effects during construction of onshore infrastructure and consequential effects on access and road closures. Any road closures or disruptions to traffic (and tourism) as a consequence of the Project are likely to be minimal so corresponding socio-economic implications have not been assessed further as they are consequently anticipated to be non-significant.

25.5.1. Impact Identification

164. The key impact pathways and associated receptors which are relevant to this assessment are as follows:

- Social issues – local people and communities;
- Economic issues – the economy itself, local residents and their purchases and transactions, levels of local and wider investment;
- Jobs and employment issues – local workers, supply chain employees, remote equipment and specialist service providers;
- Available skills and training issues - the Project, the workforce local educational and training establishments, other sectors that share key skill sets;
- Effects on tourism –local and visiting tourists including day trips, and longer-term stays sector businesses and workers;
- Recreation – resident's activities, visitor activities sector businesses and workers;
- Shipping and fishing – sector businesses, supply chain businesses and sector workers; and
- Infrastructure issues – existing infrastructure operators and users.

25.5.2. Impact Screening

165. The EIA scoping process in 2015, 2017 and 2018 identified a wide range of socio-economic issues requiring consideration. To establish which of these issues had the greatest potential to cause likely significant impacts, a topic specific screening process was carried out.

166. The long list of topics identified by stakeholders was reviewed and their sensitivity considered in the context of the proposed Project. The potential impact pathway was then assessed further, and the predicted magnitude of effect determined. The outcomes of this process are detailed in **Appendix 25.1 (Volume III)**.

167. A separate exercise has been undertaken to assess possible impacts and their nature and significance on the Welsh Language (see the Morlais Welsh Language Impact Assessment).

168. The assessment of potential impacts was undertaken for each of the major phases of the Project: construction, operations and maintenance (including repowering) and decommissioning.

169. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50 % of the tenants will undertake repowering, i.e. for 50 % of the tenants, their infrastructure will be removed and replaced (potentially with different infrastructure by a different tenant). For the other 50 % of tenants, their infrastructure will remain over the lifetime of the Project.

170. On the basis of this approach any socio-economic impact that was considered to be of minor, or negligible significance was screened out from further assessment whilst those screened as Moderate or above were analysed further (see below).

171. The following are considered to be subject to likely significant impacts as identified from the impact screening process described above and were, therefore, subjected to further detailed assessment:

- Impact 1: Social benefits - Decentralisation of economic growth;
- Impact 2: Wellbeing of future generations - Green branding for locality;
- Impact 3: Economic impacts - Direct and secondary income;
- Impact 4: Economic impacts - Accumulation of grant support;
- Impact 5: Level of commerce activity - Green cluster creation;
- Impact 6: Job opportunities –Numbers;
- Impact 7: Job opportunities - Types, quality, skills areas;
- Impact 8: Training Impacts - New skills and competence needs;
- Impact 9: Training Impacts - Tertiary (Bachelor of Science (BSc), Doctor of Philosophy (PhD));
- Impact 10: Additional local services - New technical skills, workboats, cranes, better marine knowledge;
- Impact 11: Energy security - More green electricity, local supply, diversity of supply; and
- Impact 12: Decarbonisation - Clean energy, balancing services, spin-off capacity.

172. Each of these potentially significant impact issues have been assessed in detail with receptor sensitivity and effect magnitude considered. Where appropriate, each assessment has considered individual mitigation and optimisation measures available/implemented and consequently what level of residual impacts are predicted if these measures are successfully implemented.

173. It is noteworthy that the consideration of tourism and recreational impacts, including any socio-economic impact from the temporary, short term closure of coastal paths, along with the analysis of shipping and fishing impacts from a socio-economic perspective did not indicate any likely significant effects. This is due to the temporary nature of potentially disruptive construction works such as any road, path and beach closures (see **Chapter 23, Traffic and Transport)** and the use of embedded mitigation measures such as sub-zoning within the MDZ to limit effects on shipping (see **Chapter 15, Shipping and Navigation**), landscapes and seascapes (**Chapter 24, Seascape, Landscape and Visual Impact Assessment**) and hence tourism and recreation.

25.5.3. Assessment of Effects

174. Each impact is structured broadly as follows:

- Nature of the impact is described;
- Sensitivity and magnitude are described;
- Mitigation/optimisation measures identified;
- Residual impact assessed for relevant phases; and
- Monitoring proposed, where relevant.

25.5.4. Mitigation and Optimisation Measures

175. The possible mitigation and optimisation measures are considered with regards to embedded mitigation, which is already in the plan/design and an additional mitigation which is considered appropriate (See **Section 25.3.5.4**).

25.5.5. Impact 1: Social Benefits - Decentralisation of Economic Growth

25.5.5.1. Nature of Impact

176. Within the UK and Welsh economies, opportunities are constantly being sought to provide economic opportunities for peripheral areas such as Anglesey and North Wales. Tidal energy developments of the type represented by the MDZ, provide such an opportunity for decentralised development and economic growth in such areas.

177. With respect to Anglesey, the potential harnessing of the excellent tidal resources in the waters around the island provides an opportunity for dynamic and sustained economic activity, at a local and regional level, in a high-tech engineering and energy sector. This potential (beneficial) impact was raised by many stakeholders through the consultation process and is explored in more detail below.

178. The scale of potential economic and employment benefits that could arise are considered in further detail in **Sections 25.5.9** and **25.5.10.** These factors are likely to be the key drivers with regard to the opportunities for decentralised growth. The total potential capital and operational spend for the Project over the various deployment scenarios have been estimated as follows.

Table 25-16 Total Project spend (International Energy Agency (IEA) 2015))

Phase	Duration	Capital spend per MW installed	Capital spend	Capital spend per annum	Cumulative operational spend per year (£70k-£300K/MW/yr)	Total annual spend
Phase example 17 MW	2 yrs	£2.5M- £4.3M	£43M- £73M	£21.5M - £36.5M	£1.2M - £5.1M	£22.7M - £41.6M
Phase example 40 MW (add 23MW)	2 yrs	£2.2M – £3.7M	£51M - £85M	£25.5M - £42.5M	£2.8M - £12M	£28.3M- £54.5M
Phase example 100 MW (add 60 MW)	3 yrs	£1.9M – £3.2M	£114M- £192M	£38M- £64M	£7M - £30M	£45M- £94M
Phase example 240 MW (add 140MW)	6 yrs	£1.6M – 2.8M	£224M - £392M	£37M - £65M	£16.8M - £72M	£53.8M- £137M
Ongoing Operation & maintenance only (£70/KW/yr).	25 yrs	-	-	-	£16.8M	£16.8M

179. The table assumes a learning rate of 12 % between phases as per the IEA report. Given a local Anglesey spend rate of 15 % - 20 % (**Table 25-17**) during the construction activities and 35 % during operational activities the following local economic benefits could be envisaged. Note that this estimate of 35 % is based on previous experience of EMEC in Orkney, where there was a target rate of 25 % local spend on O&M, taking into account the location of Anglesey.

180. The table is also based on average figures for projects and may not be fully reflective of the intention to initially build out common infrastructure to support future phases.

Table 25-17 Local Anglesey-based spend projections

Phase	Duration	Capital spend per annum in Anglesey (15% - 25% of total)	Cumulative operational spend per year in Anglesey (35% of total)	Total annual spend in Anglesey
Phase example 17 MW	Years 1-2	£3.2M- £9.1M	£0.42M – £1.8M	£3.6M -£10.9M
Phase example 40 MW (add 23MW)	Years 4-5	£3.8M – £10.6M	£0.98M – £4.2M	£4.78M - £14.8M
Phase example 100 MW (add 60 MW)	Years 6-8	£5.7M- £16M	£2.4M – £10.5M	£8.1M - £26.5M
Phase example 240 MW (add 140MW)	Years 9 - 14	£5.5M - £16.2M	£5.8M – £25.2M	£11.3M – £41.4M
Operation & maintenance only	Years 14 - 37	-	£5.8M	£5.8M

181. In **Table 25-17** Year 3 is considered, on an indicative basis for the purposes of the socio-economic, as a review year to match the environmental monitoring required as part of the ecological commitments and therefore no capital spend is anticipated.

182. As the total economic activity of Anglesey is estimated at around £999 M GVA/per annum (ONS 2017), the local spend of the Project may add somewhere between 0.4 % and 4 % to the annual economic activity of the Island. The associated socio-economic benefits to the local area in terms of decentralisation of economic growth will, therefore, be relatively small overall, but could be significant for demographic segments, such as early and mid-career technologists/engineers.

183. Within Anglesey it has been identified by Menter Môn that there are 12 Engineering and Fabrication companies several which have already and are at present undertaking work for tidal developers in the area. There are also nine marine services companies within the island three of which are already providing services to Minesto.

184. Approximately 70 % of Minesto's supply chain for the Deep Green Holyhead Deep Project Phase I project off Anglesey has been directly sourced from companies in Wales. They have used several local SMEs including Anglesey Mechanical Solutions, Holyhead Boatyard, Jones

Brothers and Mona Lifting to support engineering aspects of their project (Marine Energy Wales (2019a). State of the Sector 2019: Economic benefits for Wales).

25.5.5.2. Sensitivity and Magnitude

185. The sensitivity of Anglesey and North Wales from a regional development perspective is considered to be low/medium (beneficial), due to chronic under-development and the recent announcements about the suspended nuclear replacement project at Wylfa Newydd Power Station. The magnitude of effect via the proposed Project is considered medium (beneficial) during the construction phase, with an anticipated local expenditure of around £41 M per annum at its peak. This leads to a preliminary impact significance of **Moderate Beneficial** during the construction phase via decentralised economic growth.

186. The O&M, repowering and decommissioning phases of the Project, are considered to have a low (beneficial) sensitivity due to the reduced activity and, therefore, reduced annual local expenditure, although the long-term nature of the Project will confer ongoing benefits. The magnitude of effect is considered low (beneficial). This leads to an impact significance classification of **Minor Beneficial,** for the operational/repowering/decommissioning phases of the Project.

25.5.5.3. Mitigation and/or Optimisation

187. The potential optimisation measures relevant to this impact include:

- Seeking to localise as much development and operational expenditure in Anglesey and North Wales as possible;
- Menter Môn will endeavour to encourage all contractors to utilise the local workforce and supply chain as much as possible;
- Encouraging the local supply chain to invest in key capabilities that maximise local contracting opportunities;
- Menter Môn will develop a supply chain portal that will advertise opportunities for the local contractors and workforce;
- Encouraging appropriate public sector support and private sector investment to back the supply chain endeavours;
- Seeking to expand the marine energy and related renewables and energy systems activity in Anglesey and North Wales, as much as possible; and
- Seeking to expand the range of development activities, to increase the activity during the operations years.

25.5.5.4. Residual Impacts

188. If the optimisation measures outlined above are successful in bringing a greater percentage of the available benefits to the region, the magnitude of effect during the construction phase could increase from Medium to High Beneficial.

189. If a greater proportion of the operational spend can be localised, then the magnitude of effect will increase to medium (beneficial).

190. In addition, if the breadth of activity can broaden to encompass other tidal and low carbon projects and/or delivery of local and regional energy services, then the annual spend can be increased in parallel with the operational phase of the Project – see Cumulative effects (**Section 25.5.17**).

191. On this basis, the level of significance during construction can be increased to **Major Beneficial** and during the operational phase to **Moderate Beneficial**. The other phases remain at **Minor Beneficial.**

25.5.5.5. Summary of Residual Impacts

192. The classification of residual impacts regarding the decentralisation of economic growth, are outlined in **Table 25-18**.

Table 25-18 Summary of Residual Impacts

Impact	Phase	Area N/R/L[5]	Post mitigation/ optimisation receptor sensitivity	Post mitigation/ optimisation effect magnitude	Residual significance level
1. Decentralisation of economic growth	Construction	N/R/L	Medium	High Beneficial	Major Beneficial
	Operation	N/R/L	Medium	Medium Beneficial	Moderate Beneficial
	Repowering & Decomm	N/R/L	Low	Minor Beneficial	Minor Beneficial

25.5.5.6. Monitoring Activities Proposed

193. Since the potential economic benefits of the Project are a major driver for the Welsh European Funding Office (WEFO) funding support received, it will be important to collect comprehensive data about the geographic location of spend (UK-wide; National; Regional; Local) by the Project and by Project clients and collaborators. A regular survey of geographic location of spend should could be distributed and feedback sought from all key funding and procurement bodies (public, voluntary and private sector).

25.5.6. Impact 2: Wellbeing of Future Generations - Green Branding of Locality

25.5.6.1. Nature of Impact

194. Over the following decades, many UK regions will be faced by major challenges and upheavals caused by climate change, political uncertainty, and globalisation, as well as demographic and social pressures. One of the tools that may help Anglesey, North Wales and Wales through such transitions is a strong focus on progressive sectors such as renewables and the 'green' agenda. The Project can be a key part of the local, regional and national green branding. This issue was raised through the consultation process.

195. The potential success for such a strategy can be seen in communities such as Orkney where the islands green credentials have been significantly enhanced though the presence of ground-

[5] N = National (Wales); R = Regional (North Wales); L = Local (Anglesey).

breaking marine energy activity. This profile and the skills and capacity associated with it have now been applied to wider innovation associated with energy storage and integrated energy systems as well as onshore and offshore wind. In turn young people are choosing renewable energy careers, with the growing prospects for local employment and issues such as fuel poverty are being acted upon with determination and imagination.

25.5.6.2. Sensitivity and Magnitude

196. Based on the preliminary impact assessment, the sensitivity of Anglesey and North Wales from a progressive "green" branding perspective is considered low (beneficial); defined as the receptor being in an acceptably favourable state, with some adaptability. This judgement considers the past regional branding focus being on aspects such as history, tourism, nuclear energy, transportation (ports) etc.

197. The magnitude of effect with regards to "green branding" from the proposed Project, is considered low (beneficial) during the construction phase, rising to medium (beneficial) during the operational phase. This leads to an impact significance classification of **Minor Beneficial** for the construction/decommissioning phase and **Minor Beneficial,** for the operational/repowering phase of the Project.

25.5.6.3. Mitigation and/or Optimisation

198. The potential optimisation measures relevant to this impact include:

- Establishing and maintaining a strong online and news media presence for the brand through the management of news, data, information and progress announcements;
- Ensuring that all activities undertaken by the Project and its delivery partners are aligned with a defined set of brand values and guidelines;
- The capturing of video and photo opportunities associated with all aspects of project development;
- Having resources available to welcome and host reporters and other interested parties;
- Organising regular local events to share the brand with local residents and ensure local buy-in;
- Attending sector events nationally and international as appropriate; and
- Seeking opportunities for publicising the Project through any appropriate media.

25.5.6.4. Residual Impacts

199. If such optimisation measures are successful in establishing a stronger, early "green brand" for the Project, the magnitude of effect during construction and operation could increase from low to medium (beneficial).

200. However, based on the EIA matrix (**Table 25-6**), the overall level of significance during construction and operation remains at **Minor Beneficial**.

25.5.6.5. Summary of Residual Impacts

The classification of residual impacts regarding green branding of the locality are outlined in **Table 25-19**.

Table 25-19 Summary of Residual Impacts

Impact	Phase	Area N/R/L	Post mitigation/ optimisation receptor sensitivity	Post mitigation/ optimisation effect magnitude	Residual significance level
2. Green Branding of Locality	Construction & Decomm	N/R/L	Low	Medium Beneficial	Minor Beneficial
	Operation & Repowering	N/R/L	Low	Medium Beneficial	Minor Beneficial

25.5.6.6. Monitoring Activities Proposed

201. A marketing strategy should be developed for the Project that should monitor the impact of the Morlais brand and wider green branding at local, regional and national levels. It should also ensure records are kept of media coverage.

25.5.7. Impact 3: Economic Impacts - Direct and Secondary Income

25.5.7.1. Nature of Impact

202. The baseline description has shown that the economic situation in Wales is considered broadly similar to the UK average (albeit slightly lower) for employment and GVA. It was noted however, that here is variation in economic performance across Wales, with Anglesey in particular notable in having the lowest levels of GVA per head of any regions across the UK (51.8 % of the UK average in 2016). Average gross weekly earning rates are also lower in North Wales and Anglesey than in other areas of Wales.

203. The Project has the potential to raise these levels closer to Wales and wider UK values, as well as supporting substantial investment to the Anglesey and the North Wales region. A recent report by Marine Energy Wales (MEW) suggests "*Combining the investment into wave and tidal energy in Wales with publicly funded Welsh research projects brings the total investment to date in marine energy in Wales to £96.2 million*" (MEW, 2019a). This level of investment has been seen even though there is very limited actual deployment to date, highlighting the potential additional benefits that may accrue once deployment at sites like the MDZ proceed.

204. The Project has the intention to deploy up to 240 MW suggesting that there will be substantial investment and research associated with these deployments. The report by MEW highlights that with a UK deployment of 100 MW per year from 2021/22, and a realistic share of a growing global market, the tidal stream industry could generate a net cumulative benefit to the UK by 2030 of £1.4 Bn, consisting of £1.6 Bn GVA from the domestic market and £1.1 Bn GVA from exports, offset by £1.3 Bn of revenue support. The report states that Wales has the potential to establish an early mover advantage in an export market worth an estimated £76 Bn by 2050. The MDZ when fully built out would contribute significantly to this activity.

205. Considering this wider activity to give realistic local and regional scenarios provides further insight into the level and distribution of benefits that could arise. In the earlier assessment of decentralisation of economic benefits (Impact 1), it was shown that Anglesey could expect to

benefit directly from local spend to the value of between £3.6 M and £41.4 M annually (see **Table 25-17**). The benefits to the North Wales region are expected to be around 60 % of that arising in Anglesey itself and may, therefore amount to between £2 M to £25 M annually, with the rest of Wales seeing possible benefits of £14.5 M to £33 M annually, depending upon the phase of activity (**Table 25-16**).

206. Accurately predicting the potential local, regional and national spend associated with marine renewable energy projects can be challenging, as highlighted in Regeneris (2013). Nevertheless, figures for relative local and national spend are available for projects elsewhere in the UK. In 2018 Nova Innovation reported that 25 % of total project spend for their Shetland Tidal Array in Bluemull Sound was in the Northern Isles, with 80 % of project spend in Scotland (Marine Energy Wales annual conference 2018).

207. Of the wave and tidal companies who have built or are building devices in Wales, at least 50 % of their supply chain has come from within Wales to date (Marine Energy Wales (2019a). State of the Sector 2019: Economic benefits for Wales)

208. The Anglesey Enterprise Zone, Energy Island Programmes and North Wales Growth Deal have all been set up to bring skilled jobs and supply chain opportunities to the area. They will help establish the island as a world class area in low carbon energy generation.

25.5.7.2. Sensitivity and Magnitude

209. Based on values presented in the recent Marine Energy Wales report (Marine Energy Wales, 2019a), it is predicted that the construction phase of the Project will generate major spend at a National scale with £32.5M already invested in Anglesey by the Welsh Government alone (Morlais and Minesto). Developments such as these rely on local skills, services and infrastructure and provide additional indirect economic benefits (MEW, 2019a). This will produce related beneficial effects across local and regional areas. The receptor in question (local/regional/national economy) is assessed as medium (beneficial), defined by the receptor being “in a tolerable, favourable state, with capacity to embrace beneficial influence”**.** This would be similar for the decommissioning phase.

210. The largest part of the overall predicted spend will be during the construction phase of the Project. Therefore, a medium (beneficial) magnitude of effect is predicted for the construction phase; defined as “change across a region or sub-region, affecting one/few key sectors or one/few key communities, with medium term direct and indirect benefits”. This results in an impact of **Moderate Beneficial** significance.

211. During the O&M and repowering stages, it is predicted that the magnitude of effect will be lower than in the construction phase. Over the longer period of the operational phase, this effect is assessed as low (beneficial) magnitude. This gives an overall impact of **Minor Beneficial** significance.

25.5.7.3. Mitigation and/or Optimisation

212. The potential optimisation measures relevant to this impact include:

- Menter Môn should attempt to maintain lobbying pressure on UK and Welsh Governments to support marine renewables;

- Menter Môn should encourage the development of support mechanisms for marine energy, such as Innovation PPA, or ring-fenced Innovation CfD, being promoted nationally (Marine Energy Council, 2019);
- Outreach work should be promoted to encourage Schools, Colleges and Universities to develop appropriate training for the workforce;
- Menter Môn will develop a supply chain portal that will advertise opportunities for the local contractors and workforce; and
- Detailed work should be undertaken, outside the framework of this EIA, to fully develop a local and regional supply chain that can take advantage of the opportunities that develop, via this Project.

25.5.7.4. Residual Impacts

213. Even if such optimisation measures are successful in bringing a greater percentage of the available economic benefits to the North Wales region and Anglesey itself, the magnitude of effect during the construction phase would be difficult to increase past the current level of moderate significance. Therefore, a **Moderate Beneficial** impact remains.

214. With the above measures fully supported, the magnitude of effect during the operational and repowering stages could be raised to Medium Beneficial, which in turn would raise the impact significance to **Moderate Beneficial**.

25.5.7.5. Summary of Residual Impacts

215. The classification of residual impacts in regard to direct and secondary income, are outlined in **Table 25-20**.

Table 25-20 Summary of Residual Impacts

Impact	Phase	Area N/R/L	Post mitigation/ optimisation receptor sensitivity	Post mitigation/ optimisation effect magnitude	Residual significance level
3. Direct & secondary income	Construction & Decomm	N/R/L	Medium Beneficial	Medium Beneficial	Moderate Beneficial
	O&M and repowering	N/R/L	Medium Beneficial	Medium Beneficial	Moderate Beneficial

25.5.7.6. Monitoring Activities Proposed

216. Regular updates on Government funding/revenue support should be monitored as well as continual review of work being done by the wider marine energy industry on lobbying of MPs.

217. Since the economic benefits of the Project are a major driver for the WEFO funding support received, it will be essential to gather robust, comprehensive data about the location of spend by the Project and by Project clients and collaborators. A regular survey of location of spend should be distributed and feedback sought from all key funding and procurement bodies (Public, Voluntary and Private sector).

25.5.8. Impact 4: Economic Impacts - Accumulation of Grant Support

25.5.8.1. Nature of Impact

218. As detailed in the previous impact assessment, the recent Marine Energy Wales study (Marine Energy Wales, 2019a) has shown a total investment to date in marine energy in Wales of £96.2 M. Of this, a large proportion has been in the form of grant aid from sources such as UK and Welsh Governments, the EU and a number of Local Authority support mechanisms. It is clear that without these large levels of grant support, the marine energy industry would not be able to develop.

219. The industry is still very much within the development stage but is on the cusp of commercialisation and this Project represents a big step towards this commercialisation phase. However, as the MDZ is still a demonstration zone it has been able to attract grant aid. It will also exist as a continued test facility, which should also attract research grant funding, for various aspects of the development.

220. As with other aspects of the Project, the parallels with Orkney are strong with respect to this impact. Orkney's success as the world's leading test centre for marine energy technologies was greatly facilitated by capital grants to set-up the facility in the first place and by further support for individual technology developers for their own technology development and deployment programmes. It would be expected that this same model would apply to Anglesey where grant funding would continue to aid the potential development (past this initial grant-funded EIA/consenting phase) and also individual developers accessing the MDZ. This experience within the EMEC test site and within the supporting supply chain of applying for and successfully implementing grant supported projects has led to many spin-off R&D opportunities which again could well apply to this Project.

25.5.8.2. Sensitivity and Magnitude

221. Receptor sensitivity is assessed as medium (beneficial) across all regions within the study area due to the uncertainty over medium to longer-term grant support, i.e. receptor is in a tolerable, favourable state, with capacity to embrace beneficial influence).

222. In terms of the magnitude of effect, the construction phase is judged to result in a medium (beneficial) effect (change across a region or sub-region, affecting one/few key sectors or one/few key communities, medium term direct and indirect benefits), as this will have the higher levels of spend and, therefore, will need to attract the larger share of grant funding. This gives an overall impact of **Moderate Beneficial** significance.

223. The O&M and repowering stage of the Project will have a low beneficial magnitude of effect as once the Project has been constructed, individual tenants' projects will attract less grant funding and therefore have a smaller magnitude of effect. This gives an overall impact of **Minor Beneficial** significance during these phases of the Project.

Within the decommissioning stage, there will be very low levels of grant available and therefore it is assessed as being non-significant.

25.5.8.3. Mitigation and/or Optimisation

224. The potential optimisation measures relevant to this impact include:

- Continued pressure exerted by Menter Môn, via both industry-coordinated lobbying and personal communications, on UK and Welsh Government to support the marine energy sector;
- Continued pressure by Menter Môn in support of the suggested development of support mechanisms for marine energy, such as Innovation PPA or ring-fenced Innovation CfD, being promoted nationally (Marine Energy Council, 2019);
- Ongoing research into the full range of grant options available to projects that intend to utilise the Project;
- Full engagement with local and national development agencies to ensure all support mechanisms are fully developed; and
- There are some risks with EU funding around Brexit. This can be mitigated against by fully engaging with relevant Welsh Government departments.

25.5.8.4. Residual Impacts

225. If such measures are successful and the full grant funding opportunities are realised and issues related to Brexit mitigated, then the construction phase magnitude of effect could be increased to high beneficial significance**,** as the levels of funding could be substantial. With continued government lobbying and development of further R&D/Grant funding opportunities, the Project is expected to experience major and moderate beneficial effects from a grant support perspective during the construction and operation\decommissioning phases respectively This would lead to an impact significance of **Major Beneficial**.

226. The O&M and repowering stage effect magnitude could also be raised to moderate beneficial, if all above mitigation is achieved (**Table 25-21**), resulting in a residual impact of **Moderate Beneficial**.

25.5.8.5. Summary of Residual Impacts

227. The classification of residual impacts regarding accumulation of grant support is outlined in **Table 25-21**.

Table 25-21 Summary of Residual Impacts

Impact	Phase	Area N/R/L	Post mitigation/ optimisation receptor sensitivity	Post mitigation/ optimisation effect magnitude	Residual significance level
4. Accumulation of grant support	Construction	N/R/L	Medium	High Beneficial	Major Beneficial
	O&M and repowering	N/R/L	Medium	Moderate Beneficial	Moderate Beneficial

25.5.8.6. Monitoring Activities Proposed

Regular updates on funding opportunities should be monitored, as well as regular contact with the development agencies, to ensure all grant support mechanisms are fully advertised and support is given to project developers to access them.

25.5.9. Impact 5: Level of Commerce Activity - Green Cluster Creation

25.5.9.1. Nature of Impact

228. There is a growing appreciation that where marine renewables development activity can take place across a number of related businesses and organisations, there can be significant advantages from what is termed a 'clustering effect'. This can be seen by the clustering around EMEC in Orkney as referenced in a Highland and Islands Enterprise (HIE) report (March 2019) and also the extensive development of areas like the Port of Grimsby in response to the offshore wind industry in the southern North Sea. This is associated with the synergies that can occur between entities working in a similar sector, the easier achievement of 'virtual' critical mass and the unforeseen benefits of having others solve problems and seek out opportunities that any one organisation may find hard to do. The need to explore and assess this issue was raised through the consultation process.

25.5.9.2. Sensitivity and Magnitude

229. In the preliminary impact assessment, the sensitivity of Anglesey from a cluster creation perspective was considered medium (beneficial) (receptor in a tolerable, favourable state with capacity to embrace beneficial influence), due to the limited technology (wave/tidal stream) focus to date in the locality. However, this impact assessment does recognise the existence and role of the current Energy Island Programme[6]. The magnitude of possible effect, with regards to green cluster creation from the proposed Project was considered medium (beneficial) during the construction, operation and possible repowering phases.

230. This magnitude of effect was associated with the potential for the Project to stimulate spin-off benefits in areas of activity linked indirectly to marine energy. These may be maritime, technology or energy storage opportunities. The North Wales Growth Deal is likely to provide stimulus for further growth and opportunities. These receptor sensitivities and effect magnitudes led to a preliminary impact significance classification of **Moderate Beneficial,** across all three phases of construction, operation/repowering and decommissioning.

25.5.9.3. Mitigation and/or Optimisation

231. The potential optimisation measures relevant to this impact include:

- Ensuring that there is an understanding of the benefits of clustering within all key stakeholders;
- Ensuring that all activities undertaken by the Project support cluster creation; in particular, through progressive partnership type procurement processes, wherever practical/possible;
- Working with the existing Energy Island Programme to explore further opportunities for cluster creation;
- Encouraging established sector players to create/join in with a local cluster; and

6 http://www.regenwales.org/upload/pdf/062414121051Crew-CaseStudy-Anglesey.pdf

- Advocating the inherent advantages and opportunities that exist on Anglesey (and possibly North Wales) for such a cluster to be created.

25.5.9.4. Residual Impacts

232. If such measures are successful in establishing a strong, local cluster of green companies/activities, then the magnitude of the possible effects of the Project may increase markedly, and the initial predicated benefits would be better assured. Consequently, the predicted magnitude of beneficial impacts could increase to High beneficial for the latter phases of operation and possible repowering, as the cluster became better established.

233. It is expected that although the residual magnitude of effect would remain moderate beneficial for construction, it could increase to major beneficial for operation and possible repowering. Combined with the medium beneficial receptor sensitivity, this results in a **Moderate Beneficial** impact during the construction phase and a **Major Beneficial** impact during the operational/repowering phase.

25.5.9.5. Summary of Residual Impacts

234. The classification of residual impacts regarding green cluster creation are outlined in **Table 25-22**.

Table 25-22 Summary of Residual Impacts

Impact	Phase	Area N/R/L	Post mitigation/ optimisation receptor sensitivity	Post mitigation/ optimisation effect magnitude	Residual significance level
5. Green cluster creation	Construction	N/R/L	Medium	Medium Beneficial	Moderate Beneficial
	Decomm	N/R/L	Negligible	Negligible	Negligible
	Operation	N/R/L	Medium	High Beneficial	Major Beneficial
	Repowering	N/R/L	Medium	High Beneficial	Major Beneficial

25.5.9.6. Monitoring Activities Proposed

235. Work should be initiated by Menter Môn to explore which existing local and regional companies already contribute to or are formal parts of the existing Energy Island Programme. This work should then review and develop a list of organisations and companies that might be encouraged to join any expanded cluster-type structure in the future. The collective capacity and achievements of the cluster should be captured, shared through various media and publicised widely to expand awareness and draw in more opportunities.

25.5.10. Impact 6: Job opportunities – Increased Numbers of Jobs

25.5.10.1. Nature of Impact

236. The creation of jobs, particularly higher value technology-oriented jobs is a key driver for regional economic development and a key reason why tidal stream energy has been supported at local, national and international levels. There are however many challenges involved in estimating the numbers of jobs that may be created by any project and in establishing where these jobs may arise geographically. This assessment has endeavoured to use the experience of the chapter authors, gleaned from over 15 years of work in the tidal energy sector, coupled with the

phasing/development scenarios used as the basis of this assessment, to predict possible job creation forecasts in the form of both numbers and location.

237. With respect to this specific impact assessment, the Project has been broken into two key phases of analysis (construction and operations/repowering phases). The geographical distribution of jobs has been defined using the local (Anglesey), regional (North Wales) and national (Wales) study area extents used throughout this chapter.

238. Job types have been categorised into Manufacturing, Foundations and Installation, Cabling and Infrastructure and Operation.

239. Within these broad categories, the exact types of jobs that will be created, and skills required, are difficult to accurately estimate. However, the Economic Impact of the Development of Marine Energy in Wales report produced on behalf Welsh Government (Regeneris, 2013) does provide a useful categorisation of potential jobs via "job groups" – see (Appendices D1 and D2).

240. These are presented below, along with relevant Standard Industrial Classification (SIC) codes. It is expected that the majority of these job types will be required to support the Morlais Project across the project life-cycle.

Manufacturing jobs (Manufacturing)

- Group 1 Concrete and non-metal products:
    - (23430) - Manufacture of ceramic insulators and insulating fittings;
    - (23610) – Manufacture of concrete products for construction purposes.

- Group 2 Activity related to metal/metal structure production:
    - (24200) - Manufacture of tubes, pipes, hollow profiles and related fittings, of steel;
    - (24510) - Casting of iron;
    - (24520) - Casting of steel;
    - (24530) - Casting of light metal;
    - (24540) - Casting of other non-ferrous metals;
    - (25110) - Manufacture of metal structures and parts of structures;
    - (25290) - Manufacture of other tanks, reservoirs and containers of metal;
    - (25500) - Forging, pressing, stamping and roll-forming of metal and powder metallurgy;
    - (25610) - Treatment and coating of metals;
    - (25910) - Manufacture of steel drums and similar containers and
    - (25990) - Manufacture of other fabricated metal products.

- Group 3 Activity related to electrical electronic industries:
    - (26110) - Manufacture of electronic components;
    - (26511) - Manufacture of electronic instruments and appliances for measuring, testing, and navigation, except industrial process control equipment;
    - (26512) - Manufacture of electronic industrial process control equipment;
    - (27110) - Manufacture of electric motors, generators and transformers;
    - (27120) - Manufacture of electricity distribution and control apparatus; and
    - (27320) - Manufacture of other electronic and electric wires and cables.

- Group 4 Other machinery and products:
  - (28131) - Manufacture of pumps;
  - (28140 - Manufacture of other taps and valves;
  - (28150) - Manufacture of bearings, gears, gearing and driving elements and
  - (30110) - Building of ships and floating structures.

Non-manufacturing jobs (Foundations and Installation, Cabling and Infrastructure and Operation)

- Group 5 Construction and installation jobs:
  - (33150) - Repair and maintenance of ships and boats;
  - (33200) - Installation of industrial machinery and equipment;
  - (42220) - Construction of utility projects for electricity and telecommunications;
  - (42990) - Construction of other civil engineering projects;
  - (43130) - Test drilling and boring;
  - (43210) - Electrical installation;
  - (50200) - Sea and coastal freight water transport; and
  - (52101) - Operation of warehousing and storage facilities for water transport activities.

- Group 5 Service jobs:
  - (65120) - Non-life insurance;
  - (70210) - Public relations and communication activities;
  - (70229) - Management consultancy activities (other than financial management);
  - (73110) - Advertising agencies;
  - (73120) - Media representation;
  - (71121) - Engineering design activities for industrial process and production;
  - (71122) - Engineering related scientific and technical consulting activities;
  - (71200) - Technical testing and analysis;
  - (74901) - Environmental consulting activities;
  - (74902) - Quantity surveying activities;
  - (77320) – Renting and leasing of construction and civil engineering machinery and equipment;
  - (77342) - Renting and leasing of freight water transport equipment;
  - (77390) - Renting and leasing of other machinery, equipment and tangible goods; and
  - (80200) - Security systems service activities.

241. For the construction phase, the basic number of jobs that may potentially be created has been predominantly based upon a study on the Marine Energy Supply Chain Survey carried out by Sgurr Energy for the Scottish Government in 2009 (Sgurr Energy, 2009). This survey used a factor of 20 FTE job years per megawatt installed as an estimate of job activity during the construction phase.

242. Aquatera’s own experience of work in Orkney since this report was published, corroborates this order of employment with a slightly higher internal estimate of 25 FTE job years per MW being

calculated for certain projects. This estimate includes both direct and indirect employment and also includes the induced impact.

243. On the worst case basis of 20 FTE job years per megawatt, the proposed Project of 240 MW final installed capacity could be expected to create up to 4,800 FTE job years over the Project lifetime in terms of capital (construction and installation) activity. This is consistent with estimates used in the Tidal Ventures Ltd (TVL) project at Torr Head in Northern Ireland and the MeyGen project (Meygen, 2012) off the North coast of Scotland.

244. It is clear that Wales has some strong aspirations to develop marine energy industry capability, as shown in the recent MEW report into the state of the sector 2019: "*Marine Energy is offering real diversification opportunities for local supply chain companies. The Welsh supply chain has capability, capacity and ambition to deliver marine energy projects. It would however be difficult to assume that the tidal turbines for the project would be manufactured in Wales*" (MEW, 2019a).

245. At this stage of the assessment, it is not certain where any manufacturing may take place for infrastructure components that may be deployed within the MDZ. Nevertheless, some geographical distribution of employment activity needs to be recognised and assessed.

246. For this Project, it has been assumed (based on Scottish experience: SSE Renewables 2011) that 50 % of the total capital expenditure of the Project will be allocated to manufacturing of the turbines and 30% for foundations and installation works (Meygen, 2012). The final 20 % covers the inter-connecting subsea cabling and onshore infrastructure (substation and onshore cables)

247. It should be noted that such single % estimates are highly indicative and the actual outcomes for any given project may differ from these values. These levels of activity would then be distributed across local, regional and national areas. The predicted split based on total jobs is estimated below. A conservative (worst-case) approach to manufacturing jobs has been taken as well as a more optimistic approach where more of the jobs are retained in Wales in addition to some of the manufacturing capability.

248. Taking these factors into account and the scales of development envisaged the predicted job totals for construction on a locational basis are estimated in **Table 25-23**.

Table 25-23 Job distribution during construction across study area

Study Area	Manufacturing	Foundation and installation	Cabling and infrastructure	Individual area totals
Worst case				
Anglesey	0%	10%	5%	15%
North Wales (exc. Anglesey)	0%	5%	5%	10%
Rest of Wales	0%	15%	0%	15%
Total in Wales	0%	30%	10%	40%
Optimistic option				
Anglesey	5%	10%	5%	20%
North Wales (exc. Anglesey)	5%	5%	5%	15%
Rest of Wales	5%	15%	10%	30%

Study Area	Manufacturing	Foundation and installation	Cabling and infrastructure	Individual area totals
Total in Wales	15%	30%	20%	65%

249. The estimates below have been calculated using two scenarios: (1) worst-case scenario of no manufacturing would represent 40 % of the construction jobs being retained in the Welsh economy; and (b) a more optimistic scenario with 65 % of the construction jobs retained in Wales.

250. It should, however, be noted that both these figures have potential to be even higher if manufacturing as well as other elements of the projects can be attracted to Wales and the local region.

251. For this Project, it is also assumed that 15 - 20 % of these temporary (construction phase) jobs have potential to be applied locally in Anglesey. Due to the stated intention of Menter Môn to retain as many of the jobs locally, together with the port infrastructure and the marine experience already developed via previous projects in the region, a figure of 15 – 20% is considered a conservative estimate for the proportion of total jobs that could be achieved in this area. This is well within the 'absorption capacity' of the area's industry supply chain and its capability in benefitting from the Project outputs. These figures are broad estimates and give a range from a worst case scenario to a more optimistic position (**Table 25-24**) used to give a basis for assessment but may vary from the eventual figures.

252. Tidal turbine installation including the turbine support structure for Phase 1 (up to 40 MW) will likely take place over a period of five years. With regard to the subsequent phases of installation, these will likely take place over a number of years and the associated workforce may well be maintained. Due to lessons learned and streamlining of activities, there is the potential to increase efficiency and as a result, reduce the length of installation activities.

253. This will require a construction workforce to be on site for several years, if all four Phases are completed. The construction of the devices will involve commissioning as many of the turbines and the associated components onshore as possible.

254. **Table 25-24** highlights the construction job estimates linked to the distribution shown in **Table 25-23**. These results are presented for two cases, a worst case where there is no device manufacturing taking place in Wales and an alternative case where some generator manufacturing does take place in Wales. It can be seen that the local jobs range from 26 to 93 per year depending upon the scenario and phase of development. The regional jobs, including local ones range from 43 to 163 per year. Finally, the overall Welsh jobs range from 68 to 303 per year.

Table 25-24 Construction phase job estimates

Phases	**Running Total MWs (Installed Capacity)**	**Additional MW installed**	**Phase completion Year**	**Total jobs/ Phase FTE yrs**	**Jobs per year FTE/yr**	**Total Construction FTE/yr**			**Totals for Wales FTE/yr**	**Regional jobs FTE/yr**	**Local jobs FTE/yr**
Worst case[7]				Based on 20 FTE/MW		Turbine Manufacture	Foundation and installation	Cabling and infrastructure	40%	25%	15%
Phase example 17 MW	17	17	2	340	170	85	51	34	68	43	26
Review of env. monitoring data collected in Yrs 1-2	17	0	3	0	0	0	0	0	0	0	0
Phase example 40 MW (add 23 MW)	40	23	5	460	230	115	69	46	92	58	35
Phase example 100 MW (add 60 MW)	100	60	8	1,200	400	200	120	80	160	100	60
Phase example 240 MW (add 140 MW)	240	140	14	2,800	467	233	140	93	187	117	70
Sub-total (FTE yrs)				4,800		2,400	1,440	960	1,920	1,200	720
Repowering of 50% of devices (FTE yrs)				1,920		1,200	720	-	720	360	240
Overall total (FTE yrs)				6,720		3,600	2,160	960	2,640	1,560	960

[7] Assuming no manufacturing in Wales.

