# LLŶR FLOATING OFFSHORE WIND PROJECT

## Llŷr 1 Floating Offshore Wind Farm

## Environmental Statement

## Volume 6: Appendix 8E, Habitats Regulations Assessment – Report to Inform Appropriate Assessment

## August 2024

Prepared by: Llŷr Floating Wind Ltd

FLOVENTIS ENERGY

## Document Status

| Version | Authored by | Reviewed by | Approved by | Date |
|---|---|---|---|---|
| FINAL | AECOM | AECOM | AECOM | August 2024 |

## Approval for Issue

| | |
|---|---|
| Prepared by | AECOM |
| Prepared for | Llŷr Floating Wind Limited |
| Approved by | Jay Hilton-Miller |

## Acronyms and Abbreviations

| Acronym or Abbreviation | Definition | Acronym or Abbreviation | Definition |
|---|---|---|---|
| AA | Appropriate Assessment | MCAA | Marine and Coastal Access Act |
| AADT | Annual Average Daily Traffic | MHW | Mean High Water |
| ADD | Acoustic Deterrent Device | MHWS | Mean High Water Springs |
| AEoSI | Adverse effect on Site integrity | mm | Millimetre |
| AL | Action Level | MMMP | Marine Mammal Mitigation Protocol |
| AQMA | Air Quality Management Area | MMMU | Marine Mammal Management Unit |
| BCT | Bat Conservation Trust | MMO | Marine Mammal Observers |
| BEIS | Department for Business, Energy & Industrial Strategy | mT | Millitesla |
| BMP | Biodiversity Management Plan | MW | Megawatt |
| BWM Convention | international Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 | NEQ | Net Explosive Quantity |
| CBRA | Cable Burial Risk Assessment | NFMS | United States National Marine Fisheries Service |
| CEFAS | Centre for Environment, Fisheries and Aquaculture Science | NRW | Natural Resources Wales |
| CEMP | Construction Environmental Management Plan | OCT | Open Cut Trenching |
| CIEEM | Chartered Institute of Ecology and Environmental Management | OfECC | Offshore export cable corridor |
| CIRIA | Construction Industry Research and Information Association | OnECC | Onshore export cable corridor |
| cm | Centimetre | OS | Ordnance Survey |
| CMP | Core Management Plan | OSPAR | The Convention for the Protection of the Marine Environment of the North-East Atlantic |
| COLREGS | International Regulations for Preventing Collisions at Sea 1972 | PAH | Polycyclic Aromatic Hydrocarbons |
| cSAC | Candidate Special Area of Conservation | PAM | Passive Acoustic Monitoring |
| CSQG | Canadian Environmental Quality Guidelines | PCC | Pembrokeshire County Council |
| CSZ | Core Sustenance Zones | PEDW | Planning and Environment Decisions Wales |
| CTV | Crew Transfer Vessels | PEMP | Project Environment Management Plan |
| DAS | Digital Aerial Survey | PCW | Phocid carnivores in water |
| dB | Decibels | PINS | Planning Inspectorate |

| Acronym or Abbreviation | Definition | Acronym or Abbreviation | Definition |
|---|---|---|---|
| dBht | Decibels above the hearing threshold | PIR | Passive Infra-Red |
| DEMP | Decommissioning Environmental Management Plan | PLONOR | Pose Little or No Risk to the Environment |
| ECoW | Ecological Clerk of Works | PLP | Design Project Array Layout Plan |
| EDR | Effective Deterrent Range | pSPAs | Proposed Special Protection Area |
| EIA | Environmental Impact Assessment | PTS | Permanent Threshold Shift |
| EMF | Electromagnetic field | PW | Phocid pinnipeds |
| EPS | European Protected Species | PVA | Population Viability Analysis |
| ES | Environmental Statement | RAM | Rapid Acoustic Model |
| EU | European Union | RIAA | Report to inform Appropriate Assessment |
| FCS | Favourable Conservation Status | RIB | Rigid Hulled Inflatable Boats |
| GPG | Good Practice Guidance | rms | root-mean-square |
| ha | Hectare | ROV | Remotely operated vehicle |
| HDD | Horizontal Directional Drilling | SAC | Special Area of Conservation |
| HDV | Heavy Duty Vehicles | SBP | Sub-bottom profiling |
| HRA | Habitats Regulations Assessment | SCI | Site of Community Importance |
| HF | High-frequency cetaceans | SEL | Sound exposure level |
| Hz | Hertz | SMP | Seabird Monitoring Programme |
| IAC | Inter Array Cables | SNCB | Statutory Nature Conservation Body |
| IAQM | Institute of Air Quality Management | SOLAS | International Convention for the Safety of Life at Sea 1974 |
| IASO | Invasive Alien Species (Enforcement and Permitting) Order 2019 (as amended) | SOPEP | Shipboard Oil Pollution Emergency Plan |
| IAQM | Institute of Air Quality Management | SPA | Special Protection Area |
| IMO | International Maritime Organization | SPL | Sound pressure level |
| INNS | Invasive Non-Native Species | SPMP | Scour Protection Management Plan |
| iPCoD | Interim Population Consequences of Disturbance | SSC | Suspended sediment concentration |
| IROPI | Imperative reasons of overriding public interest | SSS | Side scan sonar |
| IRZ | Impact Risk Zone | SSSI | Special Site of Scientific Interest |
| JNCC | Joint Nature Conservation Committee | TRJ | Transition joint bay |
| kHz | Kilohertz | TTS | Temporary threshold shift |
| km | Kilometre | USBL | Ultra-short baseline |
| KP | Kilometre Point | UK | United Kingdom |
| kV | Kilovolt | UXO | Unexploded ordnance |
| LDV | Light Duty Vehicles | VHF | Very high-frequency cetaceans |

| Acronym or Abbreviation | Definition | Acronym or Abbreviation | Definition |
|---|---|---|---|
| LEMP | Landscape Environmental Management Plan | VMP | Vessel Management Plan |
| LSE | Likely significant effect | WCA | Wildlife and Countryside Act 1981 (as amended) |
| m | Meter | WTG | Wind turbine generators |
| MARPOL | International Convention for the Prevention of Pollution from Ships | ZoI | Zone of Influence |
| MBES | Multi-beam echo sounder | µT | Microtesla |

## Glossary of Project Terms

| Term | Definition |
|---|---|
| The Applicant | The developer of the Project, Llŷr Floating Wind Limited |
| Array | All wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure within the array area, as defined, when considered collectively, excluding the offshore export cable(s). |
| Array Area | The area within which the wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure will be located |
| Floventis Energy | The company developing the proposed Project a joint venture between Cierco Ltd and SBM Offshore Ltd |
| Landfall | The location where the offshore export cable(s) from the array area, as defined, are brought onshore and connected to the onshore export cables (as defined) via the transition joint bays. |
| Llŷr 1 | The proposed Project, for which the Applicant is applying for Section 36 and marine licence consents. Including all offshore and onshore infrastructure and activities, and all project phases. |
| Marine Licence | A licence required under the Marine and Coastal Access Act 2009 for marine works which is administered by NRW Marine Licensing Team on behalf of the Welsh Ministers. |
| Offshore development area | The footprint of the offshore infrastructure and associated temporary works, comprised of the array area and the OfECC (offshore export cable corridor), as defined, that forms the offshore boundary for the S36 Consent and marine licence application |
| Offshore Export Cable | The cable(s) that transmit electricity produced by the WTGs to landfall. |
| OfECC | The area within which the offshore export cable circuit(s) will be located, from the array area to the landfall. |
| Onshore development area | The footprint of the onshore infrastructure and associated temporary works, comprised of the onshore export cable corridor (OnECC) and the onshore substation, as defined, and including new access routes and visibility splays, that forms the onshore boundary for the planning application. |
| Onshore Export Cable(s) | The cable(s) that transmit electricity from the landfall to the onshore substation |
| OnECC | The area within which the onshore export cable circuit(s) will be located. |
| proposed Project | All aspects of the Llŷr 1 development (i.e. the onshore and offshore components). |
| Onshore Substation | Located within the onshore development area, converts high voltage generated electricity into low voltage electricity that can be used for the grid and domestic consumption. |
| Section 36 consent | Consent to construct and operate an offshore generating station, under Section 36 (S.36) of the Electricity Act 1989. This includes deemed planning permission for onshore works. |

**Contents**

8-E. HABITATS REGULATIONS ASSESSMENT - REPORT TO INFORM APPROPRIATE ASSESSMENT...10
8.1 Introduction....10
8.2 Legislative Framework....19
8.3 Purpose Of This Report....21
8.4 Assessment Methodology....22
8.5 HRA Stage 2 – Information to support Appropriate Assessment....31
8.6 References....264

**List of Figures**

Figure 8-1. Project Llŷr location....13
Figure 8-2. Four Stage approach to HRA of Projects (from PINS Advice Note 10)....23
Figure 8-3. Sites designated with Annex I benthic habitats screened into AA....33
Figure 8-4. Location of Annex I benthic habitats....42
Figure 8-5. Seabed sediments within the Offshore Development Area and tidal excursion buffer....46
**Figure 8-6.** Indicative locations of sandwave levelling, cable protection and cable crossings....50
Figure 8-7. Sites designated for Annex II migratory fish screened into AA....74
Figure 8-8. Harbour porpoise and grey seal SACs of relevance to the proposed Project....130
Figure 8-9. Population trajectory counterfactual, un-impacted and impacted harbour porpoise (iPCoD)....148
Figure 8-10. Underwater noise overlap from (A) impact piling and (B) & (C) geophysical surveys, cable laying and UXO clearance activities, (B) worst-case location for West Wales Marine, and (C) worst-case location for Bristol Channel Approaches....151
Figure 8-11 Population trajectory for both the impacted and unimpacted grey seal population modelling....155
Figure 8-12. (A) Impact piling, (B) cable laying and (C) UXO clearance noise overlap with harbour porpoise SACs from this proposed Project and Erebus in-combination – worst-case locations for West Wales Marine SAC....164
Figure 8-13. (A) Impact piling, (B) cable laying and (C) UXO clearance noise overlap with harbour porpoise SACs from this proposed Project and Erebus in-combination – worst-case locations for Bristol Channel Approaches SAC....166
Figure 8-14. Breeding seabird and marine SPAs included for appropriate assessment in relation to the proposed Project....183
Figure 8-15. Sites designated with Annex I terrestrial habitats screened into AA....201
Figure 8-16. Sites designated with Annex II terrestrial flora screened into AA....212
Figure 8-17. Sites designated for Annex II terrestrial mammals screened into AA....223
Figure 8-18. Illustrative visualisation of a landfall HDD Installation (Hadlee & Brunton Ltd, 2019)....226
Figure 8-19 Sites designated with Annex II terrestrial ornithological features screened in for AA....245
Figure 8-20. LAmax HDD Noise Contours arising from construction activities within the Landfall area....250
Figure 8-21. LAeq HDD Noise Contours arising from construction activities within the Landfall area....251

**List of Tables**

Table 8-1. Summary of relevant embedded mitigation measures adopted as part of the proposed Project ..... 15
Table 8-2. Summary of the key issues raised by consultees and how each issue was addressed ..... 27
Table 8-3. Summary of the SACs designated for Annex I benthic habitats screened into AA ..... 32
Table 8-4. Potential impact pathways and ZoI associated with the proposed Project that are applicable to Annex I benthic habitats ..... 35
Table 8-5. Summary of in-combination effects on Annex I benthic habitats ..... 65
Table 8-6. Summary of AEoSI for designated sites with Annex I benthic features due to potential impact pathways associated with the proposed Project (✓ - potential to hinder conservation objectives; X – no potential to hinder conservation objectives) ..... 69
Table 8-7. Summary of the SACs designated for Annex II migratory fish screened into AA ..... 71
Table 8-8. Potential impact pathways and ZoI associated with the proposed Project that are applicable to Annex II migratory fish ..... 76
Table 8-9. Summary of in-combination effects on Annex II migratory fish ..... 112
Table 8-10. Summary of AEoSI for designated sites with Annex II migratory fish features due to potential impact pathways associated with the OfECC of the proposed Project (✓ - potential to hinder conservation objectives; X – no potential to hinder conservation objectives) ..... 120
Table 8-11. Relevant MMMU ..... 123
Table 8-12. Potential pathways for LSE on marine mammal qualifying features within SACs from HRA Screening (**Appendix 8D: Habitats Regulations Assessment Screening**) ..... 124
Table 8-13. Determination for designated sites for marine mammal qualifying features where LSE cannot be excluded at screening, listed by species (**Appendix 8D: Habitats Regulations Assessment Screening**) ..... 127
Table 8-14. Summary of the closest SACs designated for marine mammal qualifying features selected for initial assessment based on closest proximity to the proposed Project ..... 129
Table 8-15. Acoustic source levels used in noise modelling for key activities ..... 131
Table 8-16. Marine mammal hearing groups for harbour porpoise and grey seal features (NMFS, 2018) ..... 133
Table 8-17. Summary of disturbance thresholds used in quantitative assessment ..... 133
Table 8-18. Summary of site Conservation Objectives ..... 133
Table 8-19. Realistic worst-case parameters considered for the assessment of potential impact pathways (**Chapter 21: Marine Mammals**) ..... 137
Table 8-20. Summary of impact pathway refinement) ..... 145
Table 8-21 PTS-onset ranges and resulting number of harbour porpoise predicted to be at risk ..... 146
Table 8-22. Predicted disturbance ranges from noise generating activities for the proposed Project ..... 149
Table 8-23. Worst-case percentage daily footprint overlap with the Harbour porpoise SACs ..... 152
Table 8-24. Season percentage noise impact overlap with West Wales Marine and Bristol Channel Approaches SACs ..... 153
Table 8-25. Summary of grey seal PTS-onset ranges and corresponding predicted number of individuals within this range ..... 154
Table 8-26. Summary of disturbance ranges, together with threshold used, predicted number of grey seal individuals at risk of disturbance together with the percentage of the reference population affected (**Chapter 21: Marine Mammals; Appendix 21C: Marine Mammal Underwater Noise Assessment**) ..... 156
Table 8-27. Summary of disturbance ranges for Erebus (reproduced from MarineSpace Ltd. (2021)) ..... 161

Table 8-28. In-combination (Erebus and this proposed Project) total daily percentage overlap with West Wales Marine and Bristol Channel Approaches SACs ..... 163
Table 8-29. In-combination (Erebus and this proposed Project) total seasonal percentage overlap with West Wales Marine and Bristol Channel Approaches SACs ..... 167
Table 8-30. Cumulative number of grey seals at risk of disturbance. Includes vessel activity, UXO clearance (x1), piling activity and, seismic survey (x1 annually). Bold indicates piling activity for the projects. Tier 1-3 projects ..... 170
Table 8-31. Summary of AEoSI for designated sites with Annex II marine mammal features due to potential impact pathways associated with the OfECC of the proposed Project (✓ - potential to hinder conservation objectives; X – no potential to hinder conservation objectives) ..... 173
Table 8-32. Refinement of the screened SPA long list based on apportionment of breeding season impacts against SPA breeding colonies and also including relevant marine SPAs ..... 176
Table 8-33. Summary of the relevant qualifying interests and Conservation Objectives for Skomer, Skokholm and the Seas off Pembrokeshire SPA ..... 179
Table 8-34. Summary of the relevant qualifying interests and Conservation Objectives for Grassholm SPA ..... 181
Table 8-35. Irish Sea Front SPA; relevant qualifying interests and conservation objectives ..... 182
Table 8-36. Potential impact pathways to the protected sites with marine ornithology features throughout the different phases of the proposed Project ..... 185
Table 8-37. Comparison between Project-Alone Impacts and 1% Baseline Mortality Thresholds for Skomer, Skokholm and the Seas off Pembrokeshire SPA Populations ..... 192
Table 8-38. Comparison between Project-Alone Impacts and 1% Baseline Mortality Thresholds for Grassholm SPA Populations ..... 195
Table 8-39. Summary of the SACs designated for Annex I terrestrial habitats screened into AA ..... 200
Table 8-40. Summary of in-combination effects on Annex I terrestrial habitats ..... 207
Table 8-41. Summary of AEoSI for designated sites with Annex I terrestrial habitat features due to potential impact pathways associated with the OfECC of the proposed Project (✓ - potential to hinder conservation objectives; X – no potential to hinder conservation objectives) ..... 209
Table 8-42. Summary of the SACs designated for Annex II terrestrial flora screened into AA ..... 211
Table 8-43. Summary of in-combination effects on Annex II flora ..... 218
Table 8-44. Summary of AEoSI for designated sites with Annex II terrestrial flora features due to potential impact pathways associated with the OnECC of the proposed Project (✓ - potential to hinder conservation objectives; X – no potential to hinder conservation objectives) ..... 220
Table 8-45. Summary of the SAC's designated for Annex II terrestrial mammals screened into AA. 222
Table 8-46. Summary of in-combination effects Annex II terrestrial mammals ..... 239
Table 8-47. Summary of AEoSI for designated sites with Annex II terrestrial mammals features due to potential impact pathways associated with the OnECC of the proposed Project (✓ - potential to hinder conservation objectives; X – no potential to hinder conservation objectives) ..... 241
Table 8-48. Summary of the SACs designated for Annex I terrestrial ornithology screened into AA. 244
Table 8-49. Average noise levels of plant ..... 249
Table 8-50. Summary of in-combination effects associated with Annex I terrestrial ornithology ..... 255
Table 8-51. Summary of AEoSI for designated sites with Annex II terrestrial ornithology features due to potential impact pathways associated with the OfECC of the proposed Project (✓ - potential to hinder conservation objectives; X – no potential to hinder conservation objectives) ..... 257
Table 8-52. Summary of Appropriate Assessment and European Sites where there is an Adverse Effect on Site Integrity (AEoSI) ..... 259

# 8-E. HABITATS REGULATIONS ASSESSMENT - REPORT TO INFORM APPROPRIATE ASSESSMENT

## 8.1 Introduction

1. This Report to Inform Appropriate Assessment (RIAA) is Stage 2 of the Habitats Regulations Assessment (HRA). The HRA is submitted is submitted in support of the application for the Llŷr 1 Floating Offshore Wind Farm (referred to as the proposed Project) on behalf of Llŷr Floating Wind Limited (hereafter 'The Applicant'). It supports consent applications for the proposed Project to the competent authority (in this case, Natural Resources Wales (NRW) Marine Licensing Team) under the Marine and Coastal Access Act 2009 (MCAA 2009). This RIAA also supports the Section 36 application (under the Electricity Act, 1989), to be determined by Planning and Environment Decisions Wales (PEDW) on behalf of the Welsh Ministers.
2. Stage 1 of the HRA can be found in **Appendix 8D: HRA Screening**.
3. The information within this report should be read in conjunction with the following chapters and appendices from the proposed Project Environmental Statement (ES):

- **Volume 1, Chapter 04: Description of the Proposed Project**;
- **Volume 2, Chapter 08: Ecology and Biodiversity**;
- **Volume 2, Chapter 13: Traffic and Transport**;
- **Volume 2, Chapter 14: Air Quality**;
- **Volume 2, Chapter 15: Noise and Vibration**;
- **Volume 3, Chapter 17: Physical Environment**;
- **Volume 3, Chapter 18: Marine Water Quality and Sediment Quality**;
- **Volume 3, Chapter 19: Benthic Ecology**;
- **Volume 3, Chapter 20: Fish and Shellfish Ecology**;
- **Volume 3, Chapter 21: Marine Mammals**;
- **Volume 3, Chapter 22: Marine Ornithology**;
- **Volume 3, Chapter 26: Aviation and Radar**;
- **Volume 3, Chapter 28: Shipping and Navigation**;
- **Volume 4, Chapter 30: Inter-related and Cumulative Effects**;
- **Volume 6, Appendix 04A: Outline CEMP**;
- **Volume 6, Appendix 04B: INNS Plan**;
- **Volume 6, Appendix 08A: Chough Survey Report**;
- **Volume 6, Appendix 08B: PEA Report**;
- **Volume 6, Appendix 08C: Bat Survey Report**;
- **Volume 6, Appendix 08D: Habitats Regulations Assessment Screening**;
- **Volume 6, Appendix 19A: Nearshore 2023 Benthic Survey Report**;
- **Volume 6, Appendix 19B: Offshore 2023 Benthic Survey Report**;
- **Volume 6, Appendix 19C: EMF Assessment**;
- **Volume 6, Appendix 19D: 2024 DDV Survey Report**

- **Volume 6, Appendix 19E: 2024 Habitat Assessment Report**
- **Volume 6, Appendix 21A: Marine Mammals and Megafauna Baseline**;
- **Volume 6, Appendix 21B: Marine Mammals Noise Modelling**;
- **Volume 6: Appendix 21C: Marine Mammal Underwater Noise Assessment**;
- **Volume 6: Appendix 22A: Marine Ornithology Baseline**;
- **Volume 6: Appendix 22B: Marine Ornithology Colony Apportioning**;
- **Volume 6: Appendix 22C: Marine Ornithology Collision Risk Modelling**;
- **Volume 6: Appendix 22D: Marine Ornithology Displacement Assessment**;
- **Volume 6: Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios**; and
- **Volume 6: Appendix 22F: Marine Ornithology Population Modelling**.

### *8.1.1. The proposed Project*

4. The proposed Project is a floating offshore wind development within Welsh waters, positioned 35 kilometres (km) from the northeastern corner of the Array Area to Linney Head (the closest location on the coast of Pembrokeshire) in the Celtic Sea (see **Figure 8-1**). The proposed Project will make landfall at Freshwater West before connecting into Pembroke Dock power station and the national grid network.
5. The proposed Project comprises up to 10 wind turbine generators (WTG), inter array cables (IAC) and up to two offshore export cable circuits. The Array Area covers an area of 45 $km^2$ and includes WTGs, floating platforms (along with associated anchors and mooring lines), array cables and mooring systems. Installation of the export cable between the terrestrial and marine environment will be undertaken via the use of horizontal directional drilling (HDD) below the intertidal zone of Freshwater West. Each offshore export cable will connect to the respective onshore export cable via a transition joint bay (TJB), from which each onshore export cable will connect to the onshore substation and then on to one single grid connection at Pembroke Dock power station.
6. The proposed Project will comprise of the following key components:
    - Offshore infrastructure:
        - Up to 10 WTGs;
        - Up to 10 floating offshore wind platforms and associated moorings;
        - Up to eight mooring lines per platform;
        - Either drag embedment anchors or drilled pile anchors, up to eight anchors per platform;
        - Up to 11 Offshore IACs and up to one subsea connector, with a total IAC length of 17.31 km;
        - Up to two electricity export cables which will transfer electricity generated by the WTGs to the onshore cable circuits to the landfall site at Freshwater West - including associated cable protection measures. These will be up to 49 km in length; and
        - Other associated infrastructure, such as navigational buoys.

- Onshore infrastructure:
    - Up to two transition joint bays to connect the offshore cables to the onshore cables;
    - Onshore cabling between the landfall and the grid connection at Pembroke Dock power station;
    - Onshore substation building within a compound near to the grid connection point; and
    - Other associated infrastructure, such as temporary construction compounds.

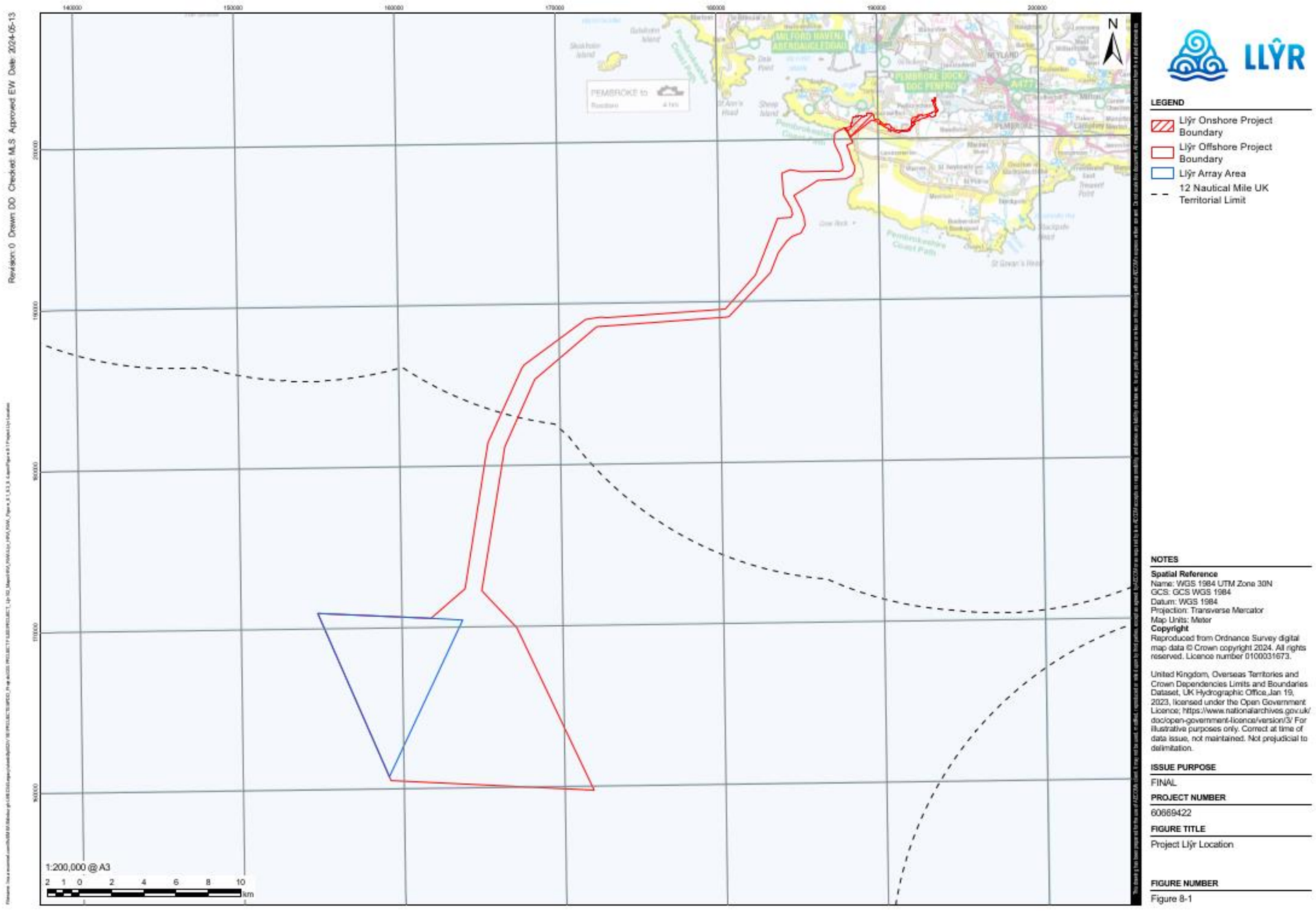


*Figure 8-1. Project Llŷr location*

### *8.1.2. Embedded Mitigation*

7. The design of the proposed Project will include embedded design control and mitigation measures that are designed to mitigate potential impacts wherever possible. In addition, a number of management plans will form conditions to any consent granted and these manage offshore construction, operation and maintenance and decommissioning activities in line with guidance and best practice as well as to further mitigate any potential impacts.
8. The embedded design control and mitigation measures and Management Plans for the proposed Project are presented in **Chapter 04: Description of the Proposed Project - Annex 4B**. A summary of relevant embedded mitigation measures[1] is provided in **Table 8-1**.

[1] This aligns with the ruling by the Court of Justice of the European Union (CJEU) in the case of People Over Wind, Peter Sweetman v Coillte Teoranta (C-323 / 17).

*Table 8-1. Summary of relevant embedded mitigation measures adopted as part of the proposed Project*

| Embedded Mitigation Measures | Description |
|---|---|
| Use of HDD as the landfall cable installation option | The Applicant has confirmed HDD as the selected installation method at landfall. HDD reduces potential effects on coastal morphology and ecology |
| Application of scour protection | The Project Design Envelope includes the installation of scour protection around the anchor installations within the Array Area. This will therefore negate the introduction of scour during the operational phase. It is anticipated that a Scour Protection Management Plan (SPMP) may be required as a condition to the Marine Licence, which will consider the need for scour protection where there is the potential for scour to develop around wind farm infrastructure in more detail. If a SPMP is required, this will be drafted post consent |
| Micrositing of WTGs and associated offshore infrastructure including cable routes. | The final proposed Project layout will be presented within the Design Project Array Layout Plan (PLP), which is anticipated to form conditions of the Section 36 and / or Marine Licence consent. As part of the pre-construction survey (which will be agreed upon with NRW) data will be analysed to ascertain the locations of the WTGs and cable routes, with the potential for micro-siting of the proposed Project infrastructure.<br><br>The Offshore Export Cable Corridor (OfECC) will avoid Annex 1 habitats – reef and sandbanks – designated by Pembrokeshire Marine SAC. |
| Nacelle, tower, and rotor design | The nacelle, tower, and rotor will be designed and constructed in order to contain leaks thereby reducing the risk of spillage into the marine environment. |
| Adherence with the international Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (the 'Ballast Water Management (BWM) Convention') | Ballast water discharges from vessels will be managed under the BWM Convention which aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments. Measures will be adopted to ensure that the discharge of ballast water with the potential to impact water quality during all proposed Project stages. |
| Removal of marine growth | The floating platform will be designed to accommodate marine growth; however, to manage weight, and subsequent removal of this growth levels will be inspected regularly, and subsequent removal of this growth will be undertaken using water jetting tools as required. |
| Minimum depth of burial | Static cables will be buried to a target depth of 1.2 m (a minimum depth of 0.8 m). Where this cannot be achieved, cable protection will be applied. This will provide some separation between the cables and benthic ecology receptors, therefore reducing the effect of electromagnetic fields (EMF). The exact minimum cable |

| Embedded Mitigation Measures | Description |
|---|---|
| | burial depths along the OfECC will be informed by a Cable Burial Risk Assessment (CBRA) and implemented through the PLP produced post-consent |
| Reducing Habitat Loss | Localised habitat loss during the installation phase is an unavoidable consequence of the proposed Project. Best practices will be followed to ensure that potential habitat loss is reduced (e.g. micrositing and reducing the benthic footprint of the Offshore Development Area). The amount of rock armour, grout bags, and concrete mattresses used to protect the OfECC, anchor, and mooring lines will be kept to a minimum where possible.<br>The CBRA considers seabed geology and the external risks to the cable including both natural, anthropogenic, and environmental events, and presents the areas of the route where external cable protection may be required.<br>The SPMP will consider the need for scour protection where there is the potential for scour to develop around wind farm infrastructure in more detail |
| Adherence with the International Convention for the Prevention of Pollution from Ships (MARPOL) | All vessels will operate in adherence with MARPOL requirements. This will include shipboard oil pollution emergency plans (SOPEP). Accordance with this will help to ensure that the potential for release of pollutants is minimised during operation and maintenance |
| Removal of debris from floating lines and cables | The accumulation of marine debris on floating lines and cables has the potential to generate adverse interactions between mobile marine species and project infrastructure. Derelict fishing gears are of particular concern due to the entanglement risk they introduce to marine megafauna, particularly marine mammals and basking sharks. Mooring lines and floating inter-array cables will be inspected during the operation and maintenance phase using a risk-based adaptive management approach.<br>Mooring line and cable inspections are expected to occur at a higher frequency initially and then reduce in frequency over a number of years, with changes to inspection periods based on evidence of risk garnered from the inspections.<br>Any inspected or detected debris on the floating lines and cables will be recovered, based on a risk assessment which considers the impact on the environment, risk to asset integrity, and cost of intervention |
| Minimum spacing between WTGs | The minimum spacing between each WTG (from the centre of each WTG structure) will be 1000 m. This will reduce the likelihood of collision and entanglement to marine mammals |
| Minimum Air Gap | Minimum air gap increased to 22 m which is a key measure to minimise collision risk to seabed species. Many seabirds fly close to the sea so that increasing the air gap between the lowest sweep of the turbine blades and |

| Embedded Mitigation Measures | Description |
|---|---|
| | the sea surface will reduce the potential for interactions between flying seabirds and the rotating turbine blades |
| Reduced Array Area | Reducing the extent of the Array Area helps to minimise displacement and barrier effects by presenting a smaller WTG area for birds to avoid or fly around. |
| Array Area reduction | The iterative design process for the Offshore Development has led to the Array Area being halved in size from 90 $km^2$ to 45 $km^2$ |
| Project Design Installation Vessel Requirements | 500 m safety distances will be adopted around installation vessels.<br>The presence of a guard vessel around the installation area perimeter will be required.<br>All vessels will follow all international regulations governing safety at sea:<br>• International Regulations for Preventing Collisions at Sea 1972 (COLREGS)<br>• International Convention for the Safety of Life at Sea 1974 (SOLAS)<br>• All vessels will follow MARPOL. This will include SOPEP.<br>All of these measures will reduce the likelihood of accidents or collisions at sea, which could result in fuel spills, adversely affecting marine water quality. The presence of guard vessel around the installation area perimeter. |
| Drilling fluid will be benign and will be PLONOR | An environmentally benign drill fluid such as bentonite will be used. |
| Project Design | To prevent disturbance by suspended sediment on benthic habitats in the jet trenching phase of cable installation 'OSPAR Commission Guidelines on Best Environmental Practice' in Cable Laying and Operation will be adhered to. This includes to minimise the number of export cables that require trenching, and avoiding sensitive benthic habitats in the route design where possible. |
| Project Design | HDD drilling fluids will be tested and selected to curtail environmental damage and potential leakage. This chiefly includes using biodegradable substances that Pose Little or No Risk to the Environment (PLONOR) and adequate contamination testing and drilling fluid disposal. |
| Biosecurity and Invasive Non-Native Species (INNS) Method Statement | All construction work will be undertaken in accordance with an INNS Management Plan. An Outline INNS plan has been prepared (**Appendix 04B: INNS Plan**). |
| Pollution Prevention and Emergency Incident Response Plan | Construction practices will incorporate measures to prevent pollution.<br>All construction work will be undertaken in accordance with a Pollution Prevention and Emergency Incident Response Plan |

| Embedded Mitigation Measures | Description |
|---|---|
| Decommissioning Environmental Management Plan (DEMP) | A DEMP will be developed to cover the decommissioning phase as required under Chapter 3 of the Energy Act 2004. As the decommissioning phase will be a similar process to the construction phase but in reverse (i.e., increased project vessels on-site, partially deconstructed structures) the embedded mitigation measure will be similar to those for the construction phase. The DEMP will be secured as a condition in the Marine Licence |
| Project design | The onshore design process has minimised the number of watercourse crossings required, and buffer strips around sections of workings adjacent to watercourse crossings and bund and embankment features will be implemented. This will avoid impacts on watercourses, including their hydrological and habitat linkages |
| Construction Environmental Management Plan (CEMP) | CEMP to include: Construction Traffic Management Plan; Air Quality Management Plan; Water Management Plan; and Soil Management Plan (**Appendix 04A: Outline CEMP**) |
| Project Design | Careful routing of the Onshore Export Cable Corridor (OnECC) and design of key crossing points to avoid key areas of sensitivity, including sand dunes, watercourses, and woodlands, wherever possible) |

## 8.2 Legislative Framework

### *8.2.1. Legislative Requirement for an HRA*

9. Protection of sites of nature conservation importance at a European level originated when the UK was part of the European Union (EU) and was required to enact EU laws into its domestic laws. The EU legislation relevant to such sites were European Directive 92 / 43 / EEC on the 'Conservation of Natural Habitats and Wild Fauna and Flora', referred to as the 'Habitats Directive', and Council Directive 2009 / 147 / EC (Birds Directive) the Conservation of Wild Birds (the codified version of Council Directive 79 / 409 / EEC on the conservation of wild birds) referred to as the 'Wild Birds Directive'. Sites falling under the definitions provided in these Directives are referred to as European sites[2] and reflect the fact that these sites are of a European level of importance. These directives were most recently transposed into domestic law by the Conservation of Habitats and Species Regulations 2017 (England and Wales) (as amended) (referred hereafter as 'the 2017 Habitats Regulations (as amended)').
10. The UK left the EU on 31 January 2020 under the terms set out in the EU (Withdrawal Agreement) Act 2020 ('the Withdrawal Act'). This established a transition period, which ended on 31 December 2020. The Withdrawal Act retains the body of existing EU-derived law within UK domestic law. In addition, The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 amended the 2017 Habitat Regulations to decouple the 2017 Habitats Regulations from the EU Directives, whilst maintaining the protection and processes related to European sites.
11. The 2017 Habitats Regulations (as amended) enable the protection of sites that host habitats and species of European importance. These sites are listed below and are collectively referred to as 'European sites'. It is noted that the term 'habitats sites' has also come into use in England and Wales to refer to these sites following the UK's departure from the EU, however, the term European sites is used here for convenience and familiarity:
    - Special Area of Conservation (SAC) including candidate cSACs;
    - Special Protection Area (SPA), including proposed pSPAs; and
    - Ramsar Sites.
12. The list of sites covered by HRA includes Ramsar sites. These are not formally covered by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (since they do not stem from European Directives) but are included in the process in line with National Planning Policy Framework Guidance (2012), which takes account of the fact that they are wetlands of international importance.
13. The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 amended the 2017 Habitats Regulations through:
    - The creation of a National Site Network within the UK territory comprising the protected sites already designated under the Nature Directives, and any further sites designated under these Regulations;
    - The establishment of management objectives for the National Site Network (the 'network objectives');

[2] The collective term for both SACs and SPAs (excluding Ramsar sites) in the UK is the National Site Network.

- A duty for appropriate authorities to manage and where necessary adapt the National Site Network as a whole to achieve the network objectives;
- An amended process for the designation of SACs;
- Arrangements for reporting on the implementation of the Regulations, given that the UK no longer provides reports to the European Commission;
- Arrangements replacing the European Commission's functions with regard to the IROPI test where a plan or project affects a priority habitat or species; and
- Arrangements for amending the schedules to the Regulations and the annexes to the Nature Directives that apply to the UK.

*8.2.2. European Sites Legislation*

14. SACs are protected areas in the UK designated under the Conservation of Habitats and Species Regulations 2017 (as amended) in England and Wales (including the adjacent territorial sea). SPAs are protected areas for birds in the UK that are classified under the Wildlife and Countryside Act 1981 (as amended) (WCA) and the 2017 Habitats Regulations (as amended) in England and Wales.
15. Ramsar sites have been designated under the Ramsar Convention (1971). Ramsar sites are selected for their international significance relating to all ecology, botany, zoology, limnology, or hydrology wetland components. The designation recognises the importance of wetlands as economic, social, and environmental entities and the need to conserve them.