Phases	**Running Total MWs (Installed Capacity)**	**Additional MW installed**	**Phase completion Year**	**Total jobs/ Phase FTE yrs**	**Jobs per year FTE/yr**	**Total Construction FTE/yr**			**Totals for Wales FTE/yr**	**Regional jobs FTE/yr**	**Local jobs FTE/yr**
Optimistic									65%	35%	20%
Phase example 17 MW	17	17	2	340	170	85	51	34	111	60	34
Review of env. monitoring data collected in Yrs 1-2	17	0	3	0	0	0	0	0	0	0	0
Phase example 40 MW (add 23 MW)	40	23	5	460	230	115	69	46	150	81	46
Phase example 100 MW (add 60 MW)	100	60	8	1,200	400	200	120	80	260	140	80
Phase example 240 MW (add 140 MW)	240	140	14	2,800	467	233	140	93	303	163	93
Sub-total (FTE yrs)				4,800		2,400	1,440	960	3,120	1,680	960
Repowering of 50% of devices (FTE yrs)				1,920		1,200	720	-	1,080	600	360
Overall total (FTE yrs)				6,720		3,600	2,160	960	4,200	2,280	1,320

255. An additional factor that has been considered for the construction activities is the repowering of berths by improved or replacement models. As an indication of possible repowering activity it has been estimated that 50% of the tenants will undertake repowering, i.e. for 50% of the berths, their devices and foundations will be removed and replaced either by the same or a different tenant). For the other 50% of tenants, their infrastructure will remain over the lifetime of the project. It is not anticipated that the cables to shore and other site infrastructure would be repowered. Since the timing of any such activity is unclear the total job estimate of FTE years has been used to establish a combined level of activity. This is also shown in **Table 25-24**.

256. An initial basis for the estimation of the O&M phase jobs has been taken from the MeyGen project which used a factor of 0.58 FTE jobs per MW per year (MeyGen, 2012). Based on experience on this project and at other development locations, it is considered that initial numbers closer to 3.0 FTE jobs per MW per year may be more appropriate. However, with O&M tasks it is expected that there will be significant efficiencies over time. Therefore due to O&M teams gaining experience and efficiencies within operations the basis for the job estimates per installed MW, provided in **Table 25-25** reduce over the different project phases (e.g. Phase example 17 MW = 3.0 jobs/MW; Phase example 240 MW = 1.0 jobs/MW).

Table 25-25 Direct, indirect and induced job estimates

Phases	Installed MW	Estimated jobs per MW	Direct Job totals	Indirect jobs 60%	Induced jobs 18.70%	Total jobs
Phase example 17 MW	17	3	51	31	15	**97**
Phase example 40 MW	40	2	80	48	24	**152**
Phase example 100 MW	100	1.5	150	90	45	**285**
Phase example 240 MW	240	1	240	144	72	**456**

257. It is important to also assess the indirect and induced employment that could arise from the Project. Indirect jobs would be created by the MDZ tenants (device developers) as they purchase supplies or other items associated with the Project. An induced job is a job that is created by the employees of the projects, spending their money, i.e. additional hotel staff needed to accommodate temporary workers.

258. In order to assess indirect and induced impacts, employment multipliers need to be added to the direct employment figures.

259. To estimate indirect and induced jobs, the typical approach is to use estimated Type I and Type II Multipliers, derived from input-output tables. A comprehensive set of these is not available for Wales, so Scottish values were chosen from the 1998 - 2015 input/output tables and Industrial Order Classifications: (IOC) 41 Construction (Scottish Government, 2019a).

- Type I employment multiplier (direct and indirect) 1.6; and
- Type II employment multiplier (direct, indirect, induced) 1.9.

Therefore:

- The indirect impact equals 60 % of the direct impact, and
- The induced impact is 18.7 % of the combined direct and indirect impact ([1.9-1.6] / 1.6).

260. Using the multipliers described above, gives the basis for the figures for indirect and induced jobs shown in **Table 25-25** (above).

261. With respect to where these jobs may be located, for this project, there is a keen interest and priority in creating jobs locally in Anglesey, within the wider North Wales region and more broadly within Wales. The possible breakdown of jobs by location is presented in **Table 25-26**.

262. As with the construction phase jobs, a range of job outcomes could be foreseen. Overall it is considered more likely that localisation within Anglesey will occur during the operational phase, with similar contributions from North Wales and wider Wales. Taking these principles into account the following estimations can be made.

263. It is thought that around 60 % to 80 % of created jobs could be secured for Wales, with 30 % to 50 % of this being within Anglesey, 20 % in the rest of North Wales and 10 % in wider Wales (**Table 25-27** to **Table 25-29**).

Table 25-26 O&M jobs breakdown by geographical area

Phases	Anglesey	North Wales (Exc. Anglesey)	Rest of Wales
Worst case	30%	20%	10%
Optimistic	50%	20%	10%

Table 25-27 O&M jobs allocation across study area per year based on 30 % local content

Phases	Total jobs	Anglesey 30%	North Wales (Exc. Anglesey) 20%	Rest of Wales 10%
Phase example 17 MW	97	29	19	10
Phase example 40 MW	152	46	30	15
Phase example 100 MW	285	86	57	29
Phase example 240 MW	456	137	91	46

Table 25-28 O&M jobs allocation across study area per year based on 50% local content

Phases	Total jobs	Anglesey 50%	North Wales (Exc. Anglesey) 20%	Rest of Wales 10%
Phase example 17 MW	97	49	19	10
Phase example 40 MW	152	76	30	15
Phase example 100 MW	285	143	57	29
Phase example 240 MW	456	228	91	46

Table 25-29 O&M jobs allocation across study area per year over project lifetime

Phases	Total jobs	Number of yrs. in phase	Total FTE per phase	Anglesey 30%	Anglesey 50%	North Wales (Exc. Angl'y) 20%	Rest of Wales 10%
Phase example 17 MW	97	3	291	87	145	58	29
Phase example 40 MW	152	2	304	91	152	61	30
Phase example 100 MW	285	3	855	256	427	171	85
Phase example 240 MW	456	6	2,736	821	1,368	547	274
Ongoing full ops	456	23	10,488	3146	5,244	2,098	1,049
Overall totals	**-**	**37**	**14,674**	**4,401**	**7,336**	**2,935**	**1,467**

25.5.10.2. Sensitivity and Magnitude

264. Based on the information presented in the tables throughout this Section, verified by the assumptions used in the previous Marine Energy Supply Chain Survey for the Scottish Government in 2009 (Sgurr Energy, 2009), and knowledge of the current economic situation on Anglesey, the sensitivity of this receptor (local, regional and national job market) is judged to be of medium (beneficial) sensitivity**.**

265. Based on the job creation predictions in **Table 25-25**, the magnitude of effect is judged to be medium (beneficial) for the construction phase, as this stage of the Project will have the highest numbers of FTE jobs created with up to 303 FTE estimated across Wales, 163 regionally and some 93 locally, before any repowering opportunities are taken into account.. This results in a predicted impact on job creation of **Moderate Beneficial** significance.

266. For the operational and repowering phases, lower numbers of jobs are anticipated to be created (see **Table 25-25**), but with good retention regionally which will give a low magnitude of effect. Coupled with the medium sensitivity of the receptor, this results in a **Minor Beneficial** impact significance.

267. The decommissioning phase will still see some substantial numbers of jobs potentially created, with approximately 100 – 150 within the region, which would have a medium magnitude effect leading to a **Moderate Beneficial** impact significance.

25.5.10.3. Mitigation and/or Optimisation

268. The potential optimisation measures relevant to this impact include:

- Ensuring support is given to developers (tenants) to manufacture and construct the devices within Wales;
- Developing training programmes to up-skill the workforce;
- Menter Môn will develop a supply chain portal that will advertise opportunities for the local contractors and workforce which will highlight the job availability across Wales, timely and in advance of the developments to encourage workforce to prepare;

- Encouraging the supply chain to prepare and bid for any contracts through utilising the local portal and direct engagement with potential developers; and
- Creating a cluster of local and region companies that can ensure local content – see Impact 5.

25.5.10.4. Residual Impacts

If the optimisation measures suggested above are implemented, it should encourage a stronger local content / more local jobs. Overall the figures are already strongly beneficial, and it is therefore not thought the proposed measures would significantly change the assessments.

25.5.10.5. Summary of Residual Impacts

The classification of residual impacts regarding increased number of jobs are outlined in **Table 25-30**.

Table 25-30 Summary of Residual Impacts

Impact	Phase	Area N/R/L	Post mitigation/ optimisation receptor sensitivity	Post mitigation/ optimisation effect magnitude	Residual significance level
6. Increased number of jobs	Construction & Decomm	N/R/L	Medium	Medium Beneficial	Moderate Beneficial
	Operation & Repowering	N/R/L	Low	Medium Beneficial	Minor Beneficial

25.5.10.6. Monitoring

It will be important to monitor the job impacts locally and across the Project. Maximising the local input and matching skill shortages to types and numbers of jobs will require regular surveying of the workforce, as well as the developers on site. Menter Môn have already completed the "Shaping the Future" project in 2015, a programme of assistance for people leaving the nuclear industry between 2016 and 2020. They have database including extensive information of Magnox and contractor employees living in the region.

25.5.11. Impact 7: Job Opportunities – Type, Quality, Skill Areas

25.5.11.1. Nature of Impact

269. The tidal industry requires a diverse range of skills to support its development. Although a number of the jobs will come from established industries such as engineering and manufacturing the innovative nature of the Project and tenants' individual projects will require a significant amount of upskilling from the local employment market. Some of the employment opportunities will be associated with the direct and indirect supply chain.

25.5.11.2. Sensitivity and Magnitude

270. As the Project develops there will be a high number of jobs created within the local economy, some of which will be highly skilled and will provide a very strong opportunity regionally and locally. Based on the criteria in **Table 25-3**, a medium (beneficial) sensitivity is assigned to this receptor group (local/regional workforce).

271. During the construction, operational and repowering stages, there is an opportunity to develop a highly skilled supply chain and work force, leading to a medium (beneficial) magnitude of effect for these areas. This gives rise to an impact of **Major Beneficial** significance with respect to an improved number of new, skilled jobs, separate to more traditional engineering and manufacturing jobs.

272. With respect to potential decommissioning phase impacts, the magnitude of effect at this stage is judged to be low (beneficial), which, when combined with the medium beneficial sensitivity of this receptor will result in an impact of **Minor Beneficial** significance.

25.5.11.3. Mitigation and/or Optimisation

273. The measures to maximise job opportunities and the creation of a highly skilled local workforce for this Project are:

- Development of appropriate training to up-skill the work force in advance of the Project;
- Menter Môn will develop a supply chain portal that will advertise opportunities for the local contractors and workforce which will highlight the job availability across Wales, timely and in advance of the developments to encourage workforce to prepare;
- Encouraging Schools, Colleges and Universities to develop appropriate training for the workforce;
- Incentivising developers to create apprentices and other training opportunities; and
- Encouraging some of the specialist skilled workforce needed to relocate to the Anglesey area.

25.5.11.4. Residual Impacts

If the measures suggested are implemented, it should encourage a stronger local content with respect to skilled, specialist jobs related to the Project. It would support the up skilling of the workforce and also improve the quality of jobs on offer, but overall the figures are strongly beneficial, and it is, therefore, not considered that it would change the assessments.

25.5.11.5. Summary of Residual Impacts

The classification of residual impacts regarding the quality of jobs, are outlined in **Table 25-31**.

Table 25-31 Summary of Residual Impacts

Impact	Phase	Area N/R/L	Post mitigation/ optimisation receptor sensitivity	Post mitigation/ optimisation effect magnitude	Residual significance level
7. Increased range and scope of available skills for the Project	Construction and Repowering	N/R/L	Medium	Beneficial Major	Major Beneficial
	Operation	N/R/L	Medium	Beneficial Major	Major Beneficial
	Decommissioning	N/R/L	Medium	Beneficial Low	Minor Beneficial

25.5.11.6. Monitoring Activities Proposed

274. No specific measures are proposed, and this could be a difficult topic area for gathering reliable data.

25.5.12. Impact 8: Training Impacts - New Skills and Competence Needs

25.5.12.1. Nature of Impact

275. The construction phase of the Project will offer temporary employment opportunities both in terms of direct construction jobs and wider opportunities in the supply chain i.e. through provision of professional services and building materials for the Project. The onshore civil works will require a number of new employees and the development of the offshore site will employ significantly more individuals again over a prolonged period of time. With suitable training and education, these personnel could be sourced locally or regionally, which could support the development of this local supply chain.

276. There is a requirement for up-skilling of the local, regional and national workforce to take advantage of the opportunities presented by the Project. The Project will require a range of new skills due to the developmental nature of the tidal industry.

25.5.12.2. Sensitivity and Magnitude

277. The sensitivity of this receptor (local/regional employment market) is considered medium (beneficial) as it has capacity to embrace beneficial influence (via new skills and competence training).

278. The majority of the benefits from new skills and competence training will occur during the construction phase, as this will be when the largest workforce would be required, as well as when the larger, more wide range of jobs types will be available. The magnitude of effect is, therefore, assessed as medium (beneficial) which gives an overall significance of **Moderate Beneficial**.

279. During the operational phase (and repowering), opportunities for training of potential employees with new skills and competencies will still exist, but these will be more limited than during the construction phase, with lower job numbers and types of roles needing to be fulfilled. Therefore, the magnitude of effect is deemed to reduce to a low (beneficial) level leading to an impact of **Minor Beneficial** significance.

280. During the decommissioning stage, there will be limited training/up-skilling opportunities than in the other phases, therefore the magnitude of effect is considered to be of negligible magnitude leading to a **Negligible Beneficial** impact.

25.5.12.3. Mitigation and/or Optimisation

281. The potential optimisation measures relevant to this impact include:

- Ensuring there is a robust and experience-based plan of what capacity, skills, and experience are required to support a project of this nature;
- Menter Môn, the third-party managers of the Project, have a remit to maximise the economic benefit to Anglesey and therefore the retraining of the potential workforce will be a high priority, to optimise and maximise this potential beneficial impact;
- Menter Môn should map out the opportunities and encourage the development of specific training programmes, that focus on the development opportunities identified in the mapping process; and

- These options could be developed throughout the phases of the Project, allowing for increased employment opportunities.

25.5.12.4. Residual Impacts

282. Implementing the proposed optimisation measures set out above has the potential to increase the training uptake and development of skills in the construction phase, although it will not be enough to alter the magnitude of effect and, thus overall significance of **Moderate Beneficial.** These measures could also improve the beneficial impacts detailed above in the operational and repowering stages although not enough to alter the existing significance of **Minor Beneficial**.

25.5.12.5. Summary of Residual Impacts

283. The classification of residual impacts regarding new skills and competence needs is outlined in **Table 25-32**.

Table 25-32 Summary of Residual Impacts

Impact	Phase	Area N/R/L	Post mitigation/ optimisation receptor sensitivity	Post mitigation/ optimisation effect magnitude	Residual significance
8. New skills and competence needs	Construction & Decommissioning	N/R/L	Medium	Medium Beneficial	Moderate Beneficial
	O&M and Repower	N/R/L	Medium	Low Beneficial	Minor Beneficial

25.5.12.6. Monitoring Activities Proposed

284. Regular review of training needs and gaps should be carried out. With surveys of local and regional supply chain to ascertain if the training being offered is appropriate to maximise benefits.

25.5.13. Impact 9: Training Impacts - Tertiary BSc, PhD educational levels

25.5.13.1. Nature of Impact

285. The development of the Project offers the opportunity to complete a number of tertiary level (BSc, MSc, PhD) research projects associated with an innovative and relatively new low carbon industry (tidal energy). The proximity of local universities with existing strong programmes in Marine Science and Engineering, enhance the options for undergraduate and post graduate research and training programmes.

286. This impact is considered beneficial for all three study area scales being assessed (local; regional; national), as there could also be benefits to other regional and national university's and training establishments. The existing SEACAMS2 partnership programme that involves Bangor, Swansea and Aberystwyth Universities is a good example of how training/research linked to the Project may be fed into research priorities for these tertiary-level educational establishments.

25.5.13.2. Sensitivity and Magnitude

287. In the preliminary impact assessment, the sensitivity of this receptor group (tertiary-level educational facilities) is considered as medium (beneficial) (receptor in a tolerable, favourable state, with capacity to embrace beneficial influence). The encouragement to broaden teaching

topics to include all aspects of tidal energy development, i.e. resource assessment; hydrodynamics; environmental impact; subsea engineering etc., could strengthen the region's academic standing.

288. The magnitude of effect predicted during the construction (and decommissioning phases) of the Project is judged to be low (beneficial). It is considered that the magnitude of this effect (research opportunities) would be greater in the operational phase (see below). Therefore, the medium (beneficial) sensitivity of the receptor and low (beneficial) magnitude of effect results in a **Minor Beneficial** impact being predicted.

289. Due to the longer duration of the operational (repowering) phase, there is greater scope for research opportunities typical of tertiary establishments (6 months for MSc through to 3+ years for PhD). Experience from Herriot Watt University in Orkney suggests that upwards of ten (10) PhD opportunities and perhaps another 10 annual internships could arise that were linked directly to the Project. This results in an effect magnitude of medium (beneficial) being assigned. The medium beneficial sensitivity and medium (beneficial) magnitude of effect results in an impact of **Moderate Beneficial** significance.

25.5.13.3. Mitigation and/or Optimisation

290. The measures to ensure a team with the right skills is built for the Project include:

- The full support of the local and regional universities to fully utilise the MDZ to develop research and courses and seek out tidal energy research students should optimise this impact; and
- Encourage schools, colleges and universities to develop appropriate training for the workforce.

25.5.13.4. Residual impacts

291. It may be difficult to raise the construction and decommissioning significance, due to the short-term nature of these projects. It is thought that with some targeted courses there could be significant academic research and training that could be developed in the Universities, raising the magnitude although not enough to alter the significance level**.**

25.5.13.5. Summary of Residual Impacts

292. The classification of residual impacts regarding tertiary training and opportunities outlined in **Table 25-33**.

Table 25-33 Summary of Residual Impacts

Sub-topic area	Phase	Area N/R/L	Post mitigation/ optimisation sensitivity	Post mitigation/ optimisation magnitude	Residual significance
9. Tertiary training opportunities	Construction & Decommissioning	N/R/L	Medium Beneficial	Low Beneficial	Minor Beneficial
	O&M and Repower	N/R/L	Medium Beneficial	Medium Beneficial	Moderate Beneficial

25.5.13.6. Monitoring Activities Proposed

293. Regular monitoring of educational needs and gaps should be carried out, to ensure that courses and research options are being targeted correctly.

25.5.14. Impact 10: Additional Local Services - New Technical Skills, Workboats, Cranes, Better Marine Skills

25.5.14.1. Nature of Impact

294. Along with the developing capacity within the Project organisation (Menter Môn), the Project will require, and will act as the catalyst for similar developing capacity within the local supply chain. This capacity could/will continue to progress and over time will provide additional, services, facilities and knowledge. In addition to the direct capacity building through the Project, the supply chain will also be able to apply capacity built through other similar projects and through activities in other sectors. The need to address this issue was raised within the consultation process.

25.5.14.2. Sensitivity and Magnitude

295. In the preliminary impact assessment, the sensitivity of this receptor (capacity for additional services) was considered to be medium (beneficial), due to the opportunities for local businesses to contribute additional capacity. The magnitude of possible beneficial effects was considered as a worst-case scenario to be medium (beneficial) during the construction phase, reducing to low (beneficial) for the subsequent operational/ repowering phases, due to lowering activity levels. These judgements result in a preliminary impact significance classification for supply chain service capacity of **Beneficial Moderate** during construction and non-significant impacts during subsequent phases.

25.5.14.3. Mitigation and/or Optimisation

296. The measures to ensure the creation of local supply chain opportunities include:

- Establishing a clear list of anticipated requirements well in advance of the need actually arising and engaging with the local supply chain to assess their interest in engaging in capacity building;
- Ensuring that there are appropriate, transparent and legal procurement mechanisms to reward proactive local capacity investment, with participation in future work activities;
- Menter Môn will develop a supply chain portal that will advertise opportunities for the local contractors and workforce;
- Exploring parallel capacity building projects with prospective supply chain partners;
- Taking forward the Action Plan produced via the 2015 Fisheries Supply Chain Study report commissioned by Menter Môn (MarineSpace and Aquatera, 2015);
- Establishing formal supply chain partnerships where there is strong alignment of purpose; and
- Ensuring that site users and clients are made aware of and beneficially directed to engage with, local suppliers who have invested in important local capacity.

25.5.14.4. Residual Impacts

297. If such measures are successful in encouraging and supporting local capacity building by the supply chain, then beneficial impacts of the Project may increase. It is thought however that this would not be enough to alter the significance assessment.

25.5.14.5. Summary of Residual Impacts

The classification of residual impacts with regard to local supply chain opportunities are outlined in **Table 25-34**.

Table 25-34 Summary of Residual Impacts

Sub-topic area	Phase	Area N/R/L	Post mitigation/ optimisation sensitivity	Post mitigation/ optimisation magnitude	Residual significance level
10. Local supply chain opportunities	Construction	R/L	Medium Beneficial	Medium Beneficial	Moderate Beneficial
	Operation	R/L	Medium Beneficial	Low Beneficial	Minor Beneficial

25.5.14.6. Monitoring Activities Proposed

298. The supply chain members willing to engage in capacity building, should be tracked down and communicated with regularly. The levels and types of investment made by the supply chain should be recognised, acknowledged and celebrated.

25.5.15. Impact 11: Energy Security – More Green Electricity, Local Supply, Diversity of Supply

25.5.15.1. Nature of Impact

299. Over the coming years the pressures on the existing energy systems are likely to increase markedly, as the transition to a more decentralised and decarbonised energy model accelerates (UK Industrial Strategy 2017). The Project will help to beneficially support such a transition, by showing how and where best tidal energy may be able to contribute effectively to local, regional and UK energy supply. This topic was requested to be addressed through the consultation process.

25.5.15.2. Sensitivity and Magnitude

300. In the preliminary impact assessment, the sensitivity of this receptor (energy security) was considered to be medium (beneficial), i.e. "receptor in a tolerable, favourable state, with capacity to embrace beneficial influence". This classification took account of the need to transition to carbon free energy sources and the recent uncertainty over the longer-term status of the Wylfa Newydd nuclear facility. The magnitude of possible effects during construction and decommissioning were considered negligible due to the relatively short-term nature of these phases. During the operational/repowering phases, the magnitude of effects at a National level was considered negligible but at Local level was considered as a worst-case scenario to be medium (beneficial). These judgements led to a preliminary impact significance classification for energy security of **Beneficial Moderate** during operations and possible repowering phases.

25.5.15.3. Mitigation and/or Optimisation

301. The measures to consider how the Project might maximise energy security benefits include:

- Consider the actual scale and pattern of power outputs at different stages of development, with different technologies and with predicted maintenance and unplanned outages;
- Consider the merits or otherwise of introducing power storage and grid system balancing technologies alongside the generation assets;
- Consider specialised energy markets that may exist locally, that could be directly serviced by power outputs; and
- Consider how supplies of tidal energy might add to the resilience of the Anglesey and nearby grid system.

25.5.15.4. Residual Impacts

302. If such measures are implemented, then the energy security benefits from tidal energy can be maximised. However, the predicted magnitude of beneficial impacts at a local level is expected to remain the same at **Beneficial Medium** for both operations and repowering phases.

It is expected that the residual magnitude of impact for these two phases would therefore also remain at **Beneficial Moderate**.

25.5.15.5. Summary of Residual Impacts

The classification of residual impacts regarding energy security is outlined in **Table 25-35**.

Table 25-35 Summary of Residual Impacts

Sub-topic area	Phase	Area N/R/L	Post mitigation/ optimisation sensitivity	Post mitigation/ optimisation magnitude	Residual significance level
11. Energy Security	Construction & Decommissioning	N/R/L	Medium	Negligible	Negligible
	Operation & Repowering	N	Medium	Negligible	Negligible
	Operation & Repowering	R/L	Medium	Beneficial Medium	Beneficial Moderate

25.5.15.6. Monitoring Activities Proposed

303. The Project needs to be aware of likely short- and longer-term grid stability, balancing issues as well as the strategy for achieving the necessary decarbonisation. Based upon this information, the Project can assess how tidal energy can best contribute and what enabling mechanisms may be needed, to ensure that tidal energy makes a beneficial energy security contribution locally.

25.5.16. Impact 12: Decarbonisation - Clean Energy, Balancing Services, Spin-Off Capacity

25.5.16.1. Nature of Impact

304. The UK is striving towards increased levels of decarbonisation. The government's industrial strategy states (UK Industrial Strategy) that "The move to cleaner economic growth – through low carbon technologies and the efficient use of resources – is one of the greatest industrial

opportunities of our time. By one estimate, the UK's clean economy could grow at "four times the rate of GDP". The document sets out how the UK should embrace clean growth, of which the Project is one example.

305. The country is increasingly in need of balanced services, with the increased penetration of intermittent renewable generation projects. These services have a value and are a potential opportunity for projects that can link different renewable technologies into a grid system

306. These options can add spin out benefits around the projects. It is expected that during the lifetime of the projects these spin out projects will change in nature as the grid system develops and changes

25.5.16.2. Sensitivity and Magnitude

307. These decarbonisation and clean growth opportunities are assessed as being of medium (beneficial) sensitivity**,** as they represent a strong opportunity across the entire study area.

308. The opportunities for decarbonisation and clean growth will only be fully realised within the operational and repowering stages of the projects. It is assessed that this is a medium (beneficial) magnitude effect which gives a combined impact of **Moderate Beneficial** significance.

25.5.16.3. Mitigation and/or Optimisation

309. The measures by which the decarbonisation benefits of the Project might be clearly demonstrated and maximised include

- Full assessment of the possible carbon savings for each of the tenant's projects within the overall Morlais Project should be quantified and maximised;
- An assessment methodology that highlights how projects and the supply chain can make carbon savings should be developed;
- Balancing services that can complement the introduction of tidal energy should be developed, in parallel with the phases of the Project; and
- Spin off opportunities should be encouraged and developed alongside the different phases of the Project.

25.5.16.4. Residual Impacts

310. It will take some significant interventions to raise the magnitude of these impacts, so it is not anticipated that (even with the mitigation measure proposed) that the assessment of **Moderate Beneficial** significance will change.

25.5.16.5. Monitoring Activities Proposed

311. The Project needs to monitor the carbon savings across the Project. These will be important in documenting the overall impact of the Project.

312. The individual tenant's projects should also be encouraged to monitor and report the savings made.

25.5.17. Cumulative Effects

25.5.17.1. Introduction

313. The cumulative effects section firstly considers the degree of cumulative impacts between different phases of the Project and between the different topic areas. It then goes on to consider the possible effects of the Project, in combination with other possible projects in the vicinity both onshore and offshore. The additional projects considered are presented below.

314. A separate exercise has been undertaken to assess possible impacts (including cumulative) and their nature and significance on the Welsh Language (see the Morlais Welsh Language Impact Assessment).

25.5.17.2. Onshore Cumulative Projects

315. During the scoping process, several projects were identified that should be considered with regard to onshore cumulative impacts

- The Land and Lake holiday resort, which would be to the East and North of the landfall;
- Residential housing to the South of the Parc Cybi;
- Lateral Eco Parks/Orthios Holyhead Eco Park- a plan to convert the Anglesey Aluminium site and surrounding area into a biomass plant (grid connection option);
- Horizon Nuclear Power Plant – the development of a new nuclear power station on the site of the existing Wylfa;
- National Grid options for upgrading the grid; and
- Stena Line Holyhead Port.

25.5.17.3. Offshore Cumulative Projects

316. For offshore cumulative impacts, the scoping process suggested inclusion of other marine energy projects along with any other non-energy marine projects within the area of Anglesey, Conwy coast and the Llŷn Peninsular that are consented, in planning or being scoped.

317. On this basis there are two tidal projects planned for North Wales that should be considered:

- Minesto Deep Green project to the immediate West of the Project; and
- Nova Innovation Ynys Enlli project 60 km to the South of the Project (Bardsey Sound).

318. As the spatial extent of the study area(s) assessed within this chapter also includes national scale (Wales), consideration is also given to other proposed marine projects in these geographic areas. These include:

- Marine Energy Test Area (META) in Milford Haven;
- Strumble Head tidal energy project off Strumble Head, Fishguard, Pembrokeshire; and
- Pembrokeshire Wave Demonstration Zone.

319. Finally, the assessment also considered whether any of these cumulative project activities may impact upon the Project itself and its ability to deliver the objectives, plan and mitigation/optimisation measures outlined.

25.5.17.4. Assessment of Cumulative Effects within the Project

320. The wide ranging and long-lasting nature of the Project has the potential to give rise to sustained impacts throughout the duration of the Project. Different impacts could also potentially interact on receptors simultaneously, leading to greater or lesser effects alone or in combination. **Table 25-36** presents a summary of the topics and stages in the Project where individual significant effects were assessed to be likely. The distribution of these effects has then been assessed to see which stages and which issues have greatest cumulative potential.

Table 25-36 Assessment of cumulative significance of issues across different phases of activity

Impact topic	Mechanism	Beneficial / Adverse	Con	Ope	Rep	Dec	Cumulative impacts across phases and issues
Social benefits	Decentralisation of economic growth	Beneficial	Minor/ Moderate	Minor	Minor	Minor	Minor
Wellbeing of future generations	Green branding for locality	Beneficial	Minor	Moderate	Minor	-	Minor
Economic impacts	Direct & secondary income	Beneficial	Moderate	Minor	Minor	Moderate	Moderate
Accumulation of grant support		Beneficial	Moderate	Minor	Minor	-	Minor
Level of commerce activity	Green cluster creation	Beneficial	Moderate	Moderate	Moderate	Minor	Moderate
Jobs opportunities	Numbers	Beneficial	Moderate	Minor	Minor	Minor	Minor
Types, quality, skills areas		Beneficial	Major	Major	Major	Moderate	Major
Training opportunities	New skills and competence needs	Beneficial	Moderate	Minor	Minor	Negligible	Minor
Tertiary BSc, Eng, PhD		Beneficial	Minor	Moderate	Minor	Minor	Minor
Additional local services	New technical skills, workboats, cranes, better sea knowledge	Beneficial	Moderate	Minor	Minor	-	Minor
New infrastructure outside project budget	New piers, storage and laydown areas	Beneficial	Moderate	Minor	Minor	-	Minor
Energy security	More green electricity, local supply,	Beneficial	-	Moderate	Moderate	-	Moderate

Impact topic	Mechanism	Beneficial / Adverse	Con	Ope	Rep	Dec	Cumulative impacts across phases and issues
	diversity of supply						
Decarbonisation	Clean energy, balancing services, spin-off capacity	Beneficial	-	Moderate	Moderate	-	Moderate
Cumulative influences within phases between disciplines			Major	Moderate	Moderate	Low	

321. It can be seen from this analysis, that in terms of phases of activity, the construction phase has greatest scope for overall cumulative effects. This potential arises from the greater scale of activity that will take place during this phase, this in turn, will lead to most pressure and most opportunity - particularly in Anglesey itself. The operational and possible repowering phases of the Project will still have significant potential for multifaceted effects upon key, social-economic receptors.

322. In terms of impact vectors, the mechanisms with greatest cumulative potential are considered to be around job opportunities and economic impacts on the local area, through the combined benefits accrued across all phases of the Project.

323. The importance of this analysis is that it will be key for the overall management strategy for the Project, to focus upon the many Beneficial and some adverse issues associated with the construction phase, which is where many benefits arise. Secondly, it will be important to have a strong policy and monitoring framework geared towards jobs and economic benefits, since this is where the greatest levels of sustained impact may arise.

25.5.17.5. Assessment of Cumulative Effects with Other Projects

324. In terms of the in-combination effects with other projects, the first stage in the process was to identify which impact mechanisms may be of key interest. This was done by reviewing the impact assessment results presented in **Appendix 25.1** (**Volume III**) and identifying the issues where it was considered that possible cumulative effects may arise (see **Appendix 25.1, Volume III**). These included areas which had already been deemed to be significant in that analysis and also those considered non-significant for the individual Project, but where cumulative effects were still considered possible.

325. From this preliminary assessment the non-significant issues that have cumulative potential were:

- Beneficial impacts of the Project from the influx of workers;
- Adverse impacts on rental housing market distortion due to worker influx;
- Beneficial impact of increased investment opportunities;
- Adverse impact of job displacement from similar roles;

- Beneficial impact of increased media attention including public outreach and information;
- Adverse impacts of congestion on piers and in ports;
- Adverse impacts on tourism of an increased sense of Industrialisation;
- Beneficial impact of new grid connections; and
- Beneficial impact with the availability of new boats.

326. Significant issues that also have cumulative potential were considered to be:

- Beneficial impact of increased direct and secondary incomes;
- Beneficial impact of more grant income attracted to area;
- Beneficial impact of green cluster development; and
- Beneficial impact of the diversification of the economy.

327. The next stage in the process was to establish which of these mechanisms could interact across which of the in-combination projects that have been identified. The results of this analysis are shown in **Table 25-37**.

Table 25-37 Cumulative effects linked to assessed projects

Key	**Potential for cumulative effects**		
Potential interaction?	High	Medium	Minor
Yes	All or most projects involved, all or most issues	Many projects involved, many issues	Few projects involved, few issues

. **Impact**	**Project**										
	Land and Lake resort	Parc Cybi housing	Holyhead Eco Park	Horizon Nuclear Power Plant	National Grid upgrades	Stena Line port expansion	Minesto tidal project	Nova tidal project	META	Strumble Head	Potential for cumulative effects
More workers	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High
House rental market	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			High
Investment opportunities			Yes				Yes	Yes	Yes	Yes	Low
Worker mobility	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			High
Regional profile	Yes		Yes	Yes		Yes	Yes	Yes			Medium
Pier congestion							Yes	Yes			Low
Industrialisat'n				Yes	Yes		Yes	Yes		Yes	Medium
Grid connections				Yes	Yes		Yes	Yes		Yes	Medium

Impact	Project										
	Land and Lake resort	Parc Cybi housing	Holyhead Eco Park	Horizon Nuclear Power Plant	National Grid upgrades	Stena Line port expansion	Minesto tidal project	Nova tidal project	META	Strumble Head	Potential for cumulative effects
New vessels						Yes	Yes	Yes			Low
Greater local GDP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	High
Greater grant income			Yes				Yes	Yes	Yes	Yes	Low
Green cluster			Yes	Yes	Yes		Yes	Yes	Yes		Medium
Economic diversification	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High
	Medium	Low	Medium	Medium	Medium	Medium	High	High	Low	Low	

328. From this analysis, it was apparent that there was greatest potential for cumulative effects with the two other tidal projects that are being considered for the region (as well as the two further afield in South Wales) and that the other onshore projects (and especially the housing project) has less potential for cumulative effects. As for individual impacts, the socio-economic topic areas where it was considered that there was most potential for impact, were associated with jobs, skills needs and economic activity.

329. This analysis strongly suggests that developing a common, strategic approach to the development of tidal energy and other related energy projects in the area, is likely to be important and beneficial and also that there is an acute need to manage and monitor the metrics associated with jobs and economic activity.

25.6. SUMMARY

330. A summary of the impact assessment presented within this chapter is shown in **Table 25-38**.

Table 25-38 Summary of Potential Impacts for Socio-Economics, Tourism and Recreation

Impact	Description	Effect	Significance
Impact 1: Social benefits - Decentralisation of economic growth	£3.6 M and £41.4 M per annum local expenditure is anticipated during the construction (peak) and operation phases of the Project. With the implementation of mitigation measures that maximise local content, the effects during construction and operation are predicted to be major and moderate beneficial.	Major and moderate beneficial	Significant
Impact 2: Wellbeing of future generations - Green branding for locality	The implementation of mitigation measures that strengthen the 'green' credentials of the Project\locality will lead to moderate beneficial effects on the wellbeing of future generations for all phases.	Moderate beneficial	Significant

Impact	Description	Effect	Significance
Impact 3: Economic impacts - Direct and secondary income	In terms of direct spending in the locality, Anglesey is expected to benefit in the region of £3.6 M and £41.4 M per annum during the construction and operation phases respectively. The construction phase of the Project is going to see major spend at a National scale. With the implementation of mitigation measures such as development of support mechanisms and the local work force, direct and secondary income is expected to experience moderate beneficial effects for all phases.	Moderate beneficial	Significant
Impact 4: Economic impacts - Accumulation of grant support	The Project would represent a big step towards this commercialisation, but it is a demonstration zone, so should still attract grant aid. It will also attract research grant funding, for various aspects of the development. With continued government lobbying and development of further R&D/Grant funding opportunities, the Project is expected to experience major and moderate beneficial effects from a grant support perspective during the construction and operation\decommissioning phases respectively.	Major and moderate beneficial	Significant
Impact 5: Level of commerce activity - Green cluster creation	The successful implementation of measures that increase the understanding of the Project and establish a strong green cluster locally, will lead to major beneficial effects during the operation and repowering phases. The effects will be moderate beneficial during construction.	Moderate beneficial	Significant
Impact 6: Job opportunities – Numbers	The Project could be expected to generate when fully realised up to 467 jobs per year during initial construction with perhaps 50% of this (approx. 230 depending on individual project timescales) associated with any repowering activities. In total, based upon progressive procurement and manufacturing strategies, the construction and repowering stages could add between 960 – 1320 FTE yrs within Anglesey, 1560 – 2280 FTE yrs in North Wales and 2640 – 4200 FTE yrs across the whole of Wales. A further total of up to 456 jobs per year could arise from O&M activity. Of these it is estimated that approximately 137 – 228 could be in Anglesey, 91 in North Wales and 46 across the rest of Wales With implementation of appropriate mitigation\optimisation, the Project is therefore expected to give rise to major beneficial impacts across all phases.	Major beneficial	Significant

Impact	Description	Effect	Significance
Impact 7: Job opportunities - Types, quality, skills areas	The Project will create a high number of jobs within the local economy, some of these will be highly skilled and will provide a very strong opportunity regionally and locally. Major beneficial effects are expected for the majority of phases with the implementation of appropriate mitigation e.g. encourage a stronger local content and support the up skilling of the workforce to improve the quality of jobs on offer.	Major beneficial	Significant
Impact 8: Training Impacts - New skills and competence needs	Project construction will offer temporary employment opportunities both in terms of direct construction jobs and opportunities in the supply chain. There is a requirement for up-skilling of the local, regional and national workforce to take advantage of the opportunities presented by the Project. Moderate beneficial effects will be experienced nationally, regionally and locally if measures such as those that increase training uptake are implemented.	Moderate and minor beneficial	Significant
Impact 9: Training impacts - Tertiary BSc, Eng, PhD	This impact is considered beneficial for all three regions being assessed, as there could also be benefits to other regional and national university's and training establishments.	Moderate and minor beneficial	Significant
Impact 10: Additional local services - New technical skills, workboats, cranes, better marine knowledge	Development of local supply chain will continue to progress and over time will provide additional, services, facilities and knowledge. Moderate and minor beneficial effects will be experienced during the construction and operation phases respectively where measures that are successful in encouraging and supporting local capacity are implemented.	Moderate beneficial	Significant
Impact 11: Energy security - More green electricity, local supply, diversity of supply	The Project will help to beneficially support a transition to a more decentralised and decarbonised energy model by showing how and where best tidal energy may be able to contribute effectively to local, regional and UK energy supply.	Moderate beneficial	Significant
Impact 12: Decarbonisation - Clean energy, balancing services, spin-off capacity	Opportunities for decarbonisation and clean growth will only be fully realised within the operational and repowering stages of the Project and tenant's projects.	Moderate beneficial	Significant

25.7. REFERENCES

Aquatera and MarineSpace (2015). Marine Services supply chain study for tidal industry, Menter Môn.

British Listed Buildings (2019). Listed buildings in Isle of Anglesey. https://britishlistedbuildings.co.uk/wales/isle-of-anglesey#.XUPkqPZFz4j [Accessed on 02/08/2019].

Cadw (2017). Heritage Impact Assessment in Wales, Welsh Government, Historic Environment Service (Cadw).

Deloitte and Oxford Economics (2013). Tourism and growth – The economic contribution of the tourism economy in the UK.

Department of Energy and Climate Change (2011). National Policy Statement for Renewable Energy Infrastructure (EN-3).

Edge Analytics (2014). Gwynedd & Anglesey Population & Household Forecasts Assumptions, Methodology & Scenario Results.

Gwynedd and Môn Public Services Board (2017). Anglesey Well Being Assessment.

Highlands and Islands Enterprise (2019). Science and Innovation Audit Report sponsored by the Department for Business, Energy and Industrial Strategy.

International Energy Agency (2015). Levelized Cost of Energy (LCOE) report 2015.

Isle of Anglesey County Council (2008). Anglesey Rights of Way Improvement Plan 2008 – 2018.

Isle of Anglesey County Council (2011). Anglesey Food Tourism Strategy and Action Plan.

Isle of Anglesey County Council (2013). Isle of Anglesey - Single Integrated Plan; 2013 – 2025.

Isle of Anglesey County Council (2014). Wylfa Newydd Supplementary Planning Guidance.

Isle of Anglesey County Council (2016a). Anglesey County Council Construction Worker Accommodation Base and Assumptions study.

Isle of Anglesey County Council (2016b). Destination Anglesey Management Plan; 2016 – 2020.

Isle of Anglesey County Council (2018). Wylfa Newydd Power Station Tourism Topic Report. Local Impact Report.

Isle of Anglesey and Gwynedd County Councils Joint Planning Policy Unit (2015). Joint Planning Policy Unit, Topic Paper 10: Welsh Language & Culture: Anglesey & Gwynedd Joint Local Development Plan.

Isle of Anglesey County Council and Gwynedd Council (2017). Anglesey and Gwynedd Joint Local Development Plan.

Krawiecki J and Biggs A ((2013). Welsh sea kayaking. Pesda Press

Marine Energy Council (2019). UK Marine Energy 2019: A new industry.

Marine Energy Wales (2019a). State of the Sector 2019. URL available at:

Marine Energy Wales (2019b), Welsh Ports information. https://www.marineenergywales.co.uk/supply-chain/ports/ [Accessed on 26.07/19].

Menter Môn https://www.mentermon.com/en/. [Accessed on 26.07/19].

Mersey Dee Alliance (2012). North Wales Sector Report. Report to the Wales Forum.

Meygen (2012). MeyGen Tidal Energy Project Phase 1 Environmental Statement.

Natural Resources Wales (2015). Wales Outdoor Recreation Survey 2014: Final Report.

National Resources Wales (2017). National survey for Wales 2016-17. Key facts for policy and practice: outdoor recreation.

North Wales Economic Ambition Board (2016). A growth vision for the economy of North Wales.

North Wales Growth Deal (2017). A growth deal for North Wales.

Office for National Statistics (2018a). Regional economic activity by gross value added (balanced), UK: 1998 to 2017.

Office for National Statistics (2018b). Labour Market Profile, Isle of Anglesey.

Regeneris Consulting Ltd (2013). The Economic Impact of the Development of Marine Energy in Wales. Report for Welsh Government. July 2013.

Scottish Government (2019a). Input / Output tables for 1998 to 2016, published July 24th 2019. Available at URL: https://www2.gov.scot/Topics/Statistics/Browse/Economy/InputOutput/Downloads [Accessed 26/07/2019].

Scottish Government (2019b). Information on the UK's possible exit from the European Union (Brexit) and how it may affect people and businesses in Scotland. Available at URL: http://www.mygov.scot/eu-exit [Accessed 26/07/2019].

SeaFish (2019). Introduction to the Wales seafood industry. Available at URL: https://www.seafish.org/article/introduction-to-the-wales-seafood-industry [Accessed 29/07/2019].

Sgurr Energy (2009). Marine Energy Supply Chain Survey report.

Sport Wales (2018). Sport and Active Lifestyles: State of the Nation. A Statistical Release from the National Survey of Wales 2017-2018.

SSE Renewables (2011). Tidal and Wave Power a Diversification Opportunity.

Stats Wales (2012). Welsh speakers by local authority, gender and detailed age groups, 2011 census.

Sustrans (2019) https://www.sustrans.org.uk/ncn/map/national-cycle-network/about-network

RYA (2019). UK Coastal Access Recreational Boating Atlas. Online GIS tool. Available at URL: https://www.rya.org.uk/knowledge-advice/planning-environment/Pages/uk-coastal-atlas-of-recreational-boating.aspx [Accessed 29/07/2019].

UK Government (2017). UK Industrial Strategy: Building a Britain fit for the future.

Welsh Government (2007). Sustainable Tourism – A Framework for Wales.

Welsh Government (2013). Strategy for Tourism 2013 – 2020, Partnership for Growth.

Welsh Government (2014). Energy Wales: A Low Carbon Transition Delivery Plan.

Welsh Government (2015). Rural Communities - Rural Development Programme 2014-2020.

Welsh Government (2018a). Workplace employment by industry in Wales, 2001 to 2016.

Welsh Government (2018b). Wales tourism accommodation occupancy survey, 2017

Welsh Government (2018c). Tourism Profile – North Wales 2014 – 2016.

Welsh Government (2018d). Gross Value Added by measure, Welsh economic region and year, 2011-2017.

Welsh Government (2019a). Wales Tourism Performance Report: January to September 2018

Welsh Government (2019b). Regional Economic & Labour Market profiles.

Welsh Government (2019c). Age distribution of population by gender and year 1871-2018. Available at URL: https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Distributions/agedistributionofpopulation-by-gender-year [Accessed 29/07/2019].

Morlais Project
Environmental Statement

Chapter 26: Cumulative, Transboundary and In-Combination Impact Assessment

Volume I

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-026

Chapter 26: Cumulative, Transboundary and In-Combination Impact Assessment

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GLOSSARY OF ABBREVIATIONS

CEMP	Construction Environmental Management Plan
CIA	Cumulative Impact Assessment
DCO	Development Consent Order
EEA	European Economic Area
ECC	Export Cable Corridor
ES	Environmental Statement
EU	European Union
HRA	Habitats Regulations Assessment
INNS	Invasive Non-Native Species
MCAA	Marine and Coastal Access Act
MDZ	Morlais Demonstration Zone
MPS	Marine Policy Statement
MSPD	Marine Spatial Planning Directive
MU	Management Unit
NSIP	Nationally Significant Infrastructure Project
ODA	Onshore Development Area
TTS	Temporary Threshold Shift
TWA	Transport and Works Act
TWAO	Transport and Works Act Order
UNECE	United Nations Economic Commission for Europe
WNMP	Welsh National Marine Plan

26. CUMULATIVE IMPACTS AND IN-COMBINATION EFFECTS

26.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) provides a summary of the Cumulative Impact Assessment (CIA) for the onshore and offshore topics, for the Morlais Project (herein 'the Project').

2. Whilst each technical assessment chapter within the ES provides its own cumulative impact assessment section in relation to that topic, the purpose of this chapter is to present an overview of the potential cumulative impacts of the Project.

3. This chapter draws information from and should be read in conjunction with each of the technical chapters from Chapter 7 to Chapter 25.

4. This chapter is also provided to meet the requirement to consider transboundary impacts required by The Convention on Environmental Impact Assessment in a Transboundary Context, UN treaty No. 34028 (termed the Espoo Convention) which was signed 10 September 1997. The Espoo Convention is implemented by the EIA Directive and transposed into UK law by way of the Environmental Impact Assessment (EIA) Regulations.

5. It should be noted that an in-combination assessment has been undertaken as part of the Habitats Regulations Assessment (HRA) process. There are elements of the approach to CIA that are mirrored by the in-combination HRA process, in particular the method used to identify other plans, projects and activities that are taken forward in each assessment. Information to Support the HRA Report is submitted as part of the Transport and Works Act Order (TWAO) application (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).

26.2. POLICY, LEGISLATION AND GUIDANCE

6. A full description of all policy and legislation relevant to the Project are included in **Chapter 2, Policy and Legislation** of this ES.

26.2.1. Legislation

7. The Transport and Works Act (TWA) 1992 sets out information that must be included in the ES, as outlined within The Transport and Works (Applications and Objections Procedure) (England and Wales) Rules 2006. This includes "*a description of the likely significant effects of the project on the environment, including direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects*".

8. This is also reflected in Schedule 3 of the Marine Works (EIA) Regulations 2010 (as amended).

9. The Project is subject to EIA under European Union (EU) EIA Directive 85/337/EEC (as amended). In 2011, the original EIA Directive and amendments were translated into EIA Directive 2011/92/EU. Directive 2014/52/EU amending Directive 2011/92/EU on the

assessment of the effects of certain public and private projects on the environment was published in the European Union's Official Journal in April 2014.

10. In line with this requirement, a description of likely significant cumulative and transboundary effects is provided in each technical chapter of the ES and summarised in this chapter.

11. The United Nations Economic Commission for Europe (UNECE) Convention on Environmental Impact Assessment in a Transboundary Context (the Espoo Convention) requires that assessments are extended across borders between Parties of the Convention when a planned activity may cause significant adverse transboundary impacts.

12. Regulation 32 of the EIA regulations sets out procedures to address issues associated with a development that might have a significant impact on the environment in another European Member State. The procedures involve providing information to the Member State and for the Planning Inspectorate to enter into consultation with that State regarding the significant impacts of the development and the associated mitigation measures. Further advice on transboundary issues, in particular with regard to timing, process and consultation is given in the Planning Inspectorate (2018) Advice Note Twelve.

26.2.2. National Policy

13. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the Welsh National Marine Plan (WNMP). The WNMP is being developed in accordance with the Marine and Coastal Access Act (MCAA) 2009, the Marine Policy Statement (MPS) and the Marine Spatial Planning Directive (EU Directive 2014/89) (MSPD). A draft version has been issued for consultation.

14. The draft WNMP contains the following policy (GOV_01) which is particularly relevant to this chapter:

"Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference:

a) avoid adverse effects; and/or

b) minimise effects where they cannot be avoided; and/or

c) mitigate effects where they cannot be minimised.

If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged."

15. **Table 26-1** sets out the national and regional policies that are relevant to cumulative impact assessments.

Table 26-1 National and Regional Policy Requirements Relevant to Cumulative and In-combination

Policy Description	Reference	ES Reference
Draft WNMP		
Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01	An assessment of cumulative, transboundary and in-combination impacts is presented in **Chapter 26**.
Proposals that consider opportunities for coexistence with other compatible sectors are encouraged in order to optimise the value and use of the marine area and marine natural resources	ECON_02:	An assessment of cumulative, transboundary and in-combination impacts is presented in **Chapter 26**.

26.2.3. Guidance

16. In preparing this ES, consideration has been given to relevant guidance issued by a of Governmental, statutory and industry bodies, including:

- Department of Energy and Climate Change: Guidelines on the Assessment of Transboundary Impacts of Energy Developments on Natura 2000 Sites outside the UK;
- Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions (European Commission 1999); and
- Cumulative Impact Assessment Guidelines – Guiding Principles for Cumulative Impacts Assessment in Offshore Wind Farms (RenewableUK 2013).

17. Guidance that is applicable to a specific assessment is identified in the relevant chapters of this ES.

18. Although this project is not seeking a Development Consent Order (DCO), its size (240 MW) means it is of equivalent scale and magnitude as a Nationally Significant Infrastructure Project (NSIP). The requirements of Directive 2014/52/EU have been formally implemented in England insofar as relevant to NSIPs in the form of a revised set of regulations entitled 'The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017' (the EIA Regulations 2017). Therefore, in accordance with best practice, Menter Môn has given consideration to the EIA Regulations 2017 within this chapter, in terms of the CIA guidance published by the Planning Inspectorate.

19. The Planning Inspectorate (2018) published Advice Note Twelve regarding the Transboundary Impacts and Process and Advice Note Seventeen (Planning Inspectorate, 2015) which provides guidance on the plans and projects that should be considered in the CIA.

26.2.3.1. The Planning Inspectorate Advice Note Twelve: Transboundary Impacts and Process (Planning Inspectorate, 2018)

20. Advice Note Twelve sets out the procedures for consultation in association with an application for a DCO to the Planning Inspectorate, where such development may have significant transboundary impacts. The Advice Note sets out the roles of the Planning Inspectorate, UK Government departments and developers. Developers are advised to identify the possible significant transboundary effects or alternatively, state why they consider that there would not be any significant effects on another European Economic Area (EEA) State.

26.2.3.2. The Planning Inspectorate Advice Note Seventeen: Cumulative Effects Assessment (The Planning Inspectorate, 2015)

21. Advice Note Seventeen outlines the following staged process for the consistent assessment of cumulative impacts:

- Stage 1: Establish the project’s zone of influence and identify a long list of other developments within this zone;
- Stage 2: Identify shortlist of other developments by applying inclusion/exclusion criteria to the Stage 1 list for CIA;
- Stage 3: Information Gathering regarding the shortlisted ‘other development’ to inform the CIA; and
- Stage 4: Assessment.

26.3. CONSULTATION

22. Consultation with stakeholders has been ongoing during the Project development (**Table 26-2**), through comments obtained from Scoping Opinion documents (2015, 2017 and 2018).

23. A request for scoping opinion for the Project was issued to the Welsh Government Planning Inspectorate under different consenting regimes in 2015 and 2017, with a final scoping opinion requested in April 2018 from Natural Resources Wales (NRW) and the Welsh Government Planning Inspectorate. All comments relevant to CIA received in these scoping opinions have been compiled in **Table 26-2** and have been responded to in this Chapter.

Table 26-2 Consultation Responses

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Scoping Comments	The Applicant intends for the supporting infrastructure of the Proposed Works to be developed with sufficient capacity to support the grid connection of the Minesto Holyhead Deep project (located northwest of the offshore scoping area). However, the Minesto Holyhead Deep project does not form part of the Proposed Works. It is recommended that the ES assesses the potential cumulative effects of the Minesto Holyhead	The Minesto Holyhead Deep Project has been assessed in the CIA for the relevant topics (**Section 26.5**). Note that although the potential for sharing a cable with the Minesto project has been suggested and has been included as part of previous EIA scoping exercises, it is not the proposal subject to the Morlais TWAO and Marine Licence applications.

Consultee	Date/Document	Comment	Response
		deep project and the Proposed Works.	
Planning Inspectorate	2018 Scoping Comments	In accordance with Rule 16 of the EIA Regulations, the ES should provide a description of the likely significant transboundary effects, where relevant.	An assessment of transboundary effects where relevant is provided in **Section 26.6**.
Planning Inspectorate	2018 Scoping Comments	Aspects to be considered: Table 10-1 identifies potential cumulative impacts for some, but not all, aspects to be assessed in the ES. There is no justification for the exclusion of aspects such as terrestrial ecology, land use and quality, air quality, noise and vibration (and this list is not exhaustive). Cumulative impacts should be assessed for all aspect chapters where significant effects are likely to occur.	Cumulative impacts have been assessed for all aspect chapters where significant effects are likely to occur. A summary is provided in **Section 26.5** with further details in each topic Chapter.
Planning Inspectorate	2018 Scoping Comments	Projects for consideration: It is recommended that the other projects to be included within the cumulative assessment are discussed, and ideally agreed, with relevant consultees. It would be useful for their locations to be identified on a figure included within the ES. Section 10.3.1 states that 'relevant' other projects will be included in the cumulative impacts assessment; the ES should clearly explain what is considered to be 'relevant'. It is understood that the Horizon Nuclear Power Plant comprises elements to be consented through the Town and Country Planning Act 1990 and elements to be consented through the Planning Act 2008. The Applicant should ensure all elements of Horizon's proposed works are considered in the cumulative assessment, including the offshore elements.	Offshore and onshore projects are shown within **Figure 26-1** (**Volume II**) and **Figure 26-2** (**Volume II**) respectively. It is understood that the Horizon Nuclear Power Plant project has been suspended. However, as a precautionary approach, this has been included in the CIA where relevant.
Planning Inspectorate	2018 Scoping Comments	Assessment methodology: The Scoping Report contains little detail on how the assessment will be undertaken. Although produced for Nationally Significant Infrastructure Projects, the Applicant is advised to utilise the approach set out in Planning Inspectorate Advice Note	Although this project is not seeking a DCO, its size (240MW) means it is of equivalent scale and magnitude as a NSIP. Therefore, in accordance with the Planning Inspectorate advice, Menter Môn has given consideration to Planning Inspectorate Advice Note

Consultee	Date/Document	Comment	Response
		Seventeen: Cumulative effects assessment.	Seventeen: Cumulative effects assessment within this chapter, as outlined in **Section 26.4.**
Planning Inspectorate	2018 Scoping Comments	The chapter of the Scoping Report is entitled 'Cumulative impacts and in-combination effects' however has only made further reference to 'cumulative impacts'. The Applicant should ensure terminology is defined and utilised consistently in the ES.	It should be noted that an in-combination assessment has been undertaken as part of the HRA process (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**)
NRW (for PINS)	2018 Scoping Comments	The new power station at Wylfa is mentioned in relation to potential onshore cumulative impacts (see section 10.1.2). We advise that offshore aspects of the power station also need to be considered, including HNP's plans for sediment and rock disposal at Holyhead Deep (this is in addition to the existing use of the disposal ground from Holyhead Port), increased boat traffic / shipping movements and biosecurity. It should also be noted that the HNP Wylfa Newydd development will mostly sit adjacent to the existing power plant rather than use the same site footprint.	The Wylfa project has been suspended indefinitely, however, this project has been considered where relevant in **Section 26.5** and the relevant topic chapters.
NRW (for PINS)	2018 Scoping Comments	It's important to note that, in addition to inter project effects outlined in Section 10, intra-development effects, where multiple development elements have the potential to impact the same receptor, need to be considered throughout the relevant ES chapters and wider EIA process.	Intra-development effects have been considered in the topic-specific chapters (**Chapter 7-25**).
IACC 2018	2018 Scoping Comments	The application strategy should be aligned with other significant projects identified within the scope of the cumulative impacts assessment.	Noted.
IACC 2017	2018 Scoping Comments	The list of projects to be assessed in terms of cumulative and in-combination impacts appears limited. The EIA should consider an agreed list of proposals at an agreed cut-off date before submission of the planning application.	Following the submission of the Scoping Report a full review of the projects to be assessment in the CIA and HRA have been reviewed. Those relevant to the Onshore Development Area were reviewed during the EIA process and the list of projects is correct at the time of writing in June 2019, prior to submission of the TWAO

Consultee	Date/Document	Comment	Response
			application. As part of the TWAO the submission of the Preliminary Environmental Information Report is not required, therefore the list of projects relevant to the Onshore Development Area incorporates the full list of pre-application, pre-determined and determined projects on the IoACC planning portal. Key projects relevant to the Offshore Development Area have been discussed with NRW and IoACC in Technical Working Group meetings.
NRW	2018 Scoping Comments	We draw your attention to the requirement of Article 6 of Schedule 3 of the MWR which requires you to consider the potential transboundary effects of the project.	An assessment of transboundary effects where relevant is provided in **Section 26.6**.
NRW	2018 Scoping Comments	The scope of the Cumulative Impact Assessment is project focused, although the temporal or ‘time frame’ boundary is not clearly defined. Please note the European Commission guidance regarding temporal boundaries, which suggests: 'Setting the time boundary in terms of future developments can be based on information provided from the relevant planning authorities during consultation and from information contained within development plans produced by local or perhaps national authorities. In setting the future time boundary it is suggested that in general, beyond 5 years there is too much uncertainty associated with most development proposals. It is therefore recommended that in the majority of cases the limit does not exceed 5 years into the future.'	Noted.
NRW	2018 Scoping Comments	The cumulative assessment should include other proposed and existing Marine Licence applications such as disposal at Holyhead North disposal site. Information on marine licence applications can be found on the Welsh Government Marine Planning Portal or downloaded from Lle. The assessment should also include developments	Noted, other proposed and existing Marine Licence applications have been considered.

Consultee	Date/Document	Comment	Response
		allocated within the statutory development plan, proposals in the AONB management plan and in the draft Wales National Marine Plan (each of which is supported by an Environmental Report and Habitats Regulations Assessment). Regard should also be given to Natural Resources Wales' emerging Area Statements (Marine and North-West Wales Areas), when published.	
NRW	2018 Scoping Comments	The cumulative and in combination effects of shipping and navigation require consideration, in particular regarding shipping routes, and the proximity of other activity or proposed developments in the area will require a detailed assessment.	Noted, a detailed cumulative assessment has been undertaken in **Chapter 15, Shipping and Navigation** (**Section 15.6.6**).
NRW	2018 Scoping Comments	The consideration of underwater noise cumulative effects should include activities in the wider are, such as navigation and fishing, as well as any other project developments.	The consideration of underwater noise has been assessed where relevant in **Section 26.5**.
NRW	2018 Scoping Comments	It should be noted that the Habitats Regulations Assessment for the Draft Welsh National Marine Plan, which was published in December 2017, was unable to rule out Adverse Effect on Integrity for multiple SPA, SAC and Ramsar sites and features. These conclusions should be taken into account when screening relevant plans or projects under the Habitats Regulations that could have an in-combination effect on those sites and when considering cumulative and synergistic effects under the Environmental Impact Assessment and Strategic Environmental Assessment Regulations.	It should be noted that an in-combination assessment has been undertaken as part of the HRA process (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**)
IoACC	2017 Scoping Comments	Agrees projects to be assessed are limited.	Noted.
NRW	2015 Scoping Comments	Cumulative effects are likely to be significant in such a busy area and the EIA must address the implications that additional activities in the area will have on environmental resources e.g. bird displacement.	Noted, cumulative impacts are summarised within **Section 26.5**. For more detail see topic specific chapters (**Chapters 7-25**).

Consultee	Date/Document	Comment	Response
NRW	2015 Scoping Comments	Other Projects and activities in addition to those considered within section of the scoping report will need to be considered when assessing the cumulative impacts and in-combination effects of Morlais. Clearly identifying the key impact pathway / receptor combinations of relevance to Morlais, once the Project design envelope has been agreed will help to identify other activities which will need to be considered. It is important to note that for wide ranging marine species such as mammals or widely foraging seabirds, this may include Projects or activities located some distance from Morlais.	Noted, numerous offshore developments have been considered within the full foraging range of the receptors where relevant.
NRW	2015 Scoping Comments	In-combination effects with other developments/proposals will also need to be assessed for HRA and WFD. These include Lateral Power and Wylfa Newydd nuclear power station.	In-combination effects for internationally designated nature conservation sites are considered in the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). In-combination effects for the WFD are scoped out within **Section 26.5.3** and **Section 26.5.12**.
NRW	2015 Scoping Comments	Section 10.1.3 – the types of Projects considered for cumulative impact assessment should include, in addition to those listed in the scoping report; > disposal of dredged material at Holyhead deep disposal site; and > cables and pipelines	Noted, the list of projects considered within the CIA is outlined in **Section 26.4**.

26.4. METHODOLOGY

26.4.1. Cumulative Impact Assessment

24. The key aim of the CIA is to assess whether impacts on a receptor may occur on a cumulative basis between the Project and other projects, activities and plans (either consented or forthcoming) in the study area.

25. The Planning Inspectorate Advice Note 17 provides guidance on plans and projects that should be considered in the CIA based on a tiered approach with decreasing levels of likely available detail:

- Projects that are under construction;
- Permitted applications, not yet implemented;
- Submitted applications not yet determined;

- Projects on the Planning Inspectorate's Programme of Projects;
- Development identified in relevant Development Plans, with weight being given as they move closer to adoption and recognising that much information on any relevant proposals will be limited; and
- Sites identified in other policy documents as development reasonably likely to come forward.

26. The CIA is a two part process in which an initial list of projects with the potential to interact with the Project is identified, based on the potential mechanism of interaction. All receptors that are to be considered as part of the EIA will initially be considered as part of the CIA, with the aim of removing receptors from the scope where no pathway to an impact can be predicted. Once relevant sources and receptors have been identified, possible pathways will be identified. Where no pathways exist, cumulative impacts can be ruled out. The spatial extent and refinement of projects will be informed through this 'screening' process.

27. Only projects which are reasonably well described and sufficiently advanced to provide information on which to base a meaningful and robust assessment have been included in the CIA.

28. Projects which are sufficiently implemented during the site characterisation for the Project are considered as part of the baseline for the EIA. Onshore plans or projects to be taken into consideration include (but not limited to):

- Building/housing developments;
- Installation or upgrade of roads;
- Installation or upgrade of cables and pipelines;
- Other energy generation infrastructure;
- Coastal protection works; and
- National Grid works.

29. Additionally, for the offshore topics, cumulative impacts may arise from interactions with the following activities and industries:

- Other tidal energy projects;
- Wave energy projects;
- Offshore wind energy projects;
- Aggregate extraction and dredging;
- Licensed disposal sites;
- Sub-sea cables and pipelines;
- Coastal protection schemes;
- Potential port/harbour development; and
- Oil and gas activities.

30. In line with the RenewableUK CIA Guidelines for offshore wind farms (RenewableUK, 2013), the approach to CIA attempts to incorporate an appropriate level of pragmatism. This is demonstrated in the confidence levels applied to various developments, particularly those that are known but currently lack detailed project application documentation, such as those projects at the scoping stage only.

31. These projects have been considered for CIA only in those chapters where it is considered that the Scoping Reports contain sufficient detail with which to undertake a meaningful assessment. Where there is a lack of specific information in the public domain, such as how and when (or if) projects will be built, it is not always possible to undertake a meaningful CIA.

26.4.2. Transboundary Impact Assessment

32. Potential transboundary impacts have been approached in a similar way to other cumulative impacts, with a clear audit trail provided to demonstrate why projects have been included or excluded.

26.5. CUMULATIVE IMPACT ASSESSMENT

26.5.1. Introduction

33. The list of all plans and projects that were scoped in for the consideration of each technical assessment can be found in **Appendix 26.1** (**Volume III**) and are illustrated in **Figure 26-1** (**Volume II**) for offshore projects and **Figure 26-2** (**Volume II**) for onshore projects.

34. The sections below lists the plans and projects from **Appendix 26.1** (**Volume III**) which were included in the CIA for each technical assessment and summarise the cumulative impacts identified for each chapter of the ES. The tables below provide the impact, a rationale of how cumulative impacts could occur and a CIA. All mitigation measures and further detail around the CIA are included in each relevant technical chapter.

26.5.2. Metocean Conditions and Coastal Processes

35. Of the projects listed in **Appendix 26.1** (**Volume III**), the only one which could potentially have a cumulative or in-combination effect with the Project in respect of coastal processes is Minesto's Holyhead Deep project. All other projects are either too remote from the Project or onshore and thus do not affect coastal processes.

Minesto's Holyhead Deep project will be an 80 MW installation of tidal energy devices, delivered in a phased manner, and located a short distance due west of the MDZ Project. The predicted impacts of Minesto's Holyhead Deep project on coastal processes have been assessed as being not significant in their own right (Minesto, 2016), and this conclusion is considered equally valid when both projects are considered in combination.

Table 26-3 provides a summary of the CIA outcomes for metocean and coastal processes.

36. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout

the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

Table 26-3 Potential Cumulative Impacts Identified for Metocean Conditions and Coastal Processes

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Changes in suspended sediment concentrations due to foundation installation in the Project	Based upon the geographical configuration of the Minesto Project Development Area (PDA) with respect to the MDZ Project, there is no possibility of changes in tidal flow interacting between projects, due to the alignment of flood and ebb flows off the coast of Anglesey (i.e. the two projects are not upstream/downstream of each other). Similarly, any (minor) sediment plumes arising from construction from either project will not coalesce because of: (i) the alignment of principal tidal flows; and (ii) likely different construction programmes (note that phase 1 of the Holyhead Deep project is already installed). The predicted impacts of Minesto's Holyhead Deep project on coastal processes have been assessed as being not significant in their own right (Minesto, 2016), and this conclusion is considered equally valid when both projects are considered in combination.	Scoped out of CIA
Changes in sea bed level (morphology) due to deposition during foundation installation in the Project		Scoped out of CIA
Changes in suspended sediment concentrations during offshore export cable installation (including nearshore)		Scoped out of CIA
Changes in sea bed level due to offshore export cable installation		Scoped out of CIA
Changes in suspended sediment concentrations during inter-array cable installation		Scoped out of CIA
Changes in sea bed level due to inter-array cable installation		Scoped out of CIA
Changes in sea bed level (morphology) due to indentations during installation in the Project		Scoped out of CIA
Operation		
Changes to the tidal regime due to the presence of structures in the Project	Based upon the geographical configuration of the Minesto Project Development Area (PDA) with respect to the MDZ Project, there is no possibility of changes in tidal flow interacting between projects, due to the alignment of flood and ebb flows off the coast of Anglesey (i.e. the two projects are not upstream/downstream of each other). Similarly, any (minor) sediment plumes arising from construction from either project will not coalesce because of: (i) the alignment of principal tidal flows; and (ii) likely different construction programmes (note that phase 1 of the Holyhead Deep project is already installed). The predicted impacts of Minesto's Holyhead Deep project on coastal processes have been assessed as being not significant in their own right (Minesto, 2016), and this conclusion is considered equally valid when both projects are considered in combination.	Scoped out of CIA
Changes to the wave regime due to the presence of structures in the Project		Scoped out of CIA
Changes to the sediment transport regime due to the presence of structures in the Project		Scoped out of CIA
Loss of sea bed morphology due to the footprint of structures in the Project		Scoped out of CIA
Morphological and sediment transport effects due to cable protection measures for offshore export cables (including nearshore and at the coastal landfall)		Scoped out of CIA
Morphological and sediment transport effects due to cable protection measures for inter-array cables		Scoped out of CIA

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Changes in sea bed level (morphology) due to maintenance during maintenance in the Project		Scoped out of CIA
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be no worse than those identified during the construction stage.		

26.5.3. Marine Water and Sediment Quality

37. The only project which could potentially have a cumulative or in-combination effect with the MDZ Project in respect of marine water and sediment quality is judged to be Minesto's Holyhead Deep project. All other projects listed are either too remote from the Project for interactions between water/sediment quality impacts or onshore and do not affect the marine environment.

38. **Table 26-4** provides a summary of the CIA outcomes for marine water and sediment quality.

39. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

Table 26-4 Potential Cumulative Impacts Identified for Marine Water and Sediment Quality

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Change in water quality due to sediment plume generated via foundation installation	Based upon the geographical configuration of the Minesto PDA with respect to the Project, there is no possibility of changes in tidal flow interacting between projects, due to the alignment of flood and ebb flows off the coast of Anglesey (i.e. the two projects are not upstream/downstream of each other). Similarly, any (minor) sediment plumes arising from construction from either project will not coalesce because of: (i) the alignment of principal tidal flows; and (ii) likely different construction programmes (note that phase 1 of the Holyhead Deep project is already installed).	Scoped out of CIA
Change in water quality due to sediment plume generated via cable installation		Scoped out of CIA
Change in water quality due to release of contaminated sediments		Scoped out of CIA
Deterioration in status of WFD waterbodies and/or local designated bathing waters		Scoped out of CIA
Change in water quality due to discharge of construction material and/or chemicals	If construction activities were to occur simultaneously on both projects, which could produce a cumulative impact via spill events and accidental discharges of liquids/materials. If this cumulative impact occurred, a significant adverse impact on local marine water quality could be produced. However, both projects would independently adopt standard best practice measures with respect to spill prevention and response and as such, the	Scoped out of CIA

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	significance of this potential cumulative impact would be reduced to a negligible level.	
Operation		
Change in water and/or sediment quality due to accidental spillages/leaks from operational devices	There is no possibility of changes interacting between projects, due to the alignment of flood and ebb flows off the coast of Anglesey (i.e. the two projects are not upstream/downstream of each other).	Scoped out of CIA
Change in water sediment quality due to sediment plumes generated by repowering and/or cable repair works		Scoped out of CIA
Change in water sediment quality due to sediment plumes produced via scour around seabed mounted project infrastructure		Scoped out of CIA
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be no worse than those identified during the construction stage.		

26.5.4. Benthic and Intertidal Ecology

40. As observed within **Chapter 9, Benthic and Intertidal Ecology**, the majority of impacts which are associated with benthic ecology are restricted to the immediate footprint of the Project. Therefore, it is only projects that will affect the same area of seabed, or more generally, the same local resource of benthic habitats that require consideration. The only identified project is Minesto's Holyhead Deep project.

41. **Table 26-5** provides a summary of the CIA outcomes for benthic and intertidal ecology.

42. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

Table 26-5 Potential Cumulative Impacts Identified for Benthic and Intertidal Ecology

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Physical disturbance to habitats and species and temporary habitat loss	Construction activities of the Project with the Minesto project may overlap on a temporal scale as the construction and installation of the Minesto project is following a phased approach and their seabed footprints should be considered in the overall footprint of habitat loss in the region. In comparison to the amount of comparable habitat identified in the survey area, the overall area of habitat that will be impacted	Scoped out of CIA

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	by the Minesto project and the Project is small and it is predicted that no significant impacts should occur.	
Increased suspended sediment concentration and sediment deposition	The combined impact of the construction activities from the two projects presents a greater risk of elevated suspended sediment concentrations beyond what has been predicted for each individual project. However, there is no possibility of changes in tidal flow interacting between projects, due to the alignment of flood and ebb flows off the coast of Anglesey (i.e. the two projects are not upstream/downstream of each other). The predicted impacts of Minesto's Holyhead Deep project on coastal processes have been assessed as being not significant in their own right (Minesto, 2016), and this conclusion is considered equally valid when both projects are considered in combination.	Scoped out of CIA
Pollution of water and sediment through accidental events	If this cumulative impact occurred, a major adverse impact on local benthic and intertidal ecology could be produced. However, both projects would independently adopt standard best practice measures with respect to spill prevention and response and as such, the significance of this potential cumulative impact would be reduced to a negligible level.	Scoped out of CIA
Physical disturbance to intertidal habitats and species during landfall works	As described above, in comparison to the amount of comparable habitat identified in the survey area, the overall area of habitat that will be impacted by the Minesto project and the Project is small and it is predicted that no significant impacts should occur. Further, Minesto and Morlais may in future investigate options to share the landfall infrastructure; which could reduce the combined footprint of both projects and ensure that any habitat loss associated is kept to a minimum.	Scoped out of CIA
Potential spread of non-native	Although there is an increased risk of the introduction of Invasive Non-Native Species (INNS) to the marine environment due to an increased amount of vessel traffic in the area and thus an increased window of opportunity, if all projects abide to similar mitigation measures and follow relevant guidelines then the probability should remain low. Therefore, the likelihood of simultaneous construction cumulatively impacting vulnerable benthic communities and receptors within the wider area is extremely low and is considered not significant.	Scoped out of CIA
Operation		

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Long term loss of benthic habitat via placement of project infrastructure	In comparison to the amount of comparable habitat identified in the survey area, the overall area of habitat that will be impacted by the Minesto project and the Project is small and it is predicted that no significant impacts should occur. Further, Minesto and Menter Môn may in future investigate options to share the future export cable; which could reduce the combined footprint of both projects and ensure that any habitat loss associated is kept to a minimum.	Scoped out of CIA
Changes in hydrodynamic and inter-related effects on benthic ecology	It is unlikely that there will be a significant alteration to the hydrodynamics in a regional context. Due to both of these projects being situated within areas of hard substrate and low levels of soft sediments, it is unlikely that scour pits will form around either projects infrastructure, and thus unlikely for an interaction to occur between the two projects.	Scoped out of CIA
Introduction of new habitat in the form of project infrastructure	Both the Project and the Minesto project involve introduction of hard substrate into a marine environment, which presents a risk of colonisation, inward migration and the settlement of species. Further, this hard substrate presents a substrate which could be utilised by INNS. However, as both of these projects are located within predominately hard substrate areas, the effects of possible colonisation of the infrastructure will not be as pronounced as those which would occur if the infrastructure was to be placed within soft sediments, as this would lead to the colonisation of an environment by species which are not typically found in this area. Further, due to the large level of available natural hard substrate (stony reef, bedrock etc), a large sink will occur to these readily available habitats. The current dominance of hard substrates within the MDZ and the wider region suggests additional hard substrate through infrastructure will not present a vastly different environment for INNS than already within the region. Therefore, it is unlikely that the new infrastructure and additional hard substrates within the region will lead to a significant impact.	Scoped out of CIA
Temporary physical disturbance of seabed caused by maintenance and repowering activities	The small scale of impact that this has on the environment within the MDZ and the Minesto project makes them unlikely to interact with each other.	Scoped out of CIA
Decommissioning		

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be no worse than those identified during the construction stage.		

26.5.5. Fish and Shellfish Ecology

43. The majority of impacts on fish and shellfish associated with the Project have a spatial extent that is limited to the site and the immediate surroundings. As such it is only projects that will affect the immediate local environment that shall be screened in for consideration. A nominal buffer of ~20 km has been chosen as a worst case maximum extent over which impacts may overlap i.e. accumulate. Any projects beyond 20 km are screened out of this CIA on the basis that they are beyond the spatial extent of impacts from the Project. In addition, any projects that do not involve any construction in the marine environment have also been screened out.

44. Migratory fish have the potential to be impacted at distances greater than non-migratory fish. However, as the cumulative impacts on Annex II migratory fish are assessed as part of the HRA and presented in the Information to Support HRA (see **Document MOR/RHDHV/DOC/0067, Information to Support HRA**) they are not included here.

45. The projects taken forward for this CIA are presented in **Chapter 10, Fish and Shellfish Ecology**. **Table 26-6** provides a summary of the CIA outcomes for fish and shellfish ecology.

46. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

Table 26-6 Potential Cumulative Impacts Identified for Fish and Shellfish Ecology

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Underwater noise	The production of underwater noise from the Wylfa decommissioning project will only arise during the potential explosive decommissioning of the cooling water jetty and associated infrastructure. The underwater noise produced by explosive detonations is typically of high intensity and short duration (<1 second). The noise from underwater explosions in itself can cause mortality in the immediate area and effects at a range of up to 350 m. There is little information on the sub-lethal impacts in fish from explosions. Due to the short temporal scale (single explosion per piece of infrastructure) of the underwater noise produced during the Wylfa decommissioning it is considered unlikely to cause any added impact	Negligible

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	above the level of impact that may arise during the Project. Marine works associated with the construction of Wylfa Nuclear Power Plant will include both permanent and temporary works. The Project Description states that "*the majority of works will be undertaken within the first two years of the Project's construction phase, though certain works may take up to five years to complete*". As the project is in suspension it is uncertain when or if these works will occur. The Project Description has identified the activities that may generate underwater noise as including drilling, piling (vibratory piling hammer), dredging, rock breaking, vessel noise. Of these, it can be expected that piling using the hydraulic drop hammer would produce the greatest amount of underwater noise. It has not been possible to ascertain any ranges of underwater noise impacts from the construction activities from Wylfa Nuclear Power Plant. If it can be assumed that the piling will produce underwater noise of a similar level to that produced by the current Project, then there is no pathway for overlap of the zone of influence of underwater noise. Indeed, even if the noise levels were higher, it is deemed highly unlikely that the zone of influence would exceed the 17.5 km distance between the two projects. Furthermore, the deposition of dredge material at the Holyhead North dredge site as part of the Wylfa Newydd project will also produce underwater noise. Little is known about the underwater noise generated from deposition at sea therefore as a worst-case scenario the sound levels from cutter suction dredging were used in the Horizon Nuclear Disposal site characterisation report. For the sound levels produced by cutter suction dredging, the maximum range for injury to fish was modelled to be 2 m, and the maximum range of Temporary Threshold Shift (TTS) was 13 m. Based on these distances there is no spatial overlap of the acoustic zones of influence produced by the two projects. It is not known when the activities creating underwater noise from the other Projects will occur. Therefore, for the purpose of this assessment, the worst-case scenario of complete temporal overlap between the noise-producing activities of the identified projects and each phase of the Project has been assumed. Following the measurements given above and taking into account the maximum impact range	

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	of worst-case noise produced during the Project activities (50 m, during construction; see Table 10.21), it can be concluded that there will be no overlap between the acoustic footprints of the Project with other projects and plans in the area. Furthermore, the footprint over which there will be elevated noise levels is small and represents only a small portion of the greater area available to fish and shellfish species. Therefore, the cumulative impacts from the underwater noise pathway are considered not significant.	
Physical disturbance of habitats and temporary habitat loss	The current Project represents 2,184,932 m^2 (2.18 km^2) of permanent subtidal habitat loss during the lifetime of the Project in addition to temporary habitat loss which is anticipated to have a maximum total of 423,499 m^2 (0.42 km^2) during each of the construction and decommissioning phase, and 127,000 m^2 (0.12 km^2) during the operational phase. The seabed footprint of marine infrastructure associated with the existing Power Station at Wylfa is very small as it comprises a single jetty not more than 150 m long. The marine works as part of the construction of the Wylfa Newydd project are in a similar location, adjacent to the coast at Wylfa on the north Anglesey coast, and are also considered small (extending a maximum of 3 km into the marine zone). Due to the small area and distance from the site it is considered that the cumulative impact of habitat disturbance and loss from these project activities on north Anglesey will have a negligible effect. In addition to construction the Wylfa Newydd project involves dredge disposal at a large site nearer to the MDZ. As part of the plume dispersion modelling, a worst-case scenario of maximum extent of deposition on the seabed (at a thickness of 1 cm) was a total area of 1.8 km^2. This value can also be utilised to represent the maximum habitat loss in the area. In comparison to the amount of comparable habitat identified in the survey area, the overall area of habitat that will be impacted by the additional seabed activities will be small and it is predicted that no significant cumulative impacts should occur.	Negligible
Increased suspended sediment concentration and sediment deposition	The decommissioning work of the existing Wylfa Power Station that are in the marine environment, i.e. the explosive demolition of the jetty, has been identified as having the potential to result in "*substantially elevated levels of suspended sediment in the water column,*	Negligible

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	possibly resulting in smothering of sensitive habitats and species". NRW requested that sediment transport modelling be conducted to predict effects, although it is uncertain if this was undertaken and no evidence of this has been found online. As part of the Environmental Statement produced for the application for the Wylfa Newydd Project a detailed assessment of the sediment regime in the area was undertaken. The results can be used to inform the potential extent of impacts from the decommissioning activity of the existing Wylfa Power Station as they are in the same location. The Environmental Statement details that, despite the high amount of wave energy, "*sediment movement is essentially limited to individual bays as rock platforms and headlands provide barriers (natural groynes)*" this prevents the movement of sediment. On this basis it is possible to infer that any increased sediment suspension as a result of marine activities in the Wylfa area will not extend as far as the Project, which is situated 17.5 km away. Dredge disposal at the Holyhead North/Deep site as part of the Wylfa Newydd project also has the potential to cause localised increase in sediment concentrations and deposition. Modelling of the environmental change and effects on fish and shellfish lead to a conclusion of negligible magnitude, a worst-case medium sensitivity of the receptor (due to commercial fish), and therefore an overall negligible impact due to increased suspended sediment concentration. Similarly, the report concluded a negligible effect on fish and shellfish receptors from smothering due to the negligible magnitude of effect (due to mortality or displacement) and the medium value/sensitivity of the receptor. It was expected that all resuspended sediment would remain wholly contained within the disposal site. Due to the minor adverse impact of increased sediment resulting from the Project, coupled with the negligible effect of the sediment pathways on fish and shellfish concluded from the only nearby project, and the lack of spatial overlap of effects, it can be concluded that the cumulative impacts from increased sediment will not be significant.	
Operation		
Underwater Noise	As per construction	Negligible

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Long-term habitat loss via placement of project infrastructure (project footprint)	As per construction	Negligible
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be no worse than those identified during the construction stage.		