*8.2.3. Content Requirements for an HRA*

16. Regulation 63 of the Habitats Regulations sets out the requirement for the HRA, stating that:

> *'A competent authority, before deciding to … give any consent for a plan or project which is likely to have a significant effect on a European site … must make an Appropriate Assessment of the implications for the plan or project in view of that site's conservation objectives… The competent authority may agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the European site.'*

17. Although an AA itself is undertaken by the competent authority (in this case, NRW), Regulation 63(2) requires that:

> *'A person applying for any such consent, permission or other authorisation must provide such information as the competent authority may reasonably require for the purposes of the assessment or to enable it to determine whether an appropriate assessment is required.'*

18. There are four key stages of an HRA that are discussed in detail in **Section 8.3**. These stages include:
    - Stage 1 – Screening for LSE;
    - Stage 2 – Appropriate Assessment (AA);
    - Stage 3 – Assessment of alternative solutions; and
    - Stage 4 - Assessment of imperative reasons of overriding public interest (IROPI).
19. The first stage therefore requires an applicant to provide sufficient information to allow the competent authority to decide if an AA is necessary. Further detail on this information and the first stage of the HRA for the proposed Project can be found in **Appendix 8D: Habitats Regulations Assessment Screening**. Should the first stage conclude that significant effects are likely, the Applicant must provide sufficient assessment information to allow the competent authority to undertake an AA. Ordinarily, consent may only be given for the proposed Project if, following an

AA undertaken by the competent authority, it is established that it will not adversely affect the integrity of the European site:

> *'In the light of the conclusions of the assessment, and subject to [considerations of overriding public interest], the competent authority may agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the European site or the European offshore marine site (as the case may be)'*

20. If an adverse effect on site integrity (AEoSI) is identified that cannot be sufficiently mitigated, or otherwise addressed, alternatives must be considered to avoid that effect. However, where no alternatives exist, and AEoSI remains, a further assessment is made, under regulation 64, as to whether the project is required for IROPI. If the project meets that IROPI test, compensatory measures will be required to maintain the overall National Site Network.
21. The overall process set out in the 2017 Habitats Regulations (as amended) is typically referred to as an 'HRA'. This has arisen to distinguish the overall process from the individual stage of 'Appropriate Assessment', which is carried out by the competent authority. Throughout this report the term HRA is used for the overall process and restricts the use of AA to the specific stage of that name.
22. The competent authority in the HRA is NRW Marine Licensing Team under jurisdiction of the Welsh Government.

## 8.3 Purpose Of This Report

23. An HRA is undertaken to assess the impact of the proposed Project on European designated sites and Ramsar sites. All other designated sites are assessed under the Environmental Impact Assessment (EIA) process rather than HRA.
24. An HRA is an iterative, methodical process undertaken in line Regulation 63 of the 2017 Habitats Regulations (as amended). This RIAA presents information required for a competent authority to undertake the second stage of the HRA process Appropriate Assessment (AA), where the potential for an adverse effect on site integrity (AEoSI) on designated sites is assessed.
25. The HRA Screening was completed to determine which designated sites have the potential to experience a likely significant effect (LSE) from activities associated with the proposed Project. Designated sites have been screened into stage 2 of the HRA during stage 1 (**Appendix 8D: Habitats Regulations Assessment Screening**).
26. Where best available evidence indicates that there is no risk that the Project activities will have an AEoSI on a designated site, by undermining its conservation objective(s), these sites will not require further assessment. This RIAA is based on the existing understanding of baseline environment and project activities, which is in line with the precautionary principle (CIEEM, 2018). Where AEoSI cannot be ruled out, for example, a clear impact pathway for adverse effect is identified, or there is reasonable doubt whether the proposed Project will or will not result in AEoSI, in view of the conservation objectives, then the respective site and feature will be taken forward to the next stage, in which an assessment of alternative solutions will be undertaken.

### *8.3.1. Report Structure*

27. This report is presented in the following sections:

- **Section 8.4** - Assessment methodology;
- **Section 44** – Stakeholder engagement and consultation; and
- **Section 8.5** – Information to support AA. This section will be split into the following sections:

- **Section 8.5.1** - Annex I benthic habitats;
- S**ection 8.5.2** - Annex II migratory fish;
- **Section 8.5.3** - Annex II marine mammals;
- **Section 8.5.4** – Annex I marine ornithology;
- **Section 8.5.5** – Annex I terrestrial habitats;
- **Section 8.5.6** – Annex II terrestrial flora;
- **Section 8.5.7** – Annex II terrestrial mammals; and
- **Section 8.5.8** – Annex I terrestrial ornithology.

## 8.4 Assessment Methodology

28. The RIAA has been developed with reference to general guidance on HRA published by the UK government in February 2021 (Defra; Natural England; Welsh Government; NRW;, 2021), and takes account of relevant EU case law (for instance, the Holohan and People over Wind cases, discussed below), and Welsh Government advice 'Technical Advice Note 5 (Nature Conservation and Planning) 2009 and The Planning Series: 16 – Habitats Regulations Assessment'.
29. The stages of HRA, are outlined in **Figure 8-2** below. Note that while **Figure 8-2** indicates all the stages of the HRA process, this document only discusses Stage 2 in further detail.

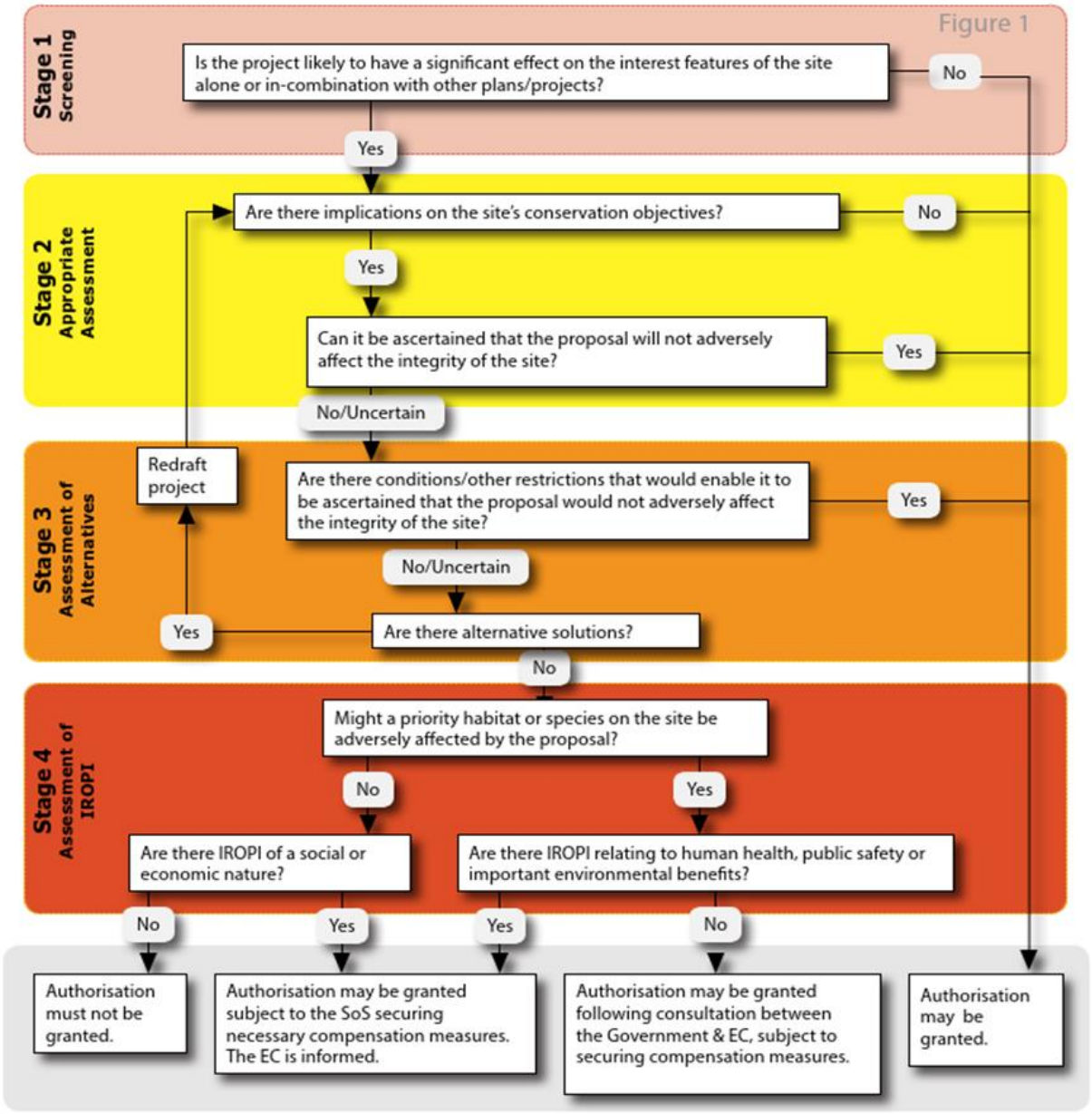


*Figure 8-2. Four Stage approach to HRA of Projects (from PINS Advice Note 10)*

#### *8.4.1. HRA Stage 1 – Screening for Likely Significant Effect*

30. Stage 1 of the HRA has been completed (see **Appendix 8D: Habitats Regulations Assessment Screening**). This exercise screened out aspects of the proposed Project and / or the European sites that can, without any detailed appraisal, be said to be unlikely to result in significant adverse effects upon European sites, usually because there is no mechanism for an adverse interaction. Where an LSE was not ruled out the remaining aspects have been then taken forward to the RIAA which provides the competent authority information to enable them to undertake an AA..

#### *8.4.2. HRA Stage 2 – Appropriate Assessment*

31. If at screening stage (Stage 1), a conclusion of LSE on the European site cannot be ruled out, an AA must then be undertaken by the competent authority to assess whether the proposed Project will result in an AEoSI. An AEoSI is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant features as it did at the time of its designation. The favourable conservation status of a European site is defined through the conservation objectives for the site, which are the responsibility of NRW.
32. At this stage, mitigation measures (in addition to embedded measures) can be considered to inform any determination as to whether there is an AEoSI. This RIAA has therefore been prepared to provide the competent authority with the relevant information to carry out their Appropriate Assessment for the proposed Project.

#### *8.4.3. HRA Stage 3 – Assessment of Alternative Solutions*

33. In cases where it cannot be determined that a plan or project under consideration will not have an AEoSI, further mitigation measures must be undertaken such that the plan or project will not adversely affect the integrity of the site. Mitigation measures aim to minimise or cancel out the negative impact of a plan or project before or after its completion. Examples of mitigation measures are as follows:

    - Sensitive timing of operations e.g., not undertaking certain activities during the breeding, migrating or over wintering season of a particular species which is a feature of the designated site in question; and
    - Specific types of tools to be used e.g., to prevent damage to fragile habitats and noise pollution impacts.

34. If adequate mitigation is not possible then alternatives to the proposed Project that would not lead to an AEoSI must be explored. If it can be demonstrated that there are no alternative solutions to the proposed Project that would have a lesser effect or avoid an adverse effect, the Project may still be granted consent if the competent authority is satisfied that the proposed Project must be carried out for reasons of IROPI.

#### *8.4.4. HRA Stage 4 – Assessment of Imperative Reason of Overriding Public Interest*

35. If the conclusion of the competent authority is that the proposed alternative solutions do not avoid AEoSI for designated sites relative to the original proposed Project an assessment of IROPI must be undertaken.
36. The HRA Report should provide justification alongside robust evidence for the continued development of the proposed Project despite the potential for an AEoSI on European protected sites scoped in for assessment. Imperative reasons are commonly associated with advantageous socio-economic benefits of the proposed Project.
37. IROPI needs to be agreed by the Welsh Government, and compensatory measures must be agreed with the competent advisor and secured to offset potential identified damage done by the plan

or project. Compensatory measures must allow the maintenance of the overall coherence of the European designated site network (Gov.Wales, 2021).

38. According to the Planning Inspectorate (PINS) Advice Note 10 (The Planning Inspectorate, 2017) the competent authority requires the IROPI justification to be based on three factors:

    - 'Imperative – essential that it proceeds for public interest reasons;
    - In the public interest – that it has benefits for the public, not just benefits for private interests; and
    - Overriding – that the public interest outweighs the harm, or risk of harm, to the integrity of the European site(s) as predicted by the AA.'

### *8.4.5. The Rochdale Envelope*

39. In July 2018, the PINS published Advice Note Nine: Rochdale Envelope (The Planning Inspectorate, 2018), explaining how the principles of the Rochdale Envelope should be used by planning applications for the EIA process, though it is equally applicable to non-statutory Environmental Appraisal.

40. The Rochdale Envelope[3] is applicable where some of the details of a Proposed Development (in this case, proposed Project) cannot be confirmed when an application is submitted, and flexibility is needed to address uncertainty. Notwithstanding, all significant potential effects of the proposed Project must be properly addressed.

41. The Rochdale Envelope encompasses three key principles:

    - The assessment should use a cautious worst-case approach;
    - The level of information assessed should be sufficient to enable the Likely Significant Effects of the proposed Project to be assessed; and
    - The allowance for flexibility should not be abused to provide inadequate descriptions of projects.

42. For the purposes of this RIAA, a realistic worst-case (i.e., the potentially most impactful) scenario has been assessed in relation to impact pathways.

### *8.4.6. In-Combination Scope*

43. It is a requirement of Regulation 63 of the Conservation of Habitats and Species Regulations 2017 (as amended) and Regulation 28 of The Conservation of Offshore Marine Habitats and Species Regulations 2017, to not only assess the impacts of the proposed Project alone, but also to investigate whether there might be 'in-combination' effects with other projects or plans. In practice, such an 'in-combination' assessment is of greatest relevance when an impact pathway relating to a project would otherwise be screened out because it is considered not to result in LSE.

44. For the purposes of this HRA, several projects (including those that have applications submitted, but are not yet approved and other projects already in operation), which may act in-combination with the proposed Project, will be identified. These projects will be identified based on their potential impact pathways to the same European sites as those discussed for the proposed Project

[3] The Rochdale Envelope arises from two cases: R. v Rochdale MBC ex parte Milne (No.1) and R. v Rochdale MBC ex parte Tew [1999], which are cases that dealt with outline planning applications for a proposed business park in Rochdale.

in isolation. In-combination effects are addressed, where relevant throughout **Section** 8.5 of this RIAA.Stakeholder Engagement and Consultation

45. Consultation with statutory and non-statutory organisations has been undertaken to inform the approach to, and scope of, the HRA Screening (Stage 1).

46. Stakeholders for the proposed Project include statutory consultees, landowners, local communities, and other sea users. In addition to the statutory consultation process, there has been ongoing engagement with statutory and non-statutory consultees to steer the development of the proposed Project and this is detailed in **Table 8-2.**

47. .

*Table 8-2. Summary of the key issues raised by consultees and how each issue was addressed*

| Consultee | Consultation type | Comment raised | How issue has been addressed and location of response in chapter |
|---|---|---|---|
| Scoping | | | |
| JNCC | Scoping opinion | Overall JNCC agree with the potential impacts that will be scoped in and will require further assessment. However, we would like to highlight that impacts from the introduction of scour protection have not been, and should be, considered here. | The assessment of potential impacts of scour have now been included for benthic habitats in **Section 8.5.1.** |
| JNCC | Scoping opinion | Underwater noise during the operational stage is not included as a potential impact pathway; this should be added. Please note that cable "thrums" have not been well characterised in terms of underwater noise levels and potential to impact marine mammals either for individual turbines or arrays. This may require specific modelling or other studies. How turbine operating noise propagates from floating turbines is also poorly understood. | Operational sound impacts on marine mammals has been assessed as an impact pathway in **Section 8.5.3**. |
| JNCC | Scoping opinion | It would be beneficial if the distance between protected sites and the array / cable scoping areas were separated as the potential impacts associated with each area could be different. | The distance to protected sites, has now been presented separately for the Array Area and OfECC. See **Section 8.5**. |
| NRW | Scoping opinion | We advise potential impacts to this designated site are also scoped in as the "Submerged or partially submerged sea caves" feature are cross-boundary features between the Limestone Coast SAC and the Pembrokeshire Marine SAC. Whilst we acknowledge the sensitivity of this feature to project secondary effects may be lower than for other habitat features, some biotopes within this feature may still be sensitive to project secondary effects. | The "Submerged or partially submerged sea caves" have been taken into consideration in **Section 8.5.1.** |

| Consultee | Consultation type | Comment raised | How issue has been addressed and location of response in chapter |
|---|---|---|---|
| NRW | Scoping opinion | We advise that the introduction and spread of INNS is also considered / assessed in the operation phase, including the ability for infrastructure to also act as a stepping-stone. Furthermore, the applicant should indicate the intention to undertake a biosecurity risk assessment for all stages of marine development and incorporate them into the PEMP. Moreover, it is important to note the introduction of hard substrate in a soft sediment habitat is a change of habitat type. The loss of a sedimentary habitat to a different habitat type is not beneficial even if the anthropogenic structure is colonised by local species as the sedimentary habitat is lost and will not be replaced. | Impact pathways associated with the introduction of hard substratum into sediment-based habitats are assessed in **Section 8.5.1**.<br><br>A biosecurity risk assessment will be undertaken as part of the PEMP by the contractor to reduce impacts from introduction of INNS (**Table 8-1**). |
| NRW | Scoping opinion | NRW agrees that underwater noise from construction activities is likely to be a primary effect on fish, especially for fish where the swim bladder is near or connected to the ear, such as in the clupeids. Recent evidence has found that Twaite shad from the River Severn undertake long range migration across the Celtic Sea, and NRW therefore recommend that to ensure any fish passing through the Fish Study Area are considered, a regional approach is taken, screening in all sites with noise sensitive fish features. Furthermore, NRW recommends that site and project specific noise modelling is undertaken to inform the detailed assessment. | The assessment considers a regional approach, to consider any migratory fish that could interact with the Project (**Appendix 8D: HRA Screening**.).<br><br>Underwater noise modelling has been undertaken in order to assess impacts on fish and has been included in **Section 8.5.2**. |
| NRW | Scoping opinion | NRW advise that Cardigan Bay and River Teifi SAC, both of which have Annex II diadromous fish features, are borderline on the screening criteria but should be included on the map and scoped in for migratory fish. | These sites are included in the RIAA. See **Section 8.5.2**. |

| Consultee | Consultation type | Comment raised | How issue has been addressed and location of response in chapter |
|---|---|---|---|
| NRW | Scoping opinion | Please see comment above relating to screening distances and inclusion of Cardigan Bay and River Teifi SAC Annex II features. NRW also advise that Atlantic salmon (Annex II migratory fish), and sea trout are included, as these are features of the Severn Estuary SAC / Ramsar site migratory fish assemblage. NRW welcomes the intention to screen in the Severn Estuary SAC but would advise that the rivers Usk and Wye SACs connected to the site, are also included and need to be scoped into the assessment. | Cardigan Bay SAC, River Teifi SAC, River Usk SAC, and River Wye SAC are included in the RIAA. See **Section 8.5.2**. Impacts on sea trout are assessed in **Chapter 20: Fish and shellfish.** |
| NRW | Scoping opinion | NRW advise that the following SACs should be scoped into the assessment:<br>• North Anglesey Marine SAC;<br>• West Wales Marine SAC;<br>• Bristol Channel Approaches SAC;<br>• Lleyn Peninsula and the Sarnau SAC;<br>• Cardigan Bay SAC; and<br>• Pembrokeshire Marine SAC. | NRW guidance (NRW, 2022e) has been considered in the screening of SACs designated for marine mammal features in the HRA process. See **Section 8.5.3**. |
| NRW | Scoping opinion | Where the MUs include SACs outside of UK waters, transboundary impacts must also be considered, and the potential impacts on SACs within other jurisdictions should be assessed. Details of these sites can be found in NRW (2020). | Transboundary impacts on marine mammals have been considered in the HRA process as presented in **Section 8.5.3**. |
| NRW | Scoping opinion | NRW advise that the proposed works are likely to have a significant effect (either alone or in combination with other plans or projects) on the SACs with marine mammal features and therefore recommend that AA is carried out on all of the sites listed. | Following NRW (2020), the SACs therein have been considered in the RIAA in **Section 8.5.3**. |

| Consultee | Consultation type | Comment raised | How issue has been addressed and location of response in chapter |
|---|---|---|---|
| NRW | Scoping opinion | NRW supports the inclusion of the Embedded and Good Practice Measures detailed to minimise the risk of impact to marine mammals. | Embedded mitigation and Good Practice Measures are listed in **Section 8.1.1**. |
| NRW | Scoping responses | Concerns regarding potential for the proposed Project to have significant effect on terrestrial protected sites. | Assessment of terrestrial protected sites completed in **Sections 8.5.5**; **8.5.6**; **8.5.7**; and **8.5.8**. |
| NRW | Scoping responses | Identifies requirement for Appropriate Assessment and consultation with NRW on likely effect on the National Site Network for terrestrial ecology. | Assessment of terrestrial protected sites completed in **Sections 8.5.5**; **8.5.6**; **8.5.7**; and **8.5.8**. |
| Pembrokeshire County Council (PCC) | Scoping opinion | Concerns regarding the number of cable route projects across the angle peninsula and likely cumulative construction and operational effects. | The in-combination assessment is completed for each receptor group within the AA (**Section 8.5**). |
| Pembrokeshire Coast National Park Authority | Scoping opinion | Suggest that the effects of cable landfall and onshore works must also be considered in combination with other projects. | The in-combination assessment is completed for each receptor group within the AA (**Section 8.5**). |

## 8.5 HRA Stage 2 – Information to support Appropriate Assessment

### *8.5.1. Annex I Benthic Habitats*

48. This section covers the assessment of risk of adverse effects on SACs designated for Annex I benthic habitats for the proposed Project and details:

- A summary of the HRA Screening;
- A description of each SAC and its conservation objectives;
- A description of the potential impact pathways and their associated ZoIs; and
- An assessment for each SAC of the risk of AEoSI for the proposed Project alone, and in-combination with other developments.

**Summary of HRA Screening**

49. The proposed Project's HRA Screening Report identified two SACs with Annex I benthic habitat features (see **Appendix 8D: Habitats Regulations Assessment Screening**). These SACs were identified based on overlap with the 14 km Benthic Study Area. The Benthic Study Area was defined based on project specific hydrodynamic modelling to define the maximum tidal excursion distance of 14 km (see **Chapter 17: Physical Environment**), which reflects the maximum potential zone of influence for benthic features.

50. The following potential impact pathways for all stages of the proposed Project (construction, operation and maintenance, and decommissioning) on benthic ecology have been screened into the HRA:

- Temporary loss and physical disturbance to benthic habitats and species;
- Temporary increase in suspended sediment concentration (SSC) and sediment deposition leading to turbidity, smothering effects and potential contaminant mobilisation;
- Impact of changes to marine water quality from the use of HDD drilling fluids;
- Impact of changes to marine water quality from accidental leaks and spills from vessels, including loss of fuel oils;
- Introduction and spread of INNS;
- Permanent direct loss and physical disturbance to benthic habitats and species;
- Alteration and / or indirect loss of habitat during the operational lifetime of the proposed Project;
- Changes to habitats due to on-going scour, changes in hydrodynamics, increased sedimentation and smothering, and abrasions, from the movement of mooring chains;
- Disturbance to benthic habitats during planned maintenance and instances of cable failure and excavation;
- Disturbance to benthic habitats and species due to subsea cable thermal emissions; and
- Effects of electromagnetic field (EMF) emissions.

**51.** Where LSE could not be excluded at the screening stage, sites have been taken forward to determine any AEoSI which will be considered during Stage 2 (**Table 8-3**; **Figure 8-3**).

*Table 8-3. Summary of the SACs designated for Annex I benthic habitats screened into AA*

| Site name | Annex I benthic habitats screened into AA | Distance to Llŷr Array Area (km) | Distance to OfECC (km) |
|---|---|---|---|
| Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | *Screened in for:*<br>• Estuaries (1130);<br>• Large shallow inlets and bays (1160);<br>• Reefs (1170);<br>• Sandbanks which are slightly covered by sea water all the time (1110);<br>• Mudflats and sandflats not covered by seawater at low tide (1140);<br>• Coastal lagoons (1150);<br>• Atlantic salt meadows *Glauco-Puccinellietalia maritimae* (1330); and<br>• Submerged or partially submerged sea caves (8330). | 23.04 | 0.00 |
| Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) | *Screened in for:*<br>• Submerged or partially submerged sea caves (8330).<br>Terrestrial components of this site are considered within **Section 8.5.5: Annex I Terrestrial Habitats**. | 35.24 | 0.00 |

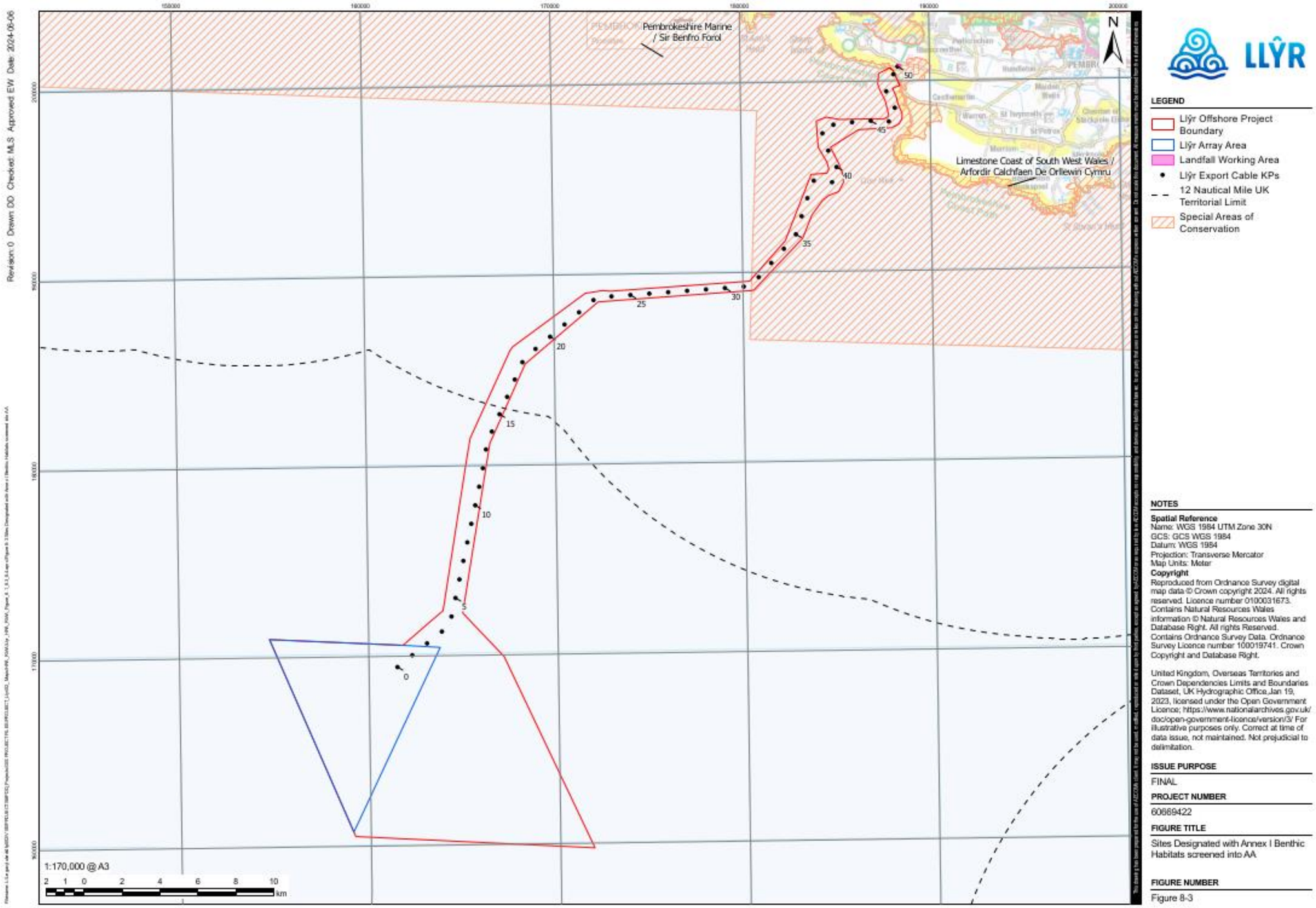


*Figure 8-3. Sites designated with Annex I benthic habitats screened into AA*

*Potential Impact pathways and Zone of Influence (ZoI)*

52. A summary of the potential impact pathways relevant to Annex I benthic habitats and their associated ZoIs is included in **Table 8-4**. This provides information required to inform the AA based on parameters associated with the worst-case scenario for the proposed Project.

*Table 8-4. Potential impact pathways and ZoI associated with the proposed Project that are applicable to Annex I benthic habitats*

| Potential impact pathway | ZoI | Rationale |
|---|---|---|
| **Construction** | | |
| Temporary loss and physical disturbance to benthic habitats and species | Localised to Offshore Development Area | Several activities occurring within the Offshore Development Area during the Construction phase may cause temporary loss and / or physical disturbance to the seabed habitats and benthic species. The sources of temporary habitat loss include:<br>• HDD breakout point for two bores (total footprint of 100 $m^2$);<br>• Sandwave levelling for a total length of 10,351 m and width of 30 m (total disturbance of 621,048 $m^2$ for two cables);<br>• Disturbance swathe of 25 m for construction of two cables, including clearance activities such as pre-grapnel run and boulder clearance over 49 km total length (total footprint 2,450,000 $m^2$); and<br>• If burial is possible, cable burial for 17.10 km of inter-array cable in a swathe of up to 25 m (total footprint of 427,500 $m^2$).<br>Any effect of temporary disturbance associated with these activities is anticipated to be highly localised at specific locations of installation activity within the Offshore Development Area. |
| Temporary increase in SSC and sediment deposition leading to turbidity, smothering effects and potential contaminant mobilisation. | 14 km from the Offshore Development Area | Construction activities associated with the proposed Project have the potential to temporarily increase SSC by creating sediment plumes in the water column which can travel away from the Offshore Development Area before depositing sediment elsewhere on the seabed. Increased SSC results in elevated turbidity, which can result in several potential effects to benthic receptors.<br>The tidal excursion distance during a mean tide is approximately 8 km to 10 km in the middle of the OfECC and 14 km in the nearshore on approach to the landfall. However, based on modelling undertaken in **Chapter 17: Physical Environment**, any measurable change in SSC during construction will be temporary and localised, with the majority of sediment in the OfECC consisting of sands and gravels which are expected to have deposited in tens of centimetres thickness on the seabed between 50 m and 500 m away of the source of disturbance. Only 6% of the surveyed sediments across nearshore and offshore sections of the Offshore Development Area consisted of mud and therefore there is the potential for a very fine layer of mud to be deposited beyond 500 m. No expected impact or change to SSC nor a measurable sediment deposition is anticipated beyond the tidal excursion distance.<br>Therefore, the greatest tidal excursion distance of 14 km is considered to represent the maximum ZoI. |

| Potential impact pathway | ZoI | Rationale |
|---|---|---|
| Impact of changes to marine water quality from the use of HDD drilling fluids | 500m from the HDD breakout | The use of HDD and therefore the discharge of drilling fluids at the breakout location at the landfall has the potential to alter marine water quality and negatively affect benthic receptors within in the surrounding habitats. It has been estimated that up to 1,700 $m^3$ of drilling mud will be generated total for the two bores. Constituents of the drilling fluids, including silt-clay sized particles that have a maximum theoretical range of approximately 14 km, which is the tidal excursion on a mean tide in the nearshore area around the landfall and outside Milford Haven. However, discharged drilling fluid is expected to subject to immediate dilution processes and rapid dispersal over this distance which will result in no detectable change from the baseline beyond 500 m. |
| Impact of changes to marine water quality from accidental leaks and spills from vessels, including loss of fuel oils | 14 km | Up to 17 project vessels will be on site concurrently. A deterioration in water quality from the accidental release of pollutants (e.g., oil, fuels, lubricants, chemicals) and planned release of wastewater from any of the vessels associated with the Construction Phase activities could result in increased turbidity, deposition and contamination that could affect benthic habitats and species.<br>Therefore, any effects are expected to be localised but considering the extent of tidal movement the ZoI is considered to be 14 km. |
| Introduction and spread of INNS from vessels | Localised to the Offshore Development Area | The accidental introduction of INNS could occur from the ballast water of the vessels that may be required during the Construction phase of the proposed Project. Up to 17 project vessels will be on site concurrently. Therefore, any impacts are considered to be localised to the Offshore Development Area. |
| **Operation and maintenance** | | |
| Permanent direct loss and physical disturbance to benthic habitats and species | Localised to the Offshore Development Area | The placement of hard substrates on the seafloor, including cable and scour protection, can result in the permanent loss of benthic habitats and species. Sources of permanent habitat loss associated with the proposed Project consist of:<br>• 50 $m^2$ of protection, such as rock placement and/or concrete mattresses, per bore at HDD exit point (total footprint of 100 $m^2$);<br>• Cable protection (excluding crossings) in OfECC over a total distance of 1,600 m per cable, with a worst-case scenario berm width of 5 m (total footprint of 16,000 $m^2$ per export cable);<br>• Four cable crossings each requiring protection (none required for Greenlink) of 200 m length and 5 m width (footprint of 8,000 $m^2$ for two cables);<br>• 11,000 m of articulated piping, 500 mm in diameter (total footprint of 11,000 $m^2$ for both cables); |

| Potential impact pathway | ZoI | Rationale |
|---|---|---|
| | | • Assuming a worst-case scenario of 20% cable protection of the 17,100 m of IAC, with a berm width of 5 m, the total area of cable protection would be 17,100 $m^2$;<br>• Potential placement of anchor scour protection (total footprint 24,800 $m^2$), placement of clump weights (total footprint 8,000 $m^2$), and drag embedment anchor or drilled pile anchors (total footprint of 6,120 $m^2$); and<br>• Subsea connector 64 $m^2$.<br>Introduction of hard substrate would replace the existing seabed, leading to the permanent loss of habitats and species, by nature, will be localised to the Offshore Development Area. |
| Temporary increase in suspended SSC and sediment deposition leading to contaminant mobilisation, turbidity, and smothering effects | 14 km from the Offshore Development Area | During cable repairs, which could include the remedial reburial of exposed cables, that may be required during the operational lifetime of the proposed Project, there is the potential for small, localised, temporary increases in SSC. Based on modelling undertaken in **Chapter 17: Physical Environment**, the ZoI is considered to be a maximum of 14 km, as with the Construction phase. |
| Alteration and / or indirect loss of habitat during the operational lifetime of the proposed Project | Localised to the Offshore Development Area | The placement of cable protection which would be left in place for the Operational phase of the proposed Project could result in the alteration and / or loss of habitat during its operational lifetime by facilitating the growth of new biological communities and / or changing the morphology of the seabed. These include:<br>• The placement of protection for two cables in the OfECC (total footprint of 30,300 $m^2$) (; and<br>• The placement of cable and scour protection on IACs and associated mooring / anchoring systems and subsea connector (total footprint 56,084 $m^2$).<br>Therefore, effects will be localised to the Offshore Development Area. |
| Changes to habitats due to on-going scour, changes in hydrodynamics, increased sedimentation and smothering, and abrasions, from the movement of mooring chains | Localised to the Array Area | Although scour protection will be in place, the mooring chains on the seabed throughout the Array Area can still lead to on-going scour, changes in hydrodynamics, increased sedimentation and smothering, and abrasions, throughout the operation and maintenance phase. Scour around these structures is considered to be very limited up to a few metres. Therefore, only habitats within, or within close proximity to the Array Area are considered to be at risk from impact. |

| Potential impact pathway | ZoI | Rationale |
|---|---|---|
| Disturbance to benthic habitats during planned maintenance and instances of cable failure and excavation | Localised to the Offshore Development Area | Repair works are likely to be highly localised to the area of concern and therefore the spatial extent of any impacts would be small in extent, thus only impacting the features that overlap with the Offshore Development Area. |
| Disturbance to benthic habitats and species due to subsea cable thermal emissions | Localised to the Offshore Development Area | Operation of electricity cables generates heat due to resistance in the conductor components, which can warm the cable surface and adjacent environment (i.e. sediments; Meissner et al. (2006)). Submarine power cables have been shown to generate and dissipate heat when active, with some reaching cable surface temperatures of up to 70°C (Emeana, et al., 2016).<br>The proposed Project consists of two either 66 kV or 132 kV electricity export cables transmitting electricity from the wind turbines to the shore over a maximum estimated distance of 49 km. The export cables will be laid within separate trenches (which has a lower heat profile than bundled cables), with a minimum target separation of 50 m (which may decrease in the nearshore approach area) and a target burial depth of 1.2 m (a minimum depth of 0.8 m). The total length of all inter-array cables will be 17.31 km, as a worst case 17.1 km of which will be surface laid and buried to a target depth of 1.2 m (0.8 m minimum) where possible.<br>Sediment particle size composition has been found to influence heat transfer, with coarse silts experiencing the greatest temperature change, but to a shorter distance from the source, while fine and coarse sands had a lower temperature change but a greater affected distance (Emeana, et al., 2016). The sediments within Offshore Development Area predominantly consist of sand with varying percentages of mud and gravels, and therefore, the effect of temperature change is expected to vary. For unburied and dynamic cables within the Array Area, any temperature increase will be rapidly attenuated in water and unlikely to have an effect on benthic receptors.<br>Therefore, the ZoI is anticipated to be localised to a few metres, dependent upon the heat carrying capacity of particular sediments. |
| Effects of EMF emissions | 2 m from the Offshore Development Area | Subsea cables associated with proposed Project, including both inter-array cables and export cables are known to produce EMF emissions (Hutchison, et al., 2020). EMF has the potential to affect the foraging and migratory success and behaviour of some marine species, particularly fish, but responses in some invertebrates have also been observed.<br>EMF will be emitted for the duration of operational life of the proposed Project, from both the export and the inter-array cables. The target burial depth of subsea cables within the OfECC is 1.2 m (a |

| Potential impact pathway | ZoI | Rationale |
|---|---|---|
| | | minimum depth of 0.8 m) and potentially deeper in the OfECC region from KP42 to KP38 alongside the eastern boundary of Turbot Bank. Results from the project-specific EMF assessment (**Appendix 19C: EMF Assessment**) found that the maximum EMF strength predicted to result from the operation of the export cables at a target burial depth of 1.2 m, when a receptor is 0 m from the seabed, is 2.6 µT (microtesla). The effects of EMF reduce with distance from the cable, and the modelling shows negligible emissions beyond a distance of 2 m for this burial depth. For dynamic exposed cables in the water column, such as those within the Array Area, the maximum EMF strength at the surface of the cables has been calculated as ~5.2 mT (millitesla). This is significantly higher than the background level of geomagnetic field in the UK, which is around 50 µT but this also decreases rapidly with distance from the cable. At a distance of 0.44 m from the cable surface EMF is approximately equal to background levels (**Appendix 19C: EMF Assessment**). |
| Introduction and spread of INNS | Localised to the Offshore Development Area | The introduction of additional cable protection, required during operation and maintenance will be lower than during the construction phase. The ZoI is considered to be localised to the Offshore Development Area, as in the Construction phase. |
| **Decommissioning** | | |
| Temporary disturbance to benthic habitats and species | Localised to the Offshore Development Area | At the end of the operational life of the proposed Project, there will be a DEMP in place. Other proposed Project constraints will also be taken into consideration (e.g. safety and liability), with the least environmentally damaging option chosen if possible.<br>The full details of the decommissioning will not be agreed until towards the end of the 30-year operational lifetime of the proposed Project. However, the removal of all infrastructure from the seabed is considered a worst-case scenario for this assessment. Therefore, the decommissioning phase is expected to largely mirror the construction process over a period of 12 months (see **Chapter 04: Description of the Proposed Project**). Therefore, the impact pathways and the associated ZoI are anticipated to mirror those from the Construction phase. |
| Temporary increase in SSC and sediment deposition | 14 km from the Offshore Development Area | |
| Spread of INNS during removal of proposed Project infrastructure | Localised to the Offshore Development Area | |

**Site Descriptions and Conservation Objectives**

*Pembrokeshire Marine / Sir Benfro Forol SAC*

53. Pembrokeshire Marine SAC encompasses areas of sea, coast and estuary that support a wide range of marine habitats and wildlife, some of which are unique in Wales. The conservation objectives for the Pembrokeshire Marine SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes (NRW, 2018e). For the habitat features, this includes maintaining the range, typical species and structure and function of the features (NRW, 2018e).