26.5.6. Marine Ornithology

47. The potential effects from the project that were screened in for assessment for the Project alone were further screened for the potential for cumulative effects with other projects. This process is outlined in **Table 26-7.**

Table 26-7 Potential Cumulative Impacts Identified for Marine Ornithology

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Airborne noise and visual disturbance	The likelihood that there would be a cumulative impact is low because the impact as a result of the project occurs on a small spatial scale and it is dependent on a spatial coincidence of disturbance / displacement from other plans or projects. However, one such project has been identified, therefore a more detailed assessment will be carried out for construction and operational impacts.	Negligible
Disturbance at breeding sites	The likelihood that there would be a cumulative impact is very low because it would be dependent on a spatial co-incidence of disturbance / displacement from other plans or projects during either construction or operation of the project, of which none have not been identified.	Scoped out of CIA
Other impacts	The likelihood that there would be a cumulative impact is very low because the impact as a result of the project occurs on a small spatial scale and it is dependent on a temporal and spatial co-incidence of similar impacts from other plans or projects, of which none have not been identified or are considered likely.	Scoped out of CIA
Operation		
Collision risk with tidal devices	There is a sufficient likelihood of a cumulative impact to justify a quantitative cumulative impact assessment during the operational period of the project. Cumulative impact due to collision risk from offshore wind farms has been screened out, as the collision risk to species as a result of the	Minor Adverse, not significant

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	project that are also susceptible to collision with wind turbines (i.e. gannet) is very low (<3 birds per year under all deployment scenarios). All other species assessed as being at risk of collision during the operation of the project are known not to be susceptible to collision with wind turbines.	
Entanglement with tidal devices	The likelihood that there would be a cumulative impact is very low because the impact as a result of the project is small in scale and magnitude, especially when compared to the wider issue of seabird bycatch.	Scoped out of CIA
Other impacts	The likelihood that there would be a cumulative impact is very low because the impact as a result of the project occurs on a small spatial scale and it is dependent on a temporal and spatial co-incidence of similar impacts from other plans or projects, of which none have not been identified or are considered likely.	Scoped out of CIA
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be no worse than those identified during the construction stage.		

48. Two potential effects, airborne noise and visual disturbance, and collision risk (excluding offshore wind farms), were screened in for cumulative assessment.

49. For airborne noise and visual disturbance, only projects occurring locally that involve activities in subtidal habitat are considered to have the potential to cause cumulative impacts in conjunction with the Project (**Table 26-8**). Any projects which have been ongoing since the collection of baseline data (e.g. Holyhead Harbour Maintenance Dredging) are not considered on the basis that they form part of the baseline.

50. Only other marine energy projects (i.e. those with contributions to underwater collision risk) are considered to have potential to contribute to cumulative collision risk (**Table 26-8**). Cumulative impact due to collision risk from offshore wind farms has been screened out, as the collision risk to species as a result of the Project that are also susceptible to collision with wind turbines (i.e. gannet) is very low (approximately zero to three birds per year based on a 240 MW deployment), and the reference population very large (**Chapter 11, Marine Ornithology**).

Table 26-8 Summary of Projects Considered in CIA for Airborne Noise and Visual Disturbance Impact Pathway and Underwater Collision Risk Impact Pathway

Project	Status	Impact Pathway	Data Status	Justification for Inclusion
Holyhead Deep Phase I	Marine Licence was granted for the first 0.5 MW installation of the 10MW project	Airborne noise and visual disturbance	Complete for marine ornithology receptors	Consented project that does not yet form part of the baseline

Project	Status	Impact Pathway	Data Status	Justification for Inclusion
		Collision risk with tidal devices		
Holyhead Deep Phase II (80MW)	Scoping Report submitted in 2017	Airborne noise and visual disturbance Collision risk with tidal devices	No information available	Possible project that does not yet form part of the baseline
Holyhead Port Expansion	Scoping Report submitted 28/04/17	Airborne noise and visual disturbance	Draft, unpublished assessment available	Possible project that does not yet form part of the baseline
Bardsey Sound	An Agreement for Lease was awarded pre-May 2018. The project would include ten 100 kW turbines	Collision risk with tidal devices	None available	Possible project that does not yet form part of the baseline
Argyll Tidal Demonstration	Marine licence secured in 2015, status of works unknown	Collision risk with tidal devices	Complete for marine ornithology receptors	Consented project that does not yet form part of the baseline
Fair Head Marine Renewable Tidal Array	Environmental Statement presented. Target to be operational by 2021	Collision risk with tidal devices	Complete for marine ornithology receptors	Consented project that does not yet form part of the baseline
Sound of Islay Demonstration Site	Consented – construction programme not known	Collision risk with tidal devices	Complete for marine ornithology receptors	Consented project that does not yet form part of the baseline
West Islay Tidal Energy Farm	Consented – construction programme not known but scheduled for completion by 2022	Collision risk with tidal devices	Complete for marine ornithology receptors	Consented project that does not yet form part of the baseline

51. Potential cumulative effects are predicted for airborne noise and visual disturbance, and collision risk (excluding offshore wind farms) for the projects included in **Table 26-8**, but as summarised in **Table 26-7,** these are anticipated to be **negligible** to **minor adverse**, respectively.

52. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

26.5.7. Marine Mammals

53. The potential effects from the project that were screened in for assessment for the project alone were further screened for the potential for cumulative effects with other projects. This process is detailed in **Table 26-9.**

Table 26-9 Potential Cumulative Impacts Identified for Marine Mammals

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Underwater noise and disturbance	There is the potential for cumulative impacts from underwater noise, such as construction activities and vessels from other projects which could have a cumulative impact on marine mammals. There is no potential for cumulative impacts for auditory injury as MMMPs for each project will reduce the risk of PTS and therefore any potential cumulative impacts. Changes in prey availability as a result of any potential disturbance from underwater noise would be less that areas of potential impact assessed for marine mammals and would therefore have no further potential cumulative impacts.	Negligible for all species except for grey seal where CIA impact significance is Minor Adverse, not significant.
Potential barrier effects	It has been identified that there is no potential for cumulative barrier impacts with other projects, based on the location and distances of the projects.	Scoped out of CIA
Disturbance at seal haul-out sites	No projects have been identified that have the potential for cumulative impacts on the seal haul-out site near the MDZ and ECC.	Scoped out of CIA
Increased collision risk with vessels	There is the potential for an increased risk of collision with vessels from a number of different projects, and therefore a more detailed assessment will be carried out for construction, operation and decommissioning impacts of other projects.	Minor Adverse, not significant
Potential changes in water quality	There is no potential for any changes to water quality to impact on marine mammal species in and around the MDZ and ECC, therefore there is no potential for cumulative impacts with other projects.	Scoped out of CIA
Potential changes in prey availability from habitat loss	There is the potential for changes to prey availability to impact on marine mammal species from a number of other projects, therefore a more detailed assessment will be carried out for construction, operation and decommissioning impacts of other projects.	Negligible to Minor Adverse, not significant
Collision risk with tidal devices	It has been identified that there is the potential for collision risk from tidal devices from at least one other project, and therefore a more detailed assessment will be carried out for the operational impacts of other projects.	Minor Adverse, not significant

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Potential entanglement with moorings for floating devices	As no instances of entanglement with the mooring systems of renewable energy have been recorded, and the constant tension of the mooring line for the Holyhead Deep Phase I, the impact was concluded to be negligible for harbour porpoise, bottlenose dolphin, Risso's dolphin, common dolphin and grey seal, and low for minke whale. Taking into account the assessment of potential entanglement at MDZ there is no predicted cumulative effects	Scoped out of CIA
Potential EMF impacts	It has been identified that there is no potential for EMF impacts to marine mammal species.	Scoped out of CIA
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be no worse than those identified during the construction stage.		

54. Any projects which have been ongoing since the collection of baseline data (e.g. Holyhead Harbour Maintenance Dredging) are considered part of the baseline.

55. The projects identified have only been assessed for those species that are within the identified Management Unit that is included in the assessments. An indication has been made as to which marine mammal species each Project with the potential for cumulative impact has been included for within **Chapter 12, Marine Mammals**.

56. A summary of projects considered for CIA and their potential for cumulative impacts is presented in **Table 26-10**.

57. A summary of the impact significance for potential cumulative impacts on each species is presented in **Table 26-11**.

Table 26-10 Summary of Projects Considered in CIA and Potential for Cumulative Impacts

Project	Status	Species MU area	Distance from OfDA (km)	Potential for Cumulative Impacts			
				Underwater noise and disturbance	Collision risk from vessels	Collision risk from tidal devices	Changes to prey availability
Holyhead Deep Phase I	In April 2017, a Marine Licence was granted for the first 0.5 MW installation.	All	2	Yes	Yes	Yes	No
Holyhead Deep Tidal Array	In 2017, scoping report submitted for an 80MW extension to the Holyhead Deep tidal array.	All	2	Yes	Yes	Yes	Yes
Holyhead Port Expansion	ES currently being prepared	All	2	Yes	Yes	N/A	Yes
Holyhead Waterfront Regeneration	Awarded Outline Planning Permission in 2014, with Reserved Matters.	All	2	Yes	Yes	N/A	No
Wylfa Nuclear Power Plant	Project Suspended	All	17	Yes	Yes	N/A	Yes
Wylfa Decommissioning	Ongoing (most work on land)	All	17	Yes	Yes	N/A	Yes
Amlwch LNG	The existing consent was renewed in 2013, but future plans are unclear and timescales undefined.	All	20.5	Yes	Yes	N/A	No
North Hoyle Offshore Wind Farm	Operation and Maintenance Activities only.	All	81	Yes	No	N/A	No
Rhyl Flats Offshore Windfarm	Operation and Maintenance Activities only.	All	59	Yes	Yes	N/A	No
Gwynt y Môr Offshore Wind Farm	Operations and Maintenance activities only.	All	65	Yes	Yes	N/A	No
Barrow Offshore Wind Farm	Operations and Maintenance activities only.	All	116	Yes	Yes	N/A	No
West of Duddon Sands Offshore Wind Farm	Operations and Maintenance activities only.	All	114	Yes	Yes	N/A	No

Project	Status	Species MU area	Distance from OfDA (km)	Potential for Cumulative Impacts			
				Underwater noise and disturbance	Collision risk from vessels	Collision risk from tidal devices	Changes to prey availability
Ormonde Offshore Wind Farm	Operations and Maintenance activities only.	All	117	Yes	Yes	N/A	No
Walney Extension Offshore Wind Farm	Operations and Maintenance activities only.	All	114	Yes	No	N/A	No
Burbo Bank Extension Offshore Wind Farm	Operations and Maintenance activities only.	All	95	Yes	Yes	N/A	No
Codling Wind Park	Consented.	All	75	Yes	Yes	N/A	No
Codling Wind Park Extension.	Application submitted.	All	75	Yes	Yes	N/A	No
Alexandra Basin Redevelopment.	Current status unknown, but the project has been consented.	All	96	Yes	No	N/A	No
Isle of Man Ferry Terminal.	MLA/2018/00536. Marine Licence App submitted Dec 2018.	All	92	Yes	Yes	N/A	No
Milford Haven, Maintenance Dredge Pembrokeshire	Application submitted.	All	175	Yes	Yes	N/A	Yes
Afon Dysynni outfall gravel removal and relocation	Marine Licences issued and valid until 17/10/2021.	All	81	Yes	Yes	N/A	Yes
Belfast Harbour D3 terminal cruise ship facility	Application submitted, awaiting a decision.	All	163	Yes	Yes	N/A	No
Disposal of dredge material from the D3 approach channel	Application submitted, awaiting a decision.	All	163	Yes	Yes	N/A	No
Marine Energy Wales marine testing area	Scoping – Issued Nov 2018	All	175	Yes	Yes	Yes	No
Argyll Tidal Demonstration	Marine licence secured in 2015, status of works unknown	Grey and harbour seal	225	Yes	Yes	Yes	No

Project	Status	Species MU area	Distance from OfDA (km)	Potential for Cumulative Impacts			
				Underwater noise and disturbance	Collision risk from vessels	Collision risk from tidal devices	Changes to prey availability
		OSPAR MU only					
Sound of Islay Demonstration Site	Consented – construction programme not known	Grey and harbour seal OSPAR MU only	268	Yes	Yes	Yes	No
West of Islay Tidal Energy Park	Consented – construction programme not known	Grey and harbour seal OSPAR MU only	265	Yes	Yes	Yes	No
Enlli Tidal Energy Scheme, Bardsley Island	Scoping – Issued Nov 2018	All	53	Yes	Yes	Yes	Yes

Table 26-11 Assessment of Impact Significance for Potential Cumulative Impacts

Potential Cumulative Impact	Receptor	Mitigation	Residual Impact
Underwater noise and disturbance	Harbour porpoise	No further mitigation proposed	Negligible
	Bottlenose dolphin		Negligible
	Risso's dolphin		Negligible
	Common dolphin		Negligible
	Minke whale		Negligible
	Grey seal		Negligible
	Harbour seal		Negligible
Collision risk with tidal devices and vessels	Harbour porpoise	Phased deployment, monitoring and mitigation	Minor adverse
	Bottlenose dolphin		Minor adverse
	Risso's dolphin		Minor adverse
	Common dolphin		Minor adverse
	Minke whale		Minor adverse
	Grey seal		Minor adverse
	Harbour seal		Minor adverse
Displacement due to changes in prey availability as a result of habitat loss	Harbour porpoise	No mitigation required or proposed	Negligible to Minor adverse
	Bottlenose dolphin		Minor adverse
	Risso's dolphin		Minor adverse
	Common dolphin		Negligible
	Minke whale		Minor adverse
	Grey seal		Minor adverse
	Harbour seal		Negligible

58. In summary, significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

26.5.8. Offshore Archaeology

59. The only project which could potentially have a cumulative or in-combination effect with the Project in respect of offshore archaeology is judged to be Minesto's Holyhead Deep project. All other projects listed are either too remote from the Project for interactions between direct or indirect impacts or are located on land and thus do not affect the marine cultural heritage

60. **Table 26-12** provides a summary of the CIA outcomes for offshore archaeology.

Table 26-12 Potential cumulative impacts identified for Offshore Archaeology

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Based upon the geographical configuration of the Minesto PDA with respect to the Project, there is no cumulative direct impact on the known archaeological sites within the MDZ.	Scoped out of CIA
Indirect physical impacts on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Following mitigation, there are no significant impacts posed to this potential receptor by the Project. The Minesto development also identified potential palaeogeographic features, which may be impacted by development. Following mitigation advised in the Minesto ES, the impacts upon these features were considered to be not significant.	Scoped out of CIA
Operation		
Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Based upon the geographical configuration of the Minesto PDA with respect to the Project, there is no cumulative direct impact on the known archaeological sites within the Project.	Scoped out of CIA
Indirect physical impacts on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Following mitigation, there are no significant impacts posed to this potential receptor by the Project. The Minesto development likewise identified potential palaeogeographic features, which may be impacted by development. Following mitigation advised in the Minesto ES, the impacts upon these features were considered to be not significant.	Scoped out of CIA
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be no worse than those identified during the construction stage.		

26.5.9. Commercial Fisheries

61. The majority of impacts on commercial fisheries receptors associated with the Project have a spatial extent that is limited to the site and the immediate surroundings. As such it is only projects that will affect the immediate local environment that shall be screened in for consideration in the cumulative assessment. A buffer of 20 km has been chosen as a worst case maximum extent

over which impacts may overlap i.e. accumulate. Any projects beyond 20 km are screened out of this CIA on the basis that they are beyond the spatial extent of impacts from the Project. In addition, any projects that do not involve any construction in the marine environment have also been screened out.

62. On this basis, the only identified project considered within this cumulative assessment is Minesto's Holyhead Deep project which is located less than 1 km from the western boundary of the Project.

63. The main receptor groups that will potentially be affected by cumulative impacts are the <10m and >10m static gear vessels in MDZ area and the >10m mobile gear vessels in/around MDZ area.

64. The Project impact assessment along concluded that these receptor groups would be impacted during the construction phase of the MDZ, via the impacts listed above. It is assumed that the same type of impacts (disruption/loss of access to fishing grounds/collision risk etc.) will occur cumulatively if construction is carried out at the same time on the MDZ and Minesto sites.

65. **Table 26-13** provides a summary of the CIA outcomes for commercial fisheries.

Table 26-13 Potential Cumulative Impacts Identified for Commercial Fisheries

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Loss of access to fishing grounds due to construction activity	When considered in detail, even with the adverse impacts occurring at the same time, the magnitude of effect is not judged to increase to a degree that would alter the overall impact significance. This is based on the fact that the criteria for a high magnitude effect to arise on any of these receptors is an effect "that affects an area from which the majority of a commercial fishing receptor's annual value of landings is caught". Even when the MDZ and Minesto projects are considered together, any disruption/loss of access/damage to gear, will not be focused on an area that represents where the majority of a vessels annual catches are made.	Minor Adverse
Collision risk between commercial fishing vessels and construction vessels		Minor Adverse,
Obstruction to regular fishing vessel transit routes		Minor Adverse
Interference with static fishing gear due to additional vessel traffic		Minor Adverse
Supply chain opportunities for local fishing vessels	Even with two potential sources of supply chain support from the two projects, the conclusions on impact significance presented for the MDZ project alone are judged to remain valid, i.e. there will be a beneficial impact ranging from minor beneficial to moderate beneficial for the main fish receptor groups, with the most benefit potentially for >10m vessels with more capacity to work in both the Project and Minesto sites. This conclusion is presented on the basis that the amount of additional supply chain opportunities from the two projects considered	Minor Beneficial

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	together, whilst greater than for Project alone, will not be great enough to increase the significance of beneficial impact using the criteria in the impact assessment methodology, i.e. to increase the impact significance to a major beneficial impact for the >10m vessels receptor group, it would have to be assumed that the two projects together would "potentially provide a major source of revenue for a vessel and is likely to occur".	
Operation		
Collision risk between commercial fishing vessels and project infrastructure	Even with the adverse operational phase impacts occurring at the same time, the magnitude of effect is not judged to increase to a degree that would alter the overall impact significance. This is based on the fact that the criteria for a high magnitude effect to arise on any of these receptors is an effect "that affects an area from which the majority of a commercial fishing receptor's annual value of landings is caught". Even when the MDZ and Minesto projects are considered together, the area of disruption/loss of access/damage to gear from both sites combined (MDZ; 35km^2 plus Minesto leased area of 9.1 km^2 = 44.1 km^2), will not equate to the high magnitude effect criteria (an area that represents where the majority of a vessels annual catches are made).	Minor Adverse
Loss of access to fishing grounds and displacement of fishing effort onto adjacent grounds		Minor Adverse
Reduction in abundance of target species and reduced supply of catch to established local buyers		Minor Adverse
Presence of seabed fasteners		Minor Adverse
Supply chain opportunities for local fishing vessels	There will be a beneficial impact ranging from minor beneficial to moderate beneficial for the main fish receptor groups, with the most benefit potentially for >10m vessels with more capacity to work in both the Project and Minesto sites.	Minor Beneficial to Moderate Beneficial
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be no worse than those identified during the construction stage.		

66. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

26.5.10. Shipping and Navigation

67. The projects taken forward for this CIA are also presented within **Chapter 15, Shipping and Navigation**. The only project which could potentially have a cumulative or in-combination effect with the MDZ Project is judged to be Minesto's Holyhead Deep project. All other projects listed are either too remote from the Project for interactions between water/sediment quality impacts or onshore and do not affect the marine environment.

68. **Table 26-14** provides a summary of the CIA outcomes for shipping and navigation.

Table 26-14 Potential Cumulative Impacts Identified for Shipping and Navigation

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Cumulative Impact due to Increased Vessel Activity	Multiple offshore developments require construction and maintenance vessel activity as they transit to and from their bases of operation. Vessels associated with the Project and Holy Head Deep project may interact with one another. The level of additional vessel activity from each project will be higher during construction and decommissioning. This has the potential to increase collision risk.	Minor - Low Risk
Cumulative Impact from Cable Routes	Multiple cable routes that cross over one another may reduce the navigable depth of water. The cables are to be unburied with cable protection. Multiple cable routes are required for the project, which may result in a decrease in the charted depth in some areas and an increase in vessel activity during the construction and decommissioning phases.	Minor - Low Risk
Operation		
Cumulative Impact on Vessel Routing	Commercial shipping, fishing boats and recreational craft must all operate to avoid these developments and any works taking place. This reduces the available sea room available, concentrating them in smaller areas, potentially bringing them into conflict. The cumulative impact of these developments will result in a loss of navigable sea room which may require vessels to be rerouted which has the potential to increase the risk elsewhere. Primary cumulative impacts to routeing are the inshore passage and impact upon vessels such as ferries utilising the northern ferry route, search and rescue and Holyhead Deep maintenance vessels.	Minor - Low Risk
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be no worse than those identified during the construction stage.		

69. In summary, significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

26.5.11. Infrastructure and Other Users

70. Following a review of information currently available in the public domain, it can be identified that there is a potential for cumulative or in-combination impacts with the Deep Green Holyhead Deep Phase I and subsequently Phase II tidal projects, which neighbours the Project to the west.

71. It is likely that the Project and Minesto project will be operational simultaneously. As the leased areas for both projects overlap the current licenced area of the Holyhead Deep IS040 disposal site it may face cumulative impacts from the two projects.

72. The EIA for the Deep Green Holyhead Deep Project Phase I (Minesto, 2016) states that disposal site ISO40 has infrequent use across the area and identifies that the disposal site boundary is likely to be re-designated, and possibly reduced in size by 50 %. Minesto (2016) suggest that if ISO40 is reduced in size the operational phases of the two projects will not affect activities at and users of the disposal site. If this disposal site is not redesignated then there will be no pathway for a cumulative impact upon this receptor.

Table 26-15 Potential Cumulative Impacts Identified for Infrastructure and Other Users

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Disruption of ongoing Ministry of Defence (MOD) activities	It is possible that during construction of these projects, the presence of increased vessel activity in the area could result in some minor interference to vessels going to and from the disposal site, however the mitigation proposed in **Chapter 15, Shipping and Navigation** will manage vessel activity to ensure impacts are not significant.	Negligible
Interaction with UXO		Negligible to Minor Adverse
Interaction with active telecommunication cables		Negligible
Operation		
Disruption of ongoing MOD activities	It is possible that during construction of these projects, the presence of increased vessel activity in the area could result in some minor interference to vessels going to and from the disposal site, however the mitigation proposed will manage vessel activity to ensure impacts are not significant.	Negligible
Interaction with active telecommunication cables		Negligible
Decommissioning		
Disruption of ongoing MOD activities	It is possible that during construction of these projects, the presence of increased vessel activity in the area could result in some minor interference to vessels going to and from the disposal site, however the mitigation proposed will manage vessel activity to ensure impacts are not significant.	Negligible
Interaction with UXO		Negligible to Minor Adverse

26.5.12. Water Resources and Flood Risk

73. Projects taking place in the marine areas surrounding Holy Island and Anglesey have been scoped out due to the limited potential for impacts to act cumulatively between marine and terrestrial freshwater bodies. The projects screened in are presented in **Chapter 17, Water Resources and Flood Risk**.

74. **Table 26-16** provides a summary of the CIA outcomes for water resources and flood risk.

75. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

Table 26-16 Potential Cumulative Impacts Identified for Water Resources and Flood Risk

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Direct disturbance of surface water bodies	The small scale of the landfall and grid connection substation, together with the spatial overlap from projects identified in **Appendix 26.1** (**Volume III**), mitigation measures to prevent the supply of sediment and contaminants during construction mean that there are not considered to be any cumulative impacts associated with projects.	Negligible
Increased sediment supply		Negligible
Accidental release of contaminants		Negligible
Disruption of groundwater levels and flows		Negligible
Changes surface water runoff and flood risk		Negligible
Operation		
Changes to Surface Water Runoff, Groundwater Flows and Flood Risk	The small scale of the landfall and grid connection substation, together with the spatial overlap from projects identified in **Appendix 26.1** (**Volume III**), extensive mitigation measures to prevent the supply of sediment and contaminants during construction mean that there are not considered to be any cumulative impacts associated with projects.	Negligible
Supply of fine sediment and other contaminants		Negligible
Decommissioning		
Contractual details relating to decommissioning are yet to be finalised, however the ultimate responsibility for the decommissioning of the general onshore electrical infrastructure will lie with Menter Môn. At this stage, this is expected to consist primarily of removal of the onshore substation.		

26.5.13. Ground Conditions and Contamination

76. The projects screened in are presented in **Chapter 18, Ground Conditions and Contamination.**

77. **Table 26-17** provides a summary of the CIA outcomes for Ground Conditions and Contamination.

78. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

Table 26-17 Potential Cumulative Impacts Identified for Ground Conditions and Contamination

<table>
<tr><th>Potential Impact</th><th>Rationale for Cumulative Impact</th><th>Cumulative Impact Significance</th></tr>
<tr><td colspan="3">Construction</td></tr>
<tr><td>Impacts on designated geological sites</td><td rowspan="7">Overlapping proposed project boundaries may result in impacts of a direct and/or indirect nature on geology, controlled waters, human health and ground conditions, however, due to incorporation of a Construction Environmental Management Plan (CEMP) and the nature of the development, there will be no cumulative impacts on geology and ground conditions
Due to the distance from most projects no cumulative effects on onshore ground conditions or contamination likely.
Where projects do overlap spatially it is assumed that they will be constructed with relevant mitigation measures embedded within their design. These measures should prevent significant adverse impacts on ground conditions or contamination occurring as a result, therefore it is considered that there is no pathway for cumulative impacts.</td><td>Negligible</td></tr>
<tr><td>Impacts on Groundwater Quality in the Superficial Secondary Aquifers During Earthwork Activities</td><td>Negligible</td></tr>
<tr><td>Impacts on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from HDD</td><td>Negligible</td></tr>
<tr><td>Impact on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from Piling</td><td>Negligible</td></tr>
<tr><td>Impact on Surface Waters from Contamination of Groundwaters and Subsequent Discharge</td><td>Negligible</td></tr>
<tr><td>Impacts to Human Health</td><td>Negligible</td></tr>
<tr><td>Impacts on Controlled Waters as a Result of Construction Activities</td><td>Negligible</td></tr>
<tr><td colspan="3">Operation</td></tr>
<tr><td colspan="3">There are unlikely to be any significant cumulative impacts from the operation of the project.</td></tr>
<tr><td colspan="3">Decommissioning</td></tr>
<tr><td colspan="3">The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage.</td></tr>
</table>

26.5.14. Onshore Ecology

79. Projects taking place in the marine areas surrounding Holy Island and Anglesey have been scoped out of this chapter due to the limited potential for impacts to act cumulatively between marine and terrestrial ecology. The projects screened in are presented in **Chapter 19, Onshore Ecology**.

80. **Table 26-18** provides a summary of the CIA outcomes for onshore ecology.

81. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

Table 26-18 Potential cumulative impacts identified for Onshore Ecology

<table>
<tr><th>Potential Impact</th><th>Rationale for Cumulative Impact</th><th>Cumulative Impact Significance</th></tr>
<tr><td colspan="3">Construction</td></tr>
<tr><td>Habitat loss or disturbance of features of statutory designated nature conservation sites</td><td rowspan="5">There is not anticipated to be a significant impact to ecological connectivity to and therefore there is not anticipated to be a cumulative impact.
Due to the distance from the Project works area and most other projects will by default construct sympathetically with the ecological interest features of its own site and that the Project does not anticipate an impact on this site, impacts are likely to be highly localised to each project, and therefore will not act cumulatively with each other.
Overlapping proposed project boundaries may result in impacts on terrestrial habitats
Due to the Project being constructed on poor semi improved grassland which is not of significant ecological value or an important location for chough or notable flora or fauna species, and the project will avoid more sensitive features such as marshy grassland and woodland, there is not anticipated to be a significant cumulative impact.</td><td>Negligible</td></tr>
<tr><td>Habitat loss or disturbance of features of non-statutory designated nature conservation sites</td><td>Negligible</td></tr>
<tr><td>Habitat loss (grasslands, wetland habitat, hedgerow)</td><td>Negligible</td></tr>
<tr><td>Habitat loss, disturbance or killing of protected species</td><td>Negligible</td></tr>
<tr><td>Spread of non-native invasive species</td><td>Negligible</td></tr>
<tr><td colspan="3">Operation</td></tr>
<tr><td>Disturbance to foraging and commuting routes for bats</td><td>Impact to species due to other projects may increase the cumulative impacts to species.
There is not anticipated to be a significant impact to foraging and commuting routes and therefore there is not anticipated to be a cumulative impact.</td><td>Negligible</td></tr>
<tr><td colspan="3">Decommissioning</td></tr>
<tr><td colspan="3">The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage.</td></tr>
</table>

26.5.15. Onshore Archaeology

82. In terms of onshore archaeology and cultural heritage, any new developments within the locality of the landfall or grid connection substations could result in a cumulative indirect impact upon the setting of certain heritage assets. None of the projects identified in **Appendix 26.1** (**Volume III**) have been considered to cause this cumulative impact, as detailed in **Chapter 20, Onshore Archaeology and Cultural Heritage**.

26.5.16. Noise and Vibration

83. All offshore cumulative projects were scoped out of the noise and vibration CIA, as it was assumed that the potential for significant impacts to occur in combination with the onshore aspects considered in this assessment was minimal.

84. The projects considered in the CIA included those on Holy Island only, as due to the geography of the area is it not considered that traffic associated with projects elsewhere in North Wales would impact upon roads on Holy Island. Cumulative road traffic noise impacts may occur where the same road network will be used for multiple projects, plans or activities.

85. **Table 26-19** provides a summary of the CIA outcomes for noise and vibration.

86. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

Table 26-19 Potential Cumulative Impacts Identified for Noise and Vibration

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Construction phase Noise and vibration	Multiple projects could lead to increases in noise and vibration, human health and ecological impacts at receptors. If a temporal overlap of the construction phases were to occur, it is anticipated that the cumulative project would employ best-practice methods to minimise noise generated during construction, as recommended for the Project. With the implementation of these measures, significant cumulative noise impacts have limited potential to occur. Due to the separation distance, cumulative construction phase noise impacts would not be expected to occur.	Negligible
Construction phase road traffic noise	Multiple projects could lead to increases in traffic flows which may lead to impacts at human and ecological receptors. The Project will generate the largest amount of traffic during the construction phase, which is temporary in nature, and therefore the potential for any significant impacts to occur would be limited to a relatively short duration.	Negligible
Operation		
Operational phase noise and vibration	There are not anticipated to be any substantial noise and vibration sources or traffic movements generated during the operational phase that would give rise to significant cumulative impacts at human or ecological receptors.	Negligible
Operational phase road traffic emissions		Negligible
Decommissioning		

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Decommissioning phase noise and vibration	There are not anticipated to be any substantial noise and vibration sources, or traffic movements generated during the decommissioning phase that would give rise to significant cumulative impacts at human or ecological receptors.	Negligible
Decommissioning phase road traffic noise		Negligible

26.5.17. Air Quality

87. All offshore cumulative projects were scoped out of the air quality CIA, as it was assumed that the potential for significant impacts to occur in combination with the onshore aspects considered in this assessment was minimal.

88. The projects considered in the CIA included those on Holy Island only, as due to the geography of the area is it not considered that traffic associated with projects elsewhere in North Wales would impact upon roads on Holy Island. Cumulative road traffic emission impacts may occur where the same road network will be used for multiple projects, plans or activities.

89. Dust impacts during construction may occur within 350 m of a project boundary; therefore, cumulative impacts may occur where two or more projects are within 700 m of each other, and where there is a temporal overlap between construction phases.

90. **Table 26-20** provides a summary of the CIA outcomes for air quality.

91. Given that the predicted traffic flows associated with the construction of the Project were well below the relevant screening criteria, and the relatively low baseline (background) air pollution concentrations in the area, it is not anticipated that additional traffic associated with cumulative projects would give rise to a significant air quality impact at receptors. Furthermore, the Project will generate the largest amount of traffic during the construction phase, which is temporary in nature, and therefore the potential for any significant impacts to occur would be limited to a relatively short duration.

92. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

Table 26-20 Potential Cumulative Impacts Identified for Air Quality

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Construction phase dust emissions	Multiple projects could lead to increases in dust soiling, human health and ecological impacts at receptors. If a temporal overlap of the construction phases were to occur, it is anticipated that the cumulative project would employ best-practice methods to minimise dust generated during construction, as recommended for the Morlais project. With the	Negligible

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	implementation of these measures, significant cumulative dust impacts have limited potential to occur.	
Construction phase road traffic emissions	Multiple projects could lead to increases in traffic flows which may lead to impacts at human and ecological receptors. The Project will generate the largest amount of traffic during the construction phase, which is temporary in nature, and therefore the potential for any significant impacts to occur would be limited to a relatively short duration.	Negligible
Operation		
Operational phase dust emissions	There are not anticipated to be any substantial dust emission sources or traffic movements generated during the operational phase that would give rise to significant cumulative impacts at human or ecological receptors.	Negligible
Operational phase road traffic emissions	There are not anticipated to be any substantial dust emission sources or traffic movements generated during the operational phase that would give rise to significant cumulative impacts at human or ecological receptors.	Negligible
Decommissioning		
Decommissioning phase dust emissions	There are not anticipated to be any substantial dust emission sources or traffic movements generated during the decommissioning phase that would give rise to significant cumulative impacts at human or ecological receptors.	
Decommissioning phase road traffic emissions	There are not anticipated to be any substantial dust emission sources or traffic movements generated during the decommissioning phase that would give rise to significant cumulative impacts at human or ecological receptors.	

26.5.18. Traffic and Transport

93. All offshore cumulative projects were scoped out of the traffic and transport CIA, as it was assumed that the potential for significant impacts to occur in combination with the onshore aspects considered in this assessment was minimal.

94. It can be noted in **Chapter 23, Traffic and Transport** that the proposed traffic flows via the road links to Holy Island (the A5 and A55) are below GEART screening thresholds and are therefore, assessed to result in no discernible or negligible environmental impacts. Therefore, all projects elsewhere in North Wales offshore are scoped out of the traffic and transport CIA. The projects considered in the CIA therefore included those on Holy Island only. **Table 26-21** provides a summary of the CIA outcomes for traffic and transport.

95. No projects were taken forward for CIA. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider

study area. This is applicable throughout the lifecycle of the Project, as the key impact pathways may arise during all phases (construction through to decommissioning).

Table 26-21 Potential Cumulative Impacts Identified for Traffic and Transport

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Road Safety	It has been demonstrated that there are no inherent safety issues within the traffic and transport study area.	Negligible
Pedestrian/ Cycle Amenity	Multiple projects could lead to increases in traffic flows which may lead to cumulative impacts upon receptors. Sub-regional growth in housing and employment has been captured within TEMPro future year growth factors for 2021. Therefore, the cumulative effect of these housing and employment projects is inherent in the traffic and transport impact assessments.	Negligible
Severance		Negligible
Driver Delay (capacity)		Negligible
Driver Delay (road closures)		Negligible
Operation		
There are not anticipated to be any disenable traffic and transport impacts during the operational phase that would give rise to significant cumulative impacts.		
Decommissioning		
It is anticipated that the decommissioning impacts would be no worse than those of construction.		

26.5.19. SLVIA

96. The projects taken forward for this CIA are also presented within **Chapter 24, Seascape, Landscape and Visual Assessment** (SLVIA).

97. The following are considered to be the proposed developments with which the Project has greatest potential to result in cumulative effects;

- DG Holyhead Deep Array 80 MW Project;
- Orthios development proposals, including Anglesey Eco Park Power Station;
- Holy Island Resort; and
- Huws Gray builders' merchant at Parc Cybi.

98. **Table 26-22** provides a summary of the CIA outcomes for SLVIA.

Table 26-22 Potential Cumulative Impacts Identified for SLVIA

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Effects on landscape character (including designations)	Direct construction effects on the seascape fabric and character as a result of the offshore site are predicted to be very limited. The relatively small extent of the disturbance to the onshore landscape, the short duration of the effects	Negligible

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	during construction and the reinstatement of working areas would ensure that the effects of the construction phase on the landscape fabric, character and visual amenity of the locality would be limited.	
Operation		
Effects on seascape character (including designations) and effects on visual amenity.	As the Agreement for Lease Area for this proposed development is located further offshore, it would typically be seen behind the Project from the terrestrial parts of the Study Area. This proposed development is currently at scoping stage and it is uncertain what, if any, surface emergent elements would be deployed. The only elements that could result in combined effects with the Project would comprise navigation markers including lighting which could result in a greater magnitude of change during daylight and night hours.	Based on the existing level of information, it is difficult to draw any specific conclusions on the potential cumulative effects and these would need further consideration when the application for the Holyhead Deep Array Project is submitted.
Effects on landscape character (including designations) and effects on visual amenity.	The Orthios and Holy Island Resort development proposals have the potential to result in cumulative effects in combination with components of the Project, would be located close to the proposed Grid Connection Substation and Switchgear Building. It has been established throughout the SLVIA that the Grid Connection Substation would be located within a visually enclosed site in the context of existing industrial structures, which forms part of the baseline. In addition, the Switchgear Building would form a relatively small structure in the context of an existing development site. The Huws Gray builders' merchant development would be positioned immediately to the north west of the Switchgear building. The principle of development within this location is established through its allocation for employment uses in the Local Development Plan. the context of the Project, including both the industrial structures within the Orthios site and the employment land allocation at Parc Cybi, together with the scale and prominence of the Switchgear Building and Grid Connection Substation will restrict its overall contribution to cumulative effects.	Negligible to minor adverse
Decommissioning		
It is anticipated that the decommissioning impacts would be no worse than those of construction.		