54. The OfECC intersects Pembrokeshire Marine SAC for approximately 15.14 km between the kilometre point (KP) 32.4 and KP 48 (**Figure 8-3**). Thus, the site has been screened into the AA for potential LSE on the following Annex I benthic habitat qualifying features (**Table 8-3**):

- Estuaries (1130);
- Large shallow inlets and bays (1160);
- Reefs (1170);
- Sandbanks which are slightly covered by sea water all the time (1110);
- Mudflats and sandflats not covered by seawater at low tide (1140);
- Coastal lagoons (1150);
- Atlantic salt meadows *Glauco-Puccinellietalia maritimae* (1330); and
- Submerged or partially submerged sea caves (8330).

*Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC*

55. Limestone Coast of South West Wales SAC covers both marine and terrestrial habitats including mudflats and sandflats, and grasslands (Countryside Council for Wales, 2008). The SAC encompasses Freshwater West where the OfECC makes landfall and transitions between the offshore and onshore elements (**Figure 8-3**). Therefore, this SAC has been screened into the RIAA for potential LSE on the Annex I benthic habitat, submerged or partially submerged sea caves. The conservation objectives for this SAC are to achieve and maintain favourable conservation status for the features. For 'submerged or partially submerged sea caves' (**Table 8-3**), this includes maintaining condition and extent for the feature (Countryside Council for Wales, 2008a).

56. Terrestrial habitats will be addressed in Section 8.5.5: Annex I Terrestrial Habitats.

**Information for Appropriate Assessment**

*Pembrokeshire Marine / Sir Benfro Forol SAC - Assessment of Adverse Effects Alone*

*Construction phase*

***Temporary loss and physical disturbance to benthic habitats and species***

57. Several activities during the Construction phase have the potential to cause temporary loss and / or physical disturbance to the seabed habitats and benthic species including sandwave levelling, clearance, and burial activities (**Table 8-4**). The effect of any temporary disturbance is anticipated to be very localised and within the Offshore Development Area (**Table 8-4**).

58. As the Pembrokeshire Marine SAC is located 23.04 km from the Array Area, it is not anticipated that the temporary disturbance associated with Construction phase activities within the Array Area will result in an impact on the Annex I benthic habitat features of the SAC (**Table 8-3**). Based on this distance, the temporary loss and physical disturbance to benthic habitats and species of

as a result of Construction phase activities within the Array Area are not considered further in this assessment.

59. The OfECC intersects Pembrokeshire Marine SAC for approximately 15.14 km between the KP 32.4 and KP 48 (**Figure 8-3**), and thus there is potential for impacts on any of the Annex I benthic habitat features present at this location from Construction phase activities (**Figure 8-4**).

60. The OfECC does not intersect the following Annex I benthic habitats, and thus the temporary loss and physical disturbance to these features are not considered further in this assessment:

    - Estuaries;
    - Shallow inlets and bays;
    - Mudflats;
    - Sandflats;
    - Coastal lagoons;
    - Salt meadows;
    - Sea caves.

61. Additionally, the proposed Project has committed to routing the OfECC avoiding direct impacts on Annex I reef and the Turbot Bank designated area (**Chapter 04: Description of the Proposed Project**). Avoidance of these features is as follows:

    - Reef habitat in the nearshore region (between the HDD exit point at KP 48 and KP 41.5 at the top of Turbot Bank) (**Figure 8-4**) has been avoided by routing through sediment habitats east of the reef in Freshwater West and installation along an identified sediment channel in the reef with some micro-routing around small areas of outcropping rock that sits within a mosaic of rock and sediment habitats.
    - The cables will be surface laid, using iron articulated pipe protection, in a westerly direction for up to 4.2 km per cable, avoiding encroachment onto potential Annex I reef between KP 46 and KP 41.8. No other cable protection measures are proposed within this area.

62. From KP41.8 to KP38, cable installation around Turbot Bank maintains a position outside of the designated Annex I sandbank feature and avoids encroachment onto potential Annex I reef (**Figure 8-4**). The intention is to bury the cable in this region but at this stage it has been assumed installation will be achieved via the laying of iron articulated pipe protected cable directly on the seabed and no other cable protection measures are proposed. As such, the temporary loss and physical disturbance to the Annex I reef and sandbank features of the Pembrokeshire Marine SAC as a result of Construction phase activities are not considered further in this assessment.

63. Therefore, it is not anticipated that there will be any temporary loss or physical disturbance of the Annex I features of Pembrokeshire Marine SAC from Construction phase activities, and it can be concluded that there is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to temporary loss or physical disturbance as a result of Construction phase activities of the proposed Project**.

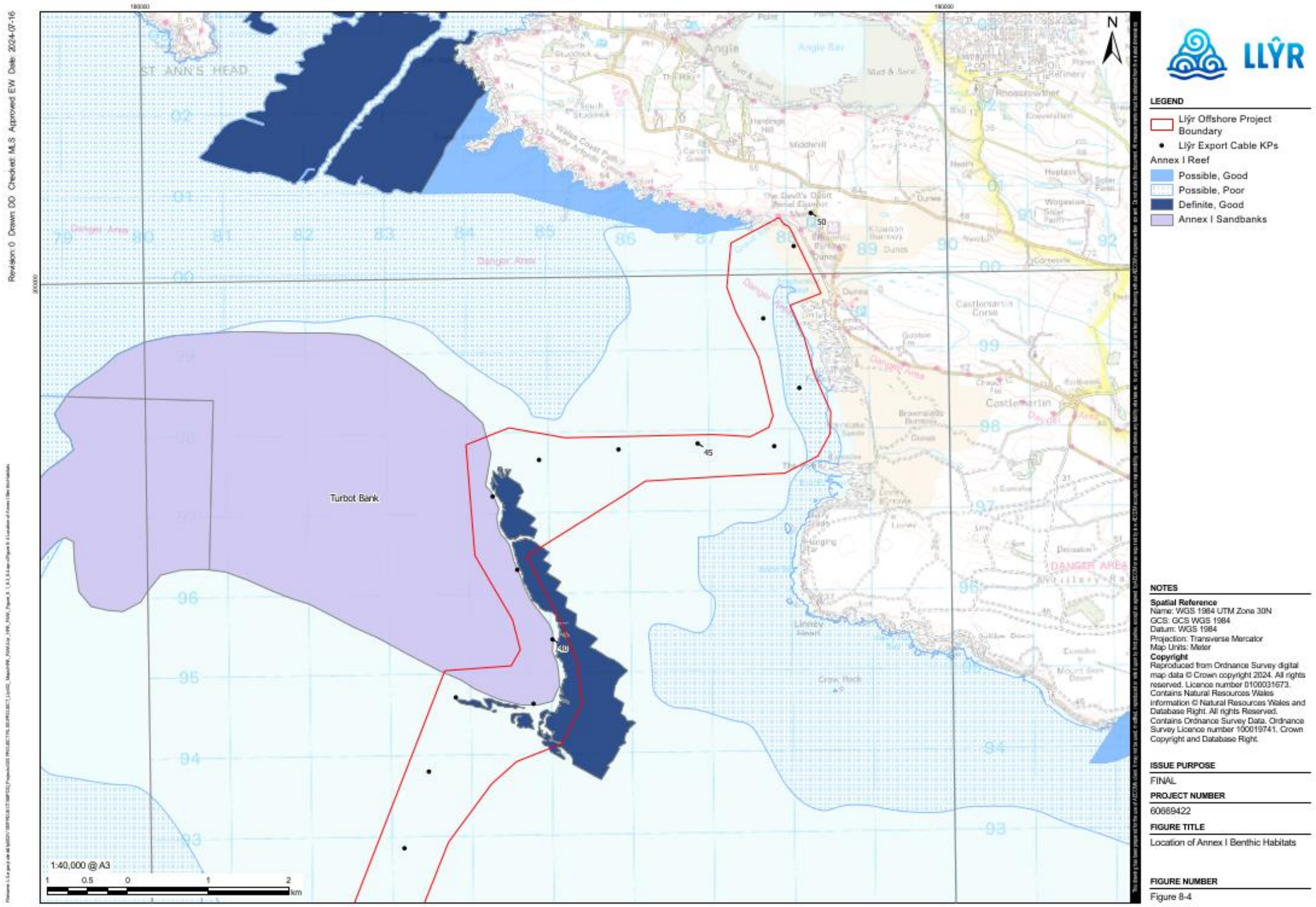


*Figure 8-4. Location of Annex I benthic habitats*

***Temporary increase in SSC and sediment deposition leading to contaminant mobilisation, turbidity and smothering effects***

64. Construction phase activities associated with the proposed Project, such as ploughing and jet trenching which disturb the seabed, have the potential to temporarily increase SSC by creating sediment plumes in the water column which can travel away from the Offshore Development Area before depositing sediment elsewhere on the seabed. Increased SSC results in elevated turbidity, which can result in several potential effects to benthic receptors, including reduced rates of photosynthesis via a reduction in light availability, reduced feeding efficiency of filter feeders if clogging of filtering systems occurs, smothering of invertebrate species (Miller, et al., 2002) where sediments re-settle to the seabed, and indirect effects on benthic species from the release of any sediment contaminants such as heavy metals and hydrocarbons.

65. The largest sediment plumes and highest levels of increased SSC are associated with the disturbance of sediments which have a high proportion of fine particulate matter, such as muds and clays. These fine sediments remain in suspension for longer and therefore travel the furthest distance from the source of disturbance, settling to the seabed more slowly. In comparison, coarser materials such as sand and gravel are expected to settle more quickly within a few hours of disturbance and within only a few tens of metres from the source (**Chapter 17: Physical Environment**).

**66.** The extent of sediment dispersion and deposition as a result of the proposed Project activities have been assessed in **Chapter 17: Physical Environment**, and is presented in **Table 8-4.** Although the greatest tidal excursion distance is 14 km in nearshore areas, the majority of the sediment in the OfECC and the Array Area is dominated by sand and gravel particles, which have the potential to be deposited in tens of centimetres thickness on the seabed between 50 m – 500 m away of the source of disturbance though the larger gravel particles will settle to the seabed much more rapidly and are unlikely to extend this far (**Chapter 17: Physical Environment**). A small proportion of the surveyed sediments across nearshore and offshore sections of the Offshore Development Area consisted of mud (**Figure 8-5**) and therefore there is the potential for a very fine layer of mud to be deposited beyond 500 m during construction, though this will be very limited since the area and volume of sediment disturbed is within a narrow swathe. Thus, based on the modelling undertaken, any measurable change in suspended sediment concentrations during construction will be temporary and localised, with the majority of sediments settling close to the area of disturbance in areas of very similar sediment conditions.

67. Sediment chemistry in the Offshore Development Area indicates contamination levels are generally low and consistent with concentrations present at a regional level and so any increase in contaminant levels as a result of sediment mobilisation are not considered likely.

68. Several mitigation measures are embedded into the cable construction methods to minimise increased SSC during the Construction phase of the proposed Project. These are outlined in **Section 8.1.1** and includes the selection of the most appropriate installation method based on the local sediment conditions.

***Annex I Reefs (1170)***

69. Annex I Reef has been identified within the zone of influence for this impact pathway (**Table 8-4**), within the OfECC in the nearshore area where the cable will be installed between the HDD exit point at KP48 and KP42 close to Turbot Bank (**Figure 8-4**). These habitats could, therefore, be at risk of an impact from increased SSC and deposition from cable construction activities. Reef habitats support diverse assemblages of sessile species, including coral, sponges, ascidians and blue mussels, that are sensitive to high levels of SSC and deposition.

70. However, the method of construction in the region where Annex 1 reef is present will be the placement of iron articulated protected cable directly on the seabed, without the need for any sediment excavation. Therefore, any sediment disturbance will be minimal and not likely to result in SSC or deposition at a level that would affect Annex 1 reef habitats in the vicinity of the cable. The magnitude of impact is therefore considered negligible and it is not anticipated that the placement of the iron articulated cable will result in sediment disturbance that would hinder the conservation objectives of the reef feature of Pembrokeshire Marine SAC.

***Annex I Sandbanks which are slightly covered by sea water all the time (1110)***

71. Annex I sandbank features of Pembrokeshire Marine SAC were identified within the zone of influence of potential SSC dispersion (**Table 8-4**).
72. However, the OfECC avoids direct impacts on the Annex I Turbot Bank (**Figure 8-4**) as cable installation will be via lay of iron articulated cable directly on the seabed. Therefore, any increase in SSC is considered to be negligible and unlikely to affect sandbanks.
73. Where burial is possible these activities will generate sediment plumes that are likely to be transitory in nature. Furthermore, the majority of the sediment consists of sand or gravel (**Figure 8-5**). Gravel and sand particles are expected to settle to the seabed very quickly, within 50 m – 500 m away of the source of disturbance. Therefore, an increase in SSC and deposition of sediment into Annex I sandbanks is not anticipated to result in considerable changes to the habitat.
74. Sandbanks are dynamic features, therefore are regularly exposed to wave action, turbidity changes, and varying levels of energy. In addition, the majority of the sediment likely to be disturbed is sand, and thus, the addition of sediment from deposition following increased SSC is not expected to cause a deviation from baseline conditions. Therefore, it is not anticipated that temporary increase in SSC and deposition will hinder the conservation objectives of the sandbank feature of Pembrokeshire Marine SAC.

***Intertidal Annex I features***

75. All other Annex I benthic habitat features are intertidal in nature. These include the following features:

    - Estuaries (1130);
    - Large shallow inlets and bays (1160);
    - Mudflats and sandflats not covered by seawater at low tide (1140);
    - Coastal lagoons (1150);
    - Atlantic salt meadows *Glauco-Puccinellietalia maritimae* (1330); and
    - Submerged or partially submerged sea caves (8330).

76. These features are located beyond 500 m from the Offshore Development Area and since cable installation in the nearshore waters (KP48 to KP46) will be by direct lay on the seabed any sediment disturbance will be negligible and the potential for any sediment deposition in the vicinity of intertidal features can be ruled out. Furthermore, these features are predominantly located within the intertidal zone and are regularly exposed to wave action. Therefore, species and communities inhabiting these habitats are considered to have some habituation to increased SSC, and so any increase will not hinder the conservation objectives of these Annex I intertidal benthic habitat features of Pembrokeshire Marine SAC.

***Conclusion***

77. To conclude, the potential impact pathway of a temporary increase in SSC and sediment deposition is not anticipated to hinder the conservation objectives of any Annex I benthic habitat

features of Pembrokeshire Marine SAC. This is due to the proposed installation methods, the prevalence of sand and gravel sediment within the Offshore Development Area resulting in rapid re-settlement of any disturbed sediment and the wave exposure experienced in the Pembrokeshire Martine SAC. Should burial take place around Turbot Bank this Annex I benthic habitat features is not sensitive to high levels of temporary turbidity (**Chapter 19: Benthic Ecology**). Therefore, with adherence to the mitigation measures embedded into the cable construction methods (**Section 8.1.2**), and due to the localised and temporary nature of the effects, there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to a temporary increase in SSC and sediment deposition.**

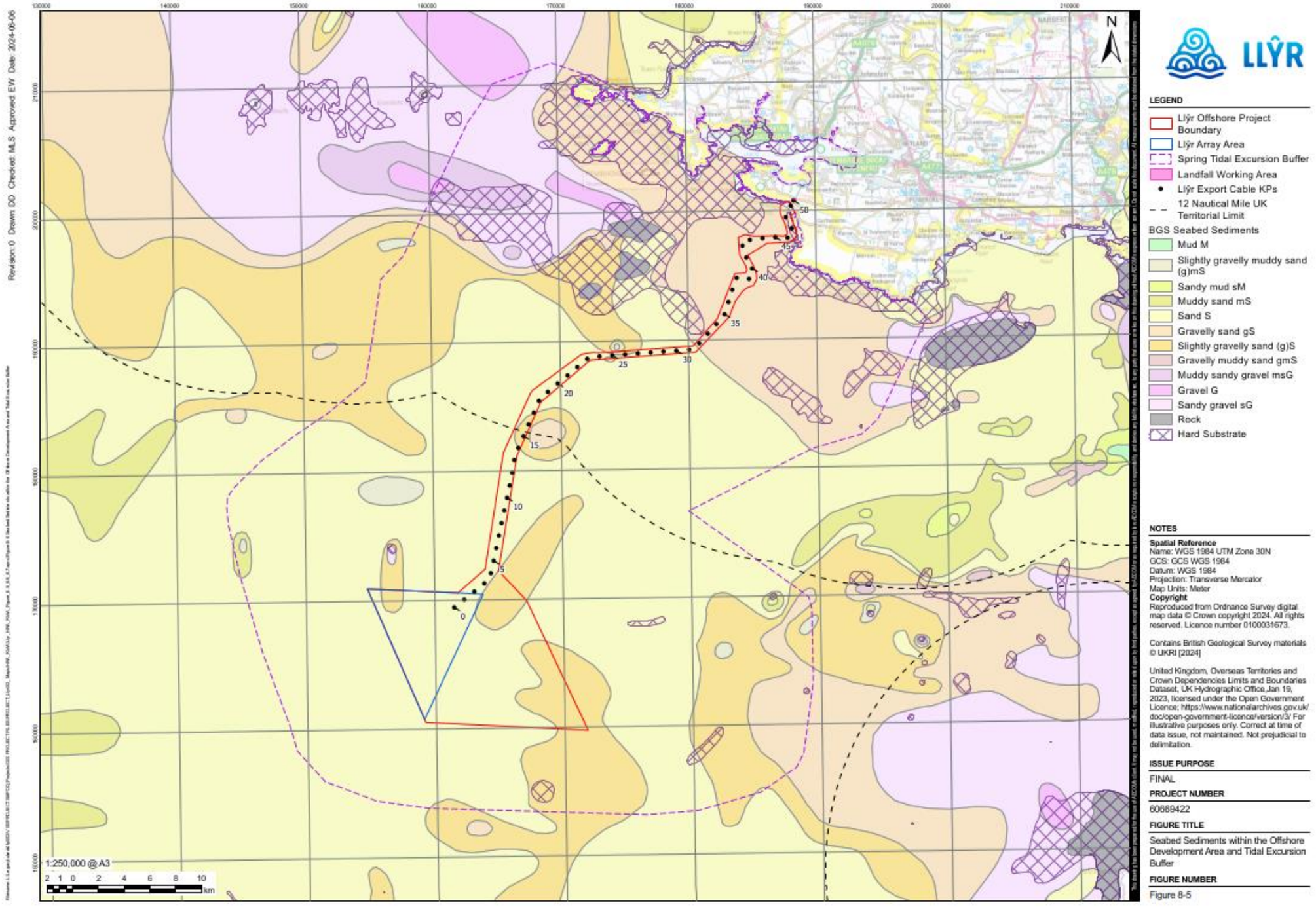


*Figure 8-5. Seabed sediments within the Offshore Development Area and tidal excursion buffer*

***Impact of changes to marine water quality from the use of HDD drilling fluids***

78. Installation of the export cable between the terrestrial and marine environment will be undertaken via the use of HDD below the intertidal zone of Freshwater West, exiting at KP48 in a water depth of around 5 - 8 m (**Volume 1, Chapter 04: Description of the Proposed Project**), and therefore in a dynamic area with considerable wave action and tidal water movement.

79. The use of HDD, and therefore the discharge of drilling fluids, at the landfall breakout location has the potential to alter marine water quality (**Chapter 18: Marine Water Quality and Sediment Quality**) and negatively affect benthic receptors within the surrounding habitats of Pembrokeshire Marine SAC. It has been estimated that up to 1,700 $m^3$ of drilling mud will be generated. However, all drilling fluids used will be selected from the OSPAR List of Substances / Preparations Used and Discharged Offshore (2021) which are considered to PLONOR.

80. Due to the small amounts of fluid likely to be released, and dynamic nature of the coastal environment, it is anticipated that only a short-term and temporary local reduction in water quality at the HDD breakout may occur. Much of the drilling mud will be released in sand dominated habitat where faunal communities are unlikely to significantly affected. Some particulates from the drilling muds may settle on bedrock but due to the dynamic nature of the shallow subtidal environment, any fluid is expected to be rapidly diluted and dispersed within the marine environment, with no detectable change from the baseline beyond 500 m (**Chapter 18: Marine Water and Sediment Quality; Table 8-4**).

**81.** The HDD exit point is within largely sandy habitat. However, there are also areas of Annex I reef in the vicinity of the HDD exit point. These reef habitats may support epifaunal species that may have a high sensitivity to increase sediment load, but considering the low volume of drill arisings, the generally dynamic nature of the shallow water environment, and the presence of sandy areas, there is likely to be some tolerance of natural resuspension of sediments occurring due to tides and wave action.

**82.** All other Annex I benthic habitats of Pembrokeshire Marine SAC (**Table 8-3**) are over 500 m from the HDD exit point and thus are not anticipated to be impacted by changes water quality from HDD drilling fluids, and are not assessed further.

**83.** Based on the above information, it is not anticipated that changes in water quality from the use of HDD will hinder the conservation objectives for the Annex I benthic habitat features, and thus there is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to changes to marine water quality from the use of HDD drilling fluids.**

***Impact of changes to marine water quality from accidental leaks and spills from vessels, including loss of fuel oils***

84. A deterioration in water quality from the accidental release of pollutants (e.g., oil, fuels, lubricants, chemicals) and planned release of wastewater from any of the vessels associated with the proposed Project activities could result in increased turbidity, deposition and contamination that could affect Annex I benthic habitats. Potential impacts can be temporary and short-term or more long-term, with the potential for contaminants to be present in the water column or settle into sediment, remaining there for prolonged periods of time.

85. To ensure the risk of accidental spills is as low as reasonably practicable, the proposed Project will adhere to relevant guidance (e.g., Pollution Prevention Guidance). A CEMP (**Appendix 04A: Outline CEMP**) including an Emergency Spill Response Plan and Waste Management Plan will be implemented during the Construction phase of the proposed Project to minimise the risk of accidental releases. Control measures and a SOPEP will be in place and adhered to under MARPOL Annex I requirements for all vessels. Planned effluent dischargers will be compliant with MARPOL

Annex IV 'Prevention of Pollution from Ships' standards. The Annex I benthic habitat features within the Benthic Study Area, such as sandbanks and reef, support a diverse range of fauna which could be susceptible to the effects of spills, particularly those that are less mobile. Moreover, substances from leaks and spills could also accumulate in Annex I sea caves, disrupting communities utilising the cave habitats. Such habitats support a range of species assemblages which could be susceptible to impacts resulting from accidental spills. However, with the embedded measures in place **(Section 8.1.2**), the risk of an accidental leak or spill is considered unlikely.

**86.** Therefore, should a spill occur, the leak or spill is expected to be minor, localised, and temporary with only small amounts of pollutant released into the marine environment which will be subject to immediate dilution and dispersion over the tidal cycle (see **Chapter 17: Physical Environment**).

**87.** Therefore, it is not anticipated that changes in water quality from accidental leaks and spills from vessels will hinder the conservation objectives of any of the Annex I benthic habitat feature (**Table 8-3**), and thus there is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to changes to marine water quality from accidental leaks and spills from vessels, including loss of fuel oils.**

***Introduction and spread of INNS from vessels***

88. The accidental introduction of INNS could occur from the vessels that will be required during the construction phase of the proposed Project. Whilst most non-native species are unlikely to become invasive, some species can out-compete native species and introduce diseases which could result in significant changes to community composition and mortality (Bax, et al., 2003). Any introduction of INNS therefore has the potential to cause detrimental changes to the Annex I benthic habitats features of Pembrokeshire Marine SAC.

89. The Great Britain INNS Strategy provides guidance for the prevention, detection, eradication, and management of INNS, including marine species. Best practice measures will be adopted to minimise INNS. In particular, all proposed Project vessels will adhere to the BWM Convention with the aim of preventing the spread of INNS from any release of ballast water (IMO, 2017). In addition, vessels will be required to adhere to the IMO guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (Biofouling Guidelines). These measures, implemented via the CEMP and INNS Plan (**Appendix 04A: Outline CEMP**; **Appendix 04B: INNS Plan**) lower the probability of INNS transmission from vessels to the benthic habitat.

90. The sensitivity of benthic habitats and species to INNS can be high, particularly for native species that can be outcompeted by non-natives. The spread of INNS in intertidal habitats is more of a concern than subtidal zones (OSPAR, 2023). As HDD is being used, exiting in the shallow subtidal zone the intertidal area will be completely +avoided. Moreover, no INNS were identified in the OfECC during the project-specific benthic survey (**Appendix 19A: Nearshore 2023 Benthic Survey Report**; **Appendix 19B: Offshore 2023 Benthic Survey Report**). Moreover, to date, no spread of INNS caused by submarine cabling has been documented (Taormina, et al., 2018).

91. Therefore, with mitigation and best practice measures in place as stated above and in **Section 8.1.2**, the risk of the spread of any existing INNS is considered unlikely to hinder the conservation objectives of Annex I benthic habitat features. Therefore, there is considered to be **no potential for an AEoSI on the Pembrokeshire Marine SAC due to the introduction and spread of INNS from vessels**.

*Operation and Maintenance Phase*

***Permanent direct loss and physical disturbance to benthic habitats and species***

92. Several activities during the Construction phase, may lead to the permanent direct loss and physical disturbance to benthic habitats and species.

93. The sources of permanent habitat loss in the Array Area are cable and scour protection, placement of clump weights for the mooring line, scour protection for the anchors, installation of drilled pile anchors and the presence of a subsea connector on the seabed. However, as Pembrokeshire Marine SAC is 23.04 km from the Array Area, it is not anticipated that any permanent loss at this location will result in an impact on the Annex I benthic habitat features of the SAC. Therefore, the permanent direct loss and physical disturbance within the Array Area are not considered further in this assessment.

94. Within the OfECC, cable and scour protection, in the form of rock berms or concrete mattresses are likely to be needed at some locations where a minimum cable burial depth of 0.8 m cannot be achieved. Introduction of hard substrate would replace the existing seabed, leading to the permanent loss of these habitats and species. Until construction has commenced, it is not yet known specifically where cable protection and / or scour protection will be required along the OfECC. However, based on currently available data it has been estimated that a total distance of 1,600 m of the OfECC will require cable protection (**Figure 8-6; Table 8-4**). However, no other cable protection is currently estimated for any areas where there are Annex I benthic habitats of the Pembrokeshire Marine SAC (**Table 8-3**), including sandbanks and reef.

95. Therefore, as proposed Project has oriented the OfECC to avoid reef, sandbanks and other Annex I habitat types (**Figure 8-6**), no cable protection is anticipated for any areas where there are Annex I benthic habitats present, and there will be no permanent direct loss or physical disturbance of the Annex I benthic habitat features. Thus it can be concluded that there is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to direct permanent loss or physical disturbance**.

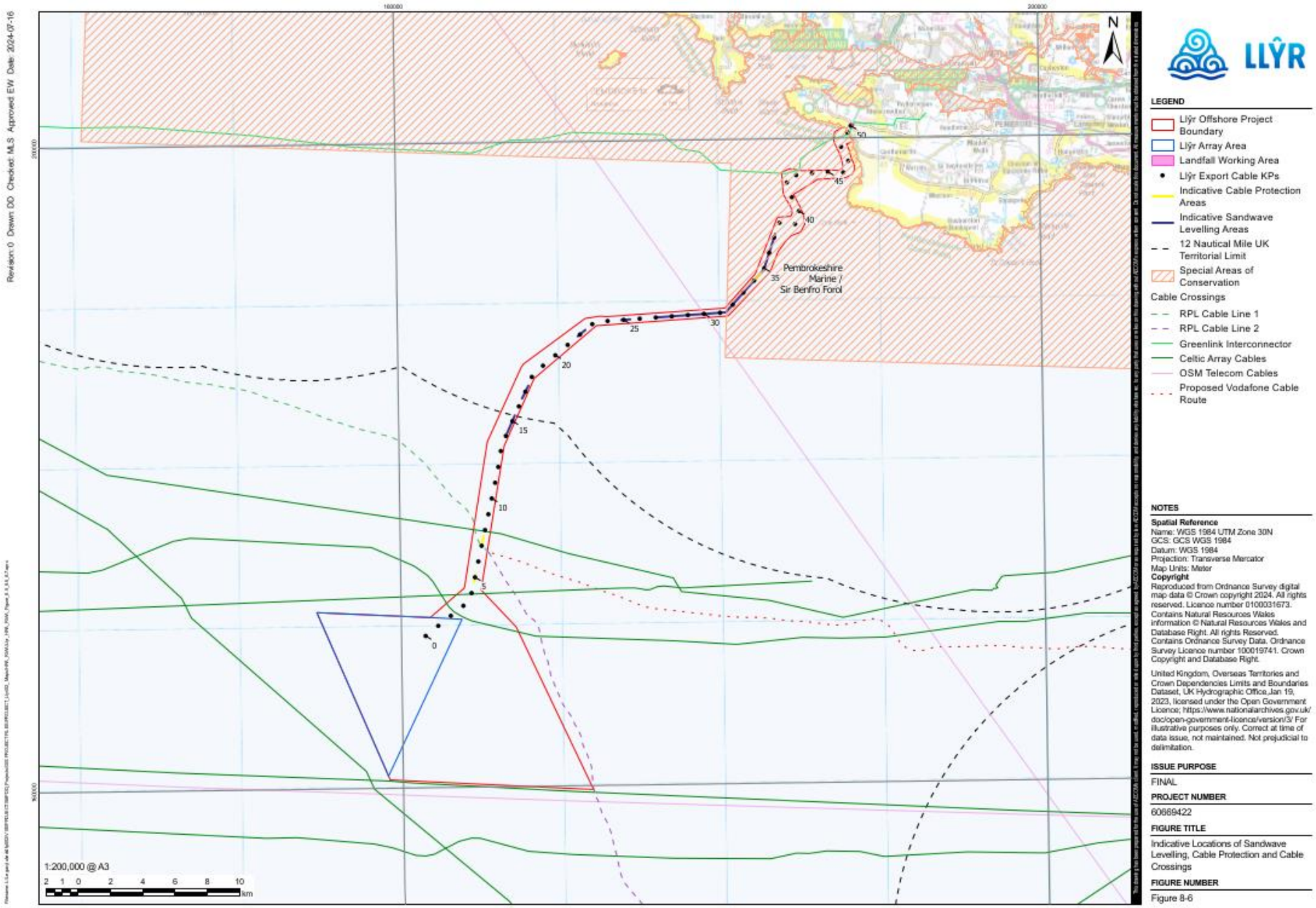


***Figure 8-6.*** *Indicative locations of sandwave levelling, cable protection and cable crossings*

***Temporary increase in SSC and sediment deposition leading to contaminant mobilisation, turbidity and smothering effects***

96. During cable repairs and maintenance activities, which could include the remedial reburial of exposed cables, that may be required during the operational lifetime of the proposed Project, there is the potential for small, localised, temporary increases in SSC and subsequent sediment deposition. Such Operational phase activities could lead to increases in turbidity and smothering and the remobilisation of contaminants.

97. The remobilisation of contaminants is not a concern as the concentration of heavy metals, hydrocarbons and other pollutants in the sediments of the Offshore Development Area have been found to be consistent with the wider area.

98. During the lifetime of the proposed Project, up to five cable repairs are expected, and it is anticipated that the duration and extent of any repairs would be a small portion of that proposed for the Construction phase. Due to the expected shorter period of time over which repairs would take place in comparison to the Construction phase activities, and the very localised nature of the works, any local increases in SSC and therefore contaminants, turbidity and smothering will be no greater than that associated with the Construction phase (**Paragraphs 64** to **77**), and it is not anticipated that temporary loss and physical disturbance will hinder the conservation objectives of any of the Annex I features (**Table 8-3**) of Pembrokeshire Marine SAC.

99. Therefore, with adherence to the embedded mitigation measures (**Section 8.1.2**), and due to the localised and temporary nature of the effects, there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to a temporary increase in SSC and sediment deposition.**

***Alteration and / or indirect loss of habitat during the operational lifetime of the proposed Project***

100. The proposed Project involves the introduction of new infrastructure, which could result in the alteration and / or loss of habitat during its operational lifetime. Habitat loss is considered at the point of installation, in the construction section above, but will endure for the operational duration of the proposed Project (**Paragraphs 64** to **77**).

101. New infrastructure present on the seabed could increase heterogeneity of the seabed habitat, facilitating the growth of new biological communities. Such infrastructure results in the introduction of new, hard substrate into areas of seabed which may otherwise consist of soft sediments. This may lead to positive impacts such as increasing biodiversity and heterogeneity of habitat. However, as such infrastructure does not provide a like-for-like habitat, over time during the operational lifetime of the proposed Project communities consistent with those found in rocky habitats may start to colonise infrastructure, including INNS (**Paragraphs 88** to **90**).

102. The effect of any is anticipated to be localised to the Offshore Development Area (**Table 8-4**). As the Pembrokeshire Marine SAC is located 23.04 km from the Array Area, it is not anticipated that the alteration and / or indirect loss of habitat associated with operational activities within the Array Area will hinder the conservation objectives of the Annex I benthic habitat features of the SAC. Therefore, infrastructure within the Array Area is not considered further in this assessment.

103. The placement of cable protection, in the form of rock berms, grout bags or concrete mattressing, which would be left in place in the OfECC may lead to and increase heterogeneity of the seabed habitat and facilitating the growth of new biological communities. The OfECC intersects Pembrokeshire Marine SAC for approximately 15.14 km between the KP 32.4 and KP 48 (**Figure 8-3**), and thus there is potential for impacts on the benthic habitat features present at this location.

104. However, as the proposed Project has oriented the OfECC to avoid reef and other Annex I habitat types (**Table 8-3**)), it is not anticipated that there will be any alteration and / or indirect loss of habitat of the Annex I features of Pembrokeshire Marine SAC. Therefore, it can be concluded that there is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to alteration and / or indirect loss of habitat**.

***Changes to habitats due to on-going scour, changes in hydrodynamics, increased sedimentation and smothering, and abrasions, from the movement of mooring chains***

105. Several activities which involve the introduction of new infrastructure as part of the proposed Project that could result on-going scour and abrasion around proposed Project infrastructure.

106. The placement of IACs and associated mooring / anchoring systems on the seabed within the Array Area can lead to on-going scour, changes in hydrodynamics, increased sedimentation and smothering, and abrasions, throughout the operation and maintenance phase. Any scour around these structures ais considered to be very limited. Therefore, only habitats within, or within close proximity to the Array Area are considered to be at risk from changes to habitats from the movement of mooring chains. As the Pembrokeshire Marine SAC is located 23.04 km from the Array Area, it is not anticipated that effects within the Array Area will hinder the conservation objectives of the Annex I benthic habitat features of the SAC. Given this, the impact of these effects is not considered further in this assessment.

107. Additionally, as discussed in further detail in **Chapter 17: Physical Environment**, any changes in hydrodynamics, sediment transport, or abrasions from movement of mooring chains are expected to be very small, with any changes to the seabed difficult to discern from those which may occur under baseline conditions.

108. It is likely that mechanical protection will be required in several locations along the length of the OfECC where minimum burial depth of 0.8 m cannot be reached. As discussed in further detail in **Chapter 17: Physical Environment**, the design of the cable protection, based on a worst-case scenario of rock berms, is such that there is limited potential for flow disturbance and scour. However, the placement of cable protection, in the form of rock berms, grout bags, polyurethane material protection or concrete mattresses, may cause local elevations in turbulence which could cause secondary scour. All scour associated with the proposed Project is anticipated to be localised a few to tens of metres from the structure and tens of centimetres deep, resulting in being highly localised.

109. However, as the proposed Project has oriented to avoid reef and other Annex I habitat types (**Figure 8-4**). it is not anticipated that there will be any impact to any of the Annex I features of Pembrokeshire Marine SAC (**Table 8-3**) from the movement of mooring chains. Therefore, it can be concluded that there is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to changes to habitats from the movement of mooring chains**.

***Disturbance to benthic habitats during planned maintenance and instances of cable failure and excavation***

110. Maintenance and cable repair activities during instances of cable failure and excavation, where required, will be carried out using the same or similar methods as the Construction Phase activities. Therefore the potential pathways for impacts to benthic ecology are expected to be the same as those identified for the Construction Phase of the proposed Project.

111. During the lifetime of the proposed Project, up to five cable repairs are expected, and it is anticipated that the duration and extent of repair would be a small fraction of that proposed for the construction phase. Any repair works are likely to be highly localised to the area of concern and therefore the spatial extent of any impacts would be small in extent (**Table 8-4**). Maintenance

and unforeseen cable repair, although unlikely, are considered routine, and the procedures and processes are well defined and common in the industry.

112. The OfECC intersects Pembrokeshire Marine SAC for approximately 15.14 km between the KP 32.4 and KP 48 (**Figure 8-4**Figure 8-3), and thus there is potential for impacts associated with repair works on the benthic habitat features present at this location. However, as the proposed Project has oriented the OfECC to avoid reef, sandbanks, and other Annex I habitat types (**Figure 8-4**; **Table 8-3**), it is not anticipated that there will be any disturbance during planned maintenance works of the Annex I features of Pembrokeshire Marine SAC. Therefore, there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to disturbance during planned maintenance works**.

***Disturbance to benthic habitats and species due to subsea cable thermal emissions***

113. Operation of electricity cables generates heat due to resistance in the conductor components, which can warm the cable surface and adjacent environment such as sediments (Meissner et al. (2006). Submarine power cables have been shown to generate and dissipate heat when active, with some reaching cable surface temperatures of up to 70°C (Emeana, et al., 2016). Temperatures such as these have the potential to cause sediment dwelling and demersal mobile organisms to move away from the affected area. Increased heat could also alter the physico-chemical conditions such as oxygen concentration and bacterial activity in surrounding sediments, which may lead to alterations to faunal composition and localised ecological shifts (Meissner, et al., 2006). The full effects of temperature changes on sediment composition and related biogeochemical cycling are unknown. However, preliminary studies which have been conducted have indicated that increased temperatures could cause shifts in the community composition of bacteria, with corresponding changes in $NH_4$ concentrations and nitrogen cycling also occurring (Hicks, et al., 2018).

114. In the case of unburied subsea cables, the constant flow of water effectively dissipates this heat and confines it to the surface of the cable (Taormina, 2020). With buried cables, however, this thermal radiation can heat the sediments in the immediate vicinity. The spatial extent and the magnitude of the heat produced can be highly variable depending on the technical characteristics and the power rating of the cable, the type of current concerned (AC or DC), and the nature of the sediments. The most cohesive sediments (such as compacted silt) generate the highest levels of heat (up to several tens of degrees Celsius over several tens of centimetres) due to their lower thermal conductivity. The sediments in the OfECC predominantly consist of sand with varying percentages of mud and gravels, and therefore, the effect of temperature change is expected to vary slightly.

115. Within the OfECC, two 66 kV or 132 kV electricity export cables transmitting electricity from the wind turbines to the shore will cover a maximum estimated distance of 49 km. The export cables will be laid within separate trenches (which has a lower heat profile than bundled cables), or on the seabed surface, both with a minimum target separation of 50 m (which may decrease in the nearshore approach area) and a target cable burial depth of 1.2 m (minimum burial depth of 0.8 m).

116. In the Array Area the 11 IACs will have a combined length of 17.31 km, and for the purpose of this assessment, it is assumed they will be surface laid. In water, heat will dissipate very quickly and therefore, as the Pembrokeshire Marine SAC is located 23.04 km from the Array Area, it is not anticipated that the disturbance due to subsea cable thermal emissions within the Array Area will result in an impact on the Annex I benthic habitat features of the SAC. Therefore, the impact of these effects is not considered further in this assessment.

117. The temperature associated with buried cables decreases with distance from the cable. Therefore, if the target cable burial depth of 1.2 m is reached, any increase at the sediment surface or in shallow sediment depths at which infaunal species are typically found is expected to be small and likely to be only a few degrees higher than ambient temperature, with any effects localised to within a few metres of the of the cable, depending on the heat carrying capacity of the particular sediment. Additionally, the latest OSPAR report indicates that for currently used power cables, the threshold of 2°C temperature increase at a sediment depth of 20 cm will only be exceeded in rare cases and for short periods of time (OSPAR, 2023). Therefore, if the burial depth is decreased to the minimum burial depth of 0.8 m, then any further changes to temperature are considered to be negligible. Therefore, impacts will be highly localised to cable.

118. The OfECC intersects Pembrokeshire Marine SAC for approximately 15.14 km between ~KP32 and KP48 at the HDD exit (**Figure 8-3**), and thus there is potential for impacts associated with thermal emissions on the benthic habitat features present at this location. However, the proposed Project has oriented the OfECC to avoid reef, sandbanks, and other Annex I habitats (**Table 8-3**), avoiding any disturbance to Annex I habitat features from thermal emissions. Additionally, the cable will be protected by iron articulation and laid on the seabed for most of this section further minimising potential thermal effects.

119. Additionally, sea water temperature in the Celtic Sea varies seasonally and therefore small variations due to thermal emissions from the cable are expected to be accommodated by benthic receptors.

120. Although, thermal effects would be long-term and occurring continuously for the operational lifetime of the proposed Project, any impacts that do occur would be highly localised, with marginal increases on the sediment surface. Therefore, it is not anticipated that subsea cable thermal emissions will hinder the conservation objectives of any Annex I benthic habitats (**Table 8-3**), and it can be concluded that there is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to thermal emissions.**

***Effects of EMF emissions***

121. EMF will be emitted for the duration of operational life of the proposed Project, from both the export cable and the IACs. Subsea cables associated with offshore wind farms are known to produce EMF emissions (Hutchison, et al., 2020). EMF has the potential to affect behaviour of some marine species, fish in particular, but responses in some invertebrates have also been researched.

122. For dynamic exposed cables in the water column, such as those within the Array Area, or those cables laid on the seabed surface, the maximum EMF strength at the surface of the cables has been calculated as ~5.2 mT (millitesla). This is significantly higher than the background level of geomagnetic field in the UK, which is around 50 µT, but the cable EMF decreases rapidly with distance. At a distance of 0.44 m from the cable surface EMF is approximately equal to background levels (**Appendix 19C: EMF Modelling Report**). Therefore, EMF emissions associated with the IACs in the Array Area will be highly localised. The Pembrokeshire Marine SAC is located 23.04 km from the Array Area, and it is not anticipated that the temporary disturbance associated with construction activities within the Array Area will result in an impact on the Annex I benthic habitat features of the SAC. Therefore, the impact of these effects is not considered further in this assessment.

123. For buried cables, the target depth of subsea cables with the OfECC is 1.2 m, with a minimum depth of 0.8 m. Results from the project-specific EMF assessment (**Appendix 19C: EMF Assessment**) found that the maximum EMF strength predicted to result from the operation of the export cables at a buried depth of 1.2 m, when a receptor is 0 m from the seabed, is 2.6 µT

(microtesla). The effects of EMF reduce with distance from the cable, and the modelling shows negligible emissions beyond a distance of 2 m for this burial depth. Where burial is greater this distance will be further reduced. Given the low level of EMF emissions predicted, if the burial depth is reduced to 0.8 m, any changes in EMF emissions are considered to be negligible and similar in effect to that provided in the modelling.

124. At crossings with other power cables, the potential increase in EMF is higher. There are however, no crossings with other power cables. The Llyr export cable will be installed by HDD between the shallow subtidal and the land station, and whilst the Greenlink HVDC cable crosses the OfECC boundary (**Figure 8-6**) there is no actual physical crossing of the two cables and no potential for increased EMF.

125. Therefore, as the effects of EMF are highly localised and reduce with distance from a cable, resulting in negligible emissions beyond 2 m, EMF emissions have the potential to impact features that overlap with the OfECC only. The OfECC intersects Pembrokeshire Marine SAC for approximately 15.14 km between the KP 32.4 and KP 48 (**Figure 8-3**), and consequently there is potential for impacts associated with EMF emissions on the benthic habitat features present at this location. However, the proposed Project has oriented the OfECC to avoid reef, sandbanks, and other Annex I habitat types (**Figure 8-4; Table 8-3**). Therefore, it is not anticipated that EMF emissions will hinder the conservation objectives of any Annex I benthic habitat features of Pembrokeshire Marine SAC, and it can be concluded that there is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to EMF emissions**.

***Introduction and spread of INNS***

126. The accidental introduction, or spread, of INNS, such as from the installation of additional of substrate onto the seabed, such as cable protection has the potential to cause detrimental changes to benthic habitats. Additional surfaces introduced into the marine environment by the proposed Project include cable protection such as iron articulated piping, rock, grout bags and concrete mattresses, mooring systems and anchors and scour protection placed on the seabed. Non-native species can also be introduced from vessels, involved in maintenance activities. Whilst most non-native species are unlikely to become invasive, those that do can out-compete native species and introduce diseases which could result in significant changes to community composition and mortality (Bax, et al., 2003).

127. The presence of additional hard substrate could create habitat for many endemic species, increasing local biodiversity. However, the introduction of hard substrate into an area otherwise characterised by soft substrate (which is present within much of the Study Area (**Figure 8-5**)) could also act as artificial reef, providing suitable habitat and therefore an ‘ecological stepping stone’, facilitating the colonisation of existing or new INNS. Such colonisation could also reduce the amount of available habitat for local, endemic species.

128. The introduction of new anthropogenic features such as cable protection materials, although providing additional surface area for colonisation of INNS, does not provide a replicate replacement of habitat for local species. Therefore, INNS may be able to colonise at a quicker rate than local species, aiding their spread. However, to date, no spread of INNS caused by submarine cabling has been documented (Taormina, et al., 2018). Furthermore, a recent review of the impact of cables on the environment concludes that the evidence shows the majority of non-native species are observed in intertidal habitats (OSPAR, 2023).

129. Thus, the potential for the introduction of non-local, and potentially invasive fauna by the placement of artificial hard substrate (e.g., rock placement) exists, but field studies indicate that where it occurs, colonisation of the provided new habitat is by endemic, rather than invasive fauna.

130. With embedded mitigation and best practice measures in place (**Section 8.1.2**), the risk of the spread of any existing INNS is low and so is considered unlikely to hinder the conservation objectives of any of the Annex I benthic habitat features (**Table 8-3**). Therefore, there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to the introduction and spread of INNS**.

*Decommissioning Effects*

131. At the end of the operational life of the proposed Project, there will be a DEMP in place. Other proposed Project constraints will also be taken into consideration (e.g. safety and liability), with the least environmentally damaging option chosen where possible.

132. For the purpose of this assessment, it has been assumed that all infrastructure from the proposed Project will be removed during decommissioning. It is probable that equipment similar to that used to install the infrastructure could be used to reverse the installation process during decommissioning. Accordingly, the area of seabed impacted during decommissioning would be similar to the area impacted during construction.

133. The full details of the proposed decommissioning will not be agreed until towards the end of the 30-year operational lifetime of the proposed Project. However, a 'Rochdale Envelope' approach for decommissioning has been adopted, with a worst-case scenario of removal of all infrastructure from the seabed, with the exception of pin piles which will be cut off below the seabed, assumed for assessments. Thus, the decommissioning phase is expected to largely mirror the construction process over a period of 12 months (see **Chapter 04: Description of the Proposed Project**).

***Temporary and physical disturbance to benthic habitats and species***

134. Decommissioning will involve the removal of all infrastructure from the seabed, with the exception of the pin piles that will be cut off below the seabed surface. There are likely to be several methods required for the removal of infrastructure including the cable itself, cable and scour protection, anchors and mooring systems and the subsea connector.

135. The Applicant intends to maximise burial during construction, wherever practically possible. During decommissioning both IAC and offshore export cables will be lifted from the water column or seabed using a grapnel and / or ROV and cables will be recovered to a vessel for onshore disposal. Therefore, the buried cable will result in disturbance to sediments as the cable is extracted. However, as the Pembrokeshire Marine SAC is located 23.04 km from the Array Area, it is not anticipated that the temporary disturbance associated with Decommissioning phase activities within the Array Area will result in an impact on the Annex I benthic habitat features of the SAC (**Table 8-3**).

136. The OfECC intersects Pembrokeshire Marine SAC for approximately 15.14 km between KP 32.4 and KP 48 (**Figure 8-3**), thus there is potential for impacts on any of the Annex I benthic habitat features present at this location from Decommissioning phase activities (**Figure 8-4**). However, as described in **Paragraphs 60** and **61**, the proposed Project has committed to avoiding direct impacts on Annex I habitats, including reef and the Turbot Bank designated area (**Chapter 04: Description of the Proposed Project**). Therefore, it is anticipated that there will not be any temporary loss or physical disturbance of the Annex I features of Pembrokeshire Marine SAC from Decommissioning phase activities, and it can be concluded that there is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to temporary loss or physical disturbance as a result of Decommissioning phase activities of the proposed Project**.

***Temporary increase in SSC and sediment deposition***

137. The removal of any infrastructure from the seabed will result in disturbance to the sediment that will temporarily increase the concentration of particles in the water column. However, the impact from a temporary increase in SSC and sediment deposition is expected to be similar or smaller than that for the Construction phase (**Paragraphs 64** to **77**). Therefore, due to the localised, limited extent of disturbance, and temporary nature of the effects, it is not anticipated that the temporary increase in SSC and sediment deposition will hinder the conservation of any of the Annex I benthic habitats (**Figure 8-3**), and there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to a temporary increase in SSC and sediment deposition.**

***Spread of INNS during removal of proposed Project infrastructure***

138. As assessed in the Construction and Operation phases (**Paragraphs 88 to 91, and 126 to 130**) the risk of the spread or introduction of INNS is low. The sensitivity of benthic habitats and species to INNS can be high, particularly for species that outcompete native species, but the spread of INNS in intertidal habitats is more of a concern than subtidal zones (OSPAR, 2023). However, decommissioning activities are not anticipated to occur within the intertidal area.

139. With embedded mitigation and best practice measures in place (**Section 8.1.2**), and the low likelihood of colonisation by non-native species, the introduction and subsequent risk of the spread of any existing INNS during the Decommissioning phase is considered unlikely to hinder the conservation objectives of Annex I benthic habitat features. Therefore, there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to the introduction and spread of INNS during the removal of proposed Project infrastructure**.

*Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC - Assessment of Adverse Effects Alone*

*Construction Phase*

***Temporary loss and physical disturbance to benthic habitats and species***

140. Several activities during the construction phase may cause temporary loss and / or physical disturbance to the seabed habitats and benthic species. The effect of any temporary disturbance is anticipated to be localised to the Offshore Development Area (**Table 8-4**).

141. The Limestone Coast of South West Wales SAC encompasses Freshwater West where the OfECC makes landfall and transitions between the offshore and onshore elements (KP 48) (**Figure 8-3**).

142. As the cable will be installed via HDD between the shallow subtidal and the terrestrial environment, temporary loss and physical disturbance to intertidal habitats will be avoided. Therefore, it there will not be any temporary loss and physical disturbance to the Annex I sea cave feature, and thus **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to temporary loss or physical disturbance**.

***Temporary increase in SSC and sediment deposition leading to contaminant mobilisation, turbidity and smothering effects***

143. Construction activities associated with the proposed Project, such as ploughing and jet trenching, have the potential to temporarily increase SSC by creating sediment plumes in the water column which can travel away from the Offshore Development Area before depositing sediment elsewhere on the seabed.

144. As discussed previously (**Paragraphs 65 and 66**) and in Table 8-4, the tidal excursion distance during a mean tide is approximately 8 - 10 km in the middle of the OfECC and 14 km in the nearshore on approach to the landfall. However, based on modelling undertaken in Chapter 17: Physical Environment, any measurable change in SSC during construction will be temporary and

localised. Although the greatest tidal excursion distance is 14 km in nearshore areas, the majority of the sediment in the OfECC and the Array Area is dominated by sand and gravel particles, which are, for the smaller particles, can be deposited in tens of centimetres thickness on the seabed between 50 m – 500 m away of the source of disturbance, depending on the water movement at the time of disturbance (Chapter 17: Physical Environment). However, even considering the worst-case scenario, only a small proportion of the surveyed sediments have the potential to be deposited beyond 500 m, particularly since in the nearshore the cable will be surface laid.

145. The Annex I sea cave feature of the SAC is located beyond 500 m from the Offshore Development Area and therefore any sediment deposition is considered to be very low. Furthermore, the sea caves are located in the intertidal zone and are exposed to strong wave action which naturally disturbs coarse sediments in the region and on the cave floor. Moreover, sea cave communities often depend on a high degree of water movement and scour action (JNCC, 2023b) as these habitats are frequently subject to strong wave action and water surges. Therefore, the feature is not considered to be sensitive to increased SSC.

146. The nearest project activity involving burial, such as jetting which could result in the greatest disturbance of sediments, to the sea caves is over 6 km away and so beyond any potential zone of influence.

147. With adherence to the mitigation measures embedded into the cable construction methods (**Section 8.1.1**), the location of installation activities that result in an increase in SSC, and due to the localised and temporary nature of the effects, it is very unlikely that the temporary increase in SSC and sediment deposition will hinder the conservation objectives of the Annex I sea cave feature. Therefore, **there is no potential for an AEoSI on the Limestone Coast of South West Wales SAC due to increased SSC and sediment deposition**.

***Impact of changes to marine water quality from the use of HDD drilling fluids***

148. Installation of the export cable between the terrestrial and marine environment will be undertaken via the use of HDD, below the intertidal zone of Freshwater West, exiting at KP48, with a water depth of around 5 - 8 m (**Volume 1, Chapter 04: Description of the Proposed Project**), and therefore in a dynamic area with considerable wave action and tidal water movement.

149. The use of HDD and therefore the discharge of drilling fluids at the breakout location at the landfall has the potential to alter marine water quality (**Chapter 18: Marine Water Quality and Sediment Quality**) and negatively affect the surrounding habitat of the Limestone Coast of South West Wales SAC. It has been estimated that up to 1,700 $m^3$ of drilling mud will be generated. However, all drilling fluids used will be selected from the OSPAR List of Substances / Preparations Used and Discharged Offshore (2021) which are considered to PLONOR.

150. Due to the small amounts of fluid likely to be released, and dynamic nature of the coastal environment, it is anticipated that only a temporary local reduction in water quality local to the HDD breakout may occur. Much of the mud will be released in sand dominated habitat where faunal communities are generally low in diversity and abundance, and made of predominantly of infaunal species, and so unlikely to be significantly affected. Some particulates from the drilling muds may settle on bedrock but due to the dynamic nature of the shallow subtidal environment, any drilling fluid is expected to be rapidly diluted and dispersed within the marine environment, with no detectable change from the baseline beyond 500 m (**Chapter 18: Marine Water and Sediment Quality; Table 8-4**).

**151.** The Annex I sea cave feature of Limestone Coast of South West Wales SAC (**Table 8-3**) is over 500 m from the HDD exit point and thus are not anticipated to be impacted by changes water quality from HDD drilling fluids. Therefore, it is not anticipated that changes in water quality from the use of HDD will hinder the conservation objectives for the Annex I sea cave feature, and thus

there **is no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to changes to marine water quality from the use of HDD drilling fluids.**

***Impact of changes to marine water quality from accidental leaks and spills from vessels, including loss of fuel oils***

152. A deterioration in water quality from the accidental release of pollutants (e.g., oil, fuels, lubricants, chemicals) and planned release of wastewater from any of the vessels associated with the proposed Project activities could result in increased turbidity, deposition and contamination that could affect benthic habitats. For example, substances from leaks and spills could also accumulate in Annex I sea caves, disrupting the unique communities utilising the cave habitats. Potential impacts can be temporary and short-term or more long-term, with the potential for contaminants to be present in the water column or settle into sediment, remaining there for prolonged periods of time.

153. To ensure the risk of accidental spills is as low as reasonably practicable, the proposed Project will adhere to relevant guidance (e.g., Pollution Prevention Guidance). A CEMP including an Emergency Spill Response Plan and Waste Management Plan will also be implemented during the construction phase of the proposed Project to minimise releases. Control measures and a SOPEP will be in place and adhered to under MARPOL Annex I requirements for all vessels. Planned effluent dischargers will be compliant with MARPOL Annex IV 'Prevention of Pollution from Ships' standards.

154. Substances from leaks and spills could also accumulate in Annex I sea caves, disrupting habitats that support a range of species assemblages which could be susceptible to impacts resulting from accidental spills. However, with the embedded measures in place (**Section 8.1.2**), the risk of an accidental leak or spill is considered unlikely.

155. Therefore, should a spill occur, the leak or spill is expected to be minor, localised, and temporary with only small amounts of pollutant released into the marine environment which will be subject to immediate dilution and dispersion over the tidal cycle (see **Chapter 17: Physical Environment**). Therefore, it is not anticipated that changes in water quality from accidental leaks and spills from vessels will hinder the conservation objectives of the Annex I sea cave feature, and thus, it there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to changes to marine water quality from accidental leaks and spills from vessels, including loss of fuel oils.**

***Introduction and spread of INNS via vessel hull or ballast water and the placement of cable and scour protection during construction***

156. The accidental introduction of INNS could occur from the release of any ballast water of the vessels that may be required during the construction phase. Whilst most non-native species are unlikely to become invasive, those that do can out-compete native species and introduce diseases which could result in significant changes to community composition and mortality (Bax, et al., 2003). Any introduction of INNS has the potential to cause detrimental changes to the communities of the Annex I sea cave feature of the Limestone Coast of South West Wales SAC.

157. As mentioned in **Paragraph 89**, the Great Britain INNS Strategy provides guidance for the prevention, detection, eradication, and management of INNS, including marine species. Best practice measures will be adopted, in particular, all proposed Project vessels will adhere to the BWM Convention with the aim of preventing the spread of INNS (IMO, 2017). In addition, vessels will be required to adhere to the IMO guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (Biofouling Guidelines). These measures, implemented via the CEMP and INNS Plan (**Appendix 04A: Outline CEMP**; **Appendix 04B: INNS Plan**), lower the probability of INNS transmission from vessels to the sea cave feature.

158. The sensitivity of benthic habitats and species to INNS can be high, particularly for species that outcompete native species, but the spread of INNS in intertidal habitats is more of a concern than subtidal zones (OSPAR, 2023). As HDD is being used, the intertidal area will be completely avoided. Moreover, no INNS were identified in the OfECC during the project-specific benthic survey (**Appendix 19A: Nearshore 2023 Benthic Survey Report**; **Appendix 19B: Offshore 2023 Benthic Survey Report**). To date, no spread of INNS caused by submarine cabling has been documented (Taormina, et al., 2018).

**159.** Therefore, with mitigation and best practice measures in place as stated above and in **Section 8.1.2**, the risk of the spread of any existing INNS is considered unlikely to hinder the conservation objectives of Annex I sea cave feature. Therefore, there is **no potential for an AEoSI on the Limestone Coast of South West Wales SAC due to reduction in introduction and spread of INNS from vessels.**

*Operation and Maintenance Phase*

***Permanent direct loss and physical disturbance to benthic habitats and species***

160. Several activities during the operation and maintenance phase may cause permanent direct loss and physical disturbance to the seabed habitats and benthic species. The effect of any temporary disturbance is anticipated to be localised to the Offshore Development Area (**Table 8-4**). The Limestone Coast of South West Wales SAC encompasses Freshwater West where the OfECC makes landfall and transitions between the offshore and onshore elements (KP 48) (**Figure 8-3**).

161. As the cable will be installed via HDD between the shallow subtidal and the terrestrial environment, permanent loss and physical disturbance to intertidal habitats will be avoided. Therefore, it there will not be any permanent direct loss and physical disturbance to the sea cave feature, and thus there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to permanent direct loss or physical disturbance**.

***Temporary increase in SSC and sediment deposition leading to contaminant mobilisation, turbidity and smothering effects***

162. During cable repairs, which could include the remedial reburial of exposed cables, that may be required during the operational lifetime of the proposed Project, there is the potential for small, localised, temporary increases in SSC. Such Operational phase activities could lead to increases in turbidity and smothering and the remobilisation of contaminants.

163. The remobilisation of contaminants is not a concern as the concentration of heavy metals, hydrocarbons and other pollutants in the sediments of the Offshore Development Area have been found to be consistent with the wider area.

164. During the lifetime of the proposed Project, up to five cable repairs are expected and it is anticipated that the duration and extent of repair would be a small portion of that proposed for the Construction phase. Due to the expected shorter period of time over which repairs would take place in comparison to the Construction phase activities, and the very localised nature of the works, any local increases in SSC and therefore turbidity and smothering will be no greater than that associated with the Construction phase (**Paragraphs 143 to 147**), and it is not anticipated that temporary loss and physical disturbance will hinder the conservation objectives of the Annex I sea cave feature of Limestone Coast of South West Wales SAC.

165. Therefore, with adherence to the embedded mitigation measures (**Section 8.1.2**), and due to the localised and temporary nature of the effects, there is **no potential for an AEoSI on the Limestone Coast of South West Wales SAC**.

***Alteration and / or indirect loss of habitat during the operational lifetime of the proposed Project***

166. The proposed Project involves the introduction of new infrastructure which could result in the alteration and / or loss of habitat during its operational lifetime.

167. New infrastructure present on the seabed could increase heterogeneity of the seabed habitat, facilitating the growth of new biological communities and / or changing the morphology of the seabed. Such infrastructure results in the introduction of new, hard substrate into areas of seabed which may otherwise consist of soft sediments. Although such infrastructure does not provide a like-for-like habitat, during the operational lifetime of the proposed Project communities consistent with those found in rocky habitats may start to colonise infrastructure, including INNS (**Paragraphs 156** to **159**). Therefore, the effect of this potential impact pathway will be localised to the Offshore Development Area (**Table 8-4**).

168. The Limestone Coast of South West Wales SAC encompasses Freshwater West where the OfECC makes landfall and transitions between the offshore and onshore elements (KP 48) (**Figure 8-3**). Therefore, as cable protection will not be placed within the intertidal zone, it is not considered that there will be any alteration and / or indirect loss to the Annex I sea cave feature, and thus there is **no potential for an AEoSI on the Limestone Coast of South West Wales SAC due to alteration and / or indirect loss of habitat**.

***Changes to habitats due to on-going scour, changes in hydrodynamics, increased sedimentation and smothering, and abrasions, from the movement of mooring chains***

169. There are several activities which involve the introduction of new infrastructure as part of the proposed Project that could result on-going scour and abrasion around proposed Project infrastructure.

170. The placement of IACs and associated mooring / anchoring systems on the seabed within the Array Area could lead to on-going scour, changes in hydrodynamics, increased sedimentation and smothering, and abrasions, throughout the operation and maintenance phase. However, any scour around these structures is considered to be very limited, and limited to the immediate vicinity (**Chapter 17: Physical Environment**). Therefore, only habitats within, or within close proximity to the Array Area are considered to be at risk from changes to habitats from the movement of mooring chains. As the Limestone Coast of South West Wales SAC is located 35.24 km from the Array Area, it is not anticipated that effects within the Array Area will hinder the conservation objectives of the Annex I sea cave feature of the SAC. Given this, the impact of these effects is not considered further in this assessment.

171. It is likely that mechanical protection will be required in several locations along the length of the OfECC where minimum burial depth of 0.8 m cannot be reached. As discussed in further detail in Chapter 17: Physical Environment, all scour associated with the proposed Project is anticipated to be localised a few to tens of metres from the structure and tens of centimetres deep, resulting in being highly localised. Therefore, as the cable will be installed via HDD between the shallow subtidal and the terrestrial environment, the Annex I sea cave feature is anticipated to be beyond the zone of influence of any impacts associated with scour, changes in hydrodynamics and sedimentation. Therefore, it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to changes to habitats from the movement of mooring chains**.

***Disturbance to benthic habitats during planned maintenance and instances of cable failure and excavation***

172. Maintenance and cable repair activities during instances of cable failure and excavation, where required, will be carried out using the same or similar methods as the Construction Phase activities, and therefore the potential pathways for impacts to benthic ecology are expected to be the same as those identified for the Construction Phase of the proposed Project.

173. During the lifetime of the proposed Project, up to five cable repairs are expected and it is anticipated that the duration and extent of repair would be a small fraction of that proposed for the construction phase. Any repair works are likely to be highly localised to the area of concern and therefore the spatial extent of any impacts would be small in extent (**Table 8-4**). Maintenance and unforeseen cable repair, although unlikely, are considered routine, and the procedures and processes are well defined and common in the industry.

174. As the cable will be installed via HDD between the shallow subtidal and the terrestrial environment, construction in the intertidal will be avoided. Therefore, it is not considered that there will be any planned maintenance associated with the intertidal sea cave feature, and thus there is **no potential for an AEoSI on the Limestone Coast of South West Wales SAC due to disturbance during planned maintenance works**.

***Disturbance to benthic habitats and species due to subsea cable thermal emissions***

175. Operation of electricity cables generates heat due to resistance in the conductor components, which can warm the cable surface and adjacent environment (i.e. sediments; Meissner et al. (2006). As previously discussed in **Paragraphs 113 to 117**, any effects of thermal emissions are anticipated to be localised to within a few metres of the of the cable (**Table 8-4**).

176. The Limestone Coast of South West Wales SAC is located 35.24 km from the Array Area, and the cable will be installed via HDD between the shallow subtidal and the terrestrial environment. Therefore, it is not considered that there will be any disturbance from thermal emissions to the Annex I sea cave feature, and thus there is **no potential for an AEoSI Limestone Coast of South West Wales SAC due to thermal emissions**.

***Effects of EMF emissions***

177. Subsea cables associated with offshore wind farms are known to produce EMF emissions (Hutchison, et al., 2020). EMF emissions are likely to be highly localised to the area of concern and therefore the spatial extent of any impacts would be small in extent (**Table 8-4**).

178. The Limestone Coast of South West Wales SAC encompasses Freshwater West where the OfECC makes landfall and transitions between the offshore and onshore elements. As the cable will be installed via HDD between the shallow subtidal and the terrestrial environment, intertidal habitats will be avoided. Therefore, it is not considered that there will be any disturbance to the Annex I sea cave feature, and thus there is **no potential for an AEoSI on the Limestone Coast of South West Wales SAC due to thermal emissions.**

***Introduction and spread of INNS***

179. The accidental introduction, or spread, of INNS, such as from the installation of additional of substrate onto the seabed, such as cable protection has the potential to cause detrimental changes to benthic habitats. Additional surfaces introduced into the marine environment by the proposed Project include cable protection such as rock, grout bags and concrete mattresses, mooring systems and anchors and scour protection placed on the seabed. Non-native species can also be introduced from vessels, involved in maintenance activities. Whilst most non-native species are unlikely to become invasive, those that do can out-compete native species and

introduce diseases which could result in significant changes to community composition and mortality (Bax, et al., 2003).

180. The presence of additional hard substrate could create habitat for many endemic species, increasing local biodiversity. However, the introduction of hard substrate into an area otherwise characterised by soft substrate (which is present within much of the Study Area (**Figure 8-5**)) could also act as artificial reef, providing suitable habitat and therefore an 'ecological stepping stone', facilitating the colonisation of existing or new INNS. Such colonisation could also reduce the amount of available habitat for local, endemic species. The introduction of new anthropogenic features such as cable protection materials, although providing additional surface area for colonisation of INNS, does not provide a replicate replacement of habitat for local species. Therefore, INNS may be able to colonise at a quicker rate than local species, aiding the spread of such species. However, to date, no spread of INNS caused by submarine cabling has been documented (Taormina, et al., 2018). Furthermore, a recent review of the impact of cables on the environment has been produced by OSPAR (2023) and this report concludes that the majority of non-native species are observed in intertidal habitats. Thus, the potential for the introduction of non-local, and potentially invasive fauna by the placement of artificial hard substrate (e.g., rock placement) exists, but field studies indicate that where it occurs, colonisation of the provided new habitat is by endemic, rather than invasive fauna.

181. With embedded mitigation and best practice measures in place (**Section 8.1.2**), the risk of the spread of any existing INNS is considered unlikely to hinder the conservation objectives of Annex I sea cave feature. Therefore, there is **no potential for an AEoSI on the Limestone Coast of South West Wales SAC.**

*Decommissioning effects*

182. At the end of the operational life of the proposed Project, there will be a DEMP in place. Other proposed Project constraints will also be taken into consideration (e.g. safety and liability), with the least environmentally damaging option chosen if possible.

183. For the purposes of this assessment, it has been assumed that all infrastructure from the proposed Project will be removed during decommissioning. It is probable that equipment similar to that used to install the infrastructure could be used to reverse the installation process during decommissioning. Accordingly, the area of seabed impacted during decommissioning would be similar to the area impacted during construction.

184. The full details of the proposed decommissioning will not be agreed until towards the end of the 30-year operational lifetime of the proposed Project. However, a 'Rochdale Envelope' approach for decommissioning has been adopted, with a worst-case scenario of removal of all infrastructure from the seabed, with the exception of pin piles which will be cut off below the seabed, assumed for assessments. Thus, the decommissioning phase is expected to largely mirror the construction process over a period of 12 months (see **Chapter 04: Description of the Proposed Project**).

***Temporary and physical disturbance to benthic habitats and species***

185. Decommissioning will involve the removal of all infrastructure from the seabed. There are likely to be several methods required for the removal of infrastructure including the cable itself, cable and scour protection, anchors and mooring systems and the subsea connector.

186. The Applicant intends to maximise burial during construction, wherever practically possible. During decommissioning both IAC and offshore export cables will be lifted from the water column or seabed and cables will be recovered to a vessel for onshore disposal. Therefore, the buried cable will result in disturbance to sediments as the cable is extracted. However, as the Limestone

Coast of South West Wales SAC encompasses Freshwater West where the OfECC makes landfall and transitions between the offshore and onshore elements (KP 48) (**Figure 8-3**), it is not anticipated that there will be any temporary loss or physical disturbance of the Annex I sea cave feature from Decommissioning phase activities, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to temporary loss or physical disturbance as a result of Decommissioning phase activities of the proposed Project**.

***Temporary increase in SSC and sediment deposition***

187. The removal of any infrastructure from the seabed will result in disturbance to the sediment that will temporarily increase the concentration of particles in the water column. However, the impact from a temporary increase in SSC and sediment deposition is expected to be similar or smaller than that for the construction phase (**Paragraphs 143** to **147**). Therefore, the temporary increase in SSC and sediment deposition will not hinder the conservation objectives of the Annex I sea cave feature, there is **no potential for an AEoSI on the Limestone Coast of South West Wales SAC due to a temporary increase in SSC and sediment deposition.**

***Spread of INNS during removal of proposed Project infrastructure***

188. As assessed in the Construction and Operation phases (Paragraphs 156 to 159, and 179 to 181) the risk of the spread or introduction of INNS is low. The sensitivity of benthic habitats and species to INNS can be high, particularly for species that outcompete native species, but the spread of INNS in intertidal habitats is more of a concern than subtidal zones (OSPAR, 2023). However, decommissioning activities are not anticipated to occur within the intertidal area.

189. With embedded mitigation and best practice measures in place (**Section 8.1.2**), and the low likelihood of colonisation by non-native species, the introduction and subsequent risk of the spread of any existing INNS during the Decommissioning phase is considered unlikely to hinder the conservation objectives of Annex I sea cave feature. Therefore, there is **no potential for an AEoSI on the Limestone Coast of South West Wales SAC due to the introduction and spread of INNS during the removal of proposed Project infrastructure**.

**Information for Assessment of Adverse Effects In-Combination**

190. The following projects were identified in **Chapter 19: Benthic Ecology** and have been considered in order to identify whether they have the potential for in-combination effects on the Annex I benthic habitats based on their potential impact pathways to the same European sites as the Project:

- Greenlink Interconnector Ltd;
- Llyr 2 Floating Offshore Wind Project;
- Valorous;
- Erebus;
- Dragon Energy Project; and
- South Pembrokeshire Demonstration Zone.

191. This section explores the potential for in-combination effects of those short-listed projects on Pembrokeshire Marine SAC and Limestone Coast of South West Wales SAC based on their potential impact pathways. The potential for in-combination effects are summarised in **Table 8-5**, concluding that there is **no potential for in-combination effects on the Annex I benthic habitats of Pembrokeshire Marine SAC and Limestone Coast of South West Wales SAC**.

*Table 8-5. Summary of in-combination effects on Annex I benthic habitats*

| Project name | Potential for in-combination effects | |
|---|---|---|
| | Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) |
| **Greenlink Interconnector**<br>Interconnector<br>Construction | **No**.<br>Potential for in-combination effects as the proposed Project and Greenlink pass through the SAC (leading to interactions during construction, operation and maintenance, and decommissioning) (Greenlink, 2020). Greenlink identified possible effects on Annex I Reef as a qualifying feature. However, the proposed Project is committing to no cable installation on Annex I reef and no cable protection, other than articulated iron pipe, in Annex I sandbanks, concluding no AEoSI alone on Pembrokeshire Marine SAC and considers there to be no in-combination effects with Greenlink. | **No**.<br>The Limestone Coast of South West Wales SAC was screened out by Greenlink, therefore no pathway has been identified for in-combination effects on this site. |
| **Llŷr 2 Floating Offshore Wind Project**<br>Offshore Wind<br>Pre-Application | **No**.<br>Given that Llŷr 2 will adopt the same export cable corridor as the proposed Project, no in-combination effects have been identified that would hinder the conservation objectives for Annex I benthic habitats of Pembrokeshire Marine SAC. | **No**.<br>Given that Llŷr 2 will adopt the same export cable corridor as the proposed Project, no in-combination effects have been identified that would hinder the conservation objectives for Annex I sea cave features of the Limestone Coast of South West Wales SAC. |
| **Valorous / Blue Gem Wind**<br>Offshore wind<br>Planned | **No**.<br>Interaction between Valorous and the Pembrokeshire marine SAC will be limited to cable installation, remediation, reburial, and decommissioning activities associated with the export cable corridor. Due to the early stage of project development, the precise export cable route is not yet known for Project Valorous. Accordingly, it is not known which, if any, Annex I benthic habitats will be intersected by this route. Therefore, as the proposed Project can draw the | **No**.<br>Due to the early stage of project development, the precise export cable route is not yet known for Project Valorous. Accordingly, it is not known which, if any, Annex I benthic habitats will be intersected by this route. Similarly, the effects of cable installation, remediation, reburial, and decommissioning activities associated with the export cable corridor have not yet been assessed and LSE on Annex I sea caves are not yet determined. Therefore, as the proposed |

| Project name | Potential for in-combination effects | |
|---|---|---|
| | Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) |
| | conclusion of no AEoSI with mitigation alone, it is for the Valorous to demonstrate no in-combination effects. | Project can draw the conclusion of no AEoSI with mitigation alone, it is for the Valorous demonstrate no in-combination effects. |
| **Erebus**<br>Offshore wind<br>Consented | **No**.<br>Interaction between Erebus and the Pembrokeshire marine SAC will be limited to cable installation, remediation, reburial, and decommissioning activities associated with the export cable corridor. The Erebus RIAA determined that there is no potential for an AEoSI (MarineSpace Ltd, 2021), having regard to the conservation objectives of the Annex I benthic habitats feature of the Pembrokeshire Marine SAC from any pressures associated with any effect associated with the Project (alone or in-combination). | **No**.<br>The Erebus RIAA determined that there is no potential for an adverse effect on integrity (MarineSpace Ltd, 2021), having regard to the conservation objectives of any of the Annex I habitat features of the Limestone Coast of South West Wales SAC from any pressures associated with any effect associated with the Project (alone or in-combination). |
| **Dragon Energy Project**<br>Inshore Energy<br>Pre-Application | **No**.<br>The Dragon Energy Project is in concept / planning stages. Accordingly, it is not known which, if any, Annex I benthic habitats of the SAC will be affected, if at all. Therefore, as the proposed Project can draw the conclusion of no AEoSI with mitigation alone, it is for the Dragon Energy Project to demonstrate no in-combination effects. | **No**.<br>The Limestone Coast of South West Wales SAC has not been scoped in for the Dragon Energy Project, therefore no pathway has been identified for in-combination effects on this site. |
| **South Pembrokeshire Demonstration Zone**<br>Wave Energy<br>Pre-application | **No**.<br>The South Pembrokeshire Demonstration Zone Project is in concept / planning stages. Accordingly, it is not known which, if any, Annex I benthic habitats of the SAC will be affected, if at all. Therefore, as the proposed Project can draw the conclusion of no AEoSI with mitigation alone, it is | **No**.<br>The South Pembrokeshire Demonstration Zone Project is in concept/planning stages. Accordingly, it is not known which, if any, Annex I sea caves of the SAC will be affected, if at all. Therefore, as the proposed Project can draw the conclusion of no AEoSI with mitigation alone, it is for the South |

| Project name | Potential for in-combination effects | |
|---|---|---|
| | Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) |
| | for the South Pembrokeshire Demonstration Zone Project to demonstrate no in-combination effects. | Pembrokeshire Demonstration Zone Project to demonstrate no in-combination effects. |

**Summary**

192. The information provided considers the potential for impact pathways associated with the proposed Project to hinder the conservation objectives of the Annex I benthic habitat features of the Pembrokeshire Marine SAC and the Limestone Coast of South West Wales SAC.