99. Significant cumulative impacts are not expected from the Project in combination with any other reasonably foreseeable plans or projects in the wider study area during the construction and decommissioning of the project. It is also considered that there are no significant cumulative impacts during operation for the onshore elements of the Project. There may be the potential for significant impacts to the seascape as a result of the Holyhead Deep 80 MW Array Project however, insufficient detail is available to undertake the assessment.

26.5.20. Socio-economics

100. During the scoping process, several projects were identified that should be considered with regard to onshore and offshore cumulative impacts for Socio-Economics, Tourism and Recreation. The projects taken forward for this CIA and the detailed methodology for the assessment are presented within **Chapter 25, Socio-Economics, Tourism and Recreation**.

101. In terms of the in-combination effects with other projects, the first stage in the process was to identify which impact mechanisms may be of key interest.

102. **Table 26-23** provides a summary of presents a summary of the topics and stages in the Project where individual significant effects were assessed to be likely.

Table 26-23 Assessment of Cumulative Significance of Issues Across Different Phases of Activity

Impact topic	Mechanism	Beneficial/ Adverse	Cumulative impacts across phases
Social benefits	Decentralisation of economic growth	Beneficial	Minor
Wellbeing of future generations	Green branding for locality	Beneficial	Minor
Economic impacts	Direct & secondary income	Beneficial	Moderate
Accumulation of grant support		Beneficial	Minor
Level of commerce activity	Green cluster creation	Beneficial	Moderate
Jobs opportunities	Numbers	Beneficial	Minor
Types, quality, skills areas		Beneficial	Major
Skills availability	Reduced performance in project	Adverse	Moderate
Training opportunities	New skills and competence needs	Beneficial	Minor
Tertiary BSc, Eng, PhD		Beneficial	Minor
Additional local services	New technical skills, workboats, cranes, better sea knowledge	Beneficial	Minor
New infrastructure outside project budget	New piers, storage and laydown areas	Beneficial	Minor
Energy security	More green electricity, local supply, diversity of supply	Beneficial	Moderate
Decarbonisation	Clean energy, balancing services, spin-off capacity	Beneficial	Moderate

103. The next stage in the process was to establish which of these mechanisms could interact across which of the in-combination projects that have been identified. The results of this analysis are summarised in **Table 26-24**.

104. From the assessment undertaken in **Chapter 25, Socio-Economics, Tourism and Recreation**, it was apparent that there was greatest potential for cumulative effects with the two other tidal projects that are being considered for the region and that the other onshore projects have less potential for cumulative effects. As for individual impacts, the receptors where it was considered that there was most potential for impact, were associated with jobs, skills needs and economic activity.

Table 26-24 Cumulative Effects Linked to Assessed Projects for Socio-Economics, Tourism and Recreation

Mechanisms for cumulative effects	Land and Lake resort	Parc Cybi housing	Holyhead Eco Park	Horizon Nuclear Power Plant	National Grid upgrades	Stena Line port expansion	Minesto	Nova tidal project	META	Strumble Head	Potential for cumulative effects
More workers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	High
House rental market	✓	✓	✓	✓	✓	✓	✓	✓			High
Investment opportunities			✓				✓	✓	✓	✓	Low
Worker mobility	✓	✓	✓	✓	✓	✓	✓	✓			High
Regional profile	✓		✓	✓		✓	✓	✓			Medium
Pier congestion							✓	✓			Low
Industrialisation				✓	✓		✓	✓		✓	Medium
Grid connections				✓	✓		✓	✓		✓	Medium
New vessels						✓	✓	✓			Low
Greater local GDP	✓	✓	✓	✓	✓	✓	✓	✓		✓	High
Greater grant income			✓				✓	✓	✓	✓	Low
Green cluster			✓	✓	✓		✓	✓	✓		Medium
Economic diversification	✓		✓	✓	✓	✓	✓	✓	✓	✓	High
Potential for cumulative effects	Medium	Low	Medium	Medium	Medium	Medium	High	High	Low	Low	

26.6. TRANSBOUNDARY IMPACTS

105. This section presents a summary of the potential impacts on transboundary receptors for each topic within the ES. Where transboundary impacts are scoped out, this is also noted.

106. Transboundary impacts are assessed through consideration of the extent of influence of changes or effects and their potential to impact upon receptor groups that are located within other EU member states.

26.6.1. Metocean Conditions and Coastal Processes

107. The localised nature of the potential impacts on metocean conditions and coastal processes mean that significant transboundary impacts are unlikely and therefore transboundary impacts have been scoped out of the EIA.

26.6.2. Marine Water and Sediment Quality

108. The localised nature of the potential impacts on marine water and sediment quality mean that significant transboundary impacts are unlikely and therefore transboundary impacts have been scoped out of the EIA.

26.6.3. Benthic and Intertidal Ecology

109. The localised nature of the potential impacts on benthic and intertidal ecology mean that significant transboundary impacts are unlikely and therefore transboundary impacts have been scoped out of the EIA.

26.6.4. Fish and Shellfish Ecology

110. The distribution of fish and shellfish species is independent of national geographical boundaries. The impact assessment has therefore been undertaken taking account of the distribution of fish stocks and populations irrespective of political limits. As a result, it is considered that a specific assessment of transboundary effects have been scoped out of the EIA.

26.6.5. Marine Ornithology

111. With regard to the potential for transboundary cumulative impacts, there is clearly potential for underwater collisions beyond UK territorial waters. However, any proposed marine energy development in Ireland is relatively small, and/or located on the west and north coasts. Since the spatial scale and hence seabird populations sizes for a transboundary assessment would be much larger, it is apparent that the scale of development expected would make no material difference to the assessment. For this reason, a quantitative assessment has not been carried out.

26.6.6. Marine Mammals

112. The potential for transboundary impacts has been addressed by considering the reference populations, MUs, seal telemetry and potential linkages to non-UK sites.

113. The assessment of the effect on the integrity of the transboundary European sites as a result of impacts on the designated marine mammal populations has been undertaken and presented in the Report to inform the HRA, which has been submitted as part of this application (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).

114. The highly mobile nature of marine mammal species considered in this assessment means that there are potential transboundary impacts for each receptor. These transboundary impacts are already considered in the main assessment (**Chapter 12, Marine Mammals)**, as the impacts for all species have been based on the relevant MUs and reference populations.

115. For harbour porpoise, harbour seal and grey seal, the extent of the reference population includes UK, Irish and French waters.

26.6.7. Offshore Archaeology

116. Transboundary impacts to offshore archaeology stemming from changes to metocean conditions and coastal processes have been scoped out.

117. Transboundary archaeological impacts may occur if wrecks or aircraft of non-British, European nationality are subject to impact from development. Such wrecks may fall within the jurisdiction of another country, and may include, for example, foreign warships lost in UK waters. As the implementation archaeological exclusion zones will prevent direct impacts to known archaeological receptors, transboundary impacts to known wrecks and aircraft are not expected to occur.

26.6.8. Commercial Fisheries

118. The impact assessment provided within **Chapter 14, Commercial Fisheries** takes account of the potential impacts of the Project on international fleets which are known to operate in the study area. Therefore, the assessment of potential transboundary impacts is integrated within the impact assessment carried out throughout that chapter.

26.6.9. Shipping and Navigation

119. The local vessels using the MDZ mean that significant transboundary impacts are unlikely and therefore transboundary impacts have been scoped out of the EIA.

26.6.10. Infrastructure and Other Users

120. The localised nature of the potential impacts on infrastructure and other users mean that significant transboundary impacts are unlikely and therefore transboundary impacts have been scoped out of the EIA.

26.7. SUMMARY

121. This chapter of the ES provides a summary of the CIA and transboundary impact assessment for the onshore and offshore topics considered in the EIA for the Project. Full details of the CIAs for each offshore topic are presented in the relevant chapters (7 to 25).

26.8. REFERENCES

The Planning Inspectorate (2015) Advice Note Seventeen: Cumulative effects assessment relevant to nationally significant infrastructure projects

The Planning Inspectorate (2018) Advice Note Twelve: Development with significant transboundary impacts consultation

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Morlais Project
Environmental Statement

Chapter 27: Summary

Volume I

Applicant: Menter Môn Morlais Limited Document Reference: PB5034-ES-027 Chapter 27: Summary Author: Royal HaskoningDHV	

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GLOSSARY OF ABBREVIATIONS

AEZ	Archaeological Exclusion Zone
AIS	Automatic Information System
AONB	Area of Outstanding Natural Beauty
AWS	Ancient Woodland Site
CD	Chart Datum
CoCP	Code of Construction Practice
CRM	Collision Risk Modelling
DBA	Desk-Based Assessment
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EMMP	Environmental Mitigation and Monitoring Plan
EP1HS	Extended Phase 1 Habitat Survey
ERCoP	Emergency Response Cooperation Plan
ERM	Encounter Rate Modelling
ES	Environmental Statement
FLO	Fisheries Liaison Officer
FRC	Flood Risk Consequence
FSA	Formal Safety Assessment
GAPS	Gwynedd Archaeological Planning Service
GPS	Global Positioning System
HDD	Horizontal Directional Drilling
HGV	Heavy Goods Vehicle
HRA	Habitats Regulations Assessment
IALA	International Association of Lighthouse Authorities
IAQM	Institute of Air Quality Management
ICES	International Council for Exploration of the Seas
IoACC	Isle of Anglesey County Council
LAQM	Local Air Quality Management
LWS	Local Wildlife Site
MATZ	Military Aerodrome Traffic Zone
MCA	Maritime and Coastguard Agency
MDZ	Morlais Demonstration Zone
MGN	Marine Guidance Notice
MMO	Marine Mammal Observers
MoD	Ministry of Defence
MPCP	Marine Pollution Contingency Plan
NRA	Navigational Risk Assessment
NRW	Natural Resources Wales
NSR	Noise Sensitive Receptor
NtM	Notice to Mariners
OWF	Offshore Wind Farm

O&M	Operation and Maintenance
PAD	Protocol for Archaeological Discoveries
PRA	Preliminary Risk Assessment
PWS	Private Water Supplies
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SLVIA	Seascape, Landscape and Visual Impact Assessment
SoCG	Statement of Common Ground
SOPEP	Ship Oil Pollution Emergency Plan
SPA	Special Protection Area
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
TEC	Tidal Energy Converter
TMP	Traffic Management Plan
TP	Travel Plan
TWAO	Transport and Works Act Order
TWG	Technical Working Group
UK	United Kingdom
UKC	Under Keel Clearance
UKHO	United Kingdom Hydrographic Office
UXO	Unexploded Ordnance
VER	Valued Ecological Receptors
WADZ	West Anglesey Demonstration Zone
WFD	Water Framework Directive
WSI	Written Scheme of Investigation
ZTV	Zone of Theoretical Visibility

27. SUMMARY

27.1. INTRODUCTION

1. Menter Môn Morlais Limited (Menter Môn) is seeking a Transport and Works Act Order (TWAO) and Marine Licence for the proposed Morlais Project (herein referred to as 'the Project'). Menter Môn, the applicant, is a not for profit social enterprise company. When consented, the Project will have a generating capacity of up to 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ).

2. This chapter provides a summary of the potential impacts associated with the construction, operation and maintenance (O&M), repowering and decommissioning of the Project based on the assessments undertaken for each receptor, for both offshore and onshore topics as they are presented in the technical chapters of this Environmental Statement (ES) (Chapters 7 to 25). Cumulative and transboundary impacts are also detailed in each technical chapter, where applicable, and are summarised in **Chapter 26, Cumulative, Transboundary Impacts and In-Combination Impacts**.

3. This ES covers a wide range of physical, ecological and human environmental receptors for which potential impacts have been assessed. The methodology for the Environmental Impact Assessment (EIA) is outlined in **Chapter 5, EIA Methodology** and detailed further in each technical chapter (Chapters 7 to 25). Where an impact assessment methodology for a certain receptor deviates from the standard methodology outlined in **Chapter 5, EIA Methodology**, this is explained in the relevant chapter. The approach to EIA has largely been informed by consultation which has been undertaken with relevant technical consultees (see **Chapter 6, Consultation**).

27.2. OVERVIEW OF THE PROJECT

4. The Project is located within one of several marine energy demonstration zones located around the United Kingdom (UK) coast, which have been leased out by The Crown Estate in a bid to encourage and accelerate the marine energy industry. The Project is located within the West Anglesey Demonstration Zone (WADZ), a zone primarily selected for its tidal resource. Menter Môn has been appointed as the manager of the WADZ by The Crown Estate. In this ES, the WADZ is referred to as the MDZ.

5. Two scoping reports were previously submitted to Natural Resources Wales (NRW), the Marine Management Organisation (MMO) and the Isle of Anglesey County Council (IoACC) in support of earlier (lower capacity) versions of the Project. However, since those reports were submitted the proposed installed capacity of the Project has been increased and the Project is now seeking consent for up to 240 MW capacity.

6. A further request for scoping opinion, for the current 240 MW capacity Project, was submitted to the Welsh Government and NRW in April 2018, superseding the earlier scoping requests. The Welsh Government and NRW provided a detailed scoping opinion, which has been the starting point for consultation on the project. Consultation with the Welsh Government and NRW has been ongoing throughout the EIA to discuss developments in the Project, scope and design

parameters, and to agree methodologies and approaches used for environmental surveys and assessments during the EIA process (see **Chapter 6, Consultation**).

7. The Project will comprise an offshore development area including the MDZ covering an area of 35 km², combined with an export cable corridor (ECC) with an area of 4.75 km², plus associated onshore infrastructure contained within an onshore development area of 1 km².

8. The offshore and onshore development areas of the Morlais Project are shown in **Figure 1-1** and **Figure 1-2**, respectively.

9. As a pre-consented and grid connected demonstration zone, a number of different tidal devices and array configurations may be deployed within the MDZ over its lifetime. The Project aims to secure a broad consented project design envelope (PDE), which will encompass a range of tidal device types and technologies with the potential to be installed and operated as part of the project. This approach allows for deployment of a variety of currently available technologies, whilst also allowing for evolution of the designs of tidal devices over time.

10. However, the range and flexibility sought within the consent application has been limited by careful consideration of development scenarios designed to rationalise the likely approach to development and to set workable limits on potential impacts. The PDE approach used in this ES, has been tested in planning law and is often referred to as the 'Rochdale Envelope' approach

11. The details of tidal technologies and infrastructure to be installed post consent, and methods to be used, will be reviewed with regulators prior to deployment and their compliance with the PDE confirmed. The types of devices that have been used to define the Project Design Envelope for the project are discussed in **Chapter 4, Project Description** (**Volume I** of the ES)**.**

12. The key components of the offshore works associated with the Project include tidal devices deployed in multiple arrays within the MDZ, to a maximum installed capacity of 240 MW. Each single array will be comprised of the same type of tidal device (technology type) and located within a discrete location, or berth, within the MDZ. The installed capacity per array is expected to be up to 30 MW, but may in practice be greater or smaller than this, being determined by a number of factors including the individual capacity of the export cables supporting each array, the installed capacity of the Project in full, and the requirements of the tidal devices. The installed capacity of individual arrays is not a parameter of bearing upon the HRA, and all installed arrays, when summed, will fall within the total installed capacity for the Project of 240 MW.

13. For deployment of arrays, the MDZ may be spilt into a series of subzones, with the zones allowing the demarcation of different technology types. Eight indicative subzones within the MDZ are presented through the ES, however, these indicative zones may be modified to meet the requirements of tenants and regulators. Water depths and tidal resource vary across the MDZ (average depth across the MDZ is approximately 40 m), and the subzones are likely to be located in areas of stronger tidal resource, while offering a range of depth parameters.

14. A phased approach to deployment of the project may be taken, with scale and timeframe of potential phasing determined by assessments and consideration of mitigation and management

undertaken within the ES. Dependent on the type of tidal device, full deployment to 240 MW could comprise up to a maximum of up to a maximum of 620 tidal devices supporting up to 1,648 Tidal Energy Convertors (TECS) and up to 740 inter-array cables within the MDZ. This represents the worst-case scenario as outlined in **Chapter 4, Project Description** (**Volume I**).

15. The MDZ and Export Cable Corridor (ECC) will also contain the following ancillary infrastructure;

- Up to nine export cables;
- Up to nine export cable tails (shared with onshore components);
- Navigation and environmental monitoring equipment;
- Mooring and foundation structures; and
- Offshore electrical infrastructure, including submerged, floating or surface emergent hubs.

16. The key components of the onshore works associated with the Project include:

- Landfall works, including:
    - Up to nine Horizontal Directional Drilling (HDD) ducts or trenched equivalents
    - Up to nine transition pits
    - Up to nine export cable tails (shared with offshore components);
- A landfall substation at Ty-Mawr (hereafter referred to as ‘Landfall Substation’);
- A switchgear building at Parc Cybi (hereafter referred to as ‘Switchgear Building’);
- A grid connection substation at the existing Orthios Eco-Park to the east of Holyhead (the site of the former Anglesey Aluminium works) (hereafter referred to as ‘Grid Connection Substation’);
- Onshore cable route installed between Landfall Substation, Switchgear Building and Grid Connection Substation.

17. The expected life of the project is 37 years, including time required for construction, operation, repowering and decommissioning.

18. Following consent award, tidal device developers will be allocated locations or “berths” within the MDZ, within which they will be able to deploy anything from one device to arrays of multiple tidal devices. A repowering of a device/array is defined as the end of a berth/array demonstration cycle, at which time the device, device foundations, support structures, electrical hubs, tenant monitoring equipment, and inter-array cabling will be removed, in line with procedures adopted during decommissioning. Once all developer owned assets listed above have been removed, the Project will then have capacity for ‘repowering’. The berth would be available for ‘repowering’ where new devices may be installed to utilise the vacated berth or be installed at a new berth for further demonstration.

19. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50% of the tenants will undertake repowering, i.e. for 50% of the tenants, their infrastructure will be removed and replaced (potentially with different

infrastructure by a different tenant). For the other 50% of tenants, their infrastructure will remain over the lifetime of the project.

20. The Project will also provide communal electrical infrastructure, including the aforementioned Landfall and Grid Connection Substations and onshore electrical cable route. Following construction, the onshore infrastructure will not be subject to repowering, impacts will be limited to O&M and decommissioning.

21. At the end of the intended Project lifetime of 37 years, the Project is likely to be decommissioned. It is assumed that the worst-case scenario is that:

- Cables will be re-used, preserved *in situ* or removed. Removal is considered as the worst-case scenario for metocean and coastal processes;
- Cable protection material will be left *in situ* on the sea bed, assuming that it causes no unacceptable impacts or hazards;
- Gravity base foundations (including gravity anchors) may be left *in situ* with piles cut to an acceptable level;
- All other components of the tidal devices (i.e. TECs, superstructure and support structure) will be removed;
- Any electrical hubs will be removed; and
- Navigation buoys and site monitoring equipment and their foundations / moorings will be removed for re-use.

27.3. MITIGATION

22. The Project has committed to a number of mitigation measures which are embedded in the project design and therefore incorporated in the impact assessments. A number of these commitments have been made as a result of public and/or stakeholder consultation. Key commitments are detailed in **Table 27-1** and are discussed further in **Chapter 4, Project Description**. Where appropriate, further topic specific additional mitigation measures would be adopted and these are detailed in **Table 27-2** and are discussed in each technical chapter.

23. It is expected that the mitigation and monitoring measures as summarised in **Table 27-2** will form part of the eventual consent and licence conditions, many of which will require monitoring and mitigation plans to be produced. An outline Construction Environmental Monitoring Plan (CEMP) for marine aspects and outline Code of Construction Practice (CoCP) for onshore aspects, have been prepared, see **Document MOR/RHDHV/DOC/0073, Outline CEMP** and **Document MOR/RHDHV/DOC/0076, Outline CoCP** for further detail. An outline Pollution Prevention and Management Plan (**Document MOR/RHDHV/DOC/0077, Outline PPMP**) has been prepared to provide an outline of the construction practice mitigation measures to be undertaken for offshore topics, to minimise any impacts predicted.

24. Some topic specific managements will also be prepared in consultation with regulators. An outline Landscape Management Plan (LMP) and outline Invasive Non-Native Species (INNS) Management Plan have been submitted with this application (**Document**

MOR/RHDHV/DOC/0074, Outline LMP and **Document MOR/RHDHV/DOC/0075, Outline INNS Management Plan**, respectively).

25. It is recognised that monitoring is an important element in the management and verification of the actual Project impacts. The requirement for appropriate design and scope of monitoring for two key topic areas, Marine Ornithology and Marine Mammals would be agreed with NRW prior to construction works commencing. An outline Environmental Monitoring and Mitigation Plan (EMMP) has been prepared (see **Document MOR/RHDHV/DOC/0072, Outline EMMP**).

26. The above management plans will be the principle vehicles through which mitigation measures are implemented to ensure that appropriate actions are taken to prevent, reduce and offset potential impacts which have been described in the ES or identified through subsequent consultation and monitoring.

Table 27-1 Design Phase Embedded Mitigation Measures

Potential Impact	**Project infrastructure**	**Mitigation or monitoring measure**
Chapter 7, Metocean Conditions and Coastal Processes		
Impact to coastal processes	Morlais Demonstration Zone (MDZ)	Devices within the MDZ will be spaced appropriately to minimise the energy loss between adjacent rows. This also has the added advantage of causing least potential impact on the baseline tidal current regime.
Impact to coastal processes	MDZ	So far as other constraints (for example, **Chapter 24, Chapter Seascape, Landscape and Visual Impact Assessment**) allow, devices within the MDZ are most likely to be placed towards the eastern part of the MDZ, where the baseline tidal currents are higher. This means that changes in the tidal velocities will be a lower percentage change relative to the baseline conditions than if devices were to be placed towards the west of the MDZ.
Chapter 11, Marine Ornithology		
Assessing impacts from current and future tidal devices	MDZ	PDE for tidal devices defined using parameters available from established tidal device technologies, which has been assumed will be developed sufficiently for commercial use at time of deployment.
Chapter 12, Marine Mammals		
Assessing impacts from current and future tidal devices	MDZ	PDE for tidal devices defined using parameters available from established tidal device technologies, which has been assumed will be developed sufficiently for commercial use at time of deployment.
Chapter 15, Shipping and Navigation		
Impacts to navigation routes	MDZ	Preference for the deployment of seabed mounted or buoyant mid water tidal devices in the north of the MDZ to maintain under keel clearance of 20 m or more, as appropriate to vessels using those parts of the MDZ. Mitigation through the application of the spatial measure shown and defined in **Figure 4.1** (**Volume II**), where an area is labelled “Submerged tidal devices with 20 m Under Keel Clearance (UKC) only”.

Potential Impact	**Project infrastructure**	**Mitigation or monitoring measure**
Impacts to navigation routes	MDZ	Maintenance of an area inshore of any floating / surface emergent arrays deployed in the MDZ, with a minimum distance of 1 km from floating / surface emergent arrays to the nearest coastline. within which a minimum Under Keel Clearance (UKC) of 8 m is maintained. Mitigation through the application of the measure shown and defined in Figure 4.1, where an area is labelled “Submerged tidal devices with an 8 m UKC only”. When combined with the export cable corridor also shown in **Figure 4.1** (**Volume II**) (where no devices are deployed), a minimum width of 1km to shore is achieved.
Chapter 19, Onshore Ecology		
Habitat loss / disturbance	Onshore Development Area	The onshore cable corridor will be installed within the existing road network to minimise impacts to surrounding habitats. Where this is not possible due to existing services in the road, the route will be micro-sited to avoid hedgerow, marshy grassland, fen and open mosaic habitat.
Habitat loss / disturbance	Onshore Development Area	The preferred construction method for cable burial is the use of HDD at the landfall location, which will avoid disturbance of the coastal fringe habitats.
Chapter 21, Noise and Vibration		
Reduction of noise disturbance	HDD works	A 3.5 m high acoustic demountable fence will be installed around the HDD equipment and a 2 m high solid hoarding fence will be built around the works compound boundary.
Chapter 24, Seascape, Landscape and Visual Impact Assessment		
Landscape and visual impact	MDZ	Preference for the deployment of visually prominent devices in the south of the MDZ. Mitigation through the application of the measure shown and defined in **Figure 4.1** (**Volume II**), which shows where the deployment of “Floating / surface emergent and submerged tidal devices” is proposed. Potential in the future for deployment of Floating / surface emergent more northern parts of the MDZ will be kept under review on a case by case basis with regulators.
Landscape and visual impact	Landfall Substation	Selecting a recessive location in the landscape, in a relatively low lying position and using the landform to help integrate the landfall substation (cutting into the valley side rather than building a platform out).
Landscape and visual impact	Landfall Substation	Arrangement of plant and equipment within three buildings, resulting in a collection of buildings that break up the scale of the development and create a form and massing that is comparable with local agricultural buildings.
Landscape and visual impact	Landfall Substation	Using colours and materials (including natural materials) that are consistent with the vernacular associated with agricultural buildings and are recessive in the local context.
Landscape and visual impact	Landfall Substation	Using the buildings to define the boundaries of the landfall substation, reducing the requirement for security fencing.
Landscape and visual impact	Landfall Substation	Using stone walls and stock proof fencing as part of new boundaries.

Potential Impact	Project infrastructure	Mitigation or monitoring measure
Landscape and visual impact	Landfall Substation	Minimising the use of external lighting in this rural location.
Landscape and visual impact	Grid Connection Substation	Positioning of the grid connection substation in a location where industrial structures form an established part of the baseline context, and where established vegetation surrounding the site provides effective visual enclosure.
Landscape and visual impact	Switchgear Building	Positioning of the switchgear building within an allocated employment site, adjacent to an existing substation and where surrounding development will be comparable in form, massing and appearance.
Landscape and visual impact	Onshore Cable Corridor	Use of underground cabling to provide the connections between the Landfall Substation and Grid Connection Substation, avoiding the need for overhead cables
Landscape and visual impact	Onshore Cable Corridor	Routing the underground cable within the local road corridors where possible, to minimise potential disruption to field boundaries.

Table 27-2 Additional Mitigation Measures including those through Best Practice and Policy

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
Chapter 7, Metocean Conditions and Coastal Processes			
Impact to coastal processes	MDZ	Construction	An outline CEMP and PPMP will be submitted with the TWAO application and Marine Licence application. The development of the detailed design and final CEMP will refine the worst-case impacts assessed in this EIA. It is recognised that monitoring is an important element in the management and verification of the actual Project impacts. The requirement for appropriate design and scope of monitoring would be agreed with NRW prior to construction works commencing.
Chapter 8, Marine Water and Sediment Quality			
Contamination to water quality	MDZ and ECC	Construction, Operation, Repowering, Decommissioning	Adherence to a Project-specific CEMP and PPMP, which themselves will take full account of relevant pollution control legislation and guidance, i.e. MARPOL regulations.
Chapter 9, Benthic and Intertidal Ecology			
Habitat and protected species disturbance	ECC	Construction	Pre-construction surveys will be carried out to check for the presence of any rare or protected habitats and species e.g. *S. spinulosa* reefs. Following these surveys, micro-siting of the cable would be used to mitigate impacts to these receptors where possible.
Accidental Release of Contaminants	MDZ and ECC	Construction, Operation, Repowering, Decommissioning	Development of an Emergency Response Cooperation Plan (ERCoP) with guidance set out by MCA in MGN 371, issued and approved by MCA.
Accidental Release of Contaminants	MDZ and ECC	Construction, Operation, Repowering, Decommissioning	Development of a Pollution Prevention and Management Plan (PPMP) along with the implementation of other construction best practice

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			methods, which would include the following measures: • Notice to Mariners to be issued to reduce collision risks; • Vessels associated with all Project operations will comply with IMO/MCA codes for prevention of oil pollution and any vessels over 400 GT will have on board Shipboard Oil Pollution Emergency Plans (SOPEP); • Vessels associated with all Project operations will carry on-board oil and chemical spill mop up kits; and • Where possible, vessels will avoid working in poor weather conditions.
Habitat and protected species disturbance	MDZ and ECC	Construction	If it is not possible to conduct cable-lay via the preferred HDD method, prior to the excavation of the trench and installation of the cables, a detailed installation methodology would be produced through consultation with NRW. This will outline how the substratum will be reinstated with the right stratification of layers and will describe how physical impacts will be kept to a minimum, for example restricted working corridors for vehicles and personnel. Larger boulders would be moved sideways out of the cable trench corridor to an equivalent area of the shore, prior to trenching work commencing. These boulders would then be used as the upper layer after backfilling the trench.
Habitat and protected species disturbance	ECC	Construction	Pre-construction surveys would be carried out to check for the presence of any rare or protected habitats and species. Following these surveys, micro-siting of the cable would be used to mitigate impacts to these receptors where possible. This would inform areas which should be avoided and therefore minimal loss of important or protected habitats will occur.
Introduction of Invasive Non-Native Species (INNS)	MDZ and ECC	Construction, Operation, Repowering, Decommissioning	Compliance with relevant guidance regarding ballast water and INNS risk assessment prior to each deployment to identify mechanisms behind risk identified and appropriate mitigation measures. This can be undertaken once installation vessels and construction / manufacturing ports have been identified.
Habitat loss	ECC	Construction,	Pre-construction surveys will be carried out to check for the presence of any rare or protected habitats and species, including Annex I habitats which may be classified as reef features. Following these surveys, micro-siting of the cable would be used to mitigate impacts to these receptors where possible. This would inform areas which should be avoided and areas which infrastructure should not be placed.

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
Chapter 11, Offshore Ornithology			
Disturbance to sensitive species	ECC	Construction, Operation, Repowering, Decommissioning	Based on the species known to breed at each of the potentially affected seabird colonies, and excluding any species understood to possess a “low” sensitivity to disturbance and displacement when at sea, it is considered that it is appropriate to prohibit all vessel activities within 300 m of each of these colonies during the breeding season unless an ecological professional is able to supervise activities. This is considered to be March to July for Abraham’s Bosom and February to August for South Stack and Gogarth based on the species present at the last count.
Disturbance to sensitive species (40 MW deployment)	MDZ	Operation	The intention of the Project is to install a first commercial phase of development at around 40 MW. Build out to out to that scale and beyond to 240 MW will require several years, and within that timeframe the establishment of monitoring and mitigation measures through an EMMP is proposed. Before the first deployment and between subsequent deployments, detailed information on the behaviour of guillemot and razorbill breeding at the South Stack and Penlas SMP sub-colonies will be collected using three principal methods; coastal vantage point watches, colony counts, and a dual deployment of bird-borne time-depth-temperature recorders and GPS recorders on as large a sample size of the South Stack and Penlas SMP sub-colonies population as is permitted (and is possible due to practical issues such as the ability to safely access colonies for bird capture and tag deployment). Other methods such as boat-based surveys will be considered. This monitoring work would be undertaken in conjunction with SNCBs under appropriate licensing arrangements. Other methods (for example the use of sonar data for diving birds) will be considered for inclusion in the monitoring programme where their deployment could provide useful information. Further information on the proposed monitoring is described in **Document MOR/RHDHV/DOC/0072, outline EMMP**.
Disturbance to sensitive species (240 MW deployment)	MDZ	Operation	To enable the consent of an initial deployment of 240 MW of tidal devices**,** surveillance of key receptors supported by empirical information is required to give confidence that evidence of significance impacts is not present. The general goals of the monitoring strategy would be to provide finer scale information on distribution, densities, diving depths and bird behaviour in the vicinity of TECs, throughout the day and night,

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			refine the accuracy of / reduce uncertainty in input parameters and avoidance rates for ERM/CRM. This monitoring work would be undertaken in conjunction with SNCBs under appropriate licensing arrangements. Further information on the proposed monitoring is described in **Document MOR/RHDHV/DOC/0072, outline EMMP**. Should the proposed monitoring and deployment strategy be successful in justifying the refinement of CRM / ERM models such that the predicted collisions are at a level that would not result in an ecologically significant adverse effect on razorbill and guillemot (e.g. setting of avoidance to at least 99.5 % for breeding guillemot, and 99.9 % for breeding razorbill), the magnitude of impact could be revised to "low adverse" for both species, as well as the South Stack and Penlas SMP sub-colonies. This would result in a residual impact significance of Minor adverse for all three receptors.
Chapter 12, Marine Mammals			
Noise disturbance to sensitive species	MDZ and ECC	Construction, Repowering, Decommissioning	If required, Marine Mammal Mitigation Protocols (MMMPs) will be prepared to reduce the risk of any permanent auditory injury (Permanent Threshold Shift (PTS)) to marine mammals as a result of underwater noise during construction. The MMMP(s) will be developed in the pre-construction period and based upon best available information, methodologies, industry best practice, latest scientific understanding, current guidance and detailed project design. The MMMP(s) will be developed in consultation with NRW and the relevant SNCBs, detailing the proposed mitigation measures to reduce the risk of any physical or permanent auditory injury (PTS) to marine mammals from underwater noise. This will include details of embedded mitigation, as well as details of the 500 m mitigation zone and any additional mitigation measures required in order to minimise potential impacts of any physical or permanent auditory injury (PTS), for example, the use of Marine Mammal Observers (MMOs), Passive Acoustic Monitoring (PAM) and / or activation of acoustic deterrent devices (ADDs). The methods for achieving the mitigation zone would be agreed with NRW and the relevant SNCBs.
Noise disturbance to sensitive species	MDZ and ECC	Construction, Repowering, Decommissioning	The proposed mitigation to reduce the risk of any PTS, for example, 500 m mitigation zone and MMOs during drilling activity, will also reduce the risk of animals in the predicted impact area for Temporary Threshold Shift (TTS).

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
Noise disturbance to sensitive species	MDZ	Construction, Repowering, Decommissioning	A MMMP for drilling activity would be prepared prior to construction, for example with the option of having MMOs on site during drilling activities to ensure marine mammals do not enter a predetermined mitigation zone, based on the maximum potential PTS impact range, e.g. 210m for minke whale. Although, to take into account the deeper water at the MDZ compared to the Wylfa site and the potential for increased noise propagation, the proposed mitigation zone for drilling activity would be a precautionary 500m.
Noise disturbance to sensitive species	ECC	Construction, Repowering, Decommissioning	A MMMP for cable installation and cable protection activities would be prepared prior to construction, for example with the option of having MMOs on site to ensure marine mammals do not enter a predetermined mitigation zone, based on the potential PTS impact range, e.g. 100m. Although, the proposed mitigation zone could be a precautionary 500m.
Noise disturbance to sensitive species	MDZ and ECC	Decommissioning	It is proposed the MMMPs would be prepared for decommissioning activities that could have potential underwater noise impacts, such as the removal of tidal devices and cables.
Contamination to water quality	MDZ and ECC	Construction, Operation, Repowering, Decommissioning	Adherence to CEMP and PPMP.
Collision risk with sensitive species	MDZ and ECC	Construction, Operation, Repowering, Decommissioning	Where possible, all vessel movements will be kept to the minimum number that is required to reduce any potential collision risk. Additionally, vessel operators will use good practice to reduce any risk of collisions with marine mammals.
Collision risk with sensitive species	MDZ	Operation	The mitigation and monitoring plan to reduce the collision risk of marine mammals with operational turbines will be developed in the pre-construction period so that it can be based upon best available information, methodologies, industry best practice, latest scientific understanding, current guidance and detailed project design. It will be developed in consultation with NRW and the relevant SNCBs, detailing the proposed mitigation measures which could include, but may not be limited to, detecting marine mammals in and around the arrays (this could be done using remotely monitored PAM, underwater cameras, autonomous recorders, and / or high definition (HD) and thermal imaging camera systems). There would also be the use of active sonar to detect marine mammals in close proximity to the arrays / devices which could be used to trigger mitigation measures, such as the automatic activation of ADDs to deter marine mammals from a predetermined mitigation zone around the arrays / devices.

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			The approach would be based on deployment, monitoring and adaptive management, with regular reviews of the installation at appropriate deployment increments directly related to collision risk to marine mammals, specially bottlenose dolphin, to ensure that no more than one bottlenose dolphin could be theoretically at risk of collision or other significant impact.
Entanglement of sensitive species	MDZ	Operation	The mitigation and monitoring measures to reduce the risk of collision with operational turbines would also reduce the risk of entablement with mooring lines.
Chapter 13, Offshore Archaeology and Cultural Heritage			
Impacts to marine heritage assets	MDZ and ECC	Construction	Mitigation by micro-siting and adoption of archaeological exclusion zones (AEZs) around known wreck sites and medium potential geophysical anomalies
Impact to heritage assets	MDZ	Construction	Mitigation by micro-siting and avoidance or modification of construction foundation design for potential channel areas (unless archaeological value confirmed as low).
Impact to heritage assets	MDZ and ECC	Construction	Mitigation by micro-siting and adoption of AEZs around known wreck sites and medium potential geophysical anomalies. No activities or development work are to take place within the AEZs and no devices, cables (including catenary cables) or other structures may extend to within the AEZs. The extent of each AEZ comprises a footprint on the seabed and the water column above. The extent of the AEZs should reflect the likely extent of the wrecks, with an appropriate buffer. AEZs are recommended, based on the known dimensions of the wreck sites and debris, and allowing for appropriate buffers.
Impact to heritage assets	MDZ and ECC	Construction, Operation, Repowering, Decommissioning	Implement the Protocol for Archaeological Discoveries (PAD), as part of the Written Scheme of Investigation (WSI), for Offshore Renewables Projects (The Crown Estate 2014), for the duration of the Project. This protocol provides a system for identifying, recording, reporting and investigating any unexpected discoveries made during the course of the Project, including prehistoric material. If material is found, there are a range of next-step mitigation options including creation of temporary or permanent exclusion zones around areas in which archaeological sites or remains may exist.
Impact to heritage assets	MDZ and ECC	Construction, Operation, Repowering, Decommissioning	Creation of a WSI to cover all future works within the site and to include specification for archaeological involvement prepared in consultation, once the final layout details of the development site and offshore cable corridor is established. This document should be incorporated into the final Environmental Management Plan

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			(EMP). The WSI would set out the design and implementation of a programme of detailed mitigation works, which will include future monitoring of the assets.
Impact to heritage assets	MDZ and ECC	Construction, Repowering, Decommissioning	Geoarchaeological assessment should accompany any geotechnical campaigns which may take place within the site. Geoarchaeological work should follow best practice guidance set out in Offshore Geotechnical Investigations and Historic Environment Analysis: guidance for the renewable energy sector (Cowrie 2011), and Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects (The Crown Estate 2010). The assessment should include review of core logs to determine the potential for deposits of palaeoenvironmental and archaeological interest and follow a staged process which should be determined by the results of the assessment and may include analysis, reporting and publication.
Impact to heritage assets	MDZ and ECC	Construction, Repowering, Decommissioning	A watching brief should also be conducted in the intertidal zone. This is primarily to mitigate impacts upon potential maritime and intertidal remains. It would allow archaeological input in case any such remains are found and also serve to record any isolated or eroded finds from the coast. This would be particularly valuable due to the potential for eroded remains associated with the Late Iron Age and Romano-British settlement which lies c. 200 m above the high-water mark, to the north of Plas Nicol.
Chapter 14, Commercial Fisheries			
Disturbance to fishing activities	MDZ and ECC	Construction, Repowering, Decommissioning	Local fishermen to be notified of all planned construction works via Notice to Mariners
Disturbance to fishing activities	MDZ and ECC	Construction, Repowering, Decommissioning	Project-specific FLO to be appointed during construction phase.
Disturbance to fishing activities	MDZ and ECC	Construction, Repowering, Decommissioning	All construction vessels to exhibit appropriate lighting and markings at all times.
Disturbance to fishing activities	MDZ and ECC	Construction, Repowering, Decommissioning	Construction activities to be planned as far as possible so that they are focussed in discrete areas at any one time, i.e. not spread out across entire site.
Disturbance to fishing activities	MDZ and ECC	Construction, Repowering, Decommissioning	Key areas of static gear deployment to be provided by local fishermen and used to develop agreed transit routes around/through the MDZ that aim to minimise damage to static gear.
Disturbance to fishing activities	MDZ	Construction, Operation,	Where local vessels are able to demonstrate a clear loss in annual income due to loss of fishing grounds within the MDZ, Menter Môn will enter into

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
		Repowering, Decommissioning	discussions on appropriate forms of financial assistance.
Disturbance to fishing activities	MDZ	Operation	▪ Ensuring devices marked as per International Association of Lighthouse Authorities (IALA) Guidance and Aids to Navigation; ▪ Promulgation of information via Notices to Mariners (NtM); ▪ GPS off station alarm / SCADA monitoring system; ▪ Site boundaries marked in accordance with Trinity House; ▪ Surveyed and charted as required by UKHO; ▪ Restrict Navigation through the MDZ; ▪ Exclusion of fishing within the MDZ; and ▪ Establish no anchoring areas.
Chapter 15, Shipping and Navigation			
All potential impacts	MDZ and ECC	Construction, Operation, Repowering, Decommissioning	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Use of guard vessel(s) to monitor passing traffic; ▪ Temporary navigation aids as required by Trinity House; ▪ Implementation of Safety Zones; ▪ Construction vessels to be marked in accordance with COLREGS; ▪ Redesign the Northern Boundary; ▪ Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known; ▪ Provisions made for continued use of ferry poor weather routeing or alternative routes to be established; ▪ Exclusion of fishing within the MDZ; ▪ Re-design eastern boundary of the MDZ; ▪ Ensure appropriate alignment and spacing of devices; ▪ Ensure regular programme of device condition surveys; ▪ Enhanced cable protection; and ▪ Establish no anchoring areas.
Chapter 16, Marine Infrastructure and Other Users			
Disruption of MOD activities	MDZ and ECC	Construction, Operation,	Ongoing engagement with the MOD will be undertaken at all times during the construction phase. This will be via formal issue of Notices to

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
		Repowering, Decommissioning	Airmen (NoTAM's) prior to any major works and also be ensuring that regular updates are also provided via construction phase bulletins.
Disruption of MOD activities	MDZ	Operation	All project infrastructure will be communicated to the United Kingdom Hydrographic Office (UKHO) and updated on relevant Admiralty Charts.
Interaction with UXO	MDZ and ECC	Construction, Repowering, Decommissioning	It will be necessary to undertake detailed risk assessment works in the development site and export cable corridor once the final positions of the infrastructure is known in order to identify any potential UXO and establish the requirements for any further geophysical survey of specific locations. This is due to the variety of UXO that could be present. Dependent on the nature of identified UXO further investigations and/or detonations may be required, further to which a certificate would be provided to the contractor to determine that the risks associated with site investigation are reduced to As Low As Reasonably Practicable (ALARP). Any proposed pre-construction marine geophysical surveys should be designed to have the potential capability to detect UXO in sufficient detail across the development site and export cable corridor. Given the moderate risk for encountering UXO in the offshore site, it is considered that the most prudent method of managing the risk to construction would be to undertake a high resolution total field magnetometer or gradiometer survey, with survey line spacing as small as 2m, and a sensor elevation not exceeding 5m (and ideally as low as 2m). Remotely operated vehicle (ROV) inspection would be recommended to confirm whether identified targets were UXO related. It may also be necessary to undertake micro-siting of infrastructure to avoid potential UXO, depending upon the results of detailed investigation. In addition, it would be prudent to ensure that all construction staff have an awareness of the UXO hazard through contractors' induction processes. This will ensure that appropriate action is taken in the event that a suspect item is discovered. Other risk mitigation will depend on the detail and nature of any planned works.
Interaction with active telecommunication cables	MDZ and ECC	Construction, Repowering, Decommissioning	To mitigate any risk of damage to this live cable a 500 m safety buffer will be implemented around the CeltixConnect cable during all construction works. The position of this live cable will be communicated to all installation vessels and the Project will consult with the asset owner directly.
Interaction with UXO	MDZ	Operation	Mitigation measures will be the same as those discussed for the construction phase, with the exception of micro siting the cable. Any vessel

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			involved with the decommissioning phase would need to be equipped to sufficiently detect UXO across the development site and export cable corridor.
Chapter 17, Water Resources and Flood Risk			
Direct Disturbance of Surface Water Bodies	Onshore Cable Corridor	Construction	Minimise the amount of time that temporary dams are in place, flumes or pumps would be adequately sized to maintain flows downstream of the obstruction whilst minimising upstream impoundment and scour protection would be used to protect the bed downstream of the dam from higher energy flows at the outlet of the flumes or pumps. Furthermore, a fish rescue (if necessary) would be undertaken in the area between the temporary dams prior to dewatering.
Direct Disturbance of Surface Water Bodies	Onshore Cable Corridor	Construction	Cable ducts would typically be installed 2m below the bed of the watercourses (sufficient to account for climate-related changes in fluvial flows and erosion). This would be dependent upon local geology and geomorphological risks (e.g. bed scour and channel instability) and avoid exposure during periods of higher energy flow where the bed could be mobilised.
Direct Disturbance of Surface Water Bodies	Onshore Cable Corridor	Construction	Vegetation would not be removed from the banks unless necessary to undertake the works; any vegetation removal would be restricted to the smallest practicable footprint.
Direct Disturbance of Surface Water Bodies	Onshore Cable Corridor	Construction	Where possible, localised improvements to the geomorphology and in-channel habitats will be considered where the watercourse is crossed using open cut techniques. This will include sympathetic reinstatement of banks (e.g. by replacing re-sectioned banks with more natural profiles that are typical of the natural geomorphology of the watercourse). Note that any improvements would be restricted to within the works area of the proposed Project.
Direct Disturbance of Surface Water Bodies	Onshore Cable Corridor	Construction	Buffer strips of vegetation will be retained adjacent to the watercourses, where possible. Where surface vegetation has been removed, it will be reseeded to prevent future runoff (excluding arable crops).
Accidental Release of Contaminants	Onshore Cable Corridor	Construction	Buffer strips of vegetation will be retained adjacent to the watercourses, where possible, to intercept surface runoff and any dissolved or particulate contaminants associated with it.
Accidental Release of Contaminants	Onshore Cable Corridor	Construction	Cable installation activities will be designed to ensure that they will not affect groundwater in any significant manner. The majority of excavations will be shallow (approximately 1.7m deep), except for instances where HDD (or a similar method) is used.

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
Accidental Release of Contaminants/Sediment and Contaminant Disturbance	Onshore Cable Corridor	Construction, Operation	Any abstractions within the onshore cable corridor will be verified with the landowners prior to construction, and suitable mitigation measures employed at that point to ensure no adverse effects on water supplies occur.
Surface flood risk	ODA	Construction, Operation	Development of a drainage strategy including use of swales to allow for drainage of excess surface water from the Site.
Surface flood risk	ODA	Construction, Operation	Use of permeable surfacing where applicable.
Surface flood risk	ODA	Construction, Operation	Use of flood-resilient building materials e.g. concrete floors and walling.
Surface flood risk	ODA	Construction, Operation	Raised electrical infrastructure to prevent flooding of critical infrastructure during a surface water flood event.
Chapter 18, Ground Conditions and Contamination			
Contamination to groundwater	ODA	Construction	Adherence to the CoCP and PPMP, including Incident/Emergency Response Plan.
Contamination to groundwater	ODA	Construction	Avoidance of construction in areas of historical development, including all historic pits and area of infilled land that has previously been identified.
Contamination to groundwater	ODA	Construction	Should any unanticipated contamination be encountered during the work, work should be halted and a written statement on how contamination will be dealt with should be agreed with the local authority.
Contamination to groundwater	ODA	Construction	If piling is required in areas previously identified as potential sources of contamination, additional mitigation measures may be required prior to piling activities commencing, this may include a ground investigation to identify areas of concern and/or remediation.
Contamination to surface waters	ODA	Construction	The following mitigation will be employed: Code of Construction Practice (CoCP); Construction Design Management Regulation (CDM, 2015); Construction Environmental Management Plan (CEMP); CL:AIRE Industry Code of Practice for waste management; Environment Agency groundwater protection pollution prevention guidance (PPG); and General best practice.
Impacts to human health	ODA	Construction	Site and Excavated Waste Management Plan (SWMP), to ensure that any waste arising is closely monitored, and that waste prevention, re-use or recycling opportunities are maximised. The appropriate waste management route is confirmed following a waste hierarchy assessment.

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
Impacts to human health	ODA	Construction	A written scheme (based on the Model Procedures for the Management of Land Contamination, CLR11) for the management of contamination of any land and groundwater would be submitted and approved by the local authority. The document will also provide procedures to follow in the event of encountering unexpected contamination and will include proposals to deal with any waste soils excavated during the works.
Contamination to controlled waters	ODA	Construction	Mitigation measures may be required in areas previously identified as potential sources, this may include a ground investigation to identify areas of concern, backfilling with a low permeability material in these areas and/or remediation.
Chapter 19, Onshore Ecology			
Habitat loss / disturbance	Landfall	Construction	Should HDD not be possible and trenching across the maritime cliff and slope habitat and neutral grassland is required, there will be temporary trenching across the maritime cliff and slope habitat and neutral grassland and potential long term pinning of cables on the cliff habitat. Temporary habitat lost will be compensated for within the onshore site or enhancement will take place at nearby adjacent cliff and slope habitat of poorer quality than that which is being temporarily lost. This will be detailed in an EAP. The compensatory/enhancement habitat will aim to maintain the functionality of the habitat that is lost. The area of compensatory/enhancement habitat will be as a minimum the same area of habitat that is lost. Compensatory/enhancement habitat will be subject to a habitat creation and management plan, undertaken in consultation with IoACC and NRW. The habitat creation and management plan will include: ▪ A defined area which will be subject to the plan ▪ A plan for any pre-construction surveys ▪ Details of suitable planting and ground preparation and planting methodology ▪ Details of any post-creation monitoring surveys, reporting and reviewing required ▪ A schedule/programme for delivery of the plan ▪ Responsibilities attributed to the relevant parties to deliver the plan; including creation, maintenance and monitoring of the new habitat ▪ Consideration of the future of the new habitat following decommissioning of the substation site. ▪ Replacement of linkage habitat in the vicinity of ancient woodlands

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
Habitat loss / disturbance	Onshore Development Area	Construction	Toolbox talks will be delivered to all construction personnel detailing the importance of the protection of the designated sites: ▪ A strict construction working footprint will be maintained; ▪ Temporary fencing will be installed to physically delineate the rest of the designated site from the construction footprint; Materials and plant will be stored within the construction footprint; ▪ Habitats affected within and outwith the designated site will be combined within the habitat reinstatement plan; and ▪ A habitat re-instatement plan will be implemented upon completion of the works.
Habitat loss / disturbance	Onshore Development Area	Construction	Prior to construction, further detailed botanical survey work is undertaken to ensure the risk of impacts to spatulate (South Stack) fleawort, golden-hair lichen and spotted rock-rose (and other areas of botanically rich vegetation) can be avoided. Such survey work should be carried out in May or June when fleawort is in flower. This survey work will support the decision of where the Onshore Cable Route is micro-sited to, enabling the footprint of overlap into the RSPB reserve to be minimised; and
Habitat loss / disturbance	Onshore Development Area	Construction	Consultation with NRW and RSPB will be undertaken to agree the final micro-siting of the cable route.
Habitat loss / disturbance	Onshore Development Area	Construction	The following mitigation will be implemented to minimise the impact to Habitats of Principal Importance: ▪ Toolbox talks will be presented to all contractors to inform of the Habitats of Principle Importance present in the area: ▪ Microsite to avoid hedgerow, marshy grassland, fen and open mosaic habitat where possible; ▪ A strict construction working footprint will be maintained; ▪ Temporary fencing will be installed to physically delineate the rest of the habitats of principal importance from the construction footprint; ▪ Materials and plant will be stored within the construction footprint; ▪ Habitats affected within and outwith the designated site will be combined within the habitat reinstatement plan;

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			▪ Compensation habitat will be instated for any areas of Habitats of Principal Importance that are permanently lost; ▪ A habitat re-instatement plan will be instigated upon completion of the works; ▪ Root protection areas will be fenced off during construction; ▪ A pre-construction assessment of all trees to be removed will be undertaken by a suitably qualified arboriculturist; ▪ Where hedgerows are disturbed, they will be replaced following completion of construction activities to the same quality or better, with native species of local provenance. The replanting plan will be detailed in the EAP; ▪ To mitigate impacts to the OMH surrounding the aluminium works, habitat reinstatement will be undertaken upon completion of the construction phase. This would involve the reinstatement of excavated material in a way that would provide low nutrient substrate suitable for ephemeral vegetation. The replanting plan will be detailed in the EAP. Since this area is subject to scrub encroachment it is possible that some localised disturbance will be beneficial (to reduce scrub and maintain patches of open habitat); and ▪ If trenching is required at landfall through the designated land, further consultation will be undertaken with NRW and RSPB to determine full mitigation, methodology and to obtain any necessary consents.
Habitat loss / disturbance	Onshore Development Area	Construction	▪ To minimise impacts to Cloddiau, all Cloddiau to be left in situ will be clearly marked by a one metre buffer fence. ▪ A tool box talk will be presented by the ECoW to all construction personnel to ensure the importance of these features is understood. ▪ Where Cloddiau cannot be avoided by going around or underneath, the walls will be carefully dismantled by an appropriately trained professional and stored within a marked fenced area during construction. ▪ As soon as possible upon completion of construction activities, the stone walls will be

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			rebuilt in a traditional style, reusing the original materials. ▪ The EMP will provide details of storage methods and locations of the vegetated stones.
Disturbance to protected species: otter	Onshore Development Area	Construction	▪ As otter is a mobile species, a pre-construction survey for otter will be undertaken in all potential habitat prior to construction to confirm no otters have entered the project area since the 2018 surveys. This includes any watercourses, ditches or areas which may provide suitable resting sites. Should evidence of otter be found, further consultation with NRW will be conducted as ascertain the most appropriate procedures to follow. ▪ During construction activities, precautionary methods will be implemented to ensure risk of killing or injuring are minimised, such as including exit ramps on excavations; ▪ Prior to construction, a tool box talk on otter will be delivered to all relevant parties by the ECoW.
Disturbance to protected species: water vole	Onshore Development Area	Construction	▪ As water vole is a mobile species, a pre-construction survey for water vole will be undertaken in all potential habitat (i.e. ditches) prior to construction to confirm no water vole have entered the project area since the 2018 surveys. This includes any watercourses or ditches whether water vole were previously suitable or not. Should evidence of water vole be found, further consultation with NRW will be conducted to ascertain the most appropriate procedures to follow (such as micro siting, water vole method statement or displacement under licence (trapping is not anticipated to be necessary)); ▪ Prior to construction, a tool box talk on water vole will be delivered to all relevant parties by the ECoW.
Disturbance to protected species: red squirrel	Onshore Development Area	Construction	Prior to construction, a tool box talk on red squirrel will be delivered to all relevant parties by the ECoW.
Disturbance to protected species: badger	Onshore Development Area	Construction	Under a worst-case scenario, Sett 1 is unavoidable, either because of HDD or trenching activities. If Sett 1 cannot be avoided, a licence would need to be obtained from NRW to temporarily or

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			permanently exclude it. This may sometimes require the provision of a nearby replacement sett. A licence would restrict activities affecting the sett to the licensable period between July and November in a given year. A plan for sett exclusion and creation of artificial habitat will be developed in consultation with NRW and will be informed by preconstruction surveys (such as bait marking surveys) to determine the level of activity at the sett and surrounding habitat, and territories of resident badgers nearer the time of construction.
Disturbance to protected species: badger	Onshore Development Area	Construction	A pre-construction survey will be undertaken for badgers and evidence of new badger setts prior to construction activities commencing. There are numerous areas of dense thick scrub within the Onshore Study Area which could not be comprehensively searched for setts (as described in the limitations above). It is therefore recommended that if any dense scrub requires clearance that precautionary checks for badger sett are carried out while vegetation is removed before any more intrusive ground work is carried out. Where possible, the survey will be undertaken in winter months when the scrub vegetation is low and therefore more accessible.
Disturbance to protected species: badger	Onshore Development Area	Construction	▪ Precautionary methods with be implemented to minimise harm to badgers during construction, including use of exit ramps and covering trenches deeper than 1 m at the end of each working day to prevent animals becoming trapped. ▪ Badger proof fencing will be used around the Onshore Development Area to ensure badgers do not enter the site. Particular attention will be paid around the landfall. ▪ Post construction monitoring will be undertaken. ▪ Ecological management proposals will be included within the EAP. ▪ Prior to construction, a tool box talk on badgers will be delivered to all relevant parties by the ECoW.
Disturbance to protected species: bats	Onshore Development Area	Construction, Operation	The following mitigation will be included within an EAP: ▪ Night-time lighting of construction sites should be avoided where possible; ▪ If night-time working is necessary, then lighting will be designed in accordance with Bats and artificial Lighting in the UK (BCT, ILE, 2018);

Potential Impact	**Project infrastructure**	**Project Phase**	**Mitigation or monitoring measure**
			and Guidance Notes for the Reduction of Obtrusive Light ILE (2011). This is likely to require: ▪ No direct lighting of the woodland edges, scrub and hedgerow habitats, or historic roost site and use of dark buffer zones; and ▪ Consideration of appropriate luminaire specifications, sensitive light configuration, screening, glazing, dimming and part-night lighting to minimise impacts; ▪ A toolbox talk by a suitably qualified ecologist will be undertaken as part of the induction of all construction staff; ▪ Should a bat be encountered on site during the works, works will cease in that area and the advice of an experienced bat ecologist sought prior to re-commencing ▪ A survey will be undertaken to confirm the presence or absence of the historic bat roost record. If present, a buffer of 30m will be placed around the bat roost and works will not take place within this zone to avoid disturbance to this feature. ▪ Building, tree or woodland removal is not anticipated. If it is required it is recommended that further survey and assessment is carried out, in consultation with NRW, to confirm that potential roost features are not present; and ▪ Hedgerow will be replanted following completion of construction works. ▪ Lighting will be designed in accordance with Bats and artificial lighting in the UK (BCT, ILE, 2018); and Guidance Notes for the Reduction of Obtrusive Light ILE (2011). This is likely to require: ▪ No direct lighting of the woodland edges, scrub and hedgerow habitats, and use of dark buffer zones; ▪ Consideration of appropriate luminaire specifications, sensitive light configuration, screening, glazing, dimming and part-night lighting to minimise impacts.
Disturbance to protected species: reptiles	Onshore Development Area	Construction	As reptiles are mobile, a pre-construction survey for reptiles will be undertaken in all potential habitat prior to construction.

Potential Impact	**Project infrastructure**	**Project Phase**	**Mitigation or monitoring measure**
Disturbance to protected species: reptiles	Onshore Development Area	Construction	Precautionary methods of working will be utilised, including clearance of vegetation under supervision of the ECoW. The precautionary methods of working will be detailed in a CEMP and submitted to IoACC in advance of the works. The details will be dependent on the timings of the work, and may include the following: ▪ Where possible, the works will be timed within the reptile active season (March to October inclusive); ▪ A mitigation strategy for reptiles will be informed by the pre-construction survey and will be produced prior to construction and submitted to the LPA, including: ▪ Trapping and translocation, if required; ▪ Details of appropriate habitat improvement works to receptor sites for displaced reptiles; ▪ Post construction monitoring ▪ Details of the temporary fencing (including type, location and maintenance methodology) to be used to prevent reptiles from re-entering the site; ▪ Details of ecological supervision during construction including a toolbox talk; and ▪ Reptile welfare (including handling methodology); and ▪ Following construction, habitat will be reinstated as a minimum to the same value as before, using native species of local provenance.
Disturbance to protected species	Onshore Development Area	Construction	Pre- construction HSI and eDNA surveys (methodology to be agreed with IoACC in advance of surveys) to confirm the absence of GCN in the area and include a method statement within the EMP for what to do in the unlikely event an GCN is encountered on site. In addition, a toolbox talk by a suitably qualified ecologist will be undertaken as part of the induction of all construction staff.
Disturbance to protected species: breeding birds	Onshore Development Area	Construction	▪ No construction works will take place within 500 m of an active chough nest during the breeding season. ▪ A toolbox talk by the ECoW or a suitably qualified ecologist with ornithological expertise will be undertaken as part of the induction of all construction staff. ▪ Vegetation removal will be carried out outside the breeding season for birds as far as

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			possible. If vegetation removal is required within the bird breeding period, checks for nesting birds will be carried out by an ecologist; if nests are present the work will be delayed until young have fledged. This mitigation is not practical for large scale development and therefore should only be used if vegetation removal cannot be undertaken outside the bird breeding season in small parcels of land (for example where land access has been a constraint). ▪ Pre-construction checks for potential barn owl nesting sites (focusing on agricultural buildings) will be undertaken, in case there are any nests within potential disturbance distance of onshore works. Should any active nests be found, works in the vicinity of the nest will stop pending advice by the ECoW or a suitably qualified ecologist with ornithological expertise on the requirement for a works exclusion buffer around the nest until breeding activity is completed (chicks have fledged, or a nesting attempt has failed). ▪ Scrub, hedgerow, marshy grassland and maritime cliff and slope habitat that cannot be avoided will be subject to pre-construction walkover habitat survey in advance of construction commencing to inform the habitat reinstatement plans. ▪ Habitat reinstatement will be undertaken following completion of construction, using native species of local provenance. Landscaping plans will take into consideration of creation of breeding bird habitat.
Disturbance to notable plant species	Onshore Development Area	Construction	The location of the wild leek and small flowered catchfly will be clearly marked and identified with 5 m buffer fencing, and this area will be avoided during any construction work. This may require a bypass section of track to be temporarily constructed.
Disturbance to notable plant species	Onshore Development Area	Construction	It is recommended that prior to construction, further detailed botanical survey work is undertaken to ensure the risk of impacts to spatulate (South Stack) fleawort, golden-hair lichen and spotted rock-rose (and other areas of botanically rich vegetation) can be avoided. Such survey work should be carried out in May or June when fleawort

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			is in flower and morning time when spotted rock rose is more likely to flower.
Disturbance to notable plant species	Onshore Development Area	Construction	If, under a worst-case scenario, the cables are trenched at landfall, further consultation will be undertaken with NRW and RSPB to determine appropriate methods, mitigation and any appropriate consents to undertake the work. This would include any habitat reinstatement and planting schemes which will be detailed in the EAP, along with frequency of any required monitoring programme.
Disturbance to notable plant species	Onshore Development Area	Construction	A toolbox talk detailing the importance of these plant species will be delivered by the ECoW to all personnel working on site.
Disturbance to notable plant species	Onshore Development Area	Construction	Mitigation will include: - A pre-construction survey will be undertaken to ascertain up-to-date locations of any non-native invasive species within the Study Area; - An Invasive Species Management Plan (specific to Japanese knotweed) will be included in the EMP; and - A toolbox talk will be delivered by the ECoW to all personnel working on site.
Spread of INNS	Onshore Development Area	Construction	A buffer of 10 m will be placed around the known strands of non-native invasive species. If work is required in close proximity to the plants (e.g. within 7 m), advice from a specialist contractor is recommended to determine how any spoil generated from the work should be dealt with (for example, any possibly contaminated spoil may need to be disposed of at waste facility that is licenced to accepted controlled waste), and to agree an appropriate working method in this area. Treatment of strands of Japanese knotweed may be required if avoidance is not possible.
Chapter 20, Onshore Archaeology and Cultural Heritage			
Damage to previously unidentified heritage assets	Onshore Development Area	Construction	Pre-construction identification of potential archaeological sites through evaluation (geophysical survey potentially followed by trial trenching) which will in turn feed into decisions regarding micro-siting or route refinement, and the option to change design to use HDD on sections as part of the post-consent works. This will result in the avoidance of sites wherever possible, ensuring they are preserved in-situ. Where avoidance is identified as not being viable, consultation with stakeholders will be undertaken and a decision made between parties on how to proceed.
Damage to previously unidentified heritage assets	Onshore Development Area	Construction	The predicted phases of archaeological evaluation and mitigation for the Project are ▪ Geophysical survey of the landfall area, landfall substation location and onshore cable route

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			where it passes through fields or adjacent to the road where archaeological potential has been identified. This would be undertaken pre-determination of the Transport and Works Act Order (TWAO) application, to further inform stakeholders of the Project's archaeological potential; ▪ Archaeological trial trenching, to be undertaken in areas where archaeology is identified in the geophysical survey results. This will be done following consultation with GAPS, potentially pre-determination; ▪ Areas of pre-construction archaeological excavation, if the trenching results reveal that significant archaeological remains are located within the Project's footprint; ▪ Archaeological monitoring (Watching Brief) of the cable installation within the road footprint, in areas where archaeological potential is identified; ▪ Results would be presented in a grey literature report, followed by a publication if the results are worthy of such; and ▪ Wider dissemination of the results of archaeological works, through talks to local history and archaeology groups, schools or interested parties, to inform the public.
Damage to scheduled monument	Onshore Development Area	Construction	If the field to the west of the road [adjacent to Porth Dafarch Hut Circles] is used for installation, it would be far enough away to reduce any impacts from potential vibration or hydrological changes. HDD should also be assessed as a potential construction method for this section. Archaeological evaluation and investigation of the western field would be undertaken, to ensure any archaeological remains within the field that might be associated with the scheduled monument are preserved by record.
Chapter 21, Noise and Vibration			
Noise Impacts	Onshore Development Area	Construction	Standard construction noise mitigation practices and good practice construction management will be adopted throughout the construction phase. These will be captured within a Construction Noise Management Plan (CNMP) which forms part of a Code of Construction Practice (CoCP).
Noise Impacts	Onshore Development Area	Construction	The Control of Pollution Act and BS 5228 define a set of Best Practice working methods and mitigation

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			measures, referred to as BPM. Examples of these measures include: ▪ Where possible, locating temporary plant so that it is screened from receptors by on-site structures, such as site cabins; ▪ Using modern, quiet equipment and ensuring such equipment is properly maintained and operated by trained staff; ▪ Applying enclosures to particularly noisy equipment where possible; ▪ Ensuring that mobile plant is well maintained such that loose body fittings or exhausts do not rattle or vibrate; ▪ Ensuring plant machinery is turned off when not in use; ▪ Providing local residents with 24 hour contact details for a site representative in the event that disturbance due to noise from the construction works is perceived; and ▪ Establishing a community engagement process including informing local residents about the construction works, detailing the timing and duration of any particularly noisy elements, and providing a contact telephone number to them; ▪ Keeping noisy deliveries to the middle of the day where possible.
Noise Impacts	Onshore Development Area	Construction	The site induction programme and site rules should include good working practice instructions for site staff, managers, visitors and contractors to help minimise noise whilst working on the site. Good working practice guidelines/instructions could include, but not be limited to, the following points: ▪ Avoiding unnecessary revving of engines; ▪ Plant used intermittently should be shut-down between operational periods, where possible; ▪ Avoiding reversing wherever possible; ▪ Reporting any defective equipment/plant as soon as possible so that corrective maintenance can be undertaken; and ▪ Handling material in a manner that minimises noise ▪ Maintenance of construction plant ▪ Maintenance of temporary plant should be carried out routinely and in accordance with the manufacturers' guidance.

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			▪ A regular inspection of all plant and equipment should be undertaken to ensure that: ▪ All plant is in a good state of repair and fully functional; ▪ Any plant found to be requiring interim maintenance has been identified and taken out of use; ▪ Acoustic enclosures fitted to plant are in a good state of repair; ▪ Doors and covers to such enclosures remain closed during operation; and ▪ Any repairs are being undertaken by a fully qualified maintenance engineer.
Noise Impacts	Onshore Development Area	Construction	Careful scrutiny of plant selection at procurement stage would ensure that the associated noise impact of the plant is reduced as much as reasonably possible.
Chapter 22, Air Quality			
Dust and Particulate Matter Emissions	Onshore Development Area	Construction	Measures in relation to dust management include: ▪ Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by IoACC; ▪ Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken; ▪ Make the complaints log available to IoACC when asked; ▪ Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book; ▪ Liaise with any other high-risk construction sites within 500 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes; ▪ Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions;

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			▪ Plan the working area so that machinery and dust causing activities are located away from receptors, as far as is practicable; ▪ Erect solid screens or barriers around dusty activities, or the works boundary, that are at least as high as any stockpiles on site; ▪ Take measures to control site runoff of water or mud; ▪ Keep fencing, barriers and scaffolding clean using wet methods; ▪ Remove materials that have a potential to produce dust from site as soon as possible; ▪ Cover, seed or fence stockpiles to prevent wind whipping; ▪ Ensure all vehicles switch off engines when stationary - no idling vehicles; ▪ Minimise the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable; ▪ Impose and signpost a maximum-speed-limit of 15 mph on surfaced, and 10 mph on unsurfaced, haul roads and work areas; ▪ Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials; ▪ Implement the Travel Plan that has been produced for the proposed scheme, which supports and encourages sustainable travel for contractor operatives and staff (public transport, cycling, walking, and car-sharing); ▪ Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems; ▪ Use enclosed chutes and conveyors and covered skips; and ▪ Bonfires and burning of waste materials should not be permitted.
Dust and Particulate Matter Emissions	Onshore Development Area	Construction	Measures in relation to earthworks include: ▪ Re-vegetate or cover earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable; and ▪ Only remove the cover in small areas during work and not all at once.

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
Dust and Particulate Matter Emissions	Onshore Development Area	Construction	Measures specific to construction include: ▪ Ensure sand and other aggregates are stored in a controlled and well-managed manner; ▪ Avoid scabbling (roughening of concrete surfaces) if possible; ▪ Ensure bulk cement and other fine powder materials are delivered in enclosed tankers to prevent escape of material; and ▪ For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust release.
Dust and Particulate Matter Emissions	Onshore Development Area	Construction	Measures specific to trackout include: ▪ Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site; ▪ Ensure vehicles loaded with dusty materials entering and leaving sites are covered to prevent escape of materials during transport; ▪ Record all inspections of haul routes and any subsequent action in a site log book; ▪ Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned; ▪ If required as a result of visual inspection, install a wheel washing system (with rumble grids to dislodge accumulated dust and mud) prior to leaving the site where reasonably practicable; and, ▪ Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits; and.
Dust and Particulate Matter Emissions	Onshore Development Area	Construction	NRMM and plant would be well maintained. If any emissions of dark smoke occur, then the relevant machinery should stop immediately, and any problem rectified. In addition, the following controls would apply to NRMM: ▪ All NRMM should use fuel equivalent to ultralow sulphur diesel (fuel meeting the specification within EN590:2004); ▪ All NRMM will comply with regulation (EU) 2016/1628 of the European Parliament and of the European Council;

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			▪ All NRMM should be fitted with Diesel Particulate Filters (DPF) conforming to defined and demonstrated filtration efficiency (load/duty cycle permitting); ▪ The ongoing conformity of plant retrofitted with DPF, to a defined performance standard, should be ensured through a programme of onsite checks; and ▪ Implementation of energy conservation measures including instructions to throttle down or switch off idle construction equipment, switch off the engines of trucks while they are waiting to access the site and while they are being loaded or unloaded, and ensure equipment is properly maintained to ensure efficient energy consumption.
Chapter 23, Traffic and Transport			
Road Safety	Onshore Development Area	Construction	Landfall Substation new access at South Stack Road: ▪ Development of a detailed CTMP ▪ Advanced scheduling of deliveries and assigning of delivery slots to reduce the potential for two vehicles to meet at the access; ▪ Requiring drivers to call ahead to confirm their expected arrival time; and ▪ Controlling all departing HGV traffic through the use of a banksman.
Road Safety	Onshore Development Area	Construction	Additionally: ▪ The access would be provided with appropriate visibility splays to allow vehicles to safely access and exit, these would be maintained by the appointed Contractor; ▪ The access would incorporate a bound (concrete or asphalt) surface to prevent dust and dirt being tracked on to the highway, reducing the potential for vehicles to lose control on loose material; ▪ Temporary direction and warning signs to advise of turning vehicles would be provided for the construction phase. This signage would highlight the proposed access to drivers to avoid late breaking manoeuvres and highlight to the travelling public the potential for turning vehicles; and

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			▪ A temporary reduction in the existing speed limit in the vicinity of the access would be implemented during the construction phase to reduce the speed of vehicles in the vicinity of the access.
Road Safety	Onshore Development Area	Construction	Grid connection substation access (existing Orthios Eco Park access from the A5) ▪ In order to make the public aware of the potential for constriction traffic to be using these accesses, temporary direction and warning signs to advise of turning vehicles would be provided. This signage would highlight the proposed accesses to drivers to avoid late breaking manoeuvres and highlight to the travelling public the potential for turning vehicles.
Traffic impacts	Onshore Development Area	Construction	With regards to managing the traffic through the single lane closure following measures would be applied to reduce the potentially adverse impacts. These measures would be agreed with the local highway authority post consent once a Contractor has been appointed through the development of a detailed CTMP, the measures would include: ▪ Controlling traffic through temporary traffic signals/ stop go boards; ▪ Maintaining a safe route for pedestrians through the works area; and ▪ Working with the local highway authority and local stakeholders to agree an appropriate time to undertake the works.
Traffic impacts	Onshore Development Area	Construction	With regards driver delay impacts upon the three properties that would be within the road closures, the following additional mitigation measures are proposed: ▪ Establishing a direct line of communication with residents to discuss the proposed timing of the works; ▪ Providing temporary parking within the closed section of highway as close to the properties as possible; ▪ Ensure that a banksman is available to guide residents safely through the works area; and

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			▪ Provide assistance with carrying heavy items (shopping, bins, etc.) between the resident's vehicles and home.
Chapter 24, Seascape, Landscape and Visual Impact Assessment			
Landscape and visual impact	Onshore Cable Corridor	Construction	Reinstatement of the ground and landscape features following construction.
Landscape and visual impact	MDZ	Design	Further consideration could be given to mitigation at the detailed design stage, such measures could include: ▪ The colour of the tidal devices; ▪ The navigational lighting that is required; and ▪ The layout configurations of tidal devices within arrays e.g. curved rows of devices or irregular placement.
Landscape and visual impact	Landfall Substation	Design	Considering limited application of planting to help integrate the landfall substation, acknowledging the limitations associated with this in the open and exposed coastal landscape.
Chapter 25, Socioeconomics, Tourism and Recreation			
Social Benefits - Decentralisation of Economic Growth	MDZ, ECC and Onshore Development Area (ODA)	Construction	▪ Seek to localise as much development and operational expenditure in Anglesey and North Wales as possible; ▪ Encourage the local supply chain to invest in key capabilities that maximise local contracting opportunities; ▪ Encourage appropriate public sector support and private sector investment to back the supply chain endeavours; ▪ Seek to expand the marine energy and related renewables and energy systems activity in Anglesey and North Wales, as much as possible; ▪ Seek to expand the range of development activities, to increase the activity during the operations years.
Wellbeing of Future Generations - Green Branding of Locality	MDZ, ECC and Onshore Development Area (ODA)	Construction	▪ The mitigation and optimisation measures that are considered appropriate by the assessors regards wider green branding for Anglesey associated with this project are: ▪ Establishing and maintaining a strong online and news media presence for the brand through the management of news, data, information and progress announcements; ▪ Ensuring that all activities undertaken by the Project and its delivery partners are aligned

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			with a defined set of brand values and guidelines; ▪ The capturing of video and photo opportunities associated with all aspects of project development; ▪ Having resources available to welcome and host reporters and other interested parties; ▪ Organising regular local events to share the brand with local residents and ensure local buy-in; ▪ Attending sector events nationally and international as appropriate; and ▪ Seeking opportunities for telling the story of the Project through any media.
Economic Impacts - Direct and Secondary Income	MDZ, ECC and Onshore Development Area (ODA)	Construction	▪ The Project should attempt to maintain pressure on UK and Welsh Governments to support marine renewables; ▪ The Project should encourage the development of support mechanisms for marine energy, such as Innovation PPA, or ring-fenced Innovation CfD, being promoted nationally (Marine Energy Council, 2019); ▪ Encourage Schools, Colleges and Universities to develop appropriate training for the workforce; ▪ Fully develop a local and regional supply chain, that can take advantage of the opportunities that develop, thorough the project maximising the GVA benefits.
Economic Impacts - Accumulation of Grant Support	MDZ, ECC and ODA	Construction	▪ Continued pressure by the Project team exerted on UK and Welsh Government to support Marine Renewables; ▪ Continued pressure by the Project team in support of the suggested development of support mechanisms for Marine Energy, such as Innovation PPA or ring-fenced Innovation CfD, being promoted nationally (Marine Energy Council, 2019); ▪ Research full range of grant options available to projects that intend to utilise the Project; ▪ Full engagement with local and national development agencies to ensure all support mechanisms are fully developed;

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
			▪ There are some risks with EU funding around Brexit. This can be mitigated against by fully engaging with the governments' transition team.
Economic Impacts - Level of Commerce Activity - Green Cluster Creation	MDZ, ECC and ODA	Construction	▪ Ensure that there is an understanding of the benefits of clustering within all key stakeholders; ▪ Ensure that all activities undertaken by the Project support cluster creation; in particular, through progressive partnership type procurement processes, wherever practical/possible; ▪ Encourage established sector players to create/join in with a local cluster; and ▪ Advocate the inherent advantages and opportunities there are in Anglesey (and possibly North Wales) for such a cluster to be created.
Employment Issues - Job Numbers	MDZ, ECC and ODA	Construction	▪ Support given to developers to manufacture and construct the devices within Wales; ▪ Develop training programmes to up-skill the workforce; ▪ Highlight the job availability across Wales, timely and in advance of the developments to encourage workforce to prepare; ▪ Encourage the supply chain to prepare and bid for any contracts; and ▪ Create cluster of local and region companies that can ensure local content.
Employment Issues - Quality of Jobs	MDZ, ECC and ODA	Construction	▪ Development of appropriate training to up-skill the work force in advance of the Project; ▪ Highlight the job availability across Wales in a timely fashion and in advance of the developments to encourage workforce to prepare; ▪ Encourage Schools, Colleges and Universities to develop appropriate training for the workforce; ▪ Incentivise developers to create apprentices and other training opportunities; and ▪ Encourage some of the specialist skilled workforce to relocate to the area.
Skills impacts - Shortage of Necessary Skills	MDZ, ECC and ODA	Construction	▪ The Project should be ensuring there is a robust and experience based plan of what

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
- Reduced Performance of Project			capacity, skills, and experience is needed to run a site of the type envisaged; ▪ The project should establish good links and exchange of information, on a commercial basis if necessary, with established operational tidal sites; ▪ Carefully considering the personnel engagement strategy that ensures the right expertise and experience is available to the Project; and ▪ Establishing an advisory board of experienced peers who can help identify any areas of weakness and recognise areas of strength.
Training Impacts - New Skills and Competence Needs	MDZ, ECC and ODA	Construction	▪ Ensuring there is a robust and experience based plan of what capacity, skills, and experience is needed to run a site of the type envisaged; ▪ Menter Mon, the third-party managers of the Project, have a remit to maximise the economic benefit to Anglesey and therefore the retraining of the potential workforce will be a high priority, to optimise and maximise this potential beneficial impact; ▪ As part of the project Menter Môn should map out the opportunities and encourage the development of specific training programmes, that focus on the development opportunities identified in the mapping process; and ▪ These options could be developed throughout the phases of the project, allowing for increased employment opportunities.
Training Impacts - Tertiary BSc, Eng, PhD	MDZ, ECC and ODA	Construction	▪ The full support of the local and regional universities to fully utilise the demonstration zone to develop research and courses and seek out tidal energy research students should optimise this impact; and ▪ Encourage schools, colleges and universities to develop appropriate training for the workforce.
Other Impacts - Additional Local Services available within the local area - New Technical Skills, Workboats,	MDZ, ECC and ODA	Construction	▪ Establishing a clear list of anticipated requirements well in advance of the need actually arising and engaging with the local supply chain to assess their interest in engaging in capacity building;

Potential Impact	Project infrastructure	Project Phase	Mitigation or monitoring measure
Cranes, Better Marine Skills			▪ Ensuring that there are appropriate, transparent and legal procurement mechanisms to reward proactive local capacity investment, with participation in future work activities; ▪ Exploring parallel capacity building projects with prospective supply chain partners; ▪ Establishing formal supply chain partnerships where there is strong alignment of purpose; and ▪ Ensuring that site users and clients are made aware of and beneficially directed to engage with, local suppliers who have invested in important local capacity.
Energy Impacts - Energy Security – More Green Electricity, Local Supply, Diversity of Supply		Construction	▪ Consider the actual scale and pattern of power outputs at different stages of development, with different technologies and with predicted maintenance and unplanned outages; ▪ Consider the merits or otherwise of introducing power storage and grid system balancing technologies alongside the generation assets; ▪ Consider specialised energy markets that may exist locally, that could be directly serviced by power outputs; and ▪ Consider how supplies of tidal energy might add to the resilience of the Anglesey and nearby grid system.
Energy Impacts - Decarbonisation - Clean Energy, Balancing Services, Spin-Off Capacity	MDZ, ECC and ODA	Construction	▪ Full assessment of the possible carbon savings for each project within the overall Morlais project should be quantified and maximised; ▪ An assessment methodology that highlights how projects and the supply chain can make carbon savings should be developed; ▪ Balancing services that can complement the introduction of tidal energy should be developed, in parallel with the phases of the Project; and ▪ Spin off opportunities should be encouraged and developed alongside the different phases of the Project.