193. With mitigation and best practice measures in place (**Section 8.1.1**), it is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I benthic habitat features (**Table 8-6**). Therefore, it is concluded that there is **no potential for an AEoSI on the Pembrokeshire Marine SAC or the Limestone Coast of South West Wales SAC due to the proposed Project** (**Table 8-6**)**, either alone or in-combination.**

*Table 8-6. Summary of AEoSI for designated sites with Annex I benthic features due to potential impact pathways associated with the proposed Project (✓- potential to hinder conservation objectives; X – no potential to hinder conservation objectives)*

| Designated site | Benthic features screened into assessment | Potential Impact Pathway: Construction: Temporary loss and physical disturbance | Construction: Temporary increase in SSC and sediment deposition | Construction: Changes to water quality by HDD drilling fluids | Construction: Changes to water quality from vessels | Construction: Introduction and spread of INNS from vessels | Operation and Maintenance: Permanent direct loss and physical disturbance | Operation and Maintenance: Temporary increase in SSC and sediment deposition | Operation and Maintenance: Alteration and / or indirect loss of habitat | Operation and Maintenance: Changes to habitats due to movement of mooring chains | Operation and Maintenance: Disturbance to benthic habitats during planned maintenance | Operation and Maintenance: Disturbance due to subsea cable thermal emissions | Operation and Maintenance: Effects of EMF emissions | Operation and Maintenance: Introduction and spread of INNS | Decommissioning: Decommissioning effects | AEoSI / Screened into Stage 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | Estuaries (1130) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I benthic habitat features. Therefore, there is **no potential for an AEoSI on Pembrokeshire Marine SAC either alone or in-combination**. |
| | Large shallow inlets and bays (1160) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| | Reefs (1170) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| | Sandbanks which are slightly covered by sea water all the time (1110) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| | Mudflats and sandflats not covered by seawater at low tide (1140) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| | Coastal lagoons (1150) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| | Atlantic salt meadows Glauco-Puccinellietalia maritimae (1330) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| | Submerged or partially submerged sea caves (8330) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) | Submerged or partially submerged sea caves (8330) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I benthic habitat features. Therefore, there is **no potential for an AEoSI on Limestone Coast of South West Wales SAC either alone or in-combination**. |

### *8.5.2. Annex II Migratory Fish*

194. This section covers the assessment of risk of adverse effects on SACs designated for Annex II migratory fish for the proposed Project. This section details:

- A summary of the HRA Screening;
- A description of each SAC and its conservation objectives;
- A description of the potential impact pathways and their associated ZoIs; and
- An assessment for each SAC of the risk of AEoSI for the proposed Project alone, and in-combination with other developments.

**Summary of HRA Screening**

195. The proposed Project's HRA Screening Report identified 10 SACs with Annex II migratory fish features (see **Appendix 8D: Habitats Regulations Assessment Screening**). These SACs were identified based on two criteria. The first was to ascertain those sites that overlap with the Migratory Fish Study Area, a 14 km zone around the Offshore Development area. This distance was based on project specific hydrodynamic modelling to define the maximum tidal excursion distance (see **Chapter 17: Physical Environment**). The second is a wider regional approach to considering the potential for an interaction between the Offshore Development Area and potential migratory routes to designated sites (ABPMer, 2014).

196. The following potential impact pathways for all stages of the proposed Project (construction, operation and maintenance, and decommissioning) on migratory fish have been screened into the HRA:

- Temporary physical disturbance to migratory fish species from increased SSC and sediment deposition;
- Changes to marine water quality from the use of drilling fluids at HDD break-out points and resuspension of sediment contamination during seabed construction works;
- Changes to marine water quality as a result of accidental leaks and spills from vessels, including loss of fuel oils;
- Underwater noise and vibration;
- Effects of EMF emissions;
- Aggregation of fish and associated effects such as barrier effects, collision, and entanglement from the presence of floating offshore structures and associated tethering systems; and
- Effects to migratory fish from maintenance activities.

197. Where LSE could not be excluded at the screening stage, sites have been taken forward to determine any AEoSI which will be considered during Stage 2 (AA) (**Table 8-7**; **Figure 8-7**).

*Table 8-7. Summary of the SACs designated for Annex II migratory fish screened into AA*

| Site name | Annex II migratory fish screened into AA | Distance to Llŷr Array Area (km) | Distance to OfECC (km) |
|---|---|---|---|
| Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095);<br>• Allis shad *Alosa alosa* (1102); and<br>• Twaite shad *Alosa fallax* (1103). | 23.0 | 0.0 |
| Cleddau Rivers / Afonydd Cleddau SAC (UK0030074) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099); and<br>• Sea lamprey *Petromyzon marinus* (1095). | 55.0 | 16.5 |
| Carmarthen Bay and Estuaries / Bae Caerfyddin ac Aberoedd SAC (UK0020020) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095);<br>• Allis shad *Alosa alosa* (1102); and<br>• Twaite shad *Alosa fallax* (1103). | 53.9 | 24.6 |
| Cardigan Bay / Bae Ceredigion SAC (UK0012712) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099); and<br>• Sea lamprey *Petromyzon marinus* (1095). | 88.4 | 50.2 |
| Afon Teifi / River Teifi SAC (UK0012670) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095); and<br>• Atlantic salmon *Salmo salar* (1106). | 89.9 | 51.2 |

| Site name | Annex II migratory fish screened into AA | Distance to Llŷr Array Area (km) | Distance to OfECC (km) |
|---|---|---|---|
| River Tywi / Afon Tywi SAC (UK0013010) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095);<br>• Allis shad *Alosa alosa* (1102); and<br>• Twaite shad *Alosa fallax* (1103). | 90.2 | 55.1 |
| River Usk / Afon Wysg SAC (UK0013007) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095);<br>• Atlantic salmon *Salmo salar* (1106);<br>• Allis shad *Alosa alosa* (1102); and<br>• Twaite shad *Alosa fallax* (1103). | 131.1 | 98.2 |
| Severn Estuary Ramsar (UK11081) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis*;<br>• Sea lamprey *Petromyzon marinus*;<br>• Atlantic salmon *Salmo salar*;<br>• Allis shad *Alosa alosa*; and<br>• Twaite shad *Alosa fallax.* | 155.9 | 138.9 |
| Severn Estuary / Môr Hafren SAC (UK0013030) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095); and<br>• Twaite shad *Alosa fallax* (1103). | 154.8 | 133.0 |

| Site name | Annex II migratory fish screened into AA | Distance to Llŷr Array Area (km) | Distance to OfECC (km) |
|---|---|---|---|
| River Wye / Afon Gwy SAC (UK0012642) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095);<br>• Atlantic salmon *Salmo salar* (1106);<br>• Allis shad *Alosa alosa* (1102); and<br>• Twaite shad *Alosa fallax* (1103). | 174.8 | 141.2 |

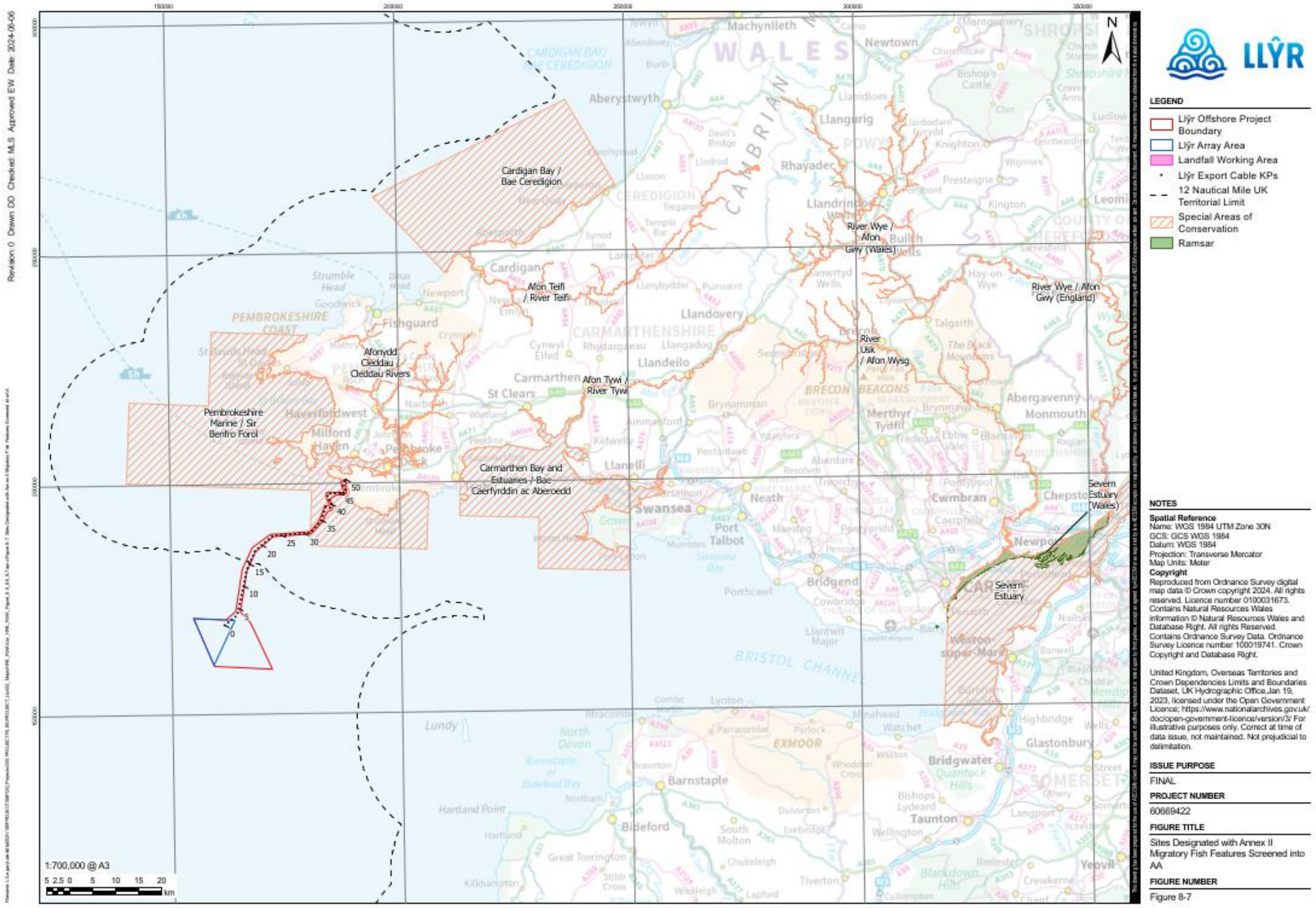


*Figure 8-7. Sites designated for Annex II migratory fish screened into AA*

*Potential impact pathways*

198. A summary of the potential impact pathways relevant to Annex II migratory fish and their associated ZoIs is included in **Table 8-8**. This provides information required to inform the AA based on parameters associated with the worst case scenario for the proposed Project.

*Table 8-8. Potential impact pathways and ZoI associated with the proposed Project that are applicable to Annex II migratory fish*

| Potential impact pathway | ZoI | Rationale |
|---|---|---|
| **Construction** | | |
| Temporary physical disturbance to migratory fish species from increased SSC and sediment deposition | 14 km from the Offshore Development Area | Construction activities associated with the proposed Project have the potential to temporarily increase SSC by creating sediment plumes in the water column which can travel away from the Offshore Development Area before depositing sediment elsewhere on the seabed. Several potential effects can arise from increased SSC and sediment deposition, including the clogging of gills and feeding apparatus, reduced feeding success of visual predators due to decreased visibility, and effects related to toxic conditions if sediment-bound contaminants are disturbed (Kjelland, et al., 2015). Fish migration and movement between important areas such as spawning and feeding grounds could also be impacted.<br>The tidal excursion distance during a mean tide is approximately 8 - 10 km in the middle of the OfECC and 14 km in the nearshore on approach to the landfall. However, based on modelling undertaken, and presented in **Chapter 17: Physical Environment**, any measurable change in SSC during construction will be temporary and localised, with the majority of sediment in the OfECC consisting of sands and gravels which are expected to have deposited in tens of centimetres thickness on the seabed between 50 m – 500 m away of the source of disturbance. Only 6% of the surveyed sediments across nearshore and offshore sections of the Offshore Development Area consisted of mud and therefore there is the potential for a very fine layer of mud to be deposited beyond 500 m. No expected impact or change to SSC nor a measurable sediment deposition is anticipated beyond the tidal excursion distance.<br>Therefore, the greatest tidal excursion distance of 14 km is considered to represent the maximum ZoI. |
| Impact of changes to marine water quality from the mobilisation of contaminants | 50 m from the Offshore Development Area | Sediment-bound contaminants including heavy metals and Polycyclic Aromatic Hydrocarbons (PAH) could have detrimental impacts on fish and shellfish when present in concentrations above relevant thresholds and resuspended during disturbance to the seabed. Impacts can include cell apoptosis in fish immune systems.<br>Contaminants are expected to be associated with finer materials, such as silts and clays, which make up a very low percentage of the total sediment composition in the OfECC. Sediment-bound contaminants have a maximum theoretical dispersal range of approximately 14 km, which is the tidal excursion on a mean tide in the Study Area. However, the majority of the sediment disturbed by installation and pre-installation activities is sand and gravel and will be deposited within 50 m, with limited measurable deposition of fine sediments beyond this distance and only a slight increase in SSC. The dilution processes over this distance are expected to result in very little or no detectable changes beyond 50 m. |

| Potential impact pathway | ZoI | Rationale |
|---|---|---|
| Impact of changes to marine water quality from the use of drilling fluids at HDD break-out points | 500 m Area from the HDD breakout | The use of HDD and therefore the discharge of drilling fluids at the breakout location at the landfall has the potential to alter marine water quality and negatively affect benthic receptors within in the surrounding habitats. It has been estimated that up to 1,700 $m^3$ of drilling mud will be generated. Constituents of the drilling fluids have a maximum theoretical range of approximately 14 km, which is the tidal excursion on a mean tide in the nearshore area around the landfall and outside Milford Haven. However, discharged drilling fluid is expected to be subject to immediate dilution processes and rapid dispersal over this distance which will result in no detectable change from the baseline beyond 500 m. |
| Impact of changes to marine water quality from accidental leaks and spills from vessels, including loss of fuel oils | 14 km from Offshore Development Area | A deterioration in water quality from the accidental release of pollutants (e.g., oil, fuels, lubricants, chemicals) and planned release of wastewater from any of the vessels associated has the potential to negatively affect water quality, with subsequent impacts to fish and shellfish species and habitats.<br>Changes in marine water quality have a maximum theoretical range of approximately 14 km, which is the tidal excursion on a mean tide in the nearshore area around the landfall and outside Milford Haven. However, any effects are expected to be much more localised than this due to the small volumes that could be released. |
| Underwater noise and vibration | 327 m from OfECC and 30.7 km from Array Area | Underwater noise and vibration will be generated by a range of project construction activities including pre-installation geophysical surveys, the potential for impact piling for the installation of piles in the seabed, and cable lay activities such as dredging, ploughing, jetting, and from increased noise generated by vessels involved in construction.<br>Fish use sound for communication, prey location and predator avoidance, and thus it is an important environmental cue (Fay & Popper, 2000). Fish ears and the lateral line perceive underwater noise through sensitivity to vibrations. Swim bladders, which are gas-filled sacs, are also used for sound detection in some teleost or bony fish (Hawkins, 1993). Sound sources, particularly of high intensity or long duration, have the potential to result in permanent and temporary injury and auditory effects and can result in masking and behavioural disturbance in fish. This includes the potential for underwater noise to act as a barrier to the movement of diadromous fish during key migratory periods.<br>The sound characteristics of the proposed Project construction activities have been determined (**Chapter 20: Fish and shellfish**), with sub-bottom profiling (SBP) and impact piling concluded to have the highest sound pressure level. |

| Potential impact pathway | ZoI | Rationale |
|---|---|---|
| | | SBP will be used to undertake geophysical surveys of the seabed to determine seabed structure, water depth, the presence of any obstructions and to track the location of ROVs within the OfECC. The maximum distance over which SBP is predicted to result in temporary threshold shift (TTS) could occur in is 204 m, with low-level behavioural disturbance was predicted within a maximum distance of 327 m.<br>Impact piling will be required to anchor the floating WTGs to the seabed, using pin-piles to attach the anchor chains within the Array Area. Impact piling will consist of pinpoint piling and each pile is expected to last for four hours. In a worst-case scenario there will be eight anchors per WTG, with a total of ten WTG. The threshold for mortality and recoverable injury for all fish species, is only predicted to occur within 0 m from the sound source, with behavioural disturbance could occur within a maximum distance of 30.7 km.<br>There is the potential for UXO to be identified within the Offshore Development Area and require detonation to be rendered harmless. Should UXO detonation be required there is the potential for the underwater sound to cause injury and disturbance to fish and shellfish. Prior to construction there will be a full geophysical survey to determine presence of UXO and the need for any explosive objects to be cleared. An application for a separate Marine Licence in respect of UXO clearance will be made post submission, when the exact number and type of detonations have been established. Using the worst-case scenario, detonation charge size of 794 kg and a threshold value of 229 dB re 1µPa $SPL_{peak,}$ mortality or injury could occur up to a maximum of 1.02 km for all hearing sensitivity fish species. Any behavioural disturbance is anticipated to be localised to Intermediate distances (i.e. hundreds of metres). |
| **Operation and maintenance** | | |
| Effects of EMF emissions | L2 m from the Offshore Development Area | Subsea cables associated with the proposed Project, including both inter-array cables and export cables are known to produce EMF emissions (Hutchison, et al., 2020). EMF has the potential to affect the foraging and migratory success and behaviour of migratory fish.<br>EMF will be emitted for the operational life of the proposed Project, from both the export and the inter-array cables. The target depth of subsea cables with the OfECC is 1.2 m (a minimum depth of 0.8 m). Results from the project-specific EMF assessment (**Appendix 19C: EMF Assessment**) found that the maximum EMF strength predicted to result from the operation of the export cables at a target burial depth of 1.2 m, when a receptor is 0 m from the seabed, is 2.6 µT. The effects of EMF reduce with |

| Potential impact pathway | ZoI | Rationale |
|---|---|---|
| | | distance from the cable, and the modelling shows negligible emissions beyond 2 m distance from the cable for 1.2 m burial depth.<br>For dynamic exposed cables in the water column, such as those within the Array Area, the maximum EMF strength at the surface of the cables has been calculated as ~5.2 mT. This is significantly higher than the background level of geomagnetic field in the UK, which is around 50 µT but this also decreases rapidly with distance from the cable. At a distance of 0.44 m from the cable surface EMF is approximately equal to background levels (**Appendix 19C: EMF Assessment**). |
| Disturbance effects to fish (such as barrier effects, collision and entanglement) from the presence of floating offshore structures and associated tethering systems | Localised to Array Area | Floating platforms may act as fish aggregating devices, changing species composition and abundance at localised scales and foraging pressure for example, from seals (e.g.Farr *et al.*, (2021)). The physical presence of floating offshore wind infrastructure also has the potential, depending on design, to cause barrier effects, entanglement, or collisions either directly or indirectly. Therefore, as floating offshore structures will only be present within the Array Area, entanglement will only occur within the footprint of the Array Area. |
| Underwater noise and vibration | 1 km from Array Area | During operation of the proposed Project, underwater noise can be produced from both the rotating machinery in the turbines (non-impulsive), and from cables that may 'snap' as cable tension is released in the mooring system (impulsive).<br>Modelling of the impact of underwater noise as a result of turbine operation, including vibration from rotating machinery in the turbines, concluded that any sound produced is expected to be very low (**Appendix 21B: Marine Mammals Noise Modelling**). Moreover, cable snapping can occur when tension which has built up in the mooring lines of the floating turbines is released. This can also generate particle motion, which is known to be a key acoustic stimulus in fish (Popper, et al., 2014) could act as a barrier to the movement of diadromous fish during key migratory periods.<br>Therefore, by its very nature, underwater noise and vibration associated with operation will only occur within the footprint of the Array Area and will be limited to a maximum estimated distance of 1 km (based on Popper *et al*., 2014 thresholds). |
| Potential effects to fish from maintenance activities | Potential effects the same as construction phase | Cable maintenance activities of the OfECC and Array Area carried out during operation will be the same, or similar, to methods employed in cable installation and will use the same type and number of vessels. Up to five cable repairs assumed to be required over the lifetime of the proposed Project. |
| **Decommissioning** | | |

| Potential impact pathway | ZoI | Rationale |
|---|---|---|
| Decommissioning effects | Temporary physical disturbance to fish and shellfish habitats and species from increased SSC and sediment deposition | At the end of the operational life of the proposed Project, there will be a DEMP in place. Other proposed Project constraints will also be taken into consideration (e.g. safety and liability), with the least environmentally damaging option chosen if possible.<br>The full details of the proposed decommissioning will not be agreed until towards the end of the 30-year operational lifetime of the proposed Project. However, the removal of all infrastructure from the seabed is considered a worst-case scenario for this assessment. Therefore, the decommissioning phase is expected to largely mirror the construction process over a period of 12 months (see **Chapter 04: Description of the Proposed Project**). |
| | Changes to marine water quality as a result of accidental leaks and spills from vessels, including loss of fuel oils | |
| | Underwater noise and vibration | |

**Site Descriptions and Conservation Objectives**

*Pembrokeshire Marine / Sir Benfro Forol SAC*

199. The Pembrokeshire Marine SAC encompasses areas of sea, coast and estuary that support a wide range of different marine habitats and wildlife, some of which are unique in Wales. The conservation objectives for the Pembrokeshire Marine SAC are to achieve and maintain favourable conservation status for species features, subject to natural processes (NRW, 2018e). For the species features, this includes maintaining the populations, range, and supporting habitats (NRW, 2018e).

200. The OfECC intersects the Pembrokeshire Marine SAC for approximately 15.14 km between the KP 32.4 and KP 49. Thus, the site has been screened into the AA for potential LSE on the following Annex II migratory fish features (**Table 8-7**):

- River lamprey *Lampetra fluviatilis* (1099);
- Sea lamprey *Petromyzon marinus* (1095);
- Allis shad *Alosa alosa* (1102); and
- Twaite shad *Alosa fallax* (1103).

201. In the Pembrokeshire Marine SAC, river lamprey are of favourable status in their freshwater populations and of unfavourable status in their marine populations; sea lamprey are assessed as unfavourable for both marine and terrestrial populations (NRW, 2018e; NRW, 2018d). Lamprey do not home to their natal river (Bergstedt & Seelye, 1995), so those using Pembrokeshire Marine SAC should be viewed as a protected component of a larger population covering the Bristol Channel and possibly wider area. In particular, the river and sea lamprey populations of the River Wye SAC, River Usk SAC, River Tywi SAC, Afon Teifi SAC, Severn Estuary SAC, Cleddau Rivers SAC and Carmarthen Bay and Estuaries SAC should be seen as linked to Pembrokeshire Marine SAC (**Figure 8-7**).

202. Not much is known about shad in the Pembrokeshire Marine SAC, but data indicate that the populations from the Rivers Tywi, Usk, Wye and Severn transit through the site. It is also understood that important habitats for shad are extensive within the SAC, and the population is known to be in favourable condition (NRW, 2018e; NRW, 2018d). The water column is considered suitable habitat (i.e. including abundant, suitable prey and adequate water quality) and of high quality (NRW, 2018e).

*Cleddau Rivers / Afonydd Cleddau SAC*

203. The Cleddau Rivers SAC is located over 16 km from the Offshore Development Area. However, this river drains directly into Milford Haven. It is therefore considered that there is a high probability that migratory fish will pass through / close to the Offshore Development Area during seasonal migration. Thus, the site has been screened into the AA for potential LSE on the following Annex II migratory fish features (**Table 8-7**):

- River lamprey *Lampetra fluviatilis* (1099); and
- Sea lamprey *Petromyzon marinus* (1095).

204. The conservation objectives for the Cleddau Rivers SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes (NRW, 2022d). For the river and sea lamprey features this includes maintenance of the watercourse, ensuring a stable or increasing population, no reduction in range, and passage through the SAC is not hindered (NRW, 2022d). Both lamprey features are understood to be in

Unfavourable conservation status, with no sea lamprey found within the reporting cycle (NRW, 2022d).

*Carmarthen Bay and Estuaries / Bae Caerfyddin ac Aberoedd SAC*

205. The Carmarthen Bay and Estuaries SAC is located over 24 km from the Offshore Development Area (**Table 8-7**). However, due to the location of the proposed Project, it is possible that migratory fish from Carmarthen Bay will pass through / close to the Offshore Development Area during seasonal migration. Thus, the site has been screened into the AA for potential LSE on the following Annex II migratory fish features (**Table 8-7**):

- River lamprey *Lampetra fluviatilis* (1099);
- Sea lamprey *Petromyzon marinus* (1095);
- Allis shad *Alosa alosa* (1102); and
- Twaite shad *Alosa fallax* (1103).

206. The conservation objectives for the Carmarthen Bay and Estuaries SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes (NRW, 2018c). For the migratory fish features, this includes ensuring a stable or increasing population, no reduction in range, and ensuring passage through the SAC is not hindered (NRW, 2018c).

207. The migratory habits of lamprey entering the estuaries of the Carmarthen Bay and Estuaries SAC are unknown. However, it is assumed that the SAC is an important migration route, as lamprey migrate through the SAC to reach the River Tywi (Countryside Council for Wales, 2009). Assessments of conservation objectives within the above Carmarthen Bay and Estuaries SAC indicated that sea lamprey are of an unfavourable status and river lamprey are of favourable status in their freshwater populations and of unfavourable status in their marine population (NRW, 2018b).

208. Similarly, shad are found in the River Tywi adjoining the SAC where counts have recorded over 10,000 fish (Countryside Council for Wales, 2009). Shad are currently in favourable status in their freshwater populations and of unfavourable status in their marine population (NRW, 2018b).

*Cardigan Bay / Bae Ceredigion SAC*

209. The Cardigan Bay SAC is located over 50 km from the Offshore Development Area (**Table 8-7**). However, due to the location of the proposed Project, it is possible that migratory fish from Cardigan Bay will pass through / close to the Offshore Development Area during seasonal migration. Thus, the site has been screened into the AA for potential LSE on the following Annex II migratory fish features (**Table 8-7**):

- River lamprey *Lampetra fluviatilis* (1099); and
- Sea lamprey *Petromyzon marinus* (1095).

210. The conservation objectives for the Cardigan Bay SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes (NRW, 2018a). For the migratory fish features, this includes ensuring a stable or increasing population, no reduction in range, and maintenance of supporting habitat (NRW, 2018a).

211. Both lamprey species migrate through the SAC to reach the Afon Teifi and River Aeron (NRW, 2018a). Although Lamprey do not home to their natal river (Bergstedt & Seelye, 1995), so lamprey using the Cardigan Bay SAC should be viewed as a protected component of a larger population covering the Bristol Channel and possibly a wider area. In particular, the river and sea lamprey populations of the River Wye, River Usk, Afon Tywi, Afon Teifi, Afonydd Cleddau, Carmarthen Bay

and Estuaries and Pembrokeshire Marine SACs should be seen as linked to Cardigan Bay SAC (NRW, 2018a).

*Afon Teifi / River Teifi SAC*

212. The River Teifi SAC is located over 51 km from the Offshore Development Area (**Table 8-7**). However, due to the location of the proposed Project, it is possible that migratory fish from the River Teifi will pass through / close to the Offshore Development Area during seasonal migration. Thus, the site has been screened into the AA for potential LSE on the following Annex II migratory fish features (**Table 8-7**):

- River lamprey *Lampetra fluviatilis* (1099);
- Sea lamprey *Petromyzon marinus* (1095); and
- Atlantic salmon *Salmo salar* (1106).

213. The conservation objectives for the River Teifi SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes (Countryside Council for Wales, 2012). For the migratory fish features, this includes ensuring a stable or increasing population for specific life stages, no reduction in range or distribution, and maintenance of water quality and hydromorphology (Countryside Council for Wales, 2012). All three of the migratory fish features are considered to be in Unfavourable condition (NRW, 2022a).

*River Tywi / Afon Tywi SAC*

214. The River Tywi SAC is located over 55 km from the Offshore Development Area (**Table 8-7**). However, due to the location of the proposed Project, it is possible that migratory fish from the River Tywi will pass through / close to the Offshore Development Area during seasonal migration. Thus, the site has been screened into the AA for potential LSE on the following Annex II migratory fish features (**Table 8-7**):

- River lamprey *Lampetra fluviatilis* (1099);
- Sea lamprey *Petromyzon marinus* (1095);
- Allis shad *Alosa alosa* (1102); and
- Twaite shad *Alosa fallax* (1103).

215. The conservation objectives for the River Tywi SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes. For the migratory fish features, this includes ensuring a stable or increasing population, no reduction in distribution, and maintenance of water quality and supporting habitats.

216. In the River Tywi SAC, a significant spawning population of twaite shad occurs. Spawning sites occur in the lower reaches of the river, with water quality and spawning activity considered adequate for the population to be self-sustaining. However, despite favourable water quality condition and spawning distribution of shad, the shad features are overall considered to be in unfavourable condition due to an unfavourable flow regime in the river. Similarly, the river lamprey is also of unfavourable status in the River Tywi SAC, where, despite a healthy population, the density of optimal habitat did not meet the target. Sea lamprey is understood to be in unfavourable condition based on its population distribution (NRW, 2022b).

*River Usk / Afon Wysg SAC*

217. The River Usk SAC is located over 98 km from the Offshore Development Area (**Table 8-7**). However, due to the location of the proposed Project, it is possible that migratory fish from the River Usk will pass through / close to the Offshore Development Area during seasonal migration.

Thus, the site has been screened into the AA for potential LSE on the following Annex II migratory fish features (**Table 8-7**):

- River lamprey *Lampetra fluviatilis* (1099);
- Sea lamprey *Petromyzon marinus* (1095);
- Atlantic salmon *Salmo salar* (1106);
- Allis shad *Alosa alosa* (1102); and
- Twaite shad *Alosa fallax* (1103).

218. The conservation objectives for the River Usk SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes (NRW, 2022c). For the migratory fish features, this includes ensuring a stable or increasing population, no reduction in range, a sufficiently large habitat (NRW, 2022c)..

219. In 2012, all migratory fish features were assessed as being in unfavourable condition (NRW, 2022c). The Atlantic salmon and sea lamprey features was considered unfavourable due to water quality parameters and migratory barriers within the river. The river lamprey had unfavourable densities of individuals, and shad were considered to be unfavourable to reduced water quality.

*Severn Estuary Ramsar*

220. The Severn Estuary Ramsar is located over 139 km from the Offshore Development Area (**Table 8-7**). However, due to the location of the proposed Project, it is possible that migratory fish from the Severn Estuary Ramsar will pass through / close to the Offshore Development Area during seasonal migration. Thus, the site has been screened into the AA for potential LSE on the following migratory fish that form part of the designated assemblage (**Table 8-7**):

- River lamprey Lampetra fluviatilis;
- Sea lamprey Petromyzon marinus;
- Atlantic salmon *Salmo salar*;
- Allis shad *Alosa alosa*; and
- Twaite shad *Alosa fallax*.

221. The Severn Estuary is a key migration route for these features to reach their spawning grounds in the many tributaries that flow into the estuary. The Severn Estuary Ramsar aims are to ensure that migratory passage is not obstructed, populations are maintained, the abundance of prey species is maintained, and that toxic contaminants in the water column are below levels that pose a risk.

*Severn Estuary / Môr Hafren SAC*

222. The Severn Estuary SAC is located over 133 km from the Offshore Development Area (**Table 8-7**). However, due to the location of the proposed Project, it is possible that migratory fish from the Severn Estuary SAC will pass through / close to the Offshore Development Area during seasonal migration. Thus, the site has been screened into the AA for potential LSE on the following Annex II migratory fish features (**Table 8-7**):

- River lamprey *Lampetra fluviatilis* (1099);
- Sea lamprey *Petromyzon marinus* (1095); and
- Twaite shad *Alosa fallax* (1103).

223. The conservation objectives for the River Wye SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes. These objectives aim to ensure that migratory passage is not obstructed, populations are maintained, the abundance of prey species is maintained, and that toxic contaminants in the water column are below levels that pose a risk. As of 2018, river lamprey are in favourable status in their freshwater populations and of unfavourable status in their marine populations due to water quality issues. Similarly, sea lamprey and twaite shad are unfavourable due to water quality issues, with twaite shad also being impacted by barriers to migration within the River (NRW, 2018f).

*River Wye / Afon Gwy SAC*

224. The River Wye SAC is located over 141 km from the Offshore Development Area (**Table 8-7**). However, due to the location of the proposed Project, it is possible that migratory fish from the River Wye will pass through / close to the Offshore Development Area during seasonal migration. Thus, the site has been screened into the AA for potential LSE on the following Annex II migratory fish features (**Table 8-7**):

- River lamprey *Lampetra fluviatilis* (1099);
- Sea lamprey *Petromyzon marinus* (1095);
- Atlantic salmon *Salmo salar* (1106);
- Allis shad *Alosa alosa* (1102); and
- Twaite shad *Alosa fallax* (1103).

225. The conservation objectives for the River Wye SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes (NRW, 2022). For the migratory fish features, this includes ensuring a stable or increasing population, no reduction in range, and a sufficiently large habitat (NRW, 2022).

226. During an assessment in 2017, river lamprey and shad features were assessed as unfavourable due to water quality issues and a depletion of river flow. Similarly, the Atlantic salmon feature was found to be unfavourable due to the population size and localised water quality failures. However, the sea lamprey feature is assessed as favourable (NRW, 2017a).

**Information for Appropriate Assessment**

*Pembrokeshire Marine / Sir Benfro Forol SAC - Assessment of Adverse Effects Alone*

*Construction phase*

***Temporary physical disturbance to fish from increased SSC and sediment deposition***

227. Construction activities associated with the proposed Project, such as ploughing and jet trenching, have the potential to temporarily increase SSC, through the disturbance of sediment and the subsequent creation of sediment plumes in the water column which can travel away from the Offshore Development Area before depositing sediment elsewhere on the seabed. Several potential effects can arise from increased SSC and sediment deposition, including the clogging of gills and feeding apparatus, reduced feeding success of visual predators due to decreased visibility, the mortality of eggs and larvae which have a lower tolerance to turbid conditions, and effects related to toxic conditions if sediment-bound contaminants are disturbed (Kjelland, et al., 2015). Fish migration and movement between important areas such as spawning and feeding grounds could also be impacted.

228. The largest sediment plumes and highest levels of increased SSC are associated with the disturbance of sediments which have a high proportion of particulate matter, such as muds and clays. Such sediments remain in suspension for the longest and therefore travel the furthest

distance from the source of disturbance, settling to the seabed more slowly. In comparison, coarser materials such as sand and gravel are expected to settle more quickly within a few hours of disturbance and within only a few tens of metres from the source (**Chapter 17: Physical Environment).** The highest percentage of sediment in the OfECC and in the Array Area is made up of sand, suggesting that the majority of sediment particles which may be disturbed during construction are of a larger particle size. Therefore, impacts will be short term with sediment likely to settle to the seabed within hours of the disturbance.

229. Based on modelling undertaken in **Chapter 17: Physical Environment**, any measurable change in SSC during construction will be temporary and localised, with the majority of sediment consisting of sands and gravels which are expected to have deposited in tens of centimetres thickness on the seabed between 50 – 500 m away of the source of disturbance. Only 6% of the surveyed sediments across nearshore and offshore sections of the Offshore Project Boundary consisted of mud (**Figure 8-5**) and therefore there is the potential for a very fine layer of mud to be deposited beyond 500 m during construction (**Chapter 19: Benthic Ecology**). However, beyond 500 m it is expected that there will only be a low to intermediate increase in SSC (dispersing to ambient levels within one day following the activity), with fine sediment unlikely to deposit in any measurable thickness.

230. Several methods are incorporated into the cable layout design to minimise turbidity during the construction phase of the proposed Project. These are outlined in **Section 8.1.1** in further detail.

***River lamprey Lampetra fluviatilis (1099) and Sea lamprey Petromyzon marinus (1095)***

231. Although the OfECC intersects Pembrokeshire Marine SAC for approximately 15 km between the HDD exit point at KP48 and KP 32.4 (**Figure 8-7**), lamprey migrate through the SAC to reach the Afonydd Cleddau on their spawning migration. Lamprey from the Rivers Usk, Wye and Teifi are also quite likely to use the inshore waters of the SAC during their migrations (NRW, 2018e). These rivers in are located more than 500 m away from the Offshore Project Boundary and therefore fall outside of the zone where increased SSC is likely to be highest greatest SSC and deposition to occur within 50 m of the OfECC).

232. Additionally, as lamprey transit through the Offshore Development Area during their migrations, they are considered to be likely to avoid the zone where increased SSC is likely to be highest. Furthermore, impacts will be short-term and temporary, thus displaced individuals are likely to return once SSC have settled. Therefore, it is not considered that the impact of increased SSC and deposition will hinder the conservation objectives of either lamprey feature of Pembrokeshire Marine SAC.

***Allis shad* Alosa alosa *(1102) and Twaite shad* Alosa fallax *(1103)***

233. Although the OfECC intersects Pembrokeshire Marine SAC for approximately 15 km between the HDD exit point and KP 32.4, shad populations from the Rivers Tywi, Usk, Wye and Severn transit through the site (NRW, 2018e). These rivers in are located more than 500 m away from the Offshore Project Boundary and therefore fall outside of the zone where increased SSC is likely to be highest (greatest SSC and deposition to occur within 50 m of the OfECC). As shad are mobile when transiting through the Offshore Development Area during their migrations, they are considered likely to avoid the zone where increased SSC is likely to be highest. Additionally, impacts will be short-term and temporary, thus displaced individuals are likely to return once SSC have settled.

234. Moreover, during all stages of their life cycle, shad are pelagic fish and predominantly occur in the surface layers of the water column, so the shad features are unlikely to encounter mobilised sediment in the bottom 5 m of the water column (**Chapter 17: Physical Environment**). Therefore,

it is not considered that the impact of increased SSC and deposition will hinder the conservation objectives of either shad feature of Pembrokeshire Marine SAC.

***Conclusion***

**235.** Based on the conclusions above, it is not anticipated that a potential increase in SSC and deposition will hinder the conservation objectives of any of the Annex II migratory fish features. This is due to the temporary and localised nature of any effects, distance from significant rivers and estuaries as well as the transitory nature of any migrating individuals (**Chapter 20: Fish and Shellfish Ecology**). Therefore, with adherence to the mitigation measures embedded into the cable construction methods (**Section 8.1.2**), there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to a temporary increase in SSC and sediment deposition.**

***Impact from changes to marine water quality from the mobilisation of contaminants***

236. Sediment-bound contaminants including heavy metals and PAHs could have detrimental impacts on fish and shellfish when present in concentrations above relevant thresholds and resuspended during disturbance to the seabed. Impacts can include cell apoptosis in fish immune systems (Reynaud & Deschaux, 2006). During the characterisation studies (**Appendix 19A: Nearshore 2023 Benthic Survey Report;** and **Appendix 19B: Offshore 2023 Benthic Survey Report**), arsenic was the only heavy metal to exceed Centre for Environment, Fisheries and Aquaculture Science (CEFAS) Action Level (AL) 1. Naphthalene was the only PAH to exceed the Canadian Sediment Quality Guidelines (CSQG) threshold effect level.

237. Contaminants are expected to be associated with finer materials such as silts and clays which make up a very low percentage of the total sediment composition Offshore Development Area (**Figure 8-5**). The majority of the sediment disturbed by installation and pre-installation activities will be deposited within 50 m (**Paragraph 229**), with limited measurable deposition of fine sediments beyond this distance and only a slight increase in SSC. The dilution processes over this distance are expected to result in very little or no detectable changes beyond 50 m, and therefore the area of affect is considered to be very small, with dilution of contaminants expected to occur rapidly if present. Additionally, natural disturbance to sediment such as during storm events and periods of strong wave action will mobilise contaminants and subject fish to temporary and localised changes in water quality. As a result, fish will have a tolerance to moderate changes in the surrounding water quality, particularly as migratory only transit the Offshore Development Area during their migration, thus can easily move away from an area of disturbance.

238. Although the OfECC intersects Pembrokeshire Marine SAC for approximately 15 km between the HDD exit at KP48 and KP 32.4, migratory fish may transit the through the SAC. Both lamprey species are understood to migrate to the Rivers Usk, Wye and Teifi (NRW, 2018e), and shad species to the Rivers Tywi, Usk, Wye and Severn (NRW, 2018e). All of these rivers are beyond 50 m away from the Offshore Development Area, at which point it is not expected that there will be detectable changes in sediment-bound contaminants.

239. Moreover, as the Annex II migratory fish features of Pembrokeshire Marine SAC are only likely to be transiting the Offshore Development Area during their migrations, they are considered likely to be able to away from any affected area. Therefore, it is not considered that the impact of changes in marine quality due to the mobilisation of contaminants will hinder the conservation objectives of the Annex II migratory fish features of Pembrokeshire Marine SAC.

240. Overall, as contaminants are low in concentration and limited in extent and if disturbed are unlikely to be above the occurred under natural conditions. Therefore, , it is not anticipated that changes in water quality due to the mobilisation of contaminants will have an effect on the conservation objectives of any of the Annex II migratory fish features, and thus is **no potential for**

**an AEoSI of the Pembrokeshire Marine SAC due to changes to marine water due to the mobilisation of contaminants.**

***Impact from changes to marine water quality from the use of drilling fluids at HDD break-out points and resuspension of sediment contamination during seabed installation works***

241. Installation of the export cable between the terrestrial and marine environment will be undertaken via the use of HDD. The use of HDD and therefore the discharge of drilling fluids at the breakout location at the landfall could result in decreased water quality that can have effects on the health of migratory fish populations. It has been estimated that up to 1,700 $m^3$ of drilling mud will be generated. Constituents of the drilling fluids, including silt-clay sized particles such as bentonite have a maximum theoretical range of approximately 14 km, which is the tidal excursion on a mean tide in the nearshore area around the landfall and outside Milford Haven. However, discharged drilling fluid is expected to be subject to immediate dilution processes and rapid dispersal over this distance, which will result in no detectable change from the baseline beyond 500 m (**Table 8-8**). Therefore, only receptors in the immediate vicinity of the HDD breakouts have the potential to be in contact with drilling fluids if a leak or spill occurs.

242. The HDD will punch out in the intertidal zone of Freshwater West, exiting at a water depth of around 3 to 8 m, up to 960 m seaward of mean high water springs (MHWS), and therefore in a dynamic area with considerable wave action and tidal water movement. Moreover, all drilling fluids used, such as bentonite, will be selected from the OSPAR List of Substances / Preparations Used and Discharged Offshore (2021) which are considered to PLONOR (**Section 8.1.2**). The drilling fluid discharges from HDD operations will be a small number of single events over a short period of time and rapidly dispersed in an open sea coastal environment. Only receptors in the immediate vicinity of the HDD breakouts are likely to be in contact with drilling fluids, which pose little or no risk to the environment.

243. Although the OfECC intersects Pembrokeshire Marine SAC for approximately 15 km between the HDD exit at KP48 and KP 32.4, migratory fish may transit the through the SAC. Both lamprey species are understood to migrate to the Rivers Usk, Wye and Teifi (NRW, 2018e), and shad species to the Rivers Tywi, Usk, Wye and Severn (NRW, 2018e). All of these rivers are beyond 500 m from the HDD breakout point, at which point there will be no detectable change from the baseline.

244. Moreover, as the Annex II migratory fish features of Pembrokeshire Marine SAC are only likely to be transiting the Offshore Development Area during their migrations, they are considered likely to be able to away from any affected area. Therefore, it is not considered that the impact of changes in marine quality due to HDD will hinder the conservation objectives of the Annex II migratory fish features of Pembrokeshire Marine SAC.

**245.** Therefore, as the drilling fluid used will be PLONAR, with the volume to be discharged being very small and is expected to be rapidly dispersed over a short period of time, it is not anticipated that changes in water quality from the use of HDD will have an effect on the conservation objectives of any of the Annex II migratory fish features, and thus is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to changes to water quality due to HDD.**

***Impact from changes to marine water quality as a result of accidental leaks and spills from vessels, including loss of fuel oils***

246. The accidental release of pollutants and planned release of wastewater could occur from any of the vessels associated throughout the proposed Project phases has the potential to alter water quality. Vessels could have cleaning fluids, oils, and hydraulic fluids onboard, which could be

accidentally discharged, releasing hydrocarbons and chemical pollutants into the surrounding seawater, with consequences for migratory fish.

247. Minor spills could occur through several activities including leaking hydraulic hoses or during refuelling. However, such spills are expected to be small, consisting of only a few litres. If released into the marine environment these minor spills are expected to undergo rapid dispersion and evaporation when subjected to wave action, wind, currents and light, as well as degradation via bacterial action. Consequently, any small releases are likely to break up and disperse in a short space of time, resulting in little impact to the marine environment.

**248.** Larger spills, such as during collisions between vessels, have the potential to impact fish and shellfish, particularly if the spill is in shallow water. Therefore, as part of proposed management plans in place to reduce the risk of collisions, vessels will be required to comply with the International Regulations for Preventing Collisions at Sea (1972) and regulations relating to International Convention for the Prevention of Pollution from Ships (MARPOL Convention 73/78) specifically including compliance with Annex IV on pollution by sewage and prevention of air pollution by ships; and Annex V on pollution by garbage from ships with the aim of preventing and minimising pollution from ships. This will include SOPEP and will be secured via the CEMP (**Section 8.1.2**). Thus, as all effluent will be discharged in accordance with the applicable MARPOL Annex IV 'Prevention of Pollution from Ships' standards, and therefore the risk of an accidental spill is very low. If a leak did occur, it would be very small in extent and subject to immediate dilution and rapid dispersal within the marine environment.

**249.** Therefore, the likelihood of impact to all Annex II migratory fish features from accidental leaks and spills from vessels and equipment is predicted to be unlikely, and it is not anticipated that changes in water quality from vessels will hinder the conservation objectives of any of the Annex II migratory fish features, and thus is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to changes to water quality from vessels.**

***Underwater noise and vibration***

250. Several activities during the construction phase of the proposed Project will generate underwater noise. Underwater noise can be either impulsive or non-impulsive in nature. Impulsive sounds are those created by high-resolution seabed imaging sources for example, such as impact piling. Non-impulsive sounds, also known as continuous sound sources, are those created by dredging, drilling type activities and sound created by vessel movements. Several factors influence the effect of anthropogenic sound on marine receptors, including intensity of the sound source, sound duration, frequency, the surrounding environment, and the sensitivity of the species.

251. Fish use sound for communication, prey location and predator avoidance, and thus it is an important environmental cue (Fay & Popper, 2000). Fish ears and the lateral line perceive underwater noise through sensitivity to vibrations. Swim bladders, which are gas-filled sacs, are also used for sound detection in some teleost or bony fish (Hawkins, 1993). Sensitivity to sound varies between fish species according to the frequency of the sound. Responses in fish to sound also vary depending on the presence and levels of noise within the range of frequencies which fish are sensitive to. Sensitivity to sound, and therefore the potential for impacts to occur in fish are largely determined by fish physiology, and particularly whether a fish has a swim bladder, and uses that swim bladder to improve hearing sensitivity and range (Popper, et al., 2014).

252. The impacts of underwater noise include:

- **Physical or physiological effects** – this includes mortality, non-recoverable and recoverable injury. Only seen in extreme cases, such as where fish are in close proximity to very high sound pressure levels such as from explosions;

- **Auditory damage** – high intensity underwater noise can cause physical damage to the auditory system structures such as the inner ear, sensory hair cells and otoliths (Parvin, et al., 2006);
- **Masking** – caused by interference with ecologically significant sounds and relates to behavioural responses; and
- **Behavioural responses** – includes changes in swimming direction, migration, feeding, and displacement.

253. The impact of underwater noise and vibration has been assessed in **Chapter 20: Fish and Shellfish Ecology.** For underwater noise impact assessments, the metrics are sound pressure level (SPL) and sound exposure levels (SEL). The SPL is a measure of the amplitude or intensity of a sound and, for impulsive sound sources, is typically measured as a peak or root-mean-square (rms) value. In contrast, the SEL is a time-integrated measurement of the sound energy, which takes account of the level of sound as well as the duration over which the sound is present in the acoustic environment. The activities with the highest SPLs were the SBP within the OfECC, and the impact piling associated with the Array Area (**Appendix 21B: Marine Mammals Noise Modelling**).

254. SBP will be used to undertake geophysical surveys of the seabed to determine seabed structure, water depth, the presence of any obstructions and to track the location of ROVs within the OfECC. Impact piling will be required to anchor the floating WTGs to the seabed within the Array Area. In a worst-case scenario there will be eight anchors per WTG, with a total of ten WTG. As these activities have the highest SPLs, these activities will be assessed within the following assessment.

255. The OfECC intersects Pembrokeshire Marine SAC for approximately 15 km between the HDD exit point at KP48 and KP 32.4. Therefore, there is the potential for the migratory fish features to be exposed to underwater noise associated with construction activities.

256. Moreover, there is the potential for UXO to be identified within the Offshore Development Area and require detonation to be rendered harmless. Should UXO detonation be required there is the potential for the underwater sound to cause injury and disturbance to migratory fish features. Prior to construction there will be a full geophysical survey to determine presence of UXO and the need for any explosive objects to be cleared. An application for a separate Marine Licence in respect of UXO clearance will be made post submission, when the exact number and type of detonations have been established. However, an assessment of the effect of UXO detonation is included here, so that regulator opinion can received prior to the application submission. Once the size and number of UXO within the Offshore Development Area have been determined an updated risk assessment will be provided to support the Marine Licence and European Protected Species (EPS) licence applications.

257. The OfECC intersects Pembrokeshire Marine SAC for approximately 15 km between the HDD exit and KP 32.4. Therefore, there is the potential for the migratory fish features to be in the vicinity of SBP activities occurring within the OfECC, as well as potentially transiting the Array Area during migration where impact piling may be employed.

***River lamprey Lampetra fluviatilis (1099) and Sea lamprey Petromyzon marinus (1095)***

258. The OfECC intersects Pembrokeshire Marine SAC for approximately 15 km between the landfall and KP 32.4, lamprey migrate through SAC to reach the Afonydd Cleddau on their spawning migration. Lamprey from the Rivers Usk, Wye and Teifi are also likely to use the inshore waters of the SAC during their migrations (NRW, 2018e). However, both sea and river lamprey are considered to have a low hearing sensitivity, meaning they do not possess a swim bladder or other gas chamber and are less susceptible to barotrauma and behavioural disturbance.

259. SBP will operate at an $SPL_{peak}$ of 238 dB re 1 µPa @ 1 m. It is not considered that the impact of underwater noise and vibration from SBP result in injury for lamprey species, however, low-level behavioural disturbance is predicted within a maximum distance of 327 m. This distance is considered to be small in extent, with mobile species, such as lamprey, able to avoid any area of potential disturbance. The Annex II lamprey populations of Pembrokeshire Marine SAC transit through the SAC to reach the Rivers Tywi, Usk, Wye and Severn (NRW, 2018e). These rivers in are located although these rivers are located more than 55 km away from the OfECC. Therefore, the limited extent of the effects of underwater noise and vibration is not considered to act as a barrier to fish migration. Furthermore, as SBP will be temporary and variable in location, it is not considered that the impact of underwater noise and vibration associated with SBP will hinder the conservation of either Annex II lamprey feature of Pembrokeshire Marine SAC.

260. Impact piling is considered to have a $SPL_{peak}$ of 235 dB re 1 µPa @ 1 m. In **Chapter 20: Fish and Shellfish Ecology**, it was concluded that the threshold for mortality and recoverable injury for all fish species, is only predicted to occur within 0 m from the sound source. Moreover, behavioural disturbance could occur within a maximum distance of 30.7 km. Based on these distances, there is potential for disturbance to Annex II lamprey populations migrating through Pembrokeshire Marine SAC to reach the Rivers Usk, Wye and Teifi (NRW, 2018e), although these rivers are located more than 89 km away from the Array Area. Despite the parameters of the modelling estimated disturbance to occur over 80 days (**Chapter 20: Fish and Shellfish Ecology**), in reality the duration of the piling works is expected to be much shorter in total, with estimates of a maximum 45 days with a minimum of 20 piling days. The anticipated piling duration per day would range between 90 minutes and 180 minutes per pile. Therefore, any impacts will be temporary and short term. Moreover, the modelling was based on a threshold of 150 dB re 1 mPa rms which is overly precautionary, and it is predicted that for low hearing sensitivity fish, such as lamprey, low-level behavioural disturbance is only anticipated in near distances (i.e. tens of metres). Although there will be avoidance behaviour to the impact piling area of disturbance, as there will be a soft-start procedure, which has been proposed as part of **Chapter 21: Marine Mammals**, and as lamprey are mobile species, they can move away from the sound source as it commences and return to the area once impact piling has stopped. Therefore, it is not considered that the impact of underwater noise and vibration associated with impact piling will hinder the conservation of either Annex II lamprey features of Pembrokeshire Marine SAC.

261. In the instance that UXO detonation will be required, using the worst-case scenario, detonation charge size of 794 kg and a threshold value of 229 dB re 1µPa $SPL_{peak,}$ mortality or injury could occur up to a maximum of 1.02 km for all hearing sensitivity fish species. Although there are currently no thresholds for behavioural disturbance, Popper *et al.* (2014) does provide broad distances over which TTS could occur from the detonation of explosives. Although onset TTS is not a behavioural disturbance metric, the use of the onset TTS is considered appropriate for UXO clearance disturbance assessments because the noise resulting from a clearance event is short lived in the environment (in the order of seconds) (Robinson, et al., 2022). (Popper, et al., 2014) reports that there is a high probability of TTS occurring at near distances (i.e. tens of metres) for fish species with a low hearing sensitivity. Therefore, any behavioural disturbance will also be highly localised and very short in duration and fish can return to the area following detonation. If behavioural disturbance is greater than 1 km, then any effects will be momentary and therefore obstruction to migratory routes will negligible.

262. As part of **Chapter 21: Marine Mammals**, JNCC guidelines (2010) will be adopted during UXO clearance activities to further minimise the potential risk of injury to marine mammals. These measures will also potentially reduce the risk to migratory fish species. Low order detonation techniques will also be adopted where possible and where multiple explosive charges are present,

wherever possible, the smaller charges shall be detonated first to maximise the 'soft-start' effect. Therefore, given the embedded measures and the short and intermittent nature of this activities and that effects are most likely to be limited to the vicinity of the area where the detonation takes place, it is not considered that the impact of UXO detonation associated with the proposed Project will hinder the conservation objectives of either Annex II lamprey feature of Pembrokeshire Marine SAC.

***Allis shad* Alosa alosa *(1102) and Twaite shad* Alosa fallax *(1103)***

263. The OfECC intersects Pembrokeshire Marine SAC for approximately 15 km between the HDD exit and KP 32.4 shad populations from the Rivers Tywi, Usk, Wye and Severn transit through the site (NRW, 2018e). Both, Allis and Twaite shad are considered to have a high hearing sensitivity as they use a swim bladder (or another gas volume) for hearing. These species can detect sound pressure and particle motion and are susceptible to barotrauma and thus have the potential to be impacted by underwater noise and vibration associated with the proposed Project.

264. SBP is considered to have a $SPL_{peak}$ of 238 dB re 1 µPa @ 1 m. In **Chapter 20: Fish and Shellfish Ecology**, it was concluded that the maximum distance over which SBP is predicted to result in TTS in high sensitivity fish is 204 m. Moreover, low-level behavioural disturbance was predicted within a maximum distance of 327 m. Therefore, these distances are considered to be small in extent, with mobile species, such as shad, able to avoid any area of potential disturbance. The Annex II shad populations of Pembrokeshire Marine SAC transit through the SAC to reach the Rivers Tywi, Usk, Wye and Severn (NRW, 2018e). These rivers in are located more than 55 km from the OfECC. Therefore, the limited extent of the effects of underwater noise and vibration is not considered to act as a barrier to fish migration. Furthermore, as SBP will be temporary and variable in location, it is not considered that the impact of underwater noise and vibration associated with SBP will hinder the conservation of either Annex II shad feature of Pembrokeshire Marine SAC.

265. Impact piling is considered to have a $SPL_{peak}$ of 235 dB re 1 µPa @ 1 m. In **Chapter 20: Fish and Shellfish Ecology**, it was concluded that the threshold for mortality and recoverable injury for all fish species, is only predicted to occur within 0 m from the sound source. Moreover, behavioural disturbance could occur within a maximum distance of 30.7 km. Based on these distances, there is potential for disturbance to Annex II shad populations migrating through Pembrokeshire Marine SAC to reach the Rivers Tywi, Usk, Wye and Severn (NRW, 2018e), although these rivers are located more than 90 km away from the Array Area. As discussed in **Paragraph 260**, despite the parameters of the modelling estimated disturbance to occur over 80 days (**Chapter 20: Fish and Shellfish Ecology**), in reality the duration of the piling works is expected to be much shorter. Therefore, any impacts will be temporary and short term. Similarly, as discussed in **Paragraph 260**, the modelling was overly precautionary, and it is predicted that for high hearing sensitivity fish, such as shad, low-level behavioural disturbance is only anticipated in intermediate distances (i.e. less than 1 km). Although there will be avoidance behaviour to the impact piling area of disturbance, as there will be a soft-start procedure, which has been proposed as part of **Chapter 21: Marine Mammals**, and shad are mobile species, they can move away from the sound source as it commences, thus it is not considered that the impact of underwater noise and vibration associated with impact piling will hinder the conservation of either Annex II shad feature of Pembrokeshire Marine SAC.

266. In the instance that UXO detonation will be required, using the worst-case scenario, detonation charge size of 794 kg and a threshold value of 229 dB re 1µPa $SPL_{peak,}$ mortality or injury could occur up to a maximum of 1.02 km for all hearing sensitivity fish species. As previously stated in **Paragraph 261**, onset TTS is considered appropriate for UXO clearance disturbance assessments because the noise resulting from a clearance event is short lived in the environment (Robinson, et al., 2022). Popper et al. (2014) reports that there is a high probability of TTS

occurring at intermediate distances (i.e. hundreds of metres) for high hearing sensitivity fish. Therefore, any behavioural disturbance will also be highly localised and very short in duration and fish can return to the area following detonation. If behavioural disturbance is greater than 1 km, then any effects will be momentary and therefore obstruction to migratory routes will negligible. As stated in **Paragraph262**, JNCC guidelines (2010) will be adopted during UXO clearance activities to further minimise the potential risk of injury to migratory fish. Therefore, given the embedded measures and the short and intermittent nature of this activity and that effects are most likely to be limited to the vicinity of the area where the detonation takes place, it is not considered that the impact of underwater noise and vibration from UXO detonation will hinder the conservation objectives of the Annex II shad feature of Pembrokeshire Marine SAC.

***Conclusion***

267. Based on the conclusions above, it is not anticipated that underwater noise and vibration will hinder the conservation objectives of any of the Annex II migratory fish features, and thus there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to underwater noise and vibration**.

*Operation and Maintenance phase*

***Effects of EMF emissions***

268. Subsea cables associated with the proposed Project, including both inter-array cables and export cables are known to produce EMF emissions (Hutchison, et al., 2020) and have the potential to affect the behaviour, foraging and migratory success of fish.

269. EMF emissions will occur for the operational lifetime of the proposed Project from the export cables and inter-array cables. The target depth of subsea cables with the OfECC is 1.2 m (a minimum depth of 0.8 m). The findings from the project-specific EMF Assessment (**Appendix 19C: EMF Assessment**) found that the maximum EMF strength predicted to result from the operation of the export cables at a burial depth of 1.2 m, when a receptor is 0 m from the seabed, is 2.6 µT. The effects of EMF reduce with distance from the cable, and the modelling shows negligible emissions beyond 2 m for this burial depth. Where burial is greater this distance will be further reduced.

270. For dynamic exposed cables in the water column, such as those within the Array Area, the maximum EMF strength at the surface of the cables has been calculated as ~5.2 mT. This is significantly higher than the background level of geomagnetic field in the UK, which is around 50 µT but this also decreases rapidly with distance from the cable. At a distance of 0.44 m from the cable surface EMF expected to be approximately equal to background levels (**Appendix 19C: EMF Assessment**) (**Table 8-8**).

271. The increase in background EMF is considered to be restricted to a small area around the proposed Project cables. Therefore, any effects are only anticipated in the immediate area of the Offshore Development Area (**Table 8-8**). The OfECC intersects Pembrokeshire Marine SAC for approximately 15 km between the HDD exit point and KP 32.4, and thus there is potential for impacts on Annex II migratory fish features at this location.

272. Although disturbance to migratory fish is not well understood, a review of literature suggests that significant responses are expected to be limited, and any reactions are only anticipated in the immediate area of the proposed Project. There is some evidence to suggest that migratory fish change their direction to avoid features which fall in the main magnetic field (Klimley, et al., 2021), and migratory fish have shown distinct directional and behavioural reactions to magnetic fields, such as reduced swimming speed in European eels (Westerberg & Begout-Anras, 2000; Westerberg & Langfelt, 2008; Öhman, et al., 2007). Conversely, studies of juvenile salmon which

had to cross a cable emitting EMF have shown no significant differences in behavioural reactions and migration success (Wyman, et al., 2018). In addition, biotelemetry studies of migrating European eels showed that the location of a subsea cable did not create a strong barrier to migration movements, with only brief changes in direction shown in small numbers of fish (Westerberg & Begout-Anras, 2000). Moreover, a recent review undertaken by the OSPAR Commission (2023) concluded that current research does not indicate negative effects of EMF on fish movement and migratory behaviour.

***River lamprey Lampetra fluviatilis (1099) and Sea lamprey Petromyzon marinus (1095)***

273. Although the exact path for migration for migratory fish features is not well understood, lamprey migrate through the Pembrokeshire Marine SAC to reach the Afonydd Cleddau on their spawning migration. Lamprey from the Rivers Usk, Wye and Teifi are also quite likely to use the inshore waters of the SAC during their migrations (NRW, 2018e).

274. Migratory species spend a large amount of time in the upper reaches and given the majority of the proposed Project is in deep water, it is expected that any changes in behaviour are more likely to occur in shallower water on approach to the landfall at Freshwater west. Freshwater West is a bay and therefore is thought to be beyond the typical migratory paths for lamprey. As such, the area where EMF emissions from the cables have the potential to affect lamprey is extremely limited.

275. Furthermore, as lamprey are mobile when transiting through the Offshore Development Area during their migrations, they are considered likely to move away from any affected areas. Therefore, it is not considered that the impact of EMF emissions will hinder the conservation objectives of either lamprey feature of Pembrokeshire Marine SAC.

***Allis shad Alosa alosa (1102) and Twaite shad Alosa fallax (1103)***

276. Shad populations from the Rivers Tywi, Usk, Wye and Severn transit through the Pembrokeshire Marine SAC (NRW, 2018e). Although the exact path for migration for migratory fish features is not well understood, the shad features of the SAC have the potential to transit through the Offshore Development Area during their migrations.

277. During all stages of their life cycle, shad are pelagic fish and in estuaries the juveniles predominantly occur in the surface layers of the water column. Given the majority of the proposed Project is in deep water, it is expected that any changes in behaviour are more likely to occur in shallower water on approach to the landfall at Freshwater west. Freshwater West is a bay and therefore is thought to be beyond the typical migratory paths for the shad. As such, the area where EMF emissions from the cables have the potential to affect shad is extremely limited.

278. Additionally, as shad are mobile when transiting through the Offshore Development Area during their migrations, they are considered to be likely to move away from any affected areas. Therefore, it is not considered that the impact of EMF emissions will hinder the conservation objectives of either shad feature of Pembrokeshire Marine SAC.

***Conclusion***

**279.** Based on the conclusions above, and considering the limited spatial area in which migratory fish are likely to experience effects of EMF, it is not anticipated that the effects of EMF associated with the proposed Project will hinder the conservation objectives of the Annex II migratory fish features, thus there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to EMF emissions.**

***Disturbance effects to fish (such as barrier effects, collision and entanglement) from the presence of floating offshore structures and associated tethering systems***

280. The floating platforms and associated infrastructure on the seabed including chains and anchor points may act as aggregation devices for fish. The anchor chains which secure the turbines to the seafloor also provide a risk for entanglement for fish species. Therefore, the risk is considered to be localised the Array Area (**Table 8-9)**, and highest during periods of high flow, as the platforms will create an area of lower water velocity behind them, which may attract fish seeking refuge from the higher flows (Marine Space Ltd, 2019b). However, migratory fish are unlikely to aggregate at offshore structures due to their migratory instinct to swim upstream.

281. In terms of collision and entanglement risk, there will be a maximum of eight mooring lines per WTG, for which there will be 10 WTGs (total of 80 mooring lines). The exact dimensions of mooring lines have not yet been determined; however, the diameter will be thin and therefore they are unlikely to act as a barrier to fish species. The additional mooring lines are also considered to be very small in number are not considered to greatly increase the risk of collision. In addition, the mooring chains will be taught or semi-taut in the water column to maintain the position of the floating platform and is not considered to be capable of forming loops. The area of the Array Area is also very small and unlikely to act as a barrier to migrating fish species in the Celtic Sea, which is expansive.

282. Therefore, it is not considered that Annex II migratory fish feature will aggregate, collide, or tangle with offshore structures, and thus the proposed Project will not hinder the conservation objectives of these features and there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to the aggregation of fish and associated effects**.

***Underwater noise and vibration***

283. During operation of the proposed Project, underwater noise can be produced from both the rotating machinery in the turbines (non-impulsive), and from cables that may 'snap' as cable tension is released in the mooring system (impulsive). The sensitivity of migratory fish is discussed with construction phase activities (**Paragraphs 250** to **252**).

284. Sound generated by mooring equipment noise is considered to be 167.2 $SPL_{peak}$ (Burns, et al., 2022), falling outside of the hearing range of fish. This sound source is not considered to pose any risk to injury or disturbance and is scoped out of further consideration.

285. Cable snapping can occur when tension which has built up in the mooring lines of the floating turbines is released. This can also generate particle motion, which is known to be a key acoustic stimulus in fish (Popper, et al., 2014). Cable snapping was not assessed in the modelling of impacts from underwater noise (**Appendix 21B: Marine Mammals Noise Modelling**) as the noise produced is considered to below the threshold for any impact in fish species (Marine Space Ltd, 2019b), and the impact is not considered further.

286. During the operation and maintenance phase of the proposed Project, vibrations generated from the rotary machinery in the turbines can radiate out into the surrounding water column. As floating turbines are anchored to the floor, they have a reduced radiating area compared to monopiles and fixed foundations (Marine Space Ltd, 2019b). This is due to the smaller weighted and buoyant section resting beneath the sea surface, the area of which the radiating source is limited to (Barham & Mason, 2021). Based on criteria by Popper *et al*. (2014) a Barham and Mason (2021) concluded that sound and vibration measurements relating to the WTG operating would be dominated by background sound from shipping lanes. Additionally, Modelling of the impact of underwater noise as a result of WTG operation, including vibration from rotating machinery in the WTGs, concluded that any sound produced is expected to be very low and would not be above the threshold for disturbance in fish (**Appendix 21B: Marine Mammals Noise Modelling**).

287. Overall, the noise produced by the vibration from the rotating machinery in the WTGs, is not expected to be above ambient or above that produced by shipping vessel noise and would not elicit any behavioural responses from fish.

**288.** Based on the conclusions above, it is not anticipated that the underwater noise and vibration associated with the operation and maintenance phase of the proposed Project will hinder the conservation objectives of the Annex II migratory fish features, thus there **is no potential for an AEoSI on the Pembrokeshire Marine SAC due to underwater noise and vibration.**

***Effects to fish from maintenance activities***

289. Maintenance activities and cable repair where required, will be carried out using the same or similar methods as cable construction, and therefore the potential pathways for impact to fish and shellfish ecology would be the same as those identified for the construction phase of the proposed Project.

290. Repair works are likely to be highly localised to the area of concern and therefore the spatial extent of any impacts would be small in extent (**Table 8-8**). Furthermore, any maintenance or repairs works would be of a significantly shorter duration. A WCS is for up to five cable repairs assumed to be required over the lifetime of the proposed Project.

291. The only exception is where cable protection would be required (where rock had not been placed previously) as part of maintenance and cable repair works to achieve cable retrenching and reburial. In this event, further permanent physical disturbance to and/or loss of fish and shellfish would arise.

292. The OfECC will be routed to achieve the precautionary target depth of lowering as much as possible and a detailed review of cable protection requirements has already been undertaken. Maintenance and unforeseen cable repair (although unlikely) are routine, and the procedures and processes are well defined and is common in the industry. Impacts of maintenance and cable repair works would be of smaller magnitude than cable construction and likely small in extent and highly localised, only likely to be required for very small areas.

293. There will also be regular maintenance within the Array Area, including the WTGs. Although this will consist of an increase in vessels, these will be limited and would not represent a significant change from baseline, with lots of vessels already transiting this area.

294. Therefore, based on the conclusions associated with construction phase activities (Paragraphs 227 to 267), there is no potential for an AEoSI on the Pembrokeshire Marine SAC due to maintenance activities.

*Decommissioning effects*

295. At the end of the operational life of the proposed Project, there will be a DEMP in place. Other proposed Project constraints will also be taken into consideration (e.g. safety and liability), with the least environmentally damaging option chosen if possible.

296. The proposed Project has an anticipated lifetime of up to 30 years from full commissioning, and therefore advances may be made in the approach to decommissioning, or changes may be made to legislative requirements for decommissioning at this time. The full details of the proposed decommissioning will not be agreed until towards the end of the 30-year operational lifetime of the proposed Project, in line with the applicable legislation and taking into account guidelines at that time. This will include the decommissioning programme, activities involved and the arrangements for post-decommissioning monitoring, maintenance, and management of the proposed Project. Engagement with regulators and stakeholders will also be undertaken prior to decommissioning. The decommissioning phase of the proposed Project is expected to be complete within 12 months, between 2052 and 2054.

297. However, the decommissioning phase is expected to largely mirror the construction process over a period of 12 months (see **Chapter 04: Description of the Proposed Project**). This will include the removal of infrastructure, such as:

- WTGs will be de-energised and IAC cables disconnected and recovered or laid down for later recovery;
- Floating platforms will be disconnected from their moorings and the platform and WTG will be towed to local ports for disassembly;
- Anchors and moorings will be dismantled and recovered to shore for onshore disposal. However, if piles have been used as the anchor solution these will be cut off below the seabed level and the remaining structure recovered to the surface for onshore disposal; The decision to leave piles *in situ* would be agreed with the Regulator and relevant consultees to ensure this represented the most suitable approach;
- Both IAC and offshore export cables will be lifted from the water column or seabed using a grapnel and / or ROV and cables will be recovered to a vessel for onshore disposal. The recovery vessel will either spool the recovered cable into a carousel or will cut the cable into lengths as it is bought aboard, before being transported to shore;
- In the case of dynamic cables, buoyancy modules will also be removed and recovered to the vessel;
- Cable or scour protection will be recovered using a grab vessel and suitable barge for transport to shore; and
- Once onshore project components will be processed and disposed of in accordance with relevant regulations at the time of disposal.

***Temporary physical disturbance to fish and shellfish habitats and species from increased SSC and sediment deposition***

298. The removal of any infrastructure during the decommissioning phase would result in increased SSC and sediment deposition and subsequent temporary disturbance to migratory fish. It is likely that the equipment used to remove any cables would be similar to that used during the Construction phase (**Paragraphs 227** to **235**) and as such, increased SSC is considered to be similar to that during the construction phase, with the majority of sediment expected to have deposited in tens of centimetres thickness on the seabed between 50 – 500 m away of the source of disturbance (**Chapter 17: Physical Environment)**.

299. Therefore, similarly to the conclusions in **Paragraphs 227** to **235**, it is not anticipated that a potential increase in SSC and deposition will hinder the conservation objectives of any of the Annex II migratory fish features, due to the temporary and localised nature of any effects, distance from significant rivers and estuaries as well as the transitory nature of any migrating individuals (**Chapter 20: Fish and Shellfish Ecology**). Therefore, with adherence to the mitigation measures embedded into the cable construction methods (**Section 8.1.2**), there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to a temporary increase in SSC and sediment deposition.**

***Changes to marine water quality as a result of accidental leaks and spills from vessels, including loss of fuel oils***

300. Vessels will be required for the removal of any infrastructure as part of the decommissioning phase and any potential surveys requires. The management plans in place during decommissioning will be similar to the construction phase and will include the following: vessels will be required to comply with the International Regulations for Preventing Collisions at Sea (1972); regulations relating to International Convention for the Prevention of Pollution from Ships (MARPOL Convention 73/78) specifically including compliance with Annex IV on pollution by

sewage and prevention of air pollution by ships; and Annex V on pollution by garbage from ships with the aim of preventing and minimising pollution from ships. This will include SOPEP and will be secured via the CEMP (**Section 8.1.2**).

**301.** Overall, any changes to marine water quality as a result of accidental leaks and spills from vessels, would be similar or smaller in extent than during the Construction phase (**Paragraphs 246** to **249**). Additionally, with embedded mitigation and management measures in place (**Section 8.1.2**) the risk of an accidental spill occurring will be very low and should an accidental spill or leak occur, it would be very small in extent and subject to immediate dilution and rapid dispersal within the marine environment. Therefore, the likelihood of impact to all Annex II migratory fish features from accidental leaks and spills from vessels and equipment is predicted to be unlikely, and it is not anticipated that changes in water quality from vessels will hinder the conservation objectives of any of the Annex II migratory fish features, and thus is **no potential for an AEoSI of the Pembrokeshire Marine SAC due to changes to water quality from vessels.**

***Underwater noise and vibration***

302. There is not considered to be a requirement for further UXO detonation or any impact piling associated with the Decommissioning phase (as the any piles used as the anchor solution will be cut off below the seabed level and the remaining structure recovered to the surface for onshore disposal). However, there is the potential that further geophysical surveys may be required to assess the condition and location of the cable and any cable and scour protection as well as other physical environment information. If SBP is used then it has the potential to effect migratory fish, as it typically operates at frequencies <1 kHz and therefore are within the hearing range of the Annex II migratory fish features of Pembrokeshire Marine SAC.

303. The duration of the geophysical survey will be similar to the Construction phase and will likely operate the SBP at the same sound intensity ($SPL_{peak}$ of 238 dB re 1 µPa @ 1 m) (**Chapter 20: Fish and Shellfish Ecology**). As with underwater noise effects during Construction, effects from the SBP operations will be temporary and highly localised, and limited to low-level behavioural disturbance to lamprey and shad species within 327 m (**Paragraphs 259** and **264**), and TTS in shad species within 204 m from the source (**Paragraph 264**). These distances are considered to be small in extent, with mobile species, such as Annex II migratory fish able to avoid any area of potential disturbance. even for high hearing sensitivity fish species.

304. Therefore, it is not anticipated that underwater noise and vibration will hinder the conservation objectives of any of the Annex II migratory fish features, and thus there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to underwater noise and vibration**.

*All Other SACs with Annex II migratory fish features - Assessment of Adverse Effects Alone*

305. Of the European sites screened into the AA, the only site with migratory fish features that overlaps with the Offshore Development Boundary is the Pembrokeshire Marine SAC. All other sites that are designated for migratory fish are over 16 km away from the Offshore Development Boundary (**Table 8-7**). These sites were screened in based on a regional approach (ABPMer, 2014) that considered the potential for interaction between the Offshore Development Area and potential migratory fish that may transit through / close to the project boundary during seasonal migrations (**Appendix 8D: Habitats Regulations Assessment Screening**). These sites are:

- Cleddau Rivers SAC;
- Carmarthen Bay and Estuaries SAC;
- Cardigan Bay SAC;
- Afon Teifi SAC;

- River Tywi SAC;
- River Usk SAC;
- Severn Estuary Ramsar;
- Severn Estuary SAC; and
- River Wye SAC.

306. Moreover, as all the migratory fish features designated under these SACs will interact with the proposed Project in a similar manner, they will be considered together in the following assessment, unless otherwise stated. These migratory fish features include:

- River lamprey *Lampetra fluviatilis* (1099);
- Sea lamprey *Petromyzon marinus* (1095);
- Atlantic salmon *Salmo salar* (1106);
- Allis shad *Alosa alosa* (1102); and
- Twaite shad *Alosa fallax* (1103).