27.4. SUMMARY OF POTENTIAL IMPACTS

27. The purpose of the EIA is to inform the decision-maker, stakeholders and all interested parties of any significant environmental issues that may result from the Project during its construction, operation and (where relevant) decommissioning. The EIA provides an independent assessment of the Project to enable interested parties to understand such potential impacts before making decisions on whether consent for the Project should be granted.

28. The process of identifying and assessing the environmental impacts of the proposed Project is iterative, running in parallel with the project design. Where any of the potential impacts are identified as being significantly adverse then, where possible, the design will be altered to mitigate these impacts.

29. The impact assessment for each chapter has considered any relevant embedded mitigation as outlined in **Table 27-1** and presents an initial impact significance. Where significant adverse impacts have been identified as a result of the Project, additional site specific mitigation measures, as outlined in **Table 27-2** are proposed to seek to reduce residual impacts to acceptable (non-significant) levels.

30. **Table 27-3** to **Table 27-21** provide a summary of the results of the impact assessment for each technical chapter within this ES, whilst overall conclusions are presented in **Section 27.5**.

Table 27-3 Summary of Potential Impacts for Metocean And Coastal Processes

Potential Effect	Scale	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Construction and Repowering Phase						
Effect 1: Changes in suspended sediment concentrations due to foundation installation in the Project	Near-field	Low	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 2: Changes in sea bed level (morphology) due to deposition during foundation installation in the Project	Near-field	Low	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 3: Changes in suspended sediment concentrations during offshore export cable installation (including nearshore) (construction only)	Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Low (sand ridge) to Negligible (elsewhere)
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 4: Changes in sea bed level due to offshore export cable installation (construction only)	Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 5: Changes in suspended sediment concentrations during inter-array cable installation	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 6: Changes in sea bed level due to inter-array cable installation	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 7: Changes in sea bed level (morphology) due to indentations during installation in the Project	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	No effect	Negligible	Negligible	Negligible	Negligible
Operational Phase						
Effect 1: Changes to the tidal regime due to the presence of structures in the Project	Device	Medium	High	Medium	Negligible	Medium
	Near-field	Low - Medium	High	Medium	Negligible	Low - Medium
	Far-field	Negligible	High	Medium	Negligible	Negligible

Potential Effect	Scale	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Effect 2: Changes to the wave regime due to the presence of structures in the Project	Device	Medium	High	Medium	Negligible	Medium
	Near-field	Low	High	Medium	Negligible	Low
	Far-field	Negligible	High	Medium	Negligible	Negligible
Effect 3: Changes to the sediment transport regime due to the presence of structures in the Project	Device	Low	High	Medium	Negligible	Low
	Near-field	Negligible	High	Medium	Negligible	Negligible
	Far-field	Negligible	High	Medium	Negligible	Negligible
Effect 4: Loss of sea bed morphology due to the footprint of structures in the Project	Near-field (direct footprint)	Low	High	Medium	Negligible	Low
	Far-field	No change	No change	No change	No change	No change
Effect 5: Morphological and sediment transport effects due to cable protection measures for offshore export cables (including nearshore and at the coastal landfall)	Near-field	Negligible	High	Medium	Negligible	Negligible
	Far-field	Negligible	High	Medium	Negligible	Negligible
Effect 6: Morphological and sediment transport effects due to cable protection measures for inter-array cables	Near-field	Negligible	High	Medium	Negligible	Negligible
	Far-field	Negligible	High	Medium	Negligible	Negligible
Effect 7: Changes in sea bed level (morphology) due to maintenance during maintenance in the Project	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	No effect	Negligible	Negligible	Negligible	Negligible
Decommissioning and Repowering Phase						
Effect 1: Changes in suspended sediment concentrations due to device and hub removal	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 2: Changes in sea bed level due to device and hub removal	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

Potential Effect	Scale	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Effect 3: Changes in suspended sediment concentrations during offshore export cable removal (including nearshore and at the coastal landfall) (decommissioning only)	Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Low (sand ridge) to Negligible (elsewhere)
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 4: Changes in sea bed levels due to removal of the offshore export cables (decommissioning only)	Near-field	Low (sand ridge) to Negligible (elsewhere)	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 5: Changes in suspended sediment concentrations during removal of parts of the inter-array cables	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 6: Changes in sea bed levels due to removal of parts of the inter-array cables	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Effect 7: Changes in sea bed level (morphology) due to indentations during decommissioning in the Project	Near-field	Negligible	Negligible	Negligible	Negligible	Negligible
	Far-field	No effect	Negligible	Negligible	Negligible	Negligible

Table 27-4 Summary of Potential Impacts for Marine Water and Sediment Quality

Potential Impact	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
Construction / Repowering Phase					
Impact 1: Change in water quality due to sediment plume generated via foundation installation	Negligible	Low	Negligible	None required	Negligible

Potential Impact	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
Impact 2: Change in water quality due to sediment plume generated via cable installation (construction only)	Low (sandwave area) Negligible (other areas)	Low	Minor Adverse (sandwave area) Negligible (other areas)	None required	Negligible
Impact 3: Change in water quality due to release of contaminated sediments	Negligible	Low	Negligible	None required	Negligible
Impact 4: Change in water quality due to discharge of construction material and/or chemicals	Low	Low	Minor Adverse	Adherence to project-specific CEMP and PPMP which themselves will take full account of relevant pollution control legislation and guidance, i.e. MARPOL regulations	Negligible
Impact 5: Deterioration in status of WFD waterbodies and/or local designated bathing waters	Low	Medium	Minor Adverse	Adherence to project-specific CEMP and PPMP which themselves will take full account of relevant pollution control legislation and guidance, i.e. MARPOL regulations	Negligible
Operational Phase					
Impact 1: Change in water and/or sediment quality due to accidental spillages/leaks from operational devices	Low	Low	Negligible	Adherence to project-specific CEMP and PPMP which themselves will take full account of relevant pollution control legislation and guidance, i.e. MARPOL regulations	Negligible
Impact 2: Change in water sediment quality due to sediment plumes generated by repowering and/or cable repair works	Negligible	Low	Negligible	None required	Negligible
Impact 3: Change in water sediment quality due to sediment plumes produced via scour around seabed	Low (sandwave/ sediment areas)	Low	Minor	None required	Minor adverse (sandwave / sediment areas)

Potential Impact	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
mounted project infrastructure	Negligible (no sediment areas)				Negligible (no sediment areas)
Decommissioning / Repowering Phase					
Impact 1: Changes in suspended sediment concentrations during removal of project infrastructure	Negligible	Low	Negligible	None required	Negligible
Impact 2: Change in water and/or sediment quality due to accidental spillages/leaks from vessels involved in decommissioning works	Low	Low	Minor Adverse	Adherence to project-specific CEMP and PPMP which themselves will take full account of relevant pollution control legislation and guidance, i.e. MARPOL regulations	Negligible

Table 27-5 Summary of Potential Impacts for Benthic and Intertidal Ecology

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase						
Impact 1: Physical disturbance to habitats and species and temporary habitat loss	VER Group 9 and 10	Medium	Low	Minor Adverse	Mitigation will be conducted to ensure minimal disturbance to and loss of habitats and species during construction via pre-construction surveys and micro-siting.	Minor Adverse
Impact 2: Increased suspended sediment concentration and sediment deposition	VER Group 10	Low	Negligible	Negligible	None required	Negligible

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Impact 3: Pollution of water and sediment through accidental events	Benthic habitats within MDZ	High	Low	Moderate	▪ Development of an Emergency Response Cooperation Plan (ERCoP) with guidance set out by MCA in MGN 371, issued and approved by MCA; ▪ Notice to Mariners issued to reduce collision risks; ▪ Vessels associated with all Project operations will comply with IMO/MCA codes for prevention of oil pollution and any vessels over 400 GT will have on board SOPEPs; ▪ Vessels associated with all Project operations and barge will carry on-board oil and chemical spill mop up kits; and ▪ Where possible, avoid working in poor weather conditions.	Minor Adverse
Impact 4: Physical disturbance to intertidal habitats and species during landfall works	VER Group 1, 9, 12	Medium	Medium	Moderate	Agree work method with NRW to minimise disturbance, using excavated materials to backfill, and to safeguard some boulders from top layer pre trench excavation, for replacement at end of backfilling.	Minor Adverse
Impact 5: Potential spread of non-native	Benthic habitats within MDZ	Medium	Medium	Moderate	Compliance with guidelines, risk assessment of project vessels for INNS and further mitigation measures if required.	Minor Adverse
Operational Phase						
Impact 6: Long term loss of benthic habitat via placement of project infrastructure	VER Habitat Group 1, 9 and 12	Medium	Medium	Moderate	Following consent, pre-construction surveys and possible micro-siting will be conducted to allow for identification of important areas of habitat.	Minor Adverse

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Impact 7: Changes in hydrodynamic and inter-related effects on benthic ecology	Benthic habitats within MDZ	Low	Medium	Minor Adverse	None required	Minor Adverse
Impact 8: Introduction of new habitat in the form of project infrastructure	Benthic habitats within MDZ	Medium	Negligible	Minor Adverse	None required	Minor Adverse
Impact 9: Temporary physical disturbance of seabed caused by maintenance and repowering activities	VER Habitat Group 9 and 10	Medium	Negligible	Minor Adverse	None required	Minor Adverse
Decommissioning Phase						
Impact 10: Physical disturbance to habitats and species and temporary habitat loss	VER Habitat Group 9 and 10	Medium	Low	Minor Adverse	Following consent, pre-construction surveys and possible micro-siting will be conducted to allow for identification of important areas of habitat.	Minor Adverse
Impact 11: Increases in suspended sediment concentration and subsequent deposition	Benthic habitats within MDZ	Low	Negligible	Negligible	None required	Negligible
Impact 12: Permanent loss of habitat	Benthic habitats within MDZ	Negligible	Negligible	Negligible	None required	Negligible

Table 27-6 Summary of Potential Impacts for Fish Ecology

Potential Impact	Receptor	Value / sensitivity combined	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase						
Impact 1: Underwater noise	All fish species	Medium	Low	Minor adverse	None proposed	Minor adverse

Potential Impact	Receptor	Value / sensitivity combined	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Impact 2: Physical disturbance of habitats and temporary habitat loss	All fish and shellfish species	Low	Low	Minor adverse	None proposed	Minor adverse
Impact 3: Increased suspended sediment concentration and sediment deposition	All fish and shellfish species	Medium	Very low	Minor adverse	None proposed	Minor adverse
Operational Phase						
Impact 4: Underwater Noise	All fish species	Medium	Low	Minor adverse	None proposed	Minor adverse
Impact 5: Long-term habitat loss via placement of project infrastructure (project footprint)	All fish and shellfish species	Medium	Low	Minor adverse	None proposed	Minor adverse
Impact 6: Barrier effects	All fish and shellfish species	Low	Medium	Minor adverse	None proposed	Minor adverse
Impact 7: Collision risk	All fish and shellfish species	Low	Negligible	Minor adverse	None proposed	Minor adverse
Impact 8: Electromagnetic fields	All fish and shellfish species	Low	Low	Minor adverse	None proposed	Minor adverse
Repowering						
Impact 9: Underwater noise	All fish species	Medium	Low	Minor adverse	None proposed	Minor adverse
Impact 10: Physical disturbance of habitats and temporary habitat loss	All fish and shellfish species	Medium	Low	Minor adverse	None proposed	Minor adverse
Impact 11: Increased suspended sediment concentration and sediment deposition	All fish and shellfish species	Medium	Very low	Minor adverse	None proposed	Minor adverse
Decommissioning Phase						
Impact 12: Underwater noise	All fish species	Medium	Low	Minor adverse	None proposed	Minor adverse

Potential Impact	Receptor	Value / sensitivity combined	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Impact 13: Physical disturbance of habitats and temporary habitat loss	All fish and shellfish species	Low	Low	Minor adverse	None proposed	Minor adverse
Impact 14: Increased suspended sediment concentration and sediment deposition	All fish and shellfish species	Medium	Very low	Minor adverse	None proposed	Minor adverse

Table 27-7 Summary of Potential Impacts for Marine Ornithology

Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase						
Impact 1: Airborne Noise and Visual Disturbance	Guillemot	High/Medium	Low	Minor adverse	None	Minor adverse
	All other species	Various	Negligible	Negligible		Negligible
Impact 2: Disturbance at Breeding Sites	Abraham's Bosom	High/Negligible for activity >300 m from colony, medium if within <300 m. Low sensitivity if outside the breeding season within <300m	Negligible for activity >300 m from colony, medium if within <300 m	Medium adverse if <300 m during breeding season, otherwise negligible	No works within 300 m of any colony during breeding season	Negligible
	South Stack and Penlas RSPB					
	Gogarth					
Impact 3: Other Impacts	All species	Various/low or negligible	Negligible	Negligible	None	Negligible
Operational Phase						
Impact 4: Airborne Noise and Visual Disturbance	Guillemot	High/Medium	Low	Minor adverse	None	Minor adverse

<table>
<tr><th>Impact</th><th>Receptor</th><th>Value/ Sensitivity</th><th>Magnitude</th><th>Significance</th><th>Additional Mitigation Measures</th><th>Residual Impact</th></tr>
<tr><td rowspan="3"></td><td>Cormorant</td><td>Low/High</td><td>Low</td><td>Minor beneficial</td><td rowspan="3"></td><td>Minor beneficial</td></tr>
<tr><td>All other species</td><td>Various</td><td>Negligible</td><td>Negligible</td><td>Negligible</td></tr>
<tr><td>Shag</td><td>Medium/Medium</td><td>Low</td><td>Minor beneficial</td><td>Minor beneficial</td></tr>
<tr><td rowspan="3">Impact 5: Disturbance at Breeding Sites</td><td>Abraham's Bosom</td><td rowspan="3">High/Negligible for activity >300 m from colony, medium if within <300 m. Low sensitivity if outside the breeding season within <300m</td><td rowspan="3">Negligible for activity >300 m from colony, medium if within <300 m</td><td rowspan="3">Medium adverse if <300 m during breeding season, otherwise negligible</td><td rowspan="3">No works within 300 m of any colony during breeding season</td><td rowspan="3">Negligible</td></tr>
<tr><td>South Stack and Penlas RSPB</td></tr>
<tr><td>Gogarth</td></tr>
<tr><td rowspan="6">Impact 6: Collision risk with tidal devices (40 MW Worst Case, 95% avoidance rate)</td><td>South Stack and Penlas SMP sub-colonies</td><td>High/High</td><td>High</td><td>Major adverse</td><td>Monitoring programme enabling use of higher avoidance rate, plus deploy, manage and monitor approach</td><td rowspan="6">Minor adverse</td></tr>
<tr><td>Gannet</td><td rowspan="5">High/Medium</td><td>Negligible</td><td>Minor adverse</td><td>None</td></tr>
<tr><td>Guillemot</td><td>Medium</td><td>Moderate adverse</td><td>Monitoring programme enabling use of higher avoidance rate, plus deploy, manage and monitor approach</td></tr>
<tr><td>Manx shearwater</td><td rowspan="2">Low</td><td rowspan="2">Minor adverse</td><td rowspan="2">None</td></tr>
<tr><td>Puffin</td></tr>
<tr><td>Razorbill</td><td>High</td><td>Major adverse</td><td>Monitoring programme enabling use of higher</td></tr>
</table>

Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
					avoidance rate, plus phased deployment	
	Red-throated diver	Medium/Medium	Low	Minor adverse	None	
	Shag		Negligible			
	All other species	Various/Negligible		Negligible		Negligible
Impact 7: Collision risk with tidal devices (240 MW Indicative Array, 95% avoidance rate)	South Stack and Penlas SMP sub-colonies	High/High	Very High	Major adverse	Monitoring programme enabling use of higher avoidance rate, plus deploy, manage and monitor approach	Minor adverse
	Gannet	High/Medium	Negligible	Minor adverse	None	
	Guillemot		Very High	Major adverse	Monitoring programme enabling use of higher avoidance rate, plus phased deployment	
	Manx shearwater		Low	Minor adverse	None	
	Puffin					
	Razorbill		Very High	Major adverse	Monitoring programme enabling use of higher avoidance rate, plus deploy, manage and monitor approach	
	Red-throated diver	Medium/Medium	Low	Minor adverse	None	
	Shag		Negligible			
	All other species	Various/Negligible		Negligible		Negligible

Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Impact 8: Entanglement with Tidal devices	Cormorant	Low/Medium	Low	Minor adverse	None	Minor adverse
	Guillemot	High/Medium				
	Puffin					
	Razorbill					
	Red-throated Diver	Medium/Medium				
	Shag					
	All other species	Various/Negligible	Negligible	Negligible	None	Negligible
Impact 9: Other Impacts	All species	Various/low or Negligible	Negligible	Negligible	None	Negligible
Decommissioning						
Impact 10: Airborne Noise and Visual Disturbance	Guillemot	High/Medium	Low	Minor adverse	None	Minor adverse
	Puffin					
	Razorbill					
	Red-throated diver	Medium/Very High				
	Shag	Medium/Medium				
	All other species	Various	Negligible	Negligible		Negligible
Impact 11: Disturbance at Breeding Sites	Abraham's Bosom	High/Negligible for activity >300 m from colony, medium if within <300 m. Low sensitivity if outside the breeding season within <300m	Negligible for activity >300 m from colony, medium if within <300 m	Medium adverse if <300 m during breeding season, otherwise negligible	No works within 300 m of any colony during breeding season	Negligible
	South Stack and Penlas RSPB					
	Gogarth					
Impact 12: Other Impacts	All species	Various/Low or negligible	Negligible	Negligible	None	Negligible

Table 27-8 Summary of Potential Impacts for Marine Mammals

Potential Impact	Receptor	Value / sensitivity combined	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction						
Impact 1: Underwater noise	All species	Medium	Negligible / very low	Minor adverse	MMMPs	Minor adverse (not significant)
Impact 2: Barrier effects from underwater noise	All species	Low	Negligible / very low	Negligible	None proposed, other than MMMPs	Negligible
Impact 3: Disturbance haul-out sites	Grey seal	Low	Negligible / very low	Negligible	None required or proposed	Negligible
Impact 4: Increased collision risk with vessels	All species	Low	Negligible to low	Negligible to Minor adverse	Not required or proposed	Negligible to Minor adverse (not significant)
Impact 5: Changes in water quality	All species	Negligible	Low	Negligible	EMMP and PPMP	Negligible
Impact 6: Changes in prey availability	All species	Low to Medium	Negligible / very low	Negligible to Minor adverse	None required or proposed	Negligible to Minor adverse (not significant)
Operational Phase						
Impact 7: Underwater noise	All species	Low	Low to Medium	Minor adverse	None required or proposed	Minor adverse (not significant)
Impact 8: Collision risk with operational turbines	Bottlenose dolphin	High	Medium to High	Major adverse	Deploy, manage and monitor approach	Minor to Moderate adverse
	All other species	Low	Low to Medium	Minor adverse		Minor adverse (not significant)
Impact 9: Increased collision risk with vessels	All species	Low	Negligible to low	Negligible to Minor adverse	None required or proposed	Negligible to Minor adverse (not significant)
Impact 10: Entanglement with mooring lines	Minke whale	Low	Low to High	Minor to Moderate adverse	Deploy, manage and monitor approach	Minor adverse (not significant)
	All other species	Low	Low to Moderate	Minor adverse		Minor adverse (not significant)
Impact 11: EMF effects	All species	Negligible	Negligible	Negligible	None required or proposed	Negligible

Potential Impact	Receptor	Value / sensitivity combined	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Impact 12: Barrier effects	All species	Low	Low	Minor adverse	None required or proposed	Minor adverse (not significant)
Impact 13: Changes in water quality	All species	Negligible	Negligible to Low	Negligible	EMMP and PPMP	Negligible
Impact 14: Changes in prey availability	All species	Low to Medium	Low	Minor adverse	None required or proposed	Minor adverse (not significant)
Decommissioning Phase						
It is anticipated that the decommissioning impacts would be no worse than those of construction.						
Cumulative Impacts						
Impact 15: Underwater noise and disturbance	All species	Low	Negligible	Negligible	No further mitigation proposed	Negligible
Impact 16: Collision risk with tidal devices and vessels	All species	Low	Medium	Minor	Deploy, manage and monitor approach	Minor adverse (not significant)
Impact 16: Displacement due to changes in prey availability / habitat loss	All species	Low to Medium	Negligible to Low	Negligible to Minor adverse	None required or proposed	Negligible to Minor adverse (not significant)

Table 27-9 Summary of Potential Impacts for Offshore Archaeology and Cultural Heritage

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase						
Impact 1: Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Negligible
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Negligible

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Negligible
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Negligible
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Negligible
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Negligible
Impact 2: Indirect physical impacts on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Negligible
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Minor adverse
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Negligible
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Minor adverse

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Minor adverse
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Minor adverse
Operational Phase						
Impact 3: Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Negligible
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Minor adverse
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Negligible
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Minor adverse
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Minor adverse
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Minor adverse

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
Impact 4: Indirect physical impacts on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Negligible
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Minor adverse
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Negligible
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Minor adverse
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Minor adverse
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Minor adverse
Decommissioning Phase						
Impact 5: Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Negligible
	Discrete submerged	High	High	Major Adverse	WSI Reporting protocol (PAD)	Minor adverse

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
	prehistoric receptors				Micro-siting and avoidance (AEZs)	
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Negligible
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Minor adverse
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Minor adverse
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Minor adverse
Impact 6: Indirect physical impacts on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Low	Medium	Minor Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	N Negligible
	Discrete submerged prehistoric receptors	Low	High	Moderate Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Negligible
	Potential redeposited prehistoric and later finds	Low	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Negligible
	Known maritime receptors	Low	High	Moderate Adverse	WSI Micro-siting and avoidance (AEZs)	Negligible

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
					Reporting protocol (PAD)	
	Unknown maritime receptors	Low	High	Moderate Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Negligible
	Unknown aviation receptors	Low	High	Moderate Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Negligible

Table 27-10 Summary of Potential Impacts for Commercial Fisheries

Potential Impact	Impact Magnitude	Receptor Sensitivity	Impact Significance	Additional Mitigation	Residual Impact
Construction Phase					
Impact 1: Loss of access to fishing grounds due to construction activity	Medium Low Low	≤10m nearshore static: Low ≤>10m MDZ static: Low >10m MDZ mobile: Negligible	Minor adverse Minor adverse Negligible	▪ Local fishermen to be notified of all planned construction works via Notice to Mariners; ▪ Project-specific FLO to be appointed during construction phase; ▪ All construction vessels to exhibit appropriate lighting and markings at all times; and ▪ Construction activities to be planned as far as possible so that they are focussed in discrete areas at any one time, i.e. not spread out across entire site. ▪ Where local vessels are able to demonstrate a clear loss in annual income due to loss of fishing grounds	Minor adverse Minor adverse Negligible

Potential Impact	Impact Magnitude	Receptor Sensitivity	Impact Significance	Additional Mitigation	Residual Impact
				within the MDZ, Menter Môn will enter into discussions on appropriate forms of financial assistance.	
Impact 2: Collision risk between commercial fishing vessels and construction vessels					See **Chapter 15, Shipping and Navigation**
Impact 3: Obstruction to regular fishing vessel transit routes	Medium Low Low	≤10m nearshore static: Low ≤>10m MDZ static: Low >10m MDZ mobile: Negligible	Minor adverse Minor adverse Negligible	As per Impact 1 plus: Where required, agreed transit routes around/through the MDZ to be developed and agreed between Menter Môn and local fishing vessels. This approach has been successfully adopted on OWF projects around the UK coast;	Minor adverse Minor adverse Negligible
Impact 4: Interference with static fishing gear due to additional vessel traffic	Medium Low Negligible	≤10m nearshore static: Medium ≤>10m MDZ static: Medium >10m MDZ mobile: Negligible	Moderate adverse Minor adverse Negligible	As per above 1 plus: Key areas of static gear deployment to be provided by local fishermen and used to develop agreed transit routes around/through the MDZ that aim to minimise damage to static gear.	Minor adverse Negligible Negligible

Potential Impact	Impact Magnitude	Receptor Sensitivity	Impact Significance	Additional Mitigation	Residual Impact
Impact 5: Supply chain opportunities for local fishing vessels	Medium Medium Medium	≤10m nearshore static: Low ≤>10m MDZ static: Low >10m MDZ mobile: Medium	Minor beneficial Minor beneficial Moderate beneficial	No mitigation required. However, to increase opportunities for local fishing vessels to support the Morlais project, the Action Plan provided as part of the 2015 study (MarineSpace, 2015) should be reviewed and, where appropriate updated. Discussions should then be held between Menter Môn and the local fishing community to identify what needs to be done to maximise these opportunities.	Minor beneficial Minor beneficial Moderate beneficial
Operational Phase					
Impact 6: Collision risk between commercial fishing vessels and project infrastructure					See Chapter 12, Shipping and Navigation
Impact 7: Loss of access to fishing grounds and displacement of fishing effort onto adjacent grounds	Negligible Medium Low	≤10m nearshore static: Medium ≤>10m MDZ static: Low >10m MDZ mobile: Negligible	Minor adverse Minor adverse Negligible	Where local vessels are able to demonstrate a clear loss in annual income due to loss of fishing grounds within the MDZ, Menter Môn will enter into discussions on appropriate forms of financial assistance.	Minor adverse Minor adverse Negligible
Impact 8: Reduction in abundance of target species and reduced supply of catch to established local buyers	Negligible Low Low	≤10m nearshore static: Medium ≤>10m MDZ static: Low >10m MDZ mobile: Negligible	Minor adverse Minor adverse Negligible	None proposed	Minor adverse Minor adverse Negligible
Impact 9: Presence of seabed fasteners	Low Negligible Negligible	≤10m nearshore static: Medium <≤>10m MDZ static: Low >10m MDZ mobile: Negligible	Minor adverse Negligible Negligible	▪ Ensuring devices marked as per International Association of Lighthouse Authorities (IALA) Guidance and Aids to Navigation ▪ Promulgation of information via NtM;	Negligible Negligible Negligible

Potential Impact	Impact Magnitude	Receptor Sensitivity	Impact Significance	Additional Mitigation	Residual Impact
				▪ GPS off station alarm / SCADA monitoring system; ▪ Site boundaries marked in accordance with Trinity House; ▪ Surveyed and charted as required by UKHO; ▪ Restrict Navigation through the MDZ; ▪ Exclusion of fishing within the MDZ; and ▪ Establish no anchoring areas.	
Impact 10: Supply chain opportunities for local fishing vessels	Low Medium Medium	≤10m nearshore static: Medium ≤>10m MDZ static: Low >10m MDZ mobile: Medium	Minor beneficial Minor beneficial Moderate beneficial	No mitigation required. However, to increase opportunities for local fishing vessels to support the Morlais project, the Action Plan provided as part of the 2015 study (MarineSpace, 2015) should be reviewed and, where appropriate updated. Discussions should then be held between Menter Môn and the local fishing community to identify what needs to be done to maximise these opportunities	Minor beneficial Minor beneficial Moderate beneficial
Decommissioning Phase					
It is anticipated that the decommissioning impacts would be no worse than those of construction.					

Table 27-11 Summary of Potential Impacts for Shipping and Navigation

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
Construction Phase					
1. Potential impacts on commercial vessels (safe operations)	Moderate (C3)	Remote (F1)	(C3 x F1) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Only deploy devices that provide at least 20m UKC within indicative subzones 1 (as shown within **Figure 4-1** (**Volume II**); ▪ Use of guard vessel(s) to monitor passing traffic; ▪ Implementation of Safety Zones; ▪ Temporary navigation aids as required by Trinity House; and ▪ Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known; ▪ Construction vessels to be marked in accordance with COLREGS; ▪ Check device surveys; and ▪ Exclusion of fishing within the MDZ (applicable to break out of device/device not at stated depth).	(C3 x F1) = **Low**
2. Potential impacts on commercial vessel routing	Minor (C2)	Remote (F1)	(C2 x F1) = Low	As above	(C2 x F1) = **Low**

Potential Impact	**Baseline Severity of Consequence**	**Baseline Frequency of Occurrence**	**Baseline Impact**	**Additional Mitigation Measures**	**Residual Impact (Risk)**
3(a). Potential impacts on Passenger Vessels (safe operations)	Moderate (C3)	Unlikely (F2)	(C3 x F2) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Only deploy devices that provide at least 20 m UKC within indicative subzones 1 (as shown within **Figure 4-1** (**Volume II**); ▪ Redesign the Northern Boundary; ▪ Use of guard vessel(s) to monitor passing traffic; ▪ Implementation of Safety Zones; ▪ Temporary navigation aids as required by Trinity House; ▪ Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known; ▪ Construction vessels to be marked in accordance with COLREGS; ▪ Appropriate spacing of devices; and ▪ Exclusion of fishing within the MDZ (applicable to break out of device/device not at stated depth).	(C3 x F1) = **Low**
3(b). Contact: Passenger Vessels with mid-water devices (<8m UKC)	Moderate (C3)	Possible (F3)	(C3 x F3) = **ALARP**	▪ Restrict navigation through the Morlais Zone; ▪ Continues monitoring by Marine Co-ordination Centre; ▪ Devices >20m to be deployed along northern boundary; ▪ Re-design northern boundary; ▪ Check device surveys; ▪ Implementation of Safety Zones;	(C3 x F2) = **Low Risk**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Guard vessel to monitor passing traffic; ▪ Construction vessels to be marked in accordance with COLREGS; and ▪ Temporary navigation aids as required by Trinity House.	
3(c). Collision Passenger Vessel ICW Passenger Vessel	Major (C4)	Unlikely (F2)	(C4 x F2) = **ALARP**	▪ Continuous monitoring by Marine Co-ordination Centre; ▪ Re-design northern boundary; ▪ Guard vessels to monitor passing traffic; ▪ Construction vessels to be marked in accordance with COLREGS; and ▪ Temporary navigation aids as required by Trinity House.	(C4 x F1) = **ALARP**
4. Potential impacts on passenger vessel routing	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	As above	(C2 x F3) = **Low**
5. Potential impact on fishing vessels	Moderate(C3)	Possible (F3)	(C3 x F3) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Ensure appropriate alignment and spacing of devices; ▪ Ensure regular programme of device condition surveys;	(C2 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Use of Guard vessel(s) to monitor passing traffic; ▪ Enhanced cable protection; ▪ Implementation of Safety Zones; ▪ Temporary navigation aids as required by Trinity House; ▪ Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known; and ▪ Construction vessels to be marked in accordance with COLREGS.	
5 (b) Contact Fishing Vessel with Mid-Water Device <8 below CD	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Ensure appropriate alignment and spacing of devices; and ▪ Check device surveys.	C2 x F3 = **Low**
5 (c) Snagging / Obstruction Fishing Vessel	Minor (C2)	Frequent (F5)	(C2 x C5) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Ensure appropriate alignment and spacing of devices; and	C2 x F3 = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Check device surveys.	
5 (d) Grounding Fishing Vessel	Minor (C2)	Likely (F4)	(C2 x F4) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Ensure appropriate alignment and spacing of devices; and ▪ Check device surveys.	(C2 x F3) = **Low**
6(a). Potential impact on recreational craft	Moderate (C3)	Possible (F3)	(C3 x F3) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Ensure appropriate alignment and spacing of devices; ▪ Ensure regular programme of device condition surveys; ▪ Use of guard vessel(s) to monitor passing traffic; ▪ Establish no anchoring areas; ▪ Enhanced cable protection; ▪ Implementation of Safety Zones;	(C3 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Temporary navigation aids as required by Trinity House; ▪ Undertake device specific NRA's prior to deployments, i.e. once exact locations and scale/type of device deployment is known; ▪ Construction vessels to be marked in accordance with COLREGS; and ▪ Exclusion of fishing within the MDZ (applicable to break out of device/device not at stated depth). ▪	
6(b). Grounding Recreational Vessel	Moderate (C3)	Frequent (F5)	(C3 x F5) = **Significant** (Unacceptable in the absence of additional mitigation).	▪ Devices >8m below CD to be deployed along the eastern boundary; and ▪ Redesign Eastern boundary.	(C3 x F3) =ALARP
7. Potential impact on Other vessels	Moderate (C3)	Likely (F4)	(C3 x F4) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Use of guard vessel(s) to monitor passing traffic; ▪ Temporary navigation aids as required by Trinity House; and ▪ Construction vessels to be marked in accordance with COLREGS	(C2 x F3) = **Low**
8. Potential impact on emergency response operations	Minor (C2)	Unlikely (F2)	(C2 x F2) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ;	(C2 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
				▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Ensure appropriate alignment and spacing of devices; ▪ Ensure regular programme of device condition surveys; ▪ Use of guard vessel(s) to monitor passing traffic; ▪ Implementation of Safety Zones; ▪ Temporary navigation aids as required by Trinity House; ▪ Construction vessels to be marked in accordance with COLREGS; and ▪ Marine pollution contingency planning.	
8 (b) Contact SAR Vessel with Surface or Mid-Water Device (<8m below CD).	Minor (C2)	Likely (F4)	(C2 x F4) = **ALARP**	▪ Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices. Local Promulgation; Creation of Emergency Response Cooperation Plan (ERCOP).	(C2 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
9. Subsea Infrastructure – impact on all receptors	Minor (C2)	Possible (F3)	(C2 x F3) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Ensure appropriate alignment and spacing of devices; ▪ Ensure regular programme of device condition surveys; ▪ Use of guard vessel(s) to monitor passing traffic; ▪ Implementation of Safety Zones; ▪ Temporary navigation aids as required by Trinity House; ▪ Construction vessels to be marked in accordance with COLREGS; and ▪ cable protection by burial (where possible), rock bags, burial, mattresses or split pipe. ▪	(C2 x F2) = **Low**
Operational Phase					
1. Potential impacts on commercial vessels (safe operations)	Moderate (C3)	Remote (F1)	(C3 x F1) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Check device surveys; ▪ Only deploy devices that provide at least 20 m UKC within indicative subzones 1 (as shown within **Figure 4-1** (**Volume II**); and	(C3 x F1) = **Low**

Potential Impact	**Baseline Severity of Consequence**	**Baseline Frequency of Occurrence**	**Baseline Impact**	**Additional Mitigation Measures**	**Residual Impact (Risk)**
				▪ Use of guard vessel(s) to monitor passing traffic.	
2. Potential impacts on commercial vessel routing	Minor (C2)	(Likely) F)	(C2 x F4) = Low	As above	(C2 x F1) = **Low**
3(a). Potential impacts on Passenger Vessels (safe operations)	Moderate (C3)	Unlikely (F2)	(C3 x F2) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Check device surveys; ▪ Only deploy devices that provide at least 20 m UKC within indicative subzones 1 (as shown within **Figure 4-1** (**Volume II**); ▪ Redesign Northern Boundary; and ▪ Use of Guard vessel(s) to monitor passing traffic;	(C3 x F1) = **Low**
3(b). Potential impact on passenger vessels: Contact: Passenger Vessels with mid-water devices (<8m UKC)	Moderate (C3)	Possible (F4)	(C3 x F4) = **ALARP**	As above	(C3 x F2) = **Low**
3(c). Collision Passenger Vessel ICW Passenger Vessel	Major (C4)	Remote (F2)	(C4 x F2) = **ALARP**	As above	(C4 x F1) = **ALARP**
4(a). Potential impacts on passenger vessel routing	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	As above	(C2 x F3) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
5. Potential impacts on fishing vessels	Minor (C2)	Possible (F3)	(C2 x F3) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Ensure appropriate alignment and spacing of devices; and ▪ Check device surveys.	(C2 x F1) = **Low**
5 (b) Contact Fishing Vessel with Mid-Water Device <8 below CD	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Ensure appropriate alignment and spacing of devices; and ▪ Check device surveys.	C2 x F3 = Low
Snagging / Obstruction Fishing Vessel	Minor (C2)	Frequent(F5)	(C2 x F5) = **ALARP**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Exclusion of fishing within the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Ensure appropriate alignment and spacing of devices; and ▪ Check device surveys.	C2 x F3 = **Low**

Potential Impact	**Baseline Severity of Consequence**	**Baseline Frequency of Occurrence**	**Baseline Impact**	**Additional Mitigation Measures**	**Residual Impact (Risk)**
6(a). Potential impacts on recreational craft	Minor (C2)	Possible (F3)	(C2 x F3) = **Low**	▪ Restrict navigation throughout the MDZ; ▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Check device surveys; and ▪ Ensure appropriate alignment and spacing of devices; and ▪ Establish no anchoring areas.	(C4 x F2) = **Low**
6(b). Grounding Recreational Vessel	Minor (C3)	Frequent (F5)	(C3 x F5) = **Significant** (Unacceptable in absence of additional mitigation)	▪ Devices >8m below CD to be deployed along the eastern boundary; and ▪ Redesign Eastern boundary	(C3 x F3) = **ALARP**
6 (c) Contact Recreational Vessel with Surface Device	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	▪ Restrict navigation throughout the MDZ; ▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Check device surveys; and ▪ Ensure appropriate alignment and spacing of devices; and ▪ Establish no anchoring areas.	(C2 x F3) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
6 (d) Contact Recreational Vessel with Mid-Water Device (<8m below CD)	Minor (C2)	Likely (F5)	(C2 x F5) = **ALARP**	▪ Restrict navigation throughout the MDZ; ▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; ▪ Check device surveys; and ▪ Ensure appropriate alignment and spacing of devices; and ▪ Establish no anchoring areas.	(C2 x F3) = **Low**
7. Potential Impacts on other vessels	Minor (C2)	Likely (F3)	(C2 x F3) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; and ▪ Construction vessels to be marked in accordance with COLREGS. ▪	(C3 x F2) = **Low**
7 (b) Contact Other Vessels with Mid-Water Device (<8m below CD).	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	As Above	C2 x F3) = Low
8.(a) Potential impacts on emergency response operations	Minor (C2)	Unlikely (F2)	(C2 x F2) = **Low**	▪ Continuous Monitoring by Marine Co-ordination Centre; ▪ Restrict Navigation through the MDZ; ▪ Only deploy devices that allow at least 8 m UKC along eastern boundary; ▪ Re-design eastern boundary of the MDZ; and ▪ Check device surveys.	(C2 x F2) = **Low**

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
8 (b) Contact SAR Vessel with Mid-Water Device (<8m below CD).	Minor(C2)	Likely (F4)	(C2 x F4) = **ALARP**	▪ Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; ▪ Devices >8m below CD to be deployed along eastern boundary; ▪ Redesign eastern boundary; ▪ Check Device Surveys; ▪ Appropriate spacing of devices. ▪ Local Promulgation; ▪ Creation of Emergency Response Cooperation Plan (ERCOP).	(C2 x F2) = **Low**
9. (a) Subsea Infrastructure – potential impacts on all receptors	Minor (C2)	Unlikely (F2)	(C2 x F2) = **Low**	As above	(C2 x F2) = **Low**
9 (b) Snagging / Obstruction Fishing Vessel	Minor (C2)	Frequent (F5)	(C2 x F5) = **ALARP**	As above	(C2 x F3) = **Low**
Decommissioning Phase					
	It is likely that decommissioning of individual structures will be the responsibility of the individual developers, as overseen by Mentor Môn. Decommissioning of the site comprises the complete removal of all infrastructure associated with the tidal energy project. Offshore decommissioning methodologies would vary considerably between devices but would be expected to be similar to the construction phase in reverse. As the methodologies for decommissioning are expected to be similar to construction it can be assumed that the same impacts arise and can be applied to the decommissioning phase. It should be noted that this is a highly precautionary assessment as it is likely that the impacts from decommissioning will be less than those from construction.				

Potential Impact	Baseline Severity of Consequence	Baseline Frequency of Occurrence	Baseline Impact	Additional Mitigation Measures	Residual Impact (Risk)
Cumulative Impacts					
C1. Impact from increased vessel activity	Minor (C2)	Unlikely (F2)		▪ Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; ▪ Devices >8m below CD to be deployed along eastern boundary; ▪ Redesign eastern boundary; ▪ Check Device Surveys; ▪ Appropriate spacing of devices. ▪ Local Promulgation; ▪ Creation of Emergency Response Cooperation Plan (ERCOP).	(C2 x F2) = **Low**
C2. Impact on vessel routing	Minor (C2)	Unlikely (F2)		As above	(C2 x F2) = **Low**
C3. Impact from subsea cables	Minor (C2)	Unlikely (F2)		As above	(C2 x F2) = **Low**

Table 27-12 Summary of Potential Impacts for Marine Infrastructure and Other Users

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase						
Impact 1: Disruption of ongoing MOD activities	MOD	High	Very Low	Minor	On-going stakeholder engagement. Plotting MDZ on Admiralty charts.	Negligible
Impact 2: Interaction with UXO	Sea Users (crew / vessels), environmental receptors	N/A	N/A	Potential to disturb and expose UXO	Risk assessment and potential survey required to identify location of potential UXO. If UXO present, infrastructure could be micro-sited or UXO cleared. Contractors to be made aware of potential risks.	Minor
Impact 3: Interaction with active telecommunication cables	CeltixConnect Subsea cable	High	Very low	Minor	Implementation of 500 m safety buffer around active subsea cable. The position of this live cable will be communicated to all installation vessels and the Project will consult with the asset owner directly.	Negligible
Operational Phase						
Impact 4: Disruption of ongoing MOD activities	MOD	High	Very Low	Minor	Ongoing stakeholder engagement.	Negligible
Impact 5: Interaction with active telecommunication cables	CeltixConnect Subsea cable	High	Very low	Minor	None required.	Negligible
Decommissioning Phase						
Impact 6: Disruption of ongoing MOD activities	MOD	High	Very Low	Minor	Ongoing stakeholder engagement.	Negligible
Impact 7: Interaction with UXO	Sea Users (crew / vessels), environmental receptors	N/A	N/A	Potential to disturb and expose UXO	As per construction	Minor

Table 27-13 Summary of Potential Impacts for Water Resources and Flood Risk

Potential Impact	Receptor	Sensitivity	Value	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase							
Impact 1: Direct disturbance of surface water bodies	Natural streams	Medium	High	Low	Moderate adverse	Measures to minimise the impacts of temporary watercourse crossings, install infrastructure below the active bed of the channel, and reinstate bed and banks.	Minor adverse
	Modified watercourses	Negligible	Negligible	No impact	-		-
	Area of marshy grassland containing undefined drains	Low	Low	Low	Minor adverse		Negligible
	Standing water	Low	Low	No impact	-		-
	Ynys Mon groundwater body	Medium	Low	No impact	-		-
Impact 2: Increased sediment supply	Natural streams	Medium	High	Medium	Minor adverse	Additional construction best practice measures to manage sediment and surface drainage, including Guidance for Pollution Prevention (GPPs) from NRW, Scottish Environment Protection Agency and the Northern Ireland Environment Agency; specifically GPP5.	Minor adverse
	Modified watercourses	Negligible	Negligible	Minor adverse	Negligible		Negligible
	Area of marshy grassland containing undefined drains.	Low	Low	Low	Minor adverse		Negligible
	Standing water	Low	Low	No impact	-		-
	Ynys Mon groundwater body	Medium	Low	No impact	-		-
Impact 3: Accidental release of contaminants	Natural streams	Medium	High	Low	Moderate adverse	A construction method statement will be produced in line with best practice guidance on pollution control measures.	Minor adverse
	Modified watercourses	Negligible	Negligible	Low	Negligible		Negligible
	Area of marshy grassland containing undefined drains	Low	Low	Low	Minor adverse		Negligible
	Standing water	Low	Low	No impact	-		-
	Ynys Mon groundwater body	Medium	Low	Low	Minor adverse		Negligible
Impact 4: Increased	Natural streams	Medium	High	Low	Minor adverse	Measures to minimise impact of temporary culverts, if	Negligible
	Modified watercourses	Negligible	Negligible	Low	Negligible		Negligible

Potential Impact	Receptor	Sensitivity	Value	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
surface water runoff and flood risk	Area of marshy grassland containing undefined drains	Low	Low	Medium	Minor adverse	applicable, including the creation of drainage changes to manage construction drainage.	Negligible
	Standing water	Low	Low	No impact	-		-
	Ynys Mon groundwater body	Medium	Low	Low	Minor adverse		Negligible
Operational Phase							
Impact 5: Changes to surface water runoff, groundwater flows and flood risk	Natural streams	Medium	High	Low	Minor adverse	A surface water drainage plan will be developed, particularly for the substation locations.	Negligible
	Modified watercourses	Negligible	Negligible	Low	Negligible		Negligible
	Area of marshy grassland containing undefined drains	Low	Low	Medium	Minor adverse		Negligible
	Standing water	Low	Low	No impact	-		-
	Ynys Mon groundwater body	Medium	Low	Low	Minor adverse		Negligible
Impact 6: Supply of fine sediment and other contaminants	Natural streams	Medium	High	Low	Minor adverse	Surface water drainage system will include oil interceptors and bund pumps.	Negligible
	Modified watercourses	Negligible	Negligible	Negligible	Negligible		Negligible
	Area of marshy grassland containing undefined drains	Low	Low	No impact	-		-
	Standing water	Low	Low	Negligible	Negligible		No Impact
	Ynys Mon groundwater body	Medium	Low	Negligible	Minor adverse		Minor adverse
Decommissioning Phase							
Contractual details relating to decommissioning are yet to be finalised, however the ultimate responsibility for the decommissioning of the general onshore electrical infrastructure will lie with Menter Môn. At this stage, this is expected to consist primarily of removal of the landfall and grid connection substations. It is anticipated that the decommissioning impacts would be no worse than those of construction.							

Table 27-14 Summary of Potential Impacts for Ground Conditions and Contamination

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase						
Impact 1: Impacts on designated geological sites	Geology	High	Low	Minor Adverse	N/A	N/A
Impact 2: Impacts on Groundwater Quality in the Superficial Secondary Aquifers During Earthwork Activities	Secondary A and Undifferentiated Aquifers	Low	Low	Negligible	N/A	N/A
Impact 3: Impacts on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from HDD	Secondary B Aquifers	Negligible	Negligible	Negligible	N/A	N/A
Impact 4: Impact on Groundwater Quality in the Secondary B Bedrock Aquifers Resulting from Piling	Secondary B Aquifers	Negligible	Negligible	Negligible	N/A	N/A
Impact 5: Impact on Surface Waters from Contamination of Groundwaters and Subsequent Discharge	Surface Waters	Low	Low	Minor	Adherence to the Environment Agency pollution prevention guidance.	Negligible
Impact 6: Impacts to Human Health	Humans	High	Low	Moderate Adverse	Appropriate personal protective equipment (PPE) and working practices to be adopted by construction workers, including subcontractors, and health and safety measures would be undertaken to mitigate any short-term risk during construction.	Negligible
Impact 7: Impacts on Controlled Waters as a Result of Construction Activities	Controlled waters	Low	Low	Minor Adverse	Use of lower permeability material to backfill trenches in areas identified as being/in close proximity to potential sources.	Negligible
Operational Phase						
No discernible impacts.						
Decommissioning Phase						
Contractual details relating to decommissioning are yet to be finalised, however the ultimate responsibility for the decommissioning of the general onshore electrical infrastructure will lie with Menter Môn. At this stage, this is expected to consist primarily of removal of the landfall and grid connection substations. It is anticipated that the decommissioning impacts would be no worse than those of construction.						

Table 27-15 Summary of Potential Impacts for Onshore Ecology

Potential Impact	Receptor	Value	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase						
Impact 1: Statutory designated nature conservation designated sites	Glannau Ynys Gybi / Holy Island Coast SSSI/SPA/SAC and Tre Wilmot SSSI	Worst case High	Medium	Worst case Major adverse	Habitat creation and management plan, in consultation with IOACC and NRW.	Worst case Moderate adverse
	Beddmanarch-Cymryan SSSI	High	Low	Minor adverse		Negligible
Impact 2: Non-statutory designated nature conservation designated sites	Local Wildlife Sites	Medium	No impact	No impact	Habitat reinstatement plan	Minor adverse
	Ancient woodlands	Medium	Negligible	Negligible		Negligible
	South stacks RSPB Reserve	Medium	Low	Minor adverse		Negligible
	Breakwater Country Park	Medium	low	Minor adverse		Negligible -
Impact 3: Habitat loss and fragmentation	Grasslands	Low	Medium	Minor adverse	Micrositing, management of construction boundaries tool box talks, habitat reinstatement	Minor adverse
	Hedgerows and trees	Medium	medium	Moderate adverse		Minor adverse
	Lowland fen and reedbed	Medium	Medium	Moderate adverse		Minor adverse
	Open mosaic habitat	Low	Low	Minor adverse		Minor beneficial
	Cloddiau	Medium	Low - high	Minor adverse – major adverse		Minor adverse
Impact 4: habitat loss, disturbance or killing of otter	Otter	Low	Low	Minor adverse	Pre- construction survey, tool box talks, use of exit ramps	Negligible

Potential Impact	Receptor	Value	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Impact 5: habitat loss, disturbance or killing of water vole	Water vole	Low	Low	Minor adverse	Pre- construction survey, tool box talks	Negligible
Impact 6: habitat loss, disturbance or killing of red squirrel	Red squirrel	Medium	Negligible	Minor adverse	Pre- construction survey, tool box talks	Negligible
Impact 7: habitat loss, disturbance or killing of badger	Badger	Medium	High	Moderate adverse	Preconstruction survey, tool box talks, sett exclusion under licence and creation of replacement set, exit ramps	Minor adverse
Impact 8: habitat loss, disturbance or killing of bats	Roosting bats	Medium	Low	Minor adverse	Sensitive lighting regime, toolbox talks, bat survey of historic roost, buffers	Negligible
	Foraging and commuting bats	Low	Low	Minor adverse		
Impact 9: habitat loss, disturbance or killing of reptiles	Reptiles	Low - Medium	Medium	Minor - moderate	Pre-construction survey, precautionary methods of vegetation clearance, mitigation strategy, toolbox talks	Minor adverse
Impacts 10: habitat loss, disturbance or killing of GCN	GCN	Low	Low	Minor adverse	Pre-construction eDNA survey, toolbox talk	Negligible
Impacts 11: habitat loss, disturbance or killing of birds	Seabirds	See **Chapter 11, Offshore Ornithology**				
	Chough	High	Low	Moderately adverse	no construction works will take place within 500m of an active chough nest during the breeding season	Minor adverse
	Raptors	Medium	Low	Minor adverse	Toolbox talks, pre-construction surveys for barn owls in any agricultural buildings within the Onshore Study Area	Negligible - Minor adverse
	Passerines and other species	Medium	Low	Minor adverse	Commence work outwith the breeding bird season, toolbox talks, micrositing, habitat reinstatement	Negligible – minor adverse
Impact 12: habitat loss, disturbance or killing of invertebrates	Invertebrates	Low	Low	Negligible	None	negligible

Potential Impact	Receptor	Value	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Impact 13: damage to notable plant species	Notable plants	Medium	High	Major adverse	Pre construction surveys, protective buffers, habitat reinstatement, toolbox talks	Minor adverse
Impact 14: Spread of non-native invasive species	Japanese knotweed	Medium	Medium	Moderate adverse	Pre construction survey, invasive species management plan, toolbox talks	Minor adverse
Operational Phase						
Impact 15: Disturbance to foraging and commuting routes for bats	Bats	Low	Low	Minor adverse	Sensitive lighting regime, toolbox talks	Negligible
Decommissioning Phase						
Contractual details relating to decommissioning are yet to be finalised, however the ultimate responsibility for the decommissioning of the general onshore electrical infrastructure will lie with Menter Môn. At this stage, this is expected to consist primarily of removal of the landfall and grid connection substations. It is anticipated that the decommissioning impacts would be no worse than those of construction.						

Table 27-16 Summary of Potential Impacts for Key Onshore Archaeology and Cultural Heritage Assets

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Additional Mitigation Measures	Residual effect (post-mitigation)
1	South Stack Lighthouse group	Medium	Construction Impact 3: Indirect impact to setting of assets during construction of offshore infrastructure.	Negligible	Minor	None required	Minor
			Operation Impact 3: Indirect impact to setting of assets from offshore infrastructure.	Medium	Moderate	None required	Minor to Moderate
4		High	Construction Impact 3: Indirect impact to setting of designated assets during installation of landfall cable.	Negligible	Minor	None required	Minor

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Additional Mitigation Measures	Residual effect (post-mitigation)
	Porth Dafarch Hut Circles		Construction Impact 2: Direct impact to designated archaeological remains due to hydrological changes or vibration	High	Major	Pre-construction identification of potential archaeological sites through evaluation (geophysical survey potentially followed by trial trenching) which will in turn feed into decisions regarding micro-siting or route refinement, and the option to change design to use trenchless construction methods on sections as part of the post-consent works. This will result in the avoidance of sites wherever possible, ensuring they are preserved in-situ. Where avoidance is identified as not being viable, consultation with stakeholders will be undertaken and a decision made between parties on how to proceed.	Minor

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Additional Mitigation Measures	Residual effect (post-mitigation)
			Construction Impact 1: Direct impact to non-designated buried remains associated with (but outside of) the scheduled area.	High	Major	Pre-construction identification of potential archaeological sites through evaluation (geophysical survey potentially followed by trial trenching) which will in turn feed into decisions regarding micro-siting or route refinement, and the option to change design to use trenchless construction methods on sections as part of the post-consent works. This will result in the avoidance of sites wherever possible, ensuring they are preserved in-situ. Where avoidance is identified as not being viable, consultation with stakeholders will be undertaken and a decision made between parties on how to proceed.	Non-significant
			Operation: No Impact	N/A	N/A	None required	N/A
5		High	Construction Impact 3: Indirect impact to setting of assets during installation of onshore cable.	Negligible	Minor	None required	Minor

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Additional Mitigation Measures	Residual effect (post-mitigation)
	Ty-Mawr Standing Stone		Construction Impact 1: Direct impact to non-designated buried remains associated with (but outside of) the scheduled area.	High	Major	Pre-construction identification of potential archaeological sites through evaluation (geophysical survey potentially followed by trial trenching) which will in turn feed into decisions regarding micro-siting or route refinement, and the option to change design to use trenchless construction methods on sections as part of the post-consent works. This will result in the avoidance of sites wherever possible, ensuring they are preserved in-situ. Where avoidance is identified as not being viable, consultation with stakeholders will be undertaken and a decision made between parties on how to proceed.	Non-significant
			Operation Impact 3: Indirect impact to setting of assets from landfall substation	Negligible	Minor	None required	Minor
8	Holyhead Mountain Hut Circles	High	Construction Impact 3: Indirect impact to setting of assets during construction of landfall substation and landfall cable.	Negligible	Minor	None required	Minor
			Operation Impact 3: Indirect impact to setting of assets from landfall substation	Negligible	Minor	None required	Minor

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Additional Mitigation Measures	Residual effect (post-mitigation)
10	Trefignath Burial Chamber	High	Construction Impact 3: Indirect impact to setting of assets during installation of onshore cable and Parc Cybi substation option.	Negligible	Minor	None required	Minor
			Operation Impact 3: Indirect impact to setting of assets from grid connection substation (Parc Cybi option)	Negligible	Minor	None required	Minor
11	Penrhosfeilw Standing Stones	High	Construction Impact 3: Indirect impact to setting of the asset during construction of the landfall substation.	Negligible	Minor	None required	Minor
			Operation Impact 3: Indirect impact to setting of assets from landfall substation	Negligible	Minor	None required	Minor
13	Kingsland Windmill	High	Construction Impact 3: Indirect impact to setting of assets during installation of onshore cable.	Negligible	Minor	None required	Minor
			Operation: No Impact	N/A	N/A	None required	N/A
14	Ellin's Tower (Twr Ellin)	Medium	Construction Impact 3: Indirect impact to the setting of asset during installation of onshore cable.	Negligible	Minor	None required	Minor
			Operation Impact 3: Indirect impact to the setting of asset due to offshore infrastructure	Medium	Moderate	None possible, reduced through embedded mitigation as far as possible	Minor to Moderate

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Additional Mitigation Measures	Residual effect (post-mitigation)
15	Old Customs Post	Medium	Construction Impact 3: Indirect impact to the setting of asset during installation of onshore cable.	Negligible	Minor	None required	Minor
			Operation: No Impact	N/A	N/A	None required	N/A
23	Ebenezer Chapel	Medium	Construction Impact 3: Indirect impact to the setting of asset during installation of onshore cable.	Negligible	Minor	None required	Minor
			Operation: No Impact	N/A	N/A	None required	N/A
32	Tan-y-Cytiau	Medium	Construction Impact 3: Indirect impact to the setting of asset during installation of onshore cable.	Low	Minor	None required	Minor
			Operation Impact 3: Indirect impact to setting of assets from landfall substation	Negligible	Minor	None required	Minor
34	Ancient Woodland, Penrhos coastal park	Low	Construction Impact 3: Indirect impact to the setting of asset during construction of grid connection substation (Orthios option).	Low	Minor	None required	Minor
			Operation: No Impact	N/A	N/A	None required	N/A

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Additional Mitigation Measures	Residual effect (post-mitigation)
35	Cemetery, Porth Dafarch	High	Construction Impact 1: Direct impact to non-designated buried remains associated with this monument record.	High	Major	Pre-construction identification of potential archaeological sites through evaluation (geophysical survey potentially followed by trial trenching) which will in turn feed into decisions regarding micro-siting or route refinement, and the option to change design to use trenchless construction methods on sections as part of the post-consent works. This will result in the avoidance of sites wherever possible, ensuring they are preserved in-situ. Where avoidance is identified as not being viable, consultation with stakeholders will be undertaken and a decision made between parties on how to proceed.	Non-significant
			Operation: No Impact	N/A	N/A	None required	N/A
36	Penrhosfeilw Chapel	Medium	Construction Impact 4: Indirect impact to the setting of a non-designated asset during installation of onshore cable.	Negligible	Minor	None required	Minor
			Operation: No Impact	N/A	N/A	None required	N/A
37	Pillbox, north-east of Tre God	Medium	Construction Impact 4: Indirect impact to the setting of a non-designated asset during installation of onshore cable.	Negligible	Minor	None required	Minor
			Operation: No Impact	N/A	N/A	None required	N/A

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Additional Mitigation Measures	Residual effect (post-mitigation)
38	Parc Cybi archaeological remains	Medium	Construction Impact 1: Direct impact to potential buried archaeological remains associated with known (recorded) archaeological remains during installation of onshore cable and grid connection substation (Parc Cybi option).	High	Major	Pre-construction identification of potential archaeological sites through evaluation (geophysical survey potentially followed by trial trenching) which will in turn feed into decisions regarding micro-siting or route refinement, and the option to change design to use trenchless construction methods on sections as part of the post-consent works. This will result in the avoidance of sites wherever possible, ensuring they are preserved in-situ. Where avoidance is identified as not being viable, consultation with stakeholders will be undertaken and a decision made between parties on how to proceed.	Non-significant
			Operation: No Impact	N/A	N/A	None required	N/A

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Additional Mitigation Measures	Residual effect (post-mitigation)
39	Cist burial, remains of hut circles & finds	Medium	Construction Impact 1: Direct Impact to potential buried archaeological remains associated with known (recorded) archaeological remains during installation of onshore cable.	High	Major	Pre-construction identification of potential archaeological sites through evaluation (geophysical survey potentially followed by trial trenching) which will in turn feed into decisions regarding micro-siting or route refinement, and the option to change design to use trenchless construction methods on sections as part of the post-consent works. This will result in the avoidance of sites wherever possible, ensuring they are preserved in-situ. Where avoidance is identified as not being viable, consultation with stakeholders will be undertaken and a decision made between parties on how to proceed.	Non-significant
			Operation: No Impact	N/A	N/A	None required	N/A

RHDHV No.	Name	Heritage Value	Impacts Summary	Magnitude of impact	Significance of effect	Additional Mitigation Measures	Residual effect (post-mitigation)
40	Remains of Hut circles & finds	Medium	Construction Impact 1: Direct Impact to potential buried archaeological remains associated with known (recorded) archaeological remains during installation of onshore cable.	High	Major	Pre-construction identification of potential archaeological sites through evaluation (geophysical survey potentially followed by trial trenching) which will in turn feed into decisions regarding micro-siting or route refinement, and the option to change design to use trenchless construction methods on sections as part of the post-consent works. This will result in the avoidance of sites wherever possible, ensuring they are preserved in-situ. Where avoidance is identified as not being viable, consultation with stakeholders will be undertaken and a decision made between parties on how to proceed.	Non-significant
			Operation: No Impact	N/A	N/A	None required	N/A

Table 27-17 Summary of Potential Impacts for Noise and Vibration

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction and operational phase noise and vibration impacts	Human receptors	Medium	No Impact	No Impact	Best practice measures. Noise and Vibration Management Plan.	Not significant
	Ecological receptors	Considered in **Chapter 19, Onshore Ecology**				N/A
Construction, operational and decommissioning phase road traffic noise and vibration impacts	Human receptors within road network study area	Medium	Negligible at worst	Negligible Impact	Not required	Not significant
	Ecological receptors	Considered in **Chapter 19, Onshore Ecology**				N/A

Table 27-18 Summary Of Potential Impacts For Air Quality

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction phase dust emissions	Human receptors within 350m	High sensitivity	Medium at worst	The IAQM guidance does not require consideration of significance prior to mitigation	Best practice dust minimisation and suppression methods as recommended by the IAQM	Not significant
	Ecological receptors within 50m	High sensitivity	Large at worst			Not significant

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction, operational and decommissioning phase road traffic emissions	Human receptors within 200m of road network	High sensitivity	Negligible	Not significant	Not required	Not significant
	Ecological receptors within 200m of road network	High sensitivity	Negligible	Not significant		Not significant

Table 27-19 Summary of Potential Impacts for Traffic and Transport

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase						
Impact 1: Severance	Links 4, 5, 6, 8	Low – High	Negligible	Negligible to Minor	N/A	Negligible to Minor
Impact 2: Pedestrian/ Cycle Amenity	Links 4 and 5	Low – High	Negligible	Negligible to Minor	N/A	Negligible to Minor
	Link 6 and 8	Low	Medium	Minor	N/A	Minor
Impact 3: Road Safety	All links	Negligible	Negligible	Negligible	N/A	Negligible
Impact 4: Driver Delay (capacity)	Junction 1, 2, 3	High	Negligible	Minor	N/A	Minor
	Landfall substation access	High	Medium	Major	CTMP management measures to prevent two HGVs meeting at the new access	Minor

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
					Provision of a new access to include a bound surface, advanced warning signs and a temporary speed limit.	
Impact 5: Driver delay (road closures)	Links 5, 8, 10 12	Low	Low	Minor	CTMP measures including: temporary traffic signals/ stop go boards; safe pedestrian routes; and agreeing timing of works	Minor
	Links 6, 11 and Mill Road	High	Negligible where direct access can be maintained	Minor	N/A	Minor
			High where direct access cannot be maintained	Major	Direct communication between the Contractor and residents; Temporary parking facilities; and Banksman to guide and assist residents through the works.	Moderate
	Links 6, 11	Low	Low	Minor	CTMP measures including: Detail of traffic management measures including proposed diversion signing; Staging of construction activities; and Details of measures to escort pedestrians and cyclists through the works.	Minor
Operational Phase						
No discernible impacts.						
Decommissioning Phase						
Contractual details relating to decommissioning are yet to be finalised, however the ultimate responsibility for the decommissioning of the general onshore electrical infrastructure will lie with Menter Môn. At this stage, this is expected to consist primarily of removal of the landfall and grid connection substations. It is anticipated that the decommissioning impacts would be no worse than those of construction.						

Table 27-20 Summary of Key Potential Impacts for Seascape, Landscape and Visual Receptors

Receptor	Sensitivity	Magnitude	Effect	Significance	Additional Mitigation Measures
Seascape					
SCA 10 – Carmel Head to Penrhyn	High/medium	Slight/negligible	Minor (adverse)	Not significant	No further mitigation, reduced through embedded mitigation as far as possible
SCA 11 – Holyhead	Medium	Slight	Minor (adverse)	Not significant	
SCA 13 – Holyhead Mountain	High	Medium	Major/moderate (adverse)	Significant	
SCA 14 – Rhoscolyn	High/medium	Medium	Moderate (adverse)	Significant	
SCA 31 – West of Anglesey	Medium	Medium/slight	Moderate (adverse)	Significant	
Designations					
Isle of Anglesey AONB	High	Medium	Moderate (adverse)	Locally significant	No further mitigation, reduced through embedded mitigation as far as possible
Heritage Coast (Holy Island)	High	Substantial	Major (adverse)	Significant	
Heritage Coast (north west Anglesey)	High/medium	Slight/negligible	Minor (adverse)	Not significant	
Mynydd Mechell SLA	Not specifically assessed	None	None	Not significant	
Conservation Areas	Not specifically assessed	Not specifically assessed	Predicted to be very limited	Not significant	
Carreglwyd Registered Park and Garden	Not specifically assessed	Not specifically assessed	Predicted to be limited	Not significant	
Settlements					
Holyhead	High	Negligible	Moderate/minor	Not significant	No further mitigation, reduced through embedded mitigation as far as possible
Trearddur	High	Slight to negligible	Moderate to moderate/minor	Not significant	
Rhosneigr	High	Negligible	Minor	Not significant	
Dispersed residential properties (north west Holy Island)	High	Substantial to medium	Major to major/moderate	Significant	
Transport routes					

Receptor	Sensitivity	Magnitude	Effect	Significance	Additional Mitigation Measures
Primary roads	Medium/low	Slight to negligible	Minor to negligible	Not significant	No further mitigation, reduced through embedded mitigation as far as possible
Secondary roads	Medium/low	Slight	Moderate/minor	Not significant	
Minor roads (north west Holy Island)	High/medium	Substantial to medium	Major/moderate	Significant	
Ferry passengers	Medium	Slight	Moderate/minor	Not significant	
Recreational Receptors					
Users of long-distance footpaths	High	Substantial to medium	Major to major/moderate (locally)	Significant	No further mitigation, reduced through embedded mitigation as far as possible
Other footpaths and Open Access Land	High	Substantial to medium	Major to major/moderate (locally)	Significant	
Promoted cycle routes	High/medium	Substantial to medium	Major to major/moderate (locally)	Significant	
Visitors to South Stack RSPB Visitor Centre	High	Substantial to medium	Major to major/moderate (locally)	Significant	
Visitors to beaches (Porth Dafarch, Trearddur Bay, Borthwen Sliver Bay, Rhosneigr and Penrhos)	High	Negligible to none	Minor to none	Not significant	
Visitors to beach at Abraham's Bosom	High	Substantial	Major	Significant	
Offshore recreational receptors	High/medium	Slight to negligible	Moderate (locally)	Not significant	

Table 27-21 Summary of Potential Impacts for Socio-Economics, Tourism and Recreation

Impact	Description	Effect	Additional Mitigation / Optimisation Measures
Impact 1: Social benefits -	£19M and £11M per annum local expenditure is anticipated during the construction (peak) and operation phases of the Project. With the implementation of	Major and moderate beneficial	▪ Seeking to localise as much development and operational expenditure in Anglesey and North Wales as possible;

Impact	Description	Effect	Additional Mitigation / Optimisation Measures
Decentralisation of economic growth	mitigation measures that maximise local content, the effects during construction and operation are predicted to be major and moderate beneficial.		▪ Encouraging the local supply chain to invest in key capabilities that maximise local contracting opportunities; ▪ Encouraging appropriate public sector support and private sector investment to back the supply chain endeavours; ▪ Seeking to expand the marine energy and related renewables and energy systems activity in Anglesey and North Wales, as much as possible; ▪ Seeking to expand the range of development activities, to increase the activity during the operations years.
Impact 2: Wellbeing of future generations - Green branding for locality	The implementation of mitigation measures that strengthen the 'green' credentials of the Project\locality will lead to moderate beneficial effects on the wellbeing of future generations for all phases.	Moderate beneficial	▪ Establishing and maintaining a strong online and news media presence for the brand through the management of news, data, information and progress announcements; ▪ Ensuring that all activities undertaken by the Project and its delivery partners are aligned with a defined set of brand values and guidelines; ▪ The capturing of video and photo opportunities associated with all aspects of project development; ▪ Having resources available to welcome and host reporters and other interested parties; ▪ Organising regular local events to share the brand with local residents and ensure local buy-in; ▪ Attending sector events nationally and international as appropriate; and ▪ Seeking opportunities for publicising the Project through any appropriate media.
Impact 3: Economic impacts - Direct and secondary income	In terms of direct spending in the locality, Anglesey is expected to benefit in the region of £10M and £5M during the construction and operation phases respectively.	Moderate beneficial	▪ Menter Môn should attempt to maintain lobbying pressure on UK and Welsh Governments to support marine renewables; ▪ Menter Môn should encourage the development of support mechanisms for marine energy, such as Innovation PPA, or

Impact	Description	Effect	Additional Mitigation / Optimisation Measures
	The construction phase of the Project is going to see major spend at a National scale. With the implementation of mitigation measures such as development of support mechanisms and the local work force, direct and secondary income is expected to experience moderate beneficial effects for all phases.		ring-fenced Innovation CfD, being promoted nationally (Marine Energy Council, 2019); ▪ Outreach work should be promoted to encourage Schools, Colleges and Universities to develop appropriate training for the workforce; and ▪ Detailed work should be undertaken, outside the framework of this EIA, to fully develop a local and regional supply chain that can take advantage of the opportunities that develop, via this Project.
Impact 4: Economic impacts - Accumulation of grant support	The Project would represent a big step towards this commercialisation, but it is a demonstration zone, so should still attract grant aid. It will also attract research grant funding, for various aspects of the development. With continued government lobbying and development of further R&D/Grant funding opportunities, the Project is expected to experience major and moderate beneficial effects from a grant support perspective during the construction and operation\decommissioning phases respectively.	Major and moderate beneficial	▪ Continued pressure exerted by Menter Môn, via both industry-coordinated lobbying and personal communications, on UK and Welsh Government to support the marine energy sector; ▪ Continued pressure by Menter Môn in support of the suggested development of support mechanisms for marine energy, such as Innovation PPA or ring-fenced Innovation CfD, being promoted nationally (Marine Energy Council, 2019); ▪ Ongoing research into the full range of grant options available to projects that intend to utilise the Project; ▪ Full engagement with local and national development agencies to ensure all support mechanisms are fully developed; and ▪ There are some risks with EU funding around Brexit. This can be mitigated against by fully engaging with relevant Welsh Government departments.
Impact 5: Level of commerce activity -	The successful implementation of measures that increase the understanding of the Project and establish a strong green cluster locally, will lead to major beneficial effects	Moderate beneficial	▪ Ensuring that there is an understanding of the benefits of clustering within all key stakeholders;

Impact	Description	Effect	Additional Mitigation / Optimisation Measures
Green cluster creation	during the operation and repowering phases. The effects will be moderate beneficial during construction.		▪ Ensuring that all activities undertaken by the Project support cluster creation; in particular, through progressive partnership type procurement processes, wherever practical/possible; ▪ Working with the existing Energy Island Programme to explore further opportunities for cluster creation; ▪ Encouraging established sector players to create/join in with a local cluster; and ▪ Advocating the inherent advantages and opportunities that exist on Anglesey (and possibly North Wales) for such a cluster to be created.
Impact 6: Job opportunities – Numbers	The Project could be expected to create between 4670 and 5980 FTE job years across Wales covering all phases of construction, installation and operations. The majority of these jobs are expected to be located within Anglesey with some 2231 to 3562 locally based jobs envisaged. The greatest proportion (90%) these job years would arise during the operations phase. In addition to these local FTE job years a further 1500 FTE job years are anticipated for North Wales and some 900 FTE job years foreseen for wider Wales. With implementation of appropriate mitigation\optimisation, the Project is expected to give rise to major beneficial impacts across all phases.	Major beneficial	▪ Ensuring support is given to developers (tenants) to manufacture and construct the devices within Wales; ▪ Developing training programmes to up-skill the workforce; ▪ Highlighting the job availability across Wales, timely and in advance of the developments to encourage workforce to prepare; ▪ Encouraging the supply chain to prepare and bid for any contracts; and ▪ Creating a cluster of local and region companies that can ensure local content – see Impact 5.
Impact 7: Job opportunities - Types, quality, skills areas	The Project will create a high number of jobs within the local economy, some of these will be highly skilled and will provide a very strong opportunity regionally and locally. Major beneficial effects are expected for the majority of phases with the implementation of appropriate mitigation e.g. encourage a stronger local content and support the	Major beneficial	▪ Development of appropriate training to up-skill the work force in advance of the Project; ▪ Highlighting the job availability across Wales in a timely fashion and in advance of the developments to encourage workforce to prepare;

Impact	Description	Effect	Additional Mitigation / Optimisation Measures
	up skilling of the workforce to improve the quality of jobs on offer.		▪ Encouraging Schools, Colleges and Universities to develop appropriate training for the workforce; ▪ Incentivising developers to create apprentices and other training opportunities; and ▪ Encouraging some of the specialist skilled workforce needed to relocate to the Anglesey area.
Impact 8: Training Impacts - New skills and competence needs	Project construction will offer temporary employment opportunities both in terms of direct construction jobs and opportunities in the supply chain. There is a requirement for up-skilling of the local, regional and national workforce to take advantage of the opportunities presented by the Project. Moderate beneficial effects will be experienced nationally, regionally and locally if measures such as those that increase training uptake are implemented.	Moderate and minor beneficial	▪ Ensuring there is a robust and experience-based plan of what capacity, skills, and experience are required to support a project of this nature; ▪ Menter Môn, the third-party managers of the Project, have a remit to maximise the economic benefit to Anglesey and therefore the retraining of the potential workforce will be a high priority, to optimise and maximise this potential beneficial impact; ▪ Menter Môn should map out the opportunities and encourage the development of specific training programmes, that focus on the development opportunities identified in the mapping process; and ▪ These options could be developed throughout the phases of the Project, allowing for increased employment opportunities.
Impact 9: Training impacts - Tertiary BSc, Eng, PhD	This impact is considered beneficial for all three regions being assessed, as there could also be benefits to other regional and national university's and training establishments.	Moderate and minor beneficial	▪ The full support of the local and regional universities to fully utilise the MDZ to develop research and courses and seek out tidal energy research students should optimise this impact; and ▪ Encourage schools, colleges and universities to develop appropriate training for the workforce.

Impact	Description	Effect	Additional Mitigation / Optimisation Measures
Impact 10: Additional local services - New technical skills, workboats, cranes, better marine knowledge	Development of local supply chain will continue to progress and over time will provide additional, services, facilities and knowledge. Moderate and minor beneficial effects will be experienced during the construction and operation phases respectively where measures that are successful in encouraging and supporting local capacity are implemented.	Moderate beneficial	▪ Establishing a clear list of anticipated requirements well in advance of the need actually arising and engaging with the local supply chain to assess their interest in engaging in capacity building; ▪ Ensuring that there are appropriate, transparent and legal procurement mechanisms to reward proactive local capacity investment, with participation in future work activities; ▪ Exploring parallel capacity building projects with prospective supply chain partners; ▪ Taking forward the Action Plan produced via the 2015 Fisheries Supply Chain Study report commissioned by Menter Môn (MarineSpace and Aquatera, 2015); ▪ Establishing formal supply chain partnerships where there is strong alignment of purpose; and ▪ Ensuring that site users and clients are made aware of and beneficially directed to engage with, local suppliers who have invested in important local capacity.
Impact 11: Energy security - More green electricity, local supply, diversity of supply	The Project will help to beneficially support a transition to a more decentralised and decarbonised energy model by showing how and where best tidal energy may be able to contribute effectively to local, regional and UK energy supply.	Moderate beneficial	▪ Consider the actual scale and pattern of power outputs at different stages of development, with different technologies and with predicted maintenance and unplanned outages; ▪ Consider the merits or otherwise of introducing power storage and grid system balancing technologies alongside the generation assets; ▪ Consider specialised energy markets that may exist locally, that could be directly serviced by power outputs; and ▪ Consider how supplies of tidal energy might add to the resilience of the Anglesey and nearby grid system.

Impact	Description	Effect	Additional Mitigation / Optimisation Measures
Impact 12: Decarbonisation - Clean energy, balancing services, spin-off capacity	Opportunities for decarbonisation and clean growth will only be fully realised within the operational and repowering stages of the Project and tenant's projects.	Moderate beneficial	▪ Full assessment of the possible carbon savings for each of the tenant's projects within the overall Morlais Project should be quantified and maximised; ▪ An assessment methodology that highlights how projects and the supply chain can make carbon savings should be developed; ▪ Balancing services that can complement the introduction of tidal energy should be developed, in parallel with the phases of the Project; and ▪ Spin off opportunities should be encouraged and developed alongside the different phases of the Project.

27.5. CONCLUSIONS

31. For onshore and offshore topics, the assessments conclude that the Project will not result in significant impacts once appropriate mitigation has been implemented, with the exception of traffic and transport, marine mammals, onshore ecology, SLVIA and onshore archaeology and cultural heritage, under a precautionary worst case scenario. It should be noted that identified significant residual impacts are predominantly localised, temporary effects, which are reversible after the completion of construction or which will reduce to not significant over time.

32. Moderate adverse impacts have been identified during construction in **Chapter 23, Traffic and Transport** for driver delay (road closures) where direct access cannot be maintained, particularly at Links 6, 11 and Mill Road, for the three properties that would be within the road closures.

33. Moderate adverse impacts have been identified during operation in **Chapter 12, Marine Mammals** for collision risk with operational turbines, on bottlenose dolphins. This has been precautionarily assessed as potentially minor to moderate adverse. This reflects the small number of individuals in the area; however, the potential risk is likely to be lower as bottlenose dolphins have not been recorded in the MDZ and are more likely to move along the coast than through the MDZ array area. Consultation to agree mitigation and monitoring will be undertaken throughout the development of the final design of the project to allow the best available practices to be implemented.

34. Moderate adverse impacts have been identified during construction in **Chapter 19, Onshore Ecology** for habitat loss and disturbance of features of statutory designated nature conservation designated sites. Under a worst-case scenario where HDD at landfall is not possible for technical / engineering reasons, landfall activities will involve trenching the cabling through a narrow coastal strip of the Holy Island SSSI, SPA, SAC designation. This will involve disturbance and temporary habitat loss of up to 0.07 % of the designated site. Following the implementation of mitigation including associated habitat reinstatement, the temporarily disturbed designated habitats by the coast are anticipated to recover over a number of seasons and will be monitored through post construction surveys with consultation with NRW of results. Therefore, the impact to the Glannau Ynys Gybi / Holy Island Coast SSSI/SPA/SAC is assessed to be reduced to moderate adverse in significance should the cables be trenched at landfall. If HDD technology is used, there will be no impact to the Glannau Ynys Gybi / Holy Island Coast SPA/SAC/SSSI.

35. Some potentially significant impacts have been identified in **Chapter 24, Seascape, Landscape and Visual Impact Assessment**, within localised extents of certain components of the project. The SLVIA has demonstrated that the significant effects would occur in relatively contained parts of the study area. The tidal energy devices would not become a defining feature of seascape or landscape character and would comprise small components within the open views that can be seen over the Irish Sea.

36. Moderate adverse impacts have bene identified during operation in **Chapter 20, Onshore Archaeology and Cultural Heritage** for indirect impact to setting of assets from offshore infrastructure at South Stack Lighthouse.

37. Sensitive site selection alongside embedded and additional topic specific mitigation, as appropriate, will deliver a project that avoids the vast majority of the potential impacts assessed entirely. Potential adverse impacts identified through the worst case assessment are of (minor to moderate) adverse significance and are typically temporally and geographically limited.

38. **Chapter 25, Socio-economics, Tourism and Recreation** demonstrates a number of beneficial impacts resulting from the project, including direct employment, direct spending in the locality, training opportunities and the development of the local supply chain.

27.6. REFERENCES

ABPmer, (2008) Atlas of UK Marine Renewable Energy Resources. Available from: https://www.renewables-atlas.info/. Accessed on: 28/07/19

Bowers, D. G. Ã., Ellis, K. M. and Jones, S. E. (2005) 'Isolated turbidity maxima in shelf seas', 25, pp. 1071–1080.

Ellis, K. M. *et al.* (2008) 'A model of turbidity maximum maintenance in the Irish Sea', 76, pp. 765–774.

Horizon Nuclear Power, 2018. Wylfa Newydd Project Water Framework Directive Compliance Assessment. 429pp;

Minesto (2016). Deep Green Holyhead Deep Project Phase I (0.5 MW) Environmental Statement. Report prepared by Xodus on behalf of Minesto. June 2016.