*Construction phase*

***Temporary physical disturbance to fish and shellfish habitats and species from increased SSC and sediment deposition***

307. Construction activities associated with the proposed Project, such as ploughing and jet trenching, have the potential to temporarily increase SSC, through the disturbance of sediment and the subsequent creation of sediment plumes in the water column which can travel away from the Offshore Development Area before depositing sediment elsewhere on the seabed. Several potential effects can arise from increased SSC and sediment deposition, including the clogging of gills and feeding apparatus, reduced feeding success of visual predators due to decreased visibility, the mortality of eggs and larvae which have a lower tolerance to turbid conditions, and effects related to toxic conditions if sediment-bound contaminants are disturbed. Fish migration and movement between important areas such as spawning and feeding grounds could also be impacted.

308. As discussed previously (Paragraphs 228 and229) and in Table 8-4, the tidal excursion distance during a mean tide is approximately 8 - 10 km in the middle of the OfECC and 14 km in the nearshore on approach to the landfall (Figure 8-5). However, based on modelling undertaken in Chapter 17: Physical Environment, any measurable change in SSC during construction will be temporary and localised. Only 6% of the surveyed sediments across nearshore and offshore sections of the Offshore Development Area consisted of mud (Figure 8-5) and therefore there is the potential for a very fine layer of mud to be deposited beyond 500 m. However, beyond 500 m it is expected that there will only be a low to intermediate increase in SSC (dispersing to ambient levels within one day following the activity), with fine sediment unlikely to deposit in any measurable thickness.

309. Several mitigation measures are embedded into the cable construction methods to minimise increased SSC during the construction phase of the proposed Project. These are outlined in **Section 8.1.1** in further detail.

310. The Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary Ramsar, Severn Estuary, and River Wye SACs are located more than 500 m away from the Offshore Project Boundary and therefore fall outside of the area where increased SSC is likely to be highest (greatest SSC and deposition to occur within 50 m of the OfECC). Moreover, the migratory fish features associated with these sites are only expected to transit

through the Offshore Development Area during their migrations, and thus are considered likely to move away from any areas that are affected, returning once SSC has settled.

311. Additionally, migratory fish tend to be pelagic, predominantly occurring in the surface layers of the water column, thus are unlikely to encounter mobilised sediment in the bottom 5 m of the water column.

***Conclusion***

312. Based on the conclusions above, it is not anticipated that a potential increase in SSC and deposition will hinder the conservation objectives of any of the Annex II migratory fish features. This is due to the temporary and localised nature of any effects, as well as the transitory nature of any migrating individuals (**Chapter 20: Fish and Shellfish Ecology**). Therefore, with adherence to the embedded measures embedded into the cable construction methods (**Section 8.1.1**), there is **no potential for an AEoSI on the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or Severn Estuary Ramsar due to increased SSC and deposition**.

***Impacts from changes to marine water quality from the mobilisation of contaminants***

313. Sediment-bound contaminants including heavy metals and PAHs could have detrimental impacts on fish and shellfish when present in concentrations above relevant thresholds and resuspended during disturbance to the seabed. Impacts can include cell apoptosis in fish immune systems (Reynaud & Deschaux, 2006). During the characterisation studies (**Appendix 19A: Nearshore 2023 Benthic Survey Report;** and **Appendix 19B: Offshore 2023 Benthic Survey Report**), arsenic was the only heavy metal to exceed CEFAS AL 1. Naphthalene was the only PAH to exceed the CSQG threshold effect level.

314. Contaminants are expected to be associated with finer materials such as silts and clays which make up a very low percentage of the total sediment composition Offshore Development Area (**Figure 8-5**). The majority of the sediment disturbed by installation and pre-installation activities will be deposited within 50 m (**Paragraph 229**), with limited measurable deposition of fine sediments beyond this distance and only a slight increase in SSC. The dilution processes over this distance are expected to result in very little or no detectable changes beyond 50 m, and therefore the area of affect is considered to be very small, with dilution of contaminants expected to occur rapidly if present.

315. The Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary Ramsar, Severn Estuary, and River Wye SACs are located more than 50 m away from the Offshore Development Area, at which point it is not expected that there will be detectable changes in sediment-bound contaminants.

316. Moreover, the migratory fish features associated with these sites are only expected to transit through the Offshore Development Area during their migrations, and thus are considered likely to move away from any areas that are affected. Additionally, migratory fish tend to be pelagic, predominantly occurring in the surface layers of the water column, thus are unlikely to encounter mobilised sediment in the bottom 5 m of the water column.

317. Based on the conclusions above, it is not anticipated that changes in water quality due to the mobilisation of contaminants will have an effect on the conservation objectives of any of the Annex II migratory fish features, and thus is **no potential for an AEoSI on the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or Severn Estuary Ramsar due to changes to marine water due to the mobilisation of contaminants.**

***Impacts from changes to marine water quality from the use of drilling fluids at HDD break-out points and resuspension of sediment contamination during seabed installation works***

318. Installation of the export cable between the terrestrial and marine environment will be undertaken via the use of HDD. The use of HDD and therefore the discharge of drilling fluids at the breakout location at the landfall could result in decreased water quality that can have effects on the health of migratory fish populations. It has been estimated that up to 1,700 $m^3$ of drilling mud will be generated. Constituents of the drilling fluids, including silt-clay sized particles such as bentonite have a maximum theoretical range of approximately 14 km, which is the tidal excursion on a mean tide in the nearshore area around the landfall and outside Milford Haven. However, discharged drilling fluid is expected to be subject to immediate dilution processes and rapid dispersal over this distance, which will result in no detectable change from the baseline beyond 500 m (**Table 8-8**). Therefore, only receptors in the immediate vicinity of the HDD breakouts have the potential to be in contact with drilling fluids if a leak or spill occurs.

319. The HDD will punch out in the intertidal zone of Freshwater West, exiting at a water depth of around 3 to 8 m, up to 960 m seaward of MHWS and therefore in a dynamic area with considerable wave action and tidal water movement. Moreover, all drilling fluids used, such as bentonite, will be selected from the OSPAR List of Substances / Preparations Used and Discharged Offshore (2021) which are considered to PLONOR (**Section 8.1.2**). The drilling fluid discharges from HDD operations will be a small number of single events over a short period of time and rapidly dispersed in an open sea coastal environment. Only receptors in the immediate vicinity of the HDD breakouts are likely to be in contact with drilling fluids, which pose little or no risk to the environment.

320. The Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary Ramsar, Severn Estuary, and River Wye SACs are located more than 500 m away from the HDD breakout point, at which point there will be no detectable change from the baseline. Due to the limited ZoI, the migratory fish features associated with these sites are only expected to potentially transit through the Offshore Development Area during their migrations and thus are considered likely to move away from any areas that are affected.

321. Therefore, based on the conclusions above, it is not anticipated that changes in water quality from the use of HDD will have an effect on the conservation objectives of any of the Annex II migratory fish features, and thus there is **no potential for an AEoSI on the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar due to changes in water quality due to HDD**.

***Impacts from changes to marine water quality as a result of accidental leaks and spills from vessels, including loss of fuel oils***

322. The accidental release of pollutants and planned release of wastewater could occur from any of the vessels associated throughout the proposed Project phases has the potential to alter water quality. Vessels could have cleaning fluids, oils, and hydraulic fluids onboard, which could be accidentally discharged, releasing hydrocarbons and chemical pollutants into the surrounding seawater, with consequences for migratory fish.

323. Minor spills could occur through several activities including leaking hydraulic hoses or during refuelling. However, such spills are expected to be small, consisting of only a few litres. If released into the marine environment these minor spills are expected to undergo rapid dispersion and evaporation when subjected to wave action, wind, currents and light, as well as degradation via bacterial action. Consequently, any small releases are likely to break up and disperse in a short space of time, resulting in little impact to the marine environment.

324. Larger spills, such as during collisions between vessels, have the potential to impact fish and shellfish, particularly if the spill is in shallow water. Therefore, as part of proposed management plans in place to reduce the risk of collisions, vessels will be required to comply with the International Regulations for Preventing Collisions at Sea (1972) and regulations relating to International Convention for the Prevention of Pollution from Ships (MARPOL Convention 73/78) specifically including compliance with Annex IV on pollution by sewage and prevention of air pollution by ships; and Annex V on pollution by garbage from ships with the aim of preventing and minimising pollution from ships. This will include SOPEP and will be secured via the CEMP (**Section 8.1.2**).

325. All effluent will be discharged in accordance with the applicable MARPOL Annex IV 'Prevention of Pollution from Ships' standards, and therefore the risk of an accidental spill is very low. If a leak did occur, it would be very small in extent and subject to immediate dilution and rapid dispersal within the marine environment. Therefore, the likelihood of impact to all migratory fish features from accidental leaks and spills from vessels and equipment is predicted to be unlikely. Therefore, it is not anticipated that changes in water quality from vessels will have an effect on the conservation objectives of any of the Annex II migratory fish features, and thus there is **no potential for an AEoSI on the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar due to changes in water quality from vessels** .

***Underwater noise and vibration***

326. The impacts of underwater noise and vibration associated with the proposed Project, and the sensitivity of migratory fish has previously been discussed in **Paragraphs 250** to **252.**

**327.** Fish use sound for communication, prey location and predator avoidance, and thus it is an important environmental cue (Fay & Popper, 2000). As discussed in **Paragraphs 252**, the impacts of underwater noise include physical or physiological effects, auditory damage, masking, and behavioural responses. Sensitivity to sound varies between fish species according to the frequency of the sound.

328. The impact of underwater noise and vibration has been assessed in **Chapter 20: Fish and Shellfish Ecology.** The activities with the highest SPLs were the SBP within the OfECC, and the impact piling associated with the Array Area.

329. As discussed in **Paragraph 254**, SBP will be used to undertake geophysical surveys of the seabed to determine seabed structure, water depth, the presence of any obstructions and to track the location of ROVs within the OfECC. Impact piling will be required to anchor the floating WTGs to the seabed within the Array Area. In a worst-case scenario there will be eight anchors per WTG, with a total of ten WTG. As these activities have the highest SPLs, these activities will be assessed within the following assessment.

330. Moreover, there is the potential for UXO detonation to be required there is the potential for the underwater sound to cause injury and disturbance to migratory fish features. As stated in **Paragraph 256**, an application for a separate Marine Licence in respect of UXO clearance will be made post submission, however, an assessment of the effect of UXO detonation is included here.

***River lamprey Lampetra fluviatilis (1099) and Sea lamprey Petromyzon marinus (1095)***

331. Both sea and river lamprey are considered to have a low hearing sensitivity, meaning they do not possess a swim bladder or other gas chamber and are less susceptible to barotrauma and behavioural disturbance.

332. SBP will operate at an $SPL_{peak}$ of 238 dB re 1 µPa @ 1 m. It is not considered that the impact of underwater noise and vibration from SBP result in injury for lamprey species, however, low-level

behavioural disturbance is predicted within a maximum distance of 327 m. This distance is considered to be small in extent and are not considered to act as a barrier to fish migration, with mobile species, such as lamprey, able to avoid any area of potential disturbance. Furthermore, as SBP will be temporary and variable in location, it is not considered that the impact of underwater noise and vibration associated with SBP will hinder the conservation of either Annex II lamprey features the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar.

333. Impact piling is considered to have a $SPL_{peak}$ of 235 dB re 1 µPa @ 1 m. In **Chapter 20: Fish and Shellfish Ecology**, it was concluded that the threshold for mortality and recoverable injury for all fish species, is only predicted to occur within 0 m from the sound source. Moreover, behavioural disturbance could occur within a maximum distance of 30.7 km. As discussed in **Paragraph 260**, despite the parameters of the modelling estimated disturbance to occur over 80 days (**Chapter 20: Fish and Shellfish Ecology**), in reality the duration of the piling works is expected to be much shorter. Therefore, any impacts will be temporary and short term. Similarly, as discussed in **Paragraph 260**, the modelling was overly precautionary, and it is predicted that for low hearing sensitivity fish, such as lamprey, low-level behavioural disturbance is only anticipated in near distances (i.e. tens of metres). Although there will be avoidance behaviour to the impact piling area of disturbance, as there will be a soft-start procedure, which has been proposed as part of **Chapter 21: Marine Mammals**, and as lamprey are mobile species, they can move away from the sound source as it commences and return to the area once impact piling has stopped. Therefore, it is not considered that the impact of underwater noise and vibration associated with impact piling will hinder the conservation of either Annex II lamprey features the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar.

334. In the instance that UXO detonation will be required, using the worst-case scenario, detonation charge size of 794 kg and a threshold value of 229 dB re 1µPa $SPL_{peak,}$ mortality or injury could occur up to a maximum of 1.02 km for all hearing sensitivity fish species. As previously stated in **Paragraph 261**, onset TTS is considered appropriate for UXO clearance disturbance assessments because the noise resulting from a clearance event is short lived in the environment (Robinson, et al., 2022). Popper et al. (2014) reports that there is a high probability of TTS occurring at near distances (i.e. tens of metres) for fish species with a low hearing sensitivity. Therefore, any behavioural disturbance will also be highly localised and very short in duration and fish can return to the area following detonation. If behavioural disturbance is greater than 1 km, then any effects will be momentary and therefore obstruction to migratory routes will negligible. As stated in **Paragraph 262**, JNCC guidelines (2010) will be adopted during UXO clearance activities to further minimise the potential risk of injury to migratory fish. Therefore, given the mitigation measures and the short and intermittent nature of this activity and that effects are most likely to be limited to the vicinity of the area where the detonation takes place, it is not considered that the impact of underwater noise and vibration associated with the proposed Project will hinder the conservation objectives of either Annex II lamprey feature of the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar.

***Allis shad Alosa alosa (1102) and Twaite shad Alosa fallax (1103)***

335. Both, Allis and Twaite shad are considered to have a high hearing sensitivity to underwater noise and vibration as they use a swim bladder (or another gas volume) for hearing. These species can detect sound pressure and particle motion and are susceptible to barotrauma and thus have the potential to be impacted by underwater noise and vibration associated with the proposed Project.

336. SBP is considered to have a $SPL_{peak}$ of 238 dB re 1 µPa @ 1 m. In **Chapter 20: Fish and Shellfish Ecology**, it was concluded that the maximum distance over which SBP is predicted to result in TTS in high sensitivity fish is 204 m. Moreover, low-level behavioural disturbance was predicted within a maximum distance of 327 m. Therefore, these distances are considered to be small in extent, with mobile species, such as shad, able to avoid any area of potential disturbance. Although, the Annex II shad populations have the potential transit through / close to the Offshore Development Area, the limited extent of the effects of underwater noise and vibration is not considered to act as a barrier to fish migration. Furthermore, as SBP will be temporary and variable in location, it is not considered that the impact of underwater noise and vibration associated with SBP will hinder the conservation of the Annex II shad features of Carmarthen Bay and Estuaries, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar.

337. Impact piling is considered to have a $SPL_{peak}$ of 235 dB re 1 µPa @ 1 m. In **Chapter 20: Fish and Shellfish Ecology**, it was concluded that the threshold for mortality and recoverable injury for all fish species, is only predicted to occur within 0 m from the sound source. Moreover, behavioural disturbance could occur within a maximum distance of 30.7 km. Based on these distances, there is potential for disturbance to Annex II shad populations migrating transit through / close to the Offshore Development Area. As discussed in **Paragraph 260**, despite the parameters of the modelling estimated disturbance to occur over 80 days (**Chapter 20: Fish and Shellfish Ecology**), in reality the duration of the piling works is expected to be much shorter. Therefore, any impacts will be temporary and short term Similarly, as discussed in **Paragraph 260**, the modelling was overly precautionary, and it is predicted that for high hearing sensitivity fish, such as shad, low-level behavioural disturbance is only anticipated in intermediate distances (i.e. less than 1 km). Although there will be avoidance behaviour to the impact piling area of disturbance, as there will be a soft-start procedure, which has been proposed as part of **Chapter 21: Marine Mammals,** and as shad are mobile and can move away from the sound source as it commences, thus it is not considered that the impact of underwater noise and vibration associated with impact piling will hinder the conservation of the Annex II shad feature of the Carmarthen Bay and Estuaries, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar.

338. In the instance that UXO detonation will be required, using the worst-case scenario, detonation charge size of 794 kg and a threshold value of 229 dB re 1µPa $SPL_{peak,}$ mortality or injury could occur up to a maximum of 1.02 km for all hearing sensitivity fish species. As previously stated in **Paragraph 261**, onset TTS is considered appropriate for UXO clearance disturbance assessments because the noise resulting from a clearance event is short lived in the environment (Robinson, et al., 2022). Popper et al. (2014) reports that there is a high probability of TTS occurring at intermediate distances (i.e. hundreds of metres) for high hearing sensitivity fish. Therefore, any behavioural disturbance will also be highly localised and very short in duration and fish can return to the area following detonation. If behavioural disturbance is greater than 1 km, then any effects will be momentary and therefore obstruction to migratory routes will negligible. As stated in **Paragraph 262**, JNCC guidelines (2010) will be adopted during UXO clearance activities to further minimise the potential risk of injury to migratory fish. Therefore, given the mitigation measures and the short and intermittent nature of this activity and that effects are most likely to be limited to the vicinity of the area where the detonation takes place, it is not considered that the impact of underwater noise and vibration from UXO detonation will hinder the conservation objectives of either Annex II shad feature of the Carmarthen Bay and Estuaries, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar.

***Atlantic salmon Salmo salar (1106)***

339. Atlantic salmon are considered to have a medium sensitivity to underwater noise and vibration as they use a swim bladder (or another gas volume) for hearing. This species possesses

a swim bladder but do not use it for hearing, instead only detect particle motion rather than sound pressure. Therefore, Atlantic salmon are still susceptible to barotrauma and thus have the potential to be impacted by underwater noise and vibration associated with the proposed Project.

340. SBP will operate at an $SPL_{peak}$ of 238 dB re 1 µPa @ 1 m. In **Chapter 20: Fish and Shellfish Ecology**, it was concluded that the maximum distance over which SBP is predicted to result in a recoverable injury is 100 m. Moreover, low-level behavioural disturbance was predicted within a maximum distance of 327 m. These distances are considered to be small in extent, with mobile species, such as Atalntic salmon, able to avoid any area of potential disturbance. Although, the Annex II Atlantic salmon have the potential transit through / close to the Offshore Development Area, the limited extent of the effects of underwater noise and vibration is not considered to act as a barrier to fish migration. Furthermore, as SBP will be temporary and variable in location, it is not considered that the impact of underwater noise and vibration associated with SBP will hinder the conservation of the Annex II Atlantic salmon features of Afon Teifi, River Usk, River Wye SACs, and Severn Estuary Ramsar.

341. In **Chapter 20: Fish and Shellfish Ecology**, it was concluded that the threshold for mortality and recoverable injury for all fish species, is only predicted to occur within 0 m from the impact piling activities. Moreover, behavioural disturbance could occur within a maximum distance of 30.7 km. Based on these distances, there is potential for disturbance to Annex II Atlantic salmon migrating transit through / close to the Offshore Development Area. However, impact piling for the proposed Project is only expected to occur over a period of four hours each time during a 24-hour period. It is estimated that the piling will last for 80 days in total and therefore, will be temporary and short term. Therefore, although there will be avoidance behaviour to the impact piling area of disturbance, as there will be a soft-start procedure and Atlantic salmon are mobile species, they can move away from the sound source as it commences, thus it is not considered that the impact of underwater noise and vibration associated with impact piling will hinder the conservation of the Annex II Atlantic salmon feature of the Afon Teifi, River Usk, River Wye SACs, and Severn Estuary Ramsar.

342. In the instance that UXO detonation will be required, using the worst-case scenario, detonation charge size of 794 kg and a threshold value of 229 dB re 1µPa $SPL_{peak,}$ mortality or injury could occur up to a maximum of 1.02 km for all hearing sensitivity fish species. As previously stated in **Paragraph 261**, onset TTS is considered appropriate for UXO clearance disturbance assessments because the noise resulting from a clearance event is short lived in the environment (Robinson, et al., 2022). Popper et al. (2014) reports that there is a high probability of TTS occurring at near distances (i.e. tens of metres) for fish species with a medium hearing sensitivity. Therefore, any behavioural disturbance will also be highly localised and very short in duration and fish can return to the area following detonation. If behavioural disturbance is greater than 1 km, then any effects will be momentary and therefore obstruction to migratory routes will negligible. As stated in **Paragraph 262**, JNCC guidelines (2010) will be adopted during UXO clearance activities to further minimise the potential risk of injury to migratory fish. Therefore, given the mitigation measures and the short and intermittent nature of this activity and that effects are most likely to be limited to the vicinity of the area where the detonation takes place, it is not considered that the impact of underwater noise and vibration from UXO detonation will hinder the conservation objectives of Annex II Atlantic salmon feature of the Afon Teifi, River Usk, River Wye SACs, and Severn Estuary Ramsar.

***Conclusion***

343. Based on the conclusions above, it is not anticipated that underwater noise and vibration will hinder the conservation objectives of any of the Annex II migratory fish features. Both lamprey features are not considered to be sensitive to underwater noise and vibration, and effects to the

shad and Atlantic salmon features will be limited avoidance behaviour that would not be significantly different to wide ranging foraging and predator avoidance behaviour, nor would migration be prevented. Therefore, it is not considered to hinder the conservation objectives of the Annex II migratory fish features, and thus there is **no potential for an AEoSI on the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar due to underwater noise and vibration**.

*Operation and Maintenance phase*

***Effects of EMF emissions***

344. Subsea cables associated with the proposed Project, including both inter-array cables and export cables are known to produce EMF emissions (Hutchison, et al., 2020) and have the potential to affect the foraging and migratory success and behaviour of fish.

345. EMF emissions will occur for the operational lifetime of the proposed Project from the export cables and inter-array cables. The target depth of subsea cables with the OfECC is 1.2 m (a minimum depth of 0.8 m). The findings from the project-specific EMF Assessment (**Appendix 19C: EMF Assessment**) found that the maximum EMF strength predicted to result from the operation of the export cables at a minimum burial depth of 1.2 m, when a receptor is 0 m from the seabed, is 2.6 µT. The effects of EMF reduce with distance from the cable, and the modelling shows negligible emissions beyond a distance of 2 m for this burial depth. Where burial is greater this distance will be further reduced.

346. For dynamic exposed cables in the water column, such as those within the Array Area, the maximum EMF strength at the surface of the cables has been calculated as ~5.2 mT. This is significantly higher than the background level of geomagnetic field in the UK, which is around 50 µT but this also decreases rapidly with distance from the cable. At a distance of 0.44 m from the cable surface EMF is approximately equal to background levels (**Appendix 19C: EMF Assessment**) (**Table 8-8**).

347. The increase in background EMF is considered to be restricted to a small area around the proposed Project cables. As all other SACs are beyond 16 km from the Offshore Development Area, there is only potential for impacts on migratory fish when transiting the waters in / near the Offshore Development Area.

348. As previously discussed (**Paragraph 272**), migratory fish have shown distinct directional and behavioural reactions to magnetic fields, such as reduced swimming speed in European eels (Westerberg & Begout-Anras, 2000; Westerberg & Langfelt, 2008; Öhman, et al., 2007). However, a recent review concluded that current research does not indicate negative effects of EMF on fish movement and migratory behaviour (OSPAR, 2023). Moreover, migratory species spend a large amount of time in the upper reaches of the water column and given the majority of the proposed Project is in deep water, it is expected that any changes in behaviour are more likely to occur in shallower water on approach to the landfall at Freshwater west. As such, the area where EMF emissions from the cables have the potential to affect lamprey is extremely limited. Furthermore, as Annex II migratory fish are mobile when transiting through the Offshore Development Area during their migrations, they are considered likely to move away from any affected areas.

***Conclusion***

**349.** Based on the conclusions above, and considering the limited spatial area in which migratory fish are likely to experience effects of EMF, it is not anticipated that the effects of EMF associated with the proposed Project will hinder the conservation objectives of the Annex II migratory fish features, thus there is **no potential for an AEoSI on the Cleddau Rivers, Carmarthen Bay and**

**Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar due to EMF emissions**.

***Disturbance effects to fish (such as barrier effects, collision and entanglement) from the presence of floating offshore structures and associated tethering systems***

350. The floating platforms and associated infrastructure on the seabed including chains and anchor points may act as aggregation devices for fish.

351. The anchor chains which secure the turbines to the seafloor also provide a risk for entanglement for fish species. Therefore, the risk is considered to be localised the Array Area **(Table 8-8),** and highest during periods of high flow, as the platforms will create an area of lower water velocity behind them, which may attract fish seeking refuge from the higher flows (Marine Space Ltd, 2019b). However, migratory fish are unlikely to aggregate at offshore structures due to their migratory instinct to swim upstream.

352. In terms of collision and entanglement risk, there will be a maximum of eight mooring lines per WTG, for which there will be 10 WTGs (total of 80 mooring lines). The exact dimensions of mooring lines have not yet been determined; however, the diameter will be thin and therefore they are unlikely to act as a barrier to fish species. The additional mooring lines are also considered to be very small in number are not considered to greatly increase the risk of collision. In addition, the mooring chains will be taught or semi-taut in the water column to maintain the position of the floating platform and is not considered to be capable of forming loops. The area of the Array Area is also very small and unlikely to act as a barrier to migrating fish species in the Celtic Sea, which is expansive.

***Conclusion***

353. It is not considered that Annex II migratory fish feature will aggregate, collide, or tangle with offshore structures, and thus the proposed Project will not hinder the conservation objectives of these features and there is **no potential for an AEoSI on the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar due to the aggregation of fish and associated effects**.

***Underwater noise and vibration***

354. During operation of the proposed Project, underwater noise can be produced from both the rotating machinery in the turbines (non-impulsive), and from cables that may 'snap' as cable tension is released in the mooring system (impulsive). The sensitivity of migratory fish is discussed with construction phase activities (**Paragraphs 250** to **252**).

355. As previously discussed in **Paragraphs 284** and **285**, sound generated by mooring equipment noise and cable snapping is scoped out of further consideration as they fall beyond the hearing range of fish.

356. During the operation and maintenance phase of the proposed Project, vibrations generated from the rotary machinery in the turbines can radiate out into the surrounding water column. Based on criteria by Popper *et al*. (2014), Barham and Mason (2021) concluded that sound and vibration measurements relating to the WTG operating would be dominated by background sound from shipping lanes. Additionally, Modelling of the impact of underwater noise as a result of WTG operation, including vibration from rotating machinery in the WTGs, concluded that any sound produced is expected to be very low and would not be above the threshold for disturbance in fish (**Appendix 21B: Marine Mammals Noise Modelling**).

357. Given the limited area of effects and that the turbines are located in deep water, it is considered that there is a large amount of additional suitable habitat during the operation and maintenance phase of the proposed Project. Furthermore, the noise produced by the vibration

from the rotating machinery in the WTGs, is not expected to be above ambient or above that produced by shipping vessel noise and would not elicit any behavioural responses from fish.

***Conclusion***

358. Based on the conclusions above, it is not anticipated that the underwater noise and vibration associated with the operation and maintenance phase of the proposed Project will hinder the conservation objectives of the Annex II migratory fish features, thus there **no potential for an AEoSI on the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or Severn Estuary Ramsar due to underwater noise and vibration**.

***Effects to fish and shellfish from maintenance activities***

359. Maintenance activities and cable repair where required, will be carried out using the same or similar methods as cable construction, and therefore the potential pathways for impact to fish and shellfish ecology would be the same as those identified for the construction phase of the proposed Project.

360. Repair works are likely to be highly localised to the area of concern and therefore the spatial extent of any impacts would be small in extent (**Table 8-8**). Furthermore, any maintenance or repairs works would be of a significantly shorter duration. A WCS is for up to five cable repairs assumed to be required over the lifetime of the proposed Project.

361. The only exception is where cable protection would be required (where rock had not been placed previously) as part of maintenance and cable repair works to achieve cable retrenching and reburial. In this event, further permanent physical disturbance to and/or loss of fish and shellfish would arise.

362. The OfECC will be routed to achieve the precautionary target depth of lowering as much as possible and a detailed review of cable protection requirements has already been undertaken. Maintenance and unforeseen cable repair (although unlikely) are routine, and the procedures and processes are well defined and is common in the industry. Impacts of maintenance and cable repair works would be of smaller magnitude than cable construction and likely small in extent and highly localised, only likely to be required for very small areas.

363. There will also be regular maintenance within the Array Area, including the WTGs. Although this will consist of an increase in vessels, these will be limited and would not represent a significant change from baseline, with lots of vessels already transiting this area.

***Conclusion***

364. Therefore, based on the conclusions associated with construction phase activities (**Paragraphs 307 to 343**), there no potential for an AEoSI on the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or Severn Estuary Ramsar due to maintenance activities.

*Decommissioning effects*

365. At the end of the operational life of the proposed Project, there will be a DEMP in place. Other proposed Project constraints will also be taken into consideration (e.g. safety and liability), with the least environmentally damaging option chosen if possible.

366. The full details of the proposed decommissioning will not be agreed until towards the end of the 30-year operational lifetime of the proposed Project, in line with the applicable legislation and taking into account guidelines at that time. This will include the decommissioning programme, activities involved and the arrangements for post-decommissioning monitoring, maintenance, and management of the proposed Project. Engagement with regulators and stakeholders will also be

undertaken prior to decommissioning. The decommissioning phase of the proposed Project is expected to be complete within 12 months, between 2052 and 2054.

367. However, the decommissioning phase is expected to largely mirror the construction process over a period of 12 months (see **Chapter 04: Description of the Proposed Project**). This will include the removal of infrastructure, such as:

- WTGs will be de-energised and IAC cables disconnected and recovered or laid down for later recovery;
- Floating platforms will be disconnected from their moorings and the platform and WTG will be towed to local ports for disassembly;
- Anchors and moorings will be dismantled and recovered to shore for onshore disposal. However, if piles have been used as the anchor solution these will be cut off below the seabed level and the remaining structure recovered to the surface for onshore disposal; The decision to leave piles *in situ* would be agreed with the Regulator and relevant consultees to ensure this represented the most suitable approach.
- Both IAC and offshore export cables will be lifted from the water column or seabed using a grapnel and / or ROV and cables will be recovered to a vessel for onshore disposal. The recovery vessel will either spool the recovered cable into a carousel or will cut the cable into lengths as it is bought aboard, before being transported to shore;
- In the case of dynamic cables, buoyancy modules will also be removed and recovered to the vessel;
- Cable or scour protection will be recovered using a grab vessel and suitable barge for transport to shore; and
- Once onshore project components will be processed and disposed of in accordance with relevant regulations at the time of disposal.

***Temporary physical disturbance to fish and shellfish habitats and species from increased SSC and sediment deposition***

368. The removal of any infrastructure during the decommissioning phase would result in increased SSC and sediment deposition and subsequent temporary disturbance to migratory fish. It is likely that the equipment used to remove any cables would be similar to that used during the Construction phase (**Paragraphs 307** to **312**) and as such, increased SSC is considered to be similar to that during the construction phase, with the majority of sediment expected to have deposited in tens of centimetres thickness on the seabed between 50 – 500 m away of the source of disturbance (**Chapter 17: Physical Environment)**.

369. Therefore, similarly to the conclusions in **Paragraphs 307** to **312**, it is not anticipated that a potential increase in SSC and deposition will hinder the conservation objectives of any of the Annex II migratory fish features, due to the temporary and localised nature of any effects, distance from significant rivers and estuaries as well as the transitory nature of any migrating individuals (**Chapter 20: Fish and Shellfish Ecology**). Therefore, with adherence to the mitigation measures embedded into the cable construction methods (**Section 8.1.2**), there is **no potential for an AEoSI on the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or Severn Estuary Ramsar due to increased SSC and deposition.**

***Changes to marine water quality as a result of accidental leaks and spills from vessels, including loss of fuel oils***

370. Vessels will be required for the removal of any infrastructure as part of the decommissioning phase and any potential surveys requires. The management plans in place during

decommissioning will be similar to the construction phase and will include the following: vessels will be required to comply with the International Regulations for Preventing Collisions at Sea (1972); regulations relating to International Convention for the Prevention of Pollution from Ships (MARPOL Convention 73/78) specifically including compliance with Annex IV on pollution by sewage and prevention of air pollution by ships; and Annex V on pollution by garbage from ships with the aim of preventing and minimising pollution from ships. This will include SOPEP and will be secured via the CEMP (**Section 8.1.2**).

**371.** Overall, any changes to marine water quality as a result of accidental leaks and spills from vessels, would be similar or smaller in extent than during the Construction phase (**Paragraphs 322** to **325**). Additionally, with embedded mitigation and management measures in place (**Section 8.1.2**) the risk of an accidental spill occurring will be very low and should an accidental spill or leak occur, it would be very small in extent and subject to immediate dilution and rapid dispersal within the marine environment. Therefore, the likelihood of impact to all Annex II migratory fish features from accidental leaks and spills from vessels and equipment is predicted to be unlikely, and it is not anticipated that changes in water quality from vessels will hinder the conservation objectives of any of the Annex II migratory fish features, and thus is **no potential for an AEoSI of the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or Severn Estuary Ramsar due to changes to water quality from vessels.**

***Underwater noise and vibration***

372. There is not considered to be a requirement for further UXO detonation or any impact piling associated with the Decommissioning phase (as the any piles used as the anchor solution will be cut off below the seabed level and the remaining structure recovered to the surface for onshore disposal). However, there is the potential that further geophysical surveys may be required to assess the condition and location of the cable and any cable and scour protection as well as other physical environment information. If SBP is used then it has the potential to effect migratory fish, as it typically operates at frequencies <1 kHz and therefore are within the hearing range of the Annex II migratory fish features of the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or the Severn Estuary Ramsar.

373. The duration of the geophysical survey will be similar to the Construction phase and will likely operate the SBP at the same sound intensity ($SPL_{peak}$ of 238 dB re 1 µPa @ 1 m) (**Chapter 20: Fish and Shellfish Ecology**). As with underwater noise effects during Construction, effects from the SBP operations will be temporary and highly localised, and limited to low-level behavioural disturbance to lamprey and shad species as well as Atlantic salmon within 327 m (**Paragraphs 332**, **336,** and, **340**,respectively). Additionally, TTS in is only anticipated in shad species within 204 m from the source (**Paragraph 336**), and the recoverable injury in Atlantic salmon is predicted within a maximum distance of 100 m (**Paragraph 340**). These distances are considered to be small in extent, with mobile species, such as Annex II migratory fish able to avoid any area of potential disturbance. even for high hearing sensitivity fish species.

374. Therefore, it is not anticipated that underwater noise and vibration will hinder the conservation objectives of any of the Annex II migratory fish features, and thus there is **no potential for an AEoSI on the Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, or Severn Estuary Ramsar due to underwater noise and vibration**.

**Information for Assessment of Adverse Effects In-Combination**

375. The following projects have been considered in order to identify whether they have the potential for in-combination effects on the Annex II migratory fish based on their potential impact pathways to the same European sites as the Project:

- Greenlink Interconnector;
- Llyr 2 Floating Offshore Wind Project;
- Valorous Wind;
- Erebus offshore wind;
- Dragon Energy Project;
- South Pembrokeshire Demonstration Zone tidal energy project;
- Trivane Demonstrator offshore wind;
- White Cross offshore wind;
- Crown Estate Leasing Round 5 offshore wind projects (including the Llewelyn and Gwynt Glas, Celtic Deep Phase 1, Celtic Deep Phase 2, Petroc, Celtic Sea RWE Renewables, and Morwind projects);
- Three telecommunications cable projects; and
- Nobel Banks Mineral Aggregate Site.

376. The potential for in-combination effects are summarised in **Table 8-9**, concluding that there is no potential for in-combination effects on the Annex II migratory fish of Pembrokeshire Marine SAC, Cleddau Rivers, Carmarthen Bay and Estuaries, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs, and Severn Estuary Ramsar.

*Table 8-9. Summary of in-combination effects on Annex II migratory fish*

| Project name | Potential for in-combination effects: Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116); Cleddau Rivers / Afonydd Cleddau SAC (UK0030074); Carmarthen Bay and Estuaries / Bae Caerfyddin ac Aberoedd; Cardigan Bay / Bae Ceredigion SAC (UK0012712); Afon Teifi / River Teifi SAC (UK0012670); River Tywi / Afon Tywi SAC (UK0013010); River Usk / Afon Wysg SAC (UK0013007); Severn Estuary Ramsar (UK11081); Severn Estuary / Môr Hafren SAC (UK0013030); River Wye / Afon Gwy SAC (UK0012642) |
|---|---|
| **Greenlink Interconnector**<br>Interconnector<br>Construction | **No**.<br>The Cleddau Rivers, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs and Severn Estuary Ramsar sites have not been scoped in for the Greenlink Interconnector HRA for Annex II migratory fish, therefore no pathway has been identified for in-combination effects on these SACs.<br>Although the Pembrokeshire Marine and Carmarthen Bay and Estuaries SACs were screened into the Greenlink Interconnector HRA., it was concluded that there was no potential for LSE on the Annex II migratory fish features of either SAC (Greenlink, 2020).<br>The proposed Project identified no AEoSI alone on either of the Pembrokeshire Marine and Carmarthen Bay and Estuaries SACs and considers there to be no in-combination effects of either site with the Greenlink Interconnector. |
| **Llŷr 2 Floating Offshore Wind Project**<br>Offshore Wind<br>Pre-Application | **No.**<br>There is potential for simultaneous construction of the proposed Project and Llŷr 2, which is anticipated to commence in 2027 / 2028.<br>Given that Llŷr 2will adopt the same OfECC as the proposed Project, the only potential impact pathways will be associated with the Array Area. These impact pathways will be limited to those associated with construction activities (temporary increase in SSC, and underwater noise and vibration), and EMF emissions from IACs, disturbance from floating offshore infrastructure, and underwater noise from rotating machinery and cable 'snapping' of the mooring system.<br>In terms of any in-combination effects of increased SSC and deposition, in-combination effect would only apply to the finer fragments of the particulate matter, as the largest sediment plumes and highest levels of increased SSC are associated with the disturbance of sediments which have a high proportion of fine particulate matter, such as muds and clays. Considering most of the sediment in the OfECC and the Array Area is dominated by sand and gravel particles, the likelihood of plumes overlapping is therefore reduced significantly. Thus, should the works be temporally separated between projects, it is considered there will be |

| Project name | Potential for in-combination effects<br>Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116)<br>Cleddau Rivers / Afonydd Cleddau SAC (UK0030074)<br>Carmarthen Bay and Estuaries / Bae Caerfyddin ac Aberoedd<br>Cardigan Bay / Bae Ceredigion SAC (UK0012712)<br>Afon Teifi / River Teifi SAC (UK0012670)<br>River Tywi / Afon Tywi SAC (UK0013010)<br>River Usk / Afon Wysg SAC (UK0013007)<br>Severn Estuary Ramsar (UK11081)<br>Severn Estuary / Môr Hafren SAC (UK0013030)<br>River Wye / Afon Gwy SAC (UK0012642) |
|---|---|
| | sufficient time to allow any localised increases in SSC to disperse and dilute. The majority of the sediment disturbed by the proposed Project will be deposited within 50 m and therefore effects are considered to be highly localised to the individual project. For impacts associated with underwater noise and vibration, the Llŷr 2 Floating Offshore Wind Project is assumed to have similar effects as that of the proposed Project, assuming that similar methods will be used. If these activities occurred concurrently, they will be short-term and temporary. If disturbance effects were to occur between the proposed Project and the Llŷr 2 Floating Offshore Wind Project, then a maximum disturbance distance of 2 km is predicted from each Array Area. However, as these sites are further offshore, this distance would not be large enough to result in a barrier to fish migration and individuals would be able to return once the temporary activities were completed.<br>Given the limited area of EMF emissions from IACs, disturbance from floating offshore infrastructure, and underwater noise from rotating machinery and cable 'snapping' of the mooring system, and the transitory presence of any migratory fish in the Array Area, the proposed Project identified no AEoSI alone on any of the SACs considered within the assessment. Furthermore, it is not anticipated that the cumulative impact of Llŷr 2 will hinder the conservation objectives of any Annex II migratory fish features of any of the SACs considered, and there is no potential for in-combination with the Llŷr 2 Floating Offshore Wind Project. |
| **Valorous / Blue Gem Wind**<br>Offshore wind<br>Planned | **No.**<br>There is potential for simultaneous construction of the proposed Project and Valorous, which is anticipated to commence in 2028. However, it should be noted, that although the Valorous scoping report noted this construction timeline, the project has been delayed and therefore the construction timelines are expected to be several years later than this. Therefore, it is not anticipated that the construction period will overlap with the proposed Project.<br>However, due to the early stage of project development, it is not known if Annex II migratory fish will be impacted by this project. Therefore, as the proposed Project can draw the conclusion of no AEoSI with mitigation alone, it is for the Valorous to demonstrate no in-combination effects on any of the SACs with Annex II migratory fish features. |

| Project name | Potential for in-combination effects |
|---|---|
| | Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) |
| | Cleddau Rivers / Afonydd Cleddau SAC (UK0030074) |
| | Carmarthen Bay and Estuaries / Bae Caerfyddin ac Aberoedd |
| | Cardigan Bay / Bae Ceredigion SAC (UK0012712) |
| | Afon Teifi / River Teifi SAC (UK0012670) |
| | River Tywi / Afon Tywi SAC (UK0013010) |
| | River Usk / Afon Wysg SAC (UK0013007) |
| | Severn Estuary Ramsar (UK11081) |
| | Severn Estuary / Môr Hafren SAC (UK0013030) |
| | River Wye / Afon Gwy SAC (UK0012642) |
| **Erebus**<br>Offshore wind<br>Consented | **No.**<br>The Carmarthen Bay and Estuaries, Afon Teifi, River Tywi, River Usk, Severn Estuary, River Wye SACs and Severn Estuary Ramsar sites have not been scoped in for the Erebus HRA, therefore no pathway has been identified for in-combination effects on these SACs.<br>Although the Pembrokeshire Marine and Cleddau Rivers SACs were screened into the Erebus HRA, it was concluded that there was no potential for LSE on the Annex II migratory fish features of either SAC (MarineSpace Ltd, 2021).<br>For in-combination effects to occur for underwater sound, activities would need to be conducted simultaneously. Construction is not anticipated to run concurrently. Additionally, any impact of EMF is anticipated to be highly localised to each project. Therefore, as the proposed Project identified no AEoSI alone on either of the Pembrokeshire Marine and Cleddau Estuaries SACs and considers there to be no in-combination effects of either site with the Erebus project. |
| **Dragon Energy Project**<br>Inshore Energy<br>Pre-Application | **No.**<br>The Dragon Energy project is screened into the in-combination assessment for the following impact pathways:<br>• Impacts of changes to marine water quality; and<br>• Underwater sound and vibration.<br>The Dragon Energy project is in concept / planning stages. Therefore, as the proposed Project can draw the conclusion of no AEoSI with mitigation alone, it is for the Dragon Energy Project to demonstrate no in-combination effects. Moreover, the Dragon Energy Project is located terrestrially, thus any impacts to Annex II migratory fish are considered to be very limited. |
| **South Pembrokeshire Demonstration Zone**<br>Wave Energy | The South Pembrokeshire Demonstration Zone Scoping Report considered all the SACs and Severn Estuary Ramsar site within the scoping assessment (Royal HaskoningDHV, 2023). Due the distance of the South Pembrokeshire Demonstration Zone from the |

| Project name | Potential for in-combination effects<br>Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | Cleddau Rivers / Afonydd Cleddau SAC (UK0030074) | Carmarthen Bay and Estuaries / Bae Caerfyddin ac Aberoedd | Cardigan Bay / Bae Ceredigion SAC (UK0012712) | Afon Teifi / River Teifi SAC (UK0012670) | River Tywi / Afon Tywi SAC (UK0013010) | River Usk / Afon Wysg SAC (UK0013007) | Severn Estuary Ramsar (UK11081) | Severn Estuary / Môr Hafren SAC (UK0013030) | River Wye / Afon Gwy SAC (UK0012642) |
|---|---|
| Pre-application | proposed Project, there is potential for in-combination underwater noise and changes in water quality to impact Annex II migratory fish features for the sites considered in this assessment.<br>Given the limited area and temporary nature of the impacts associated with the proposed Project and the transitory presence of any migratory fish in the vicinity of the projects, the proposed Project has identified no AEoSI alone on any of the sites considered within the assessment. Therefore, it is not anticipated that the cumulative impact of South Pembrokeshire Demonstration Zone will hinder the conservation objectives of any Annex II migratory fish features of any of the SACs considered, and there is no potential for in-combination with the South Pembrokeshire Demonstration Zone. |
| **Trivane Demonstrator**<br>Offshore wind<br>Pre-application | **No.**<br>Due the distance of the Trivane Demonstrator from the proposed Project, the project is only screened into the in-combination assessment for the following impact pathways:<br>• Impacts of changes to marine water quality; and<br>• Underwater sound and vibration.<br>The Trivane Demonstrator is in the pre-application stages. Accordingly, it is not known if any Annex II migratory fish of the SACs will be affected. Therefore, as the proposed Project can draw the conclusion of no AEoSI with mitigation alone, it is for the Trivane Demonstrator to demonstrate no in-combination effects. |
| **White Cross**<br>Offshore wind<br>Application submitted | **No.**<br>Due the distance of the White Cross project from the proposed Project, the project is only screened into the in-combination assessment for the following impact pathways:<br>• Impacts of changes to marine water quality; and<br>• Underwater sound and vibration. |

| Project name | Potential for in-combination effects<br>Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116)<br>Cleddau Rivers / Afonydd Cleddau SAC (UK0030074)<br>Carmarthen Bay and Estuaries / Bae Caerfyddin ac Aberoedd<br>Cardigan Bay / Bae Ceredigion SAC (UK0012712)<br>Afon Teifi / River Teifi SAC (UK0012670)<br>River Tywi / Afon Tywi SAC (UK0013010)<br>River Usk / Afon Wysg SAC (UK0013007)<br>Severn Estuary Ramsar (UK11081)<br>Severn Estuary / Môr Hafren SAC (UK0013030)<br>River Wye / Afon Gwy SAC (UK0012642) |
|---|---|
| | The Pembrokeshire Marine, Cleddau Rivers, Cardigan Bay, and Afon Teifi SACs have not been scoped in for the White Cross HRA (White Cross, 2023), therefore no pathway has been identified for in-combination effects on these SACs.<br>The White Cross project HRA did assess impact of the project on the Annex II migratory features of Carmarthen Bay and Estuaries, River Tywi, River Usk, Severn Estuary, River Wye SACs and Severn Estuary Ramsar, concluding that there was no potential for AEoSI for any of the sites (White Cross, 2023).<br>Given the limited area and temporary nature of the impacts associated with the proposed Project and the transitory presence of any migratory fish in the vicinity of the projects, the proposed Project has identified no AEoSI alone on any of the sites considered within the assessment. Therefore, it is not anticipated that the cumulative impact of White Cross will hinder the conservation objectives of any Annex II migratory fish features of any of the SACs considered, and there is no potential for in-combination with the White Cross. |
| **Crown Estate Leasing Round 5**<br>(15-27 km from OfECC)<br>Offshore wind<br>Pre-application | **No.**<br>Those projects as part of the Crown Estate Leasing Round 5 located between 15 and 27 km from the OfECC are the Llewelyn Project and the Gwynt Glas Project. These projects have been screened into the in-combination assessment for the following impact pathways:<br>• Impacts of changes to marine water quality; and<br>• Underwater sound and vibration.<br>The Carmarthen Bay and Estuaries SAC and Severn Estuary Ramsar site have not been scoped in for the Crown Estate Leasing Round 5 HRA (The Crown Estate, 2024), therefore no pathway has been identified for in-combination effects on these SACs. |

| Project name | Potential for in-combination effects<br>Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116)<br>Cleddau Rivers / Afonydd Cleddau SAC (UK0030074)<br>Carmarthen Bay and Estuaries / Bae Caerfyddin ac Aberoedd<br>Cardigan Bay / Bae Ceredigion SAC (UK0012712)<br>Afon Teifi / River Teifi SAC (UK0012670)<br>River Tywi / Afon Tywi SAC (UK0013010)<br>River Usk / Afon Wysg SAC (UK0013007)<br>Severn Estuary Ramsar (UK11081)<br>Severn Estuary / Môr Hafren SAC (UK0013030)<br>River Wye / Afon Gwy SAC (UK0012642) |
|---|---|
| | The Crown Estate Leasing Round 5 HRA Screening concluded that the interaction with Annex II migratory fish will be limited to collision (The Crown Estate, 2024). Therefore, therefore no pathway has been identified for in-combination effects on the Pembrokeshire Marine, Cleddau Rivers, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, or River Wye SACs. |
| **Telecommunication Cable – FR 0000084477 00001**<br>Telecommunications cable<br>Consented | **No.**<br>There are three consented telecommunication cables that have been screened in for consideration within the in-combination assessment (FR 0000084477 00001, FR 0000266176 00003, and FR 0000266175 00003). These have been screened into the in-combination assessment for the potential impact pathway of underwater sound and vibration.<br>There is little information of the telecommunications cable currently available. The in-combination assessment is therefore unable to predict the potential impact of the project with certainty.<br>It is considered that beyond 5 km the impact of underwater noise and vibration associated with the proposed Project will be limited to disturbance effects. Beyond 5 km, any impacts will be associated with geophysical survey activities and UXO clearance associated with the construction phase of the proposed Project. These activities will be temporary in nature, and given the transitory presence of any migratory fish in the vicinity of the proposed Project, no AEoSI alone on any of the sites and it is considered that there is no in-combination effects of any of the sites with the telecommunication cables. |
| **Nobel Banks**<br>Mineral Aggregate Site<br>Operational | **No.**<br>Nobel banks has been screened into the in-combination assessment for the potential impact pathway of underwater sound and vibration.<br>There is little information of the Nobel Banks aggregate site currently available. The in-combination assessment is therefore unable to predict the potential impact of the project with any certainty.<br>It is considered that beyond 5 km the impact of underwater noise and vibration associated with the proposed Project will be limited to disturbance effects. Beyond 5 km, any impacts will be associated with geophysical survey activities and UXO clearance |

| Project name | Potential for in-combination effects<br>Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116)<br>Cleddau Rivers / Afonydd Cleddau SAC (UK0030074)<br>Carmarthen Bay and Estuaries / Bae Caerfyddin ac Aberoedd<br>Cardigan Bay / Bae Ceredigion SAC (UK0012712)<br>Afon Teifi / River Teifi SAC (UK0012670)<br>River Tywi / Afon Tywi SAC (UK0013010)<br>River Usk / Afon Wysg SAC (UK0013007)<br>Severn Estuary Ramsar (UK11081)<br>Severn Estuary / Môr Hafren SAC (UK0013030)<br>River Wye / Afon Gwy SAC (UK0012642) |
|---|---|
| | associated with the construction phase of the proposed Project. These activities will be temporary in nature, and given the transitory presence of any migratory fish in the vicinity of the proposed Project, no AEoSI alone on any of the sites and it is considered that there is no in-combination effects of any of the sites with the existing operations at Nobel Banks. |
| **Crown Estate Leasing Round 5**<br>(39-61 km from OfECC)<br>Offshore wind<br>Pre-application | **No.**<br>Those projects as part of the Crown Estate Leasing Round 5 located between 39 and 61 km from the OfECC are Celtic Deep Phase 1**,** Celtic Deep Phase 2, Petroc, Celtic Sea RWE Renewables, and Morwind projects. These projects have been screened into the in-combination assessment for the potential impact pathway of underwater sound and vibration.<br>The Carmarthen Bay and Estuaries SAC and Severn Estuary Ramsar site have not been scoped in for the Crown Estate Leasing Round 5 HRA (The Crown Estate, 2024), therefore no pathway has been identified for in-combination effects on these SACs.<br>The Crown Estate Leasing Round 5 HRA Screening concluded that the interaction with Annex II migratory fish will be limited to collision (The Crown Estate, 2024). Therefore, therefore no pathway has been identified for in-combination effects on the Pembrokeshire Marine, Cleddau Rivers, Cardigan Bay, Afon Teifi, River Tywi, River Usk, Severn Estuary, or River Wye SACs. |

**Summary**

377. The information provided considers the potential for impact pathways associated with the proposed Project to hinder the conservation objectives of the Annex II migratory fish features of Pembrokeshire Marine SAC, Cleddau Rivers SAC, Carmarthen Bay and Estuaries SAC, Cardigan Bay SAC, Afon Teifi SAC, River Tywi SAC, River Usk SAC, Severn Estuary Ramsar, Severn Estuary SAC, and River Wye SAC.

378. With mitigation and best practice measures in place (**Section 8.1.1**), it is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features (**Table 8-10**). Therefore, it is concluded that there is **no potential for an AEoSI on Pembrokeshire Marine SAC, Cleddau Rivers SAC, Carmarthen Bay and Estuaries SAC, Cardigan Bay SAC, Afon Teifi SAC, River Tywi SAC, River Usk SAC, Severn Estuary Ramsar, Severn Estuary SAC, or River Wye SAC due to the proposed Project** (**Table 8-10**) **, either alone or in-combination.**

*Table 8-10. Summary of AEoSI for designated sites with Annex II migratory fish features due to potential impact pathways associated with the OfECC of the proposed Project (✓- potential to hinder conservation objectives; X – no potential to hinder conservation objectives)*

| Designated site | Migratory fish features screened into assessment | Potential Impact Pathways: Construction: Temporary physical disturbance to fish from increased SSC and sediment deposition | Construction: Changes to marine water quality from the mobilisation of contaminants | Construction: Changes to marine water quality from the use of drilling fluids | Construction: Changes to marine water quality from accidental leaks and spills from vessels | Construction: Underwater noise and vibration | Operation and Maintenance: Effects of EMF emissions | Operation and Maintenance: Aggregation of fish and associated effects | Operation and Maintenance: Underwater noise and vibration | Operation and Maintenance: Potential effects to fish from maintenance activities | Decommissioning: Decommissioning effects | AEoSI / Screened into Stage 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | River lamprey *Lampetra fluviatilis* (1099) | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features. Therefore, there is **no potential for an AEoSI on Pembrokeshire Marine SAC either alone or in-combination**. |
| | Sea lamprey *Petromyzon marinus* (1095) | X | X | X | X | X | X | X | X | X | X | |
| | Allis shad *Alosa alosa* (1102) | X | X | X | X | X | X | X | X | X | X | |
| | Twaite shad *Alosa fallax* (1103) | X | X | X | X | X | X | X | X | X | X | |
| Cleddau Rivers / Afonydd Cleddau SAC (UK0030074) | River lamprey *Lampetra fluviatilis* (1099) | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features. Therefore, there is **no potential for an AEoSI on Cleddau Rivers SAC either alone or in-combination**. |
| | Sea lamprey *Petromyzon marinus* (1095) | X | X | X | X | X | X | X | X | X | X | |
| Carmarthen Bay and Estuaries / Bae Caerfyddin ac Aberoedd SAC (UK0020020) | River lamprey *Lampetra fluviatilis* (1099) | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features. Therefore, there is **no potential for an AEoSI on Carmarthen Bay and Estuaries SAC either alone or in-combination**. |
| | Sea lamprey *Petromyzon marinus* (1095) | X | X | X | X | X | X | X | X | X | X | |
| | Allis shad *Alosa alosa* (1102) | X | X | X | X | X | X | X | X | X | X | |
| | Twaite shad *Alosa fallax* (1103) | X | X | X | X | X | X | X | X | X | X | |
| Cardigan Bay / Bae Ceredigion SAC (UK0012712) | River lamprey *Lampetra fluviatilis* (1099) | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features. Therefore, there is **no potential for an AEoSI on Cardigan Bay SAC either alone or in-combination**. |
| | Sea lamprey *Petromyzon marinus* (1095) | X | X | X | X | X | X | X | X | X | X | |
| Afon Teifi / River Teifi SAC (UK0012670) | River lamprey Lampetra fluviatilis (1099) | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features. Therefore, there is **no potential for an AEoSI on Afon Teifi SAC either alone or in-combination**. |
| | Sea lamprey Petromyzon marinus (1095) | X | X | X | X | X | X | X | X | X | X | |
| | Atlantic salmon Salmo salar (1106) | X | X | X | X | X | X | X | X | X | X | |
| | Allis shad Alosa alosa (1102 | X | X | X | X | X | X | X | X | X | X | |

| Designated site | Migratory fish features screened into assessment | Potential Impact Pathways: Construction – Temporary physical disturbance to fish from increased SSC and sediment deposition | Construction – Changes to marine water quality from the mobilisation of contaminants | Construction – Changes to marine water quality from the use of drilling fluids | Construction – Changes to marine water quality from accidental leaks and spills from vessels | Construction – Underwater noise and vibration | Operation and Maintenance – Effects of EMF emissions | Operation and Maintenance – Aggregation of fish and associated effects | Operation and Maintenance – Underwater noise and vibration | Operation and Maintenance – Potential effects to fish from maintenance activities | Decommissioning – Decommissioning effects | AEoSI / Screened into Stage 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Twaite shad Alosa fallax (1103) | X | X | X | X | X | X | X | X | X | X | |
| River Tywi / Afon Tywi SAC (UK0013010) | River lamprey *Lampetra fluviatilis* (1099) | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on River Tywi SAC either alone or in-combination**. |
| | Sea lamprey *Petromyzon marinus* (1095) | X | X | X | X | X | X | X | X | X | X | |
| | Allis shad *Alosa alosa* (1102) | X | X | X | X | X | X | X | X | X | X | |
| | Twaite shad *Alosa fallax* (1103) | X | X | X | X | X | X | X | X | X | X | |
| River Usk / Afon Wysg SAC (UK0013007) | River lamprey *Lampetra fluviatilis* (1099) | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on River Usk SAC either alone or in-combination**. |
| | Sea lamprey *Petromyzon marinus* (1095) | X | X | X | X | X | X | X | X | X | X | |
| | Atlantic salmon *Salmo salar* (1106) | X | X | X | X | X | X | X | X | X | X | |
| | Allis shad *Alosa alosa* (1102) | X | X | X | X | X | X | X | X | X | X | |
| | Twaite shad *Alosa fallax* (1103) | X | X | X | X | X | X | X | X | X | X | |
| Severn Estuary Ramsar (UK11081) | River lamprey *Lampetra fluviatilis* | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the migratory fish features features.<br>Therefore, there is **no potential for an AEoSI on** Severn Estuary Ramsar **either alone or in-combination**. |
| | Sea lamprey *Petromyzon marinus* | X | X | X | X | X | X | X | X | X | X | |
| | Atlantic salmon *Salmo salar* | X | X | X | X | X | X | X | X | X | X | |
| | Allis shad *Alosa alosa* | X | X | X | X | X | X | X | X | X | X | |
| | Twaite shad *Alosa fallax* | X | X | X | X | X | X | X | X | X | X | |
| Severn Estuary / Môr Hafren SAC (UK0013030) | River lamprey *Lampetra fluviatilis* (1099) | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on Severn Estuary SAC either alone or in-combination**. |
| | Sea lamprey *Petromyzon marinus* (1095) | X | X | X | X | X | X | X | X | X | X | |
| | Twaite shad *Alosa fallax* (1103) | X | X | X | X | X | X | X | X | X | X | |

| Designated site | Migratory fish features screened into assessment | Potential Impact Pathways: Construction: Temporary physical disturbance to fish from increased SSC and sediment deposition | Construction: Changes to marine water quality from the mobilisation of contaminants | Construction: Changes to marine water quality from the use of drilling fluids | Construction: Changes to marine water quality from accidental leaks and spills from vessels | Construction: Underwater noise and vibration | Operation and Maintenance: Effects of EMF emissions | Operation and Maintenance: Aggregation of fish and associated effects | Operation and Maintenance: Underwater noise and vibration | Operation and Maintenance: Potential effects to fish from maintenance activities | Decommissioning: Decommissioning effects | AEoSI / Screened into Stage 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| River Wye / Afon Gwy SAC (UK0012642) | River lamprey *Lampetra fluviatilis* (1099) | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on River Wye SAC either alone or in-combination**. |
| | Sea lamprey *Petromyzon marinus* (1095) | X | X | X | X | X | X | X | X | X | X | |
| | Atlantic salmon *Salmo salar* (1106) | X | X | X | X | X | X | X | X | X | X | |
| | Allis shad *Alosa alosa* (1102) | X | X | X | X | X | X | X | X | X | X | |
| | Twaite shad *Alosa fallax* (1103) | X | X | X | X | X | X | X | X | X | X | |

### *8.5.3. Annex II Marine Mammals*

379. This section covers the assessment of risk of adverse effects on SACs designated for Annex II marine mammals for the proposed Project, and details:

- A summary of the HRA Screening;
- Approach to the assessment of potential AEoSI;
- A description of each SAC, its Conservation Objectives, and species descriptions; and
- An assessment for each species / SAC at risk of adverse effects upon site integrity for the proposed Project alone, and in-combination with other developments.

**Summary of HRA Screening**

380. The proposed Project's HRA Screening Report identified 13 protected sites with marine mammal qualifying features within UK waters and 20 transboundary European sites (see **Appendix 8D: Habitats Regulations Assessment Screening**).

381. Relevant sites designated with marine mammal qualifying interests, with potential connectivity with the proposed Project, were identified using two criteria:

- Designated sites where there is direct spatial overlap with the proposed Project; and
- Designated sites which are located within the species-specific marine mammal management unit (MMMU) (Table 8-11).

*Table 8-11. Relevant MMMU*

| Species | MMMU | Reference |
|---|---|---|
| Harbour porpoise (*Phocoena phocoena*) | Celtic and Irish Seas | (IAMMWG, 2022) |
| Bottlenose dolphin (*Tursiops truncatus*) | Offshore Channel, Celtic Sea & SW England | (IAMMWG, 2022) |
| Grey seal (*Halichoerus grypus*) | OSPAR Region III | (NRW, 2018e) |
| Harbour seal (*Phoca vitulina)* | OSPAR Region III | (NRW, 2018e) |

382. Bottlenose dolphin has been screened out, as the proposed Project is located within the Offshore Channel, Celtic Sea and SW England MMMU for the species, within which there are no SACs designated for their protection. This is consistent with the advice received from NRW (scoping opinion, received 23rd May 2022) which stated: "*We do not consider that the bottlenose dolphin features from the SACs listed above [Pen Llŷn a'r Sarnau and Cardigan Bay] are likely to be found within the project impact area and therefore advise that there is no likely significant effect on this feature.*"

383. Harbour seal has also been screened out of the assessment as they are rare in Welsh waters and only incidentally haul out along the Welsh coast. This is supported by very low counts and at-sea usage estimates (SCOS, 2021; Carter, et al., 2022) and there were no observations in the site-specific digital aerial surveys (**Appendix 21A: Marine Mammals and Megafauna Baseline**).

384. The potential impact pathways for LSE on harbour porpoise and grey seal during the construction, operation and maintenance, and decommissioning phases of the proposed Project are summarised in **Table 8-12.**

*Table 8-12. Potential pathways for LSE on marine mammal qualifying features within SACs from HRA Screening (**Appendix 8D: Habitats Regulations Assessment Screening**)*

| Project phase | Potential impact pathway | Rationale |
|---|---|---|
| Construction, decommissioning, operation, and maintenance | Effects of underwater noise | Underwater sound may be generated by a range of Project activities, including geophysical surveys, UXO clearance, piling or drilling, cable installation and vessel traffic. Underwater noise has the potential to affect marine mammals through injury, by causing physiological damage to the individuals' auditory or other internal organs, and temporary or continuous disturbance, which includes disruption to behavioural patterns such as migration, nursing, breeding, foraging, socialising and / or sheltering (JNCC, Natural England and Countryside Council for Wales, 2010). Therefore, the potential for LSE on marine mammal features from underwater noise cannot be excluded. |
| | Collision with Project vessels | There will be an increase in vessel activity, compared to baseline levels, which may increase the risk of vessel collisions with marine mammals and can result in lethal and sub-lethal injury. Therefore, the potential for LSE on marine mammal features from collision risk cannot be excluded. |
| | Accidental pollution or contamination | Accidental/unplanned release of pollutants such as fuels from vessels, equipment and machinery could impact marine mammals by altering local water quality (Reijinders, et al., 2009). A Marine Pollution Contingency Plan will implement measures to prevent and contain accidental release of pollutants and spills and set out industry good practice in line with OSPAR, IMO and MARPOL guidelines for preventing pollution at sea. However, as the risk of accidental pollution cannot be eliminated, the potential for LSE on marine mammals from unplanned releases, accidental leaks or spills cannot be excluded at this stage. |
| | Potential for indirect effects through impacts to prey species | There is potential for changes in the abundance and distribution of prey from activities which change or disturb the seabed, result in increased suspended sediment, or generate underwater noise, which could affect prey availability (JNCC, 2018; Santos & Pierce, 2003) (Edren, et al., 2010). Therefore, at this stage the potential for LSE on marine mammal features from potential indirect effects through impacts to prey species cannot be excluded. |
| | Airborne sound and visual disturbance (pinnipeds only) | Air-borne sound and visual disturbance from vessels and cable installation has the potential to affect seals hauled out along the coastline (Edren, et al., 2010). Therefore, the potential for LSE on pinniped features from airborne sound and visual disturbance cannot be excluded. |

| Project phase | Potential impact pathway | Rationale |
|---|---|---|
| Operation and maintenance | Effects of underwater noise from floating turbines | There is potential for underwater noise to be generated by the cables between the platform and the anchor, and for noise propagation from the floating turbines. Therefore, the potential for LSE on marine mammal features from underwater noise associated with floating turbines cannot be excluded. |
| | Barrier effects from mooring lines and cables between platform and anchor | The presence of sub-surface structures may present a barrier to movement and migratory pathways (Draget, 2014). Therefore, the potential for LSE on marine mammal features from barrier effects cannot be excluded. |
| | Entanglement with mooring lines and cables | The floating configuration of the array requires long mooring lines to connect turbines with their anchors, thus posing an entanglement risk for marine mammals. These lines may also ensnare derelict fishing gear, which also pose an entanglement risk (Benjamins, et al., 2014). Therefore, the potential for LSE on marine mammal features from entanglement with mooring lines and cables cannot be excluded. |
| | Effects of EMF emissions | Marine mammals may be able to detect variations in magnetic fields and may utilise the Earth's magnetic field for navigation (Normandeau, et al., 2011). Therefore, there is potential for EMF emitted from the inter-array and export cables to interfere with marine mammal behaviour and so the potential for LSE on marine mammal features from EMF emissions cannot be excluded. |

385. As bottlenose dolphin and harbour seal features have been screened out of assessment, only sites designated for harbour porpoise and grey seal where LSE could not be excluded at the screening stage are presented in **Table 8-13**Table 8-13. These designated sites have been taken forward to determine any impacts requiring assessment in the RIAA.

*Table 8-13. Determination for designated sites for marine mammal qualifying features where LSE cannot be excluded at screening, listed by species (**Appendix 8D: Habitats Regulations Assessment Screening**)*

| Species | Sites | LSE determination |
|---|---|---|
| Harbour porpoise | *UK SACs:*<br>• West Wales Marine / Gorllewin Cymru Forol SAC;<br>• Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC;<br>• North Anglesey Marine / Gogledd Môn Forol SAC; and<br>• North Channel SAC<br>*Transboundary SACs:*<br>• Rockabill to Dalkey Island SAC;<br>• Nord Bretagne DH Site of Community Importance (SCI) / SAC;<br>• Mers Celtiques – Talus du golfe de Gascogne SCI / SAC ;<br>• Roaringwater Bay and Islands SAC;<br>• Côte de Granit rose-Sept-Iles SCI / SAC ;<br>• Ouessant-Molène SCI / SAC;<br>• Abers – Côte des legends SCI / SAC;<br>• Baie de Morlaix SCI / SAC;<br>• Tregor Goëlo SCI / SAC;<br>• Blasket Islands SAC;<br>• Chaussée de Sein SCI / SAC; and<br>• Récifs du talus du golfe de Gascogne SCI / SAC . | **LSE** |
| Grey seal | *UK SACs:*<br>• Pembrokeshire Marine / Sir Benfro Forol SAC;<br>• Lundy SAC;<br>• Cardigan Bay / Bae Ceredigion SAC; | **LSE** |

| Species | Sites | LSE determination |
|---|---|---|
| | • Lleyn Peninsula and the Sarnau / Pen Llyn a`r Sarnau SAC;<br>• Isles of Scilly Complex SAC;<br>• The Maidens SAC;<br>• Treshnish Isles SAC;<br>• Monach Islands SAC; and<br>• North Rona SAC.<br>*Transboundary SACs:*<br>• Saltee Islands SAC;<br>• Lambay Island SAC;<br>• Roaringwater Bay and Islands SAC;<br>• Blasket Islands SAC;<br>• Chaussée de Sein SCI / SAC;<br>• Slyne Head Islands SAC;<br>• Inishbofin and Inishshark SAC;<br>• Horn Head and Rinclevan SAC;<br>• Duvillaun Islands SAC;<br>• Inishkea Islands SAC; and<br>• Slieve Tooey / Tormore Island / Loughros Beg Bay SAC. | |

**Approach to Assessment**

386. The primary guidance used for the assessment of AEoSI, was the NRW (2022e) guidance "NRW's position on the use of marine mammal management units for screening and assessment in Habitats Regulations Assessments for Special Areas of Conservation with marine mammal features."

387. Although the NRW (2022e) guidance requires the use of the species specific MMMU as the area of search for designated sites, the guidance also states: "*An Appropriate Assessment should be carried out on the closest site to the proposed plan or project location first. If an AEOSI cannot be ruled out, a sequential/iterative assessment should be carried out considering the next closest site*."

388. In addition, the JNCC (2020) "Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs" has been used to inform the harbour porpoise assessment.

389. In compliance with NRW (2022e) guidance, three SACs have initially been taken through for the assessment of site integrity following the iterative assessment process. Two sites with Annex II marine mammal qualifying features overlap with the proposed Project: the offshore cable route corridor overlaps the West Wales Marine and Pembrokeshire Marine SACs. Due to the location of the proposed Project a third site, Bristol Channel Approaches SAC, has also been considered for the initial assessment due to its proximity (**Table 8-14; Figure 8-8**).

*Table 8-14. Summary of the closest SACs designated for marine mammal qualifying features selected for initial assessment based on closest proximity to the proposed Project*

| Site name | Country | Marine mammal qualifying feature | Distance to Llŷr Array Area (km) | Distance to OfECC (km) |
|---|---|---|---|---|
| West Wales Marine / Gorllewin Cymru Forol SAC (UK0030397) | Wales | Harbour porpoise | 13.65 | 0.00 |
| Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC (UK0030396) | England / Wales | Harbour porpoise | 12.11 | 1.94 |
| Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | Wales | Grey seal | 23.04 | 0.00 |

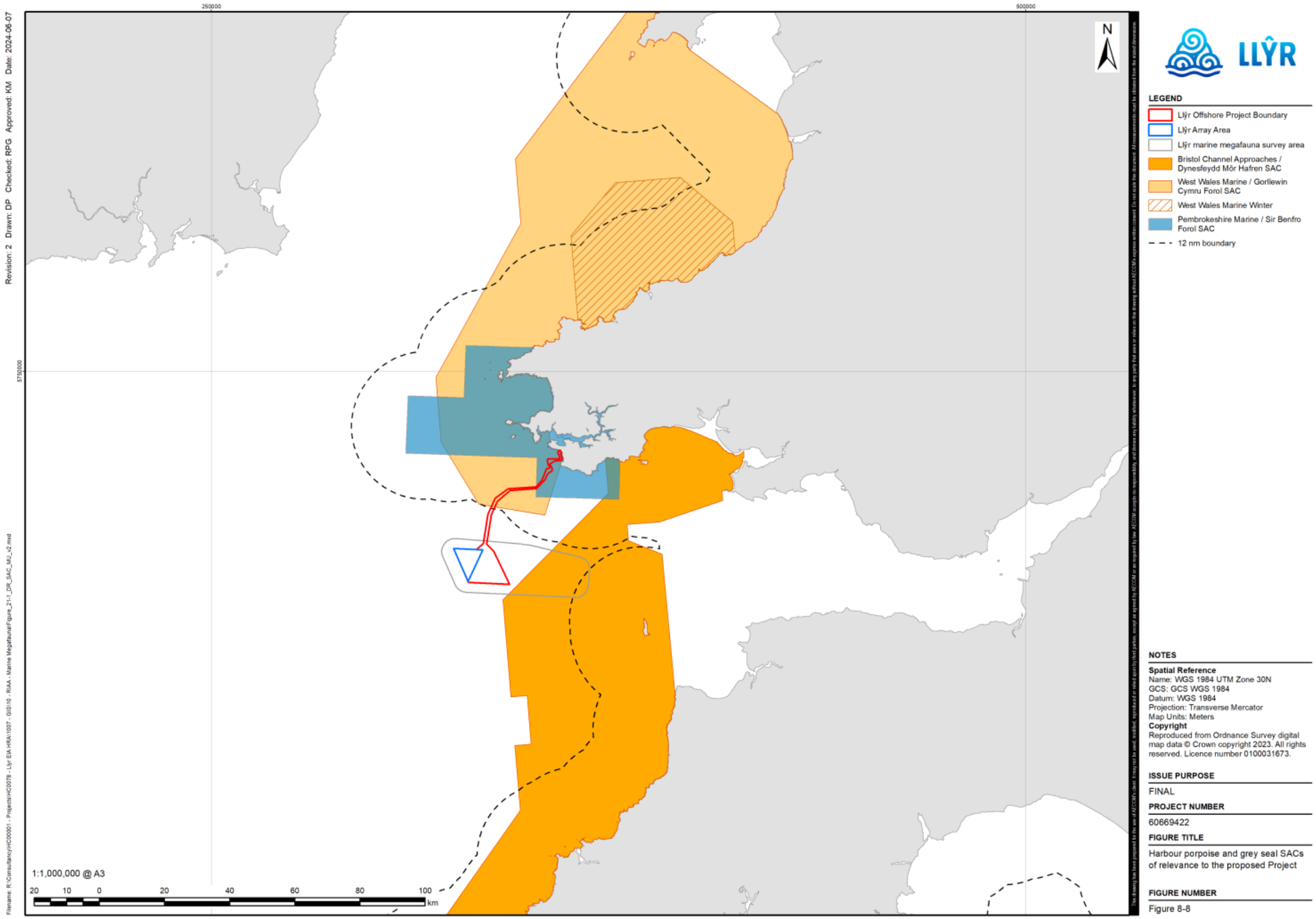


*Figure 8-8. Harbour porpoise and grey seal SACs of relevance to the proposed Project*

*Underwater noise modelling approach*

390. The noise modelling methodology is detailed in **Appendix 21B: Marine Mammals Noise Modelling** prepared by Award Environmental Consultants Ltd, and in **Appendix 21C: Marine Mammal Underwater Noise Assessment**; a brief summary is presented here.

391. There are several propagation models based on mathematical concepts that describe how sound moves through the environment. The modelling presented in **Appendix 21B: Marine Mammals Noise Modelling** used a combination of rapid acoustic models (RAM) and BELLHOP acoustic models. Both models are established and have been used extensively since the early 1990s. The two models are used in combination to best represent the full range of frequencies likely to be emitted from the noise generating activities under consideration for the proposed Project. RAM is based on a parabolic equation and is best suited for shallow water propagation and for low frequencies. BELLHOP is based on Ray theory and is most applicable in shallow water for high frequencies. The models used require input data to describe the local oceanographic conditions, e.g., water depth, temperature, salinity, as these have influence over the sound speed in the marine environment.

392. The source level of the noise generating activity is the starting point for any noise model. This represents the apparent strength of the noise source. This cannot be measured and so is usually either inferred by back calculating the noise at source using a set of far-field noise levels, or for impact piling, by using a numerical model that converts the hammer energy used into underwater acoustic energy. The modelling conducted for the proposed Project has used proxy source levels for all activities obtained from similar examples in the literature (see **Appendix 21B: Marine Mammals Noise Modelling**). The proxy characteristics have included both noise level (i.e., volume) and the frequency spectrum which describes the typical frequency content for all noise generating activities.

393. There are several metrics and terms used to measure and assess the impact of underwater noise in the marine environment. These are defined in **Appendix 21B: Marine Mammals Noise Modelling**; however, to aid the reader, the key metrics and terminology used and referred to in this section are described below.

394. Sound levels are detailed in terms of SPL and SEL and in units of dB. The dB is a ratio unit, therefore the 're 1µPa' details the reference unit in terms of Pascals (pressure). Where a source level is referenced '@1m' it indicates the apparent level at source. There are numerous acoustic processing methods to derive underwater noise metrics. Commonly subscript are used with both SPL and SEL, to detail more information on the noise metrics themselves. Peak is used to indicate the maximum sound pressure level. RMS stands for root mean square, and this is an averaged level of noise over a period of time. $SEL_{cum}$ describes the accumulated noise level over a maximum period of 24 hours. More detailed information / explanation is provided in the underwater noise modelling report (**Appendix 21B: Marine Mammals Noise Modelling**) and the underwater noise assessment (**Appendix 21C: Marine Mammal Underwater Noise Assessment**).

395. Representative source levels were used (**Table 8-15**Table 8-15) for each of the noise generating activities assessed in this Assessment.

*Table 8-15. Acoustic source levels used in noise modelling for key activities*

| Phase | Noise generating activity | Acoustic source level ($SPL_{peak}$; dB re re 1 µPa @1m) |
|---|---|---|
| Pre-installation geophysical survey | Multi-beam echo sounder (MBES) | 221 |
| | Side scan sonar (SSS) | 226 |

| Phase | Noise generating activity | Acoustic source level ($SPL_{peak}$; dB re re 1 µPa @1m) |
|---|---|---|
| | SBP | 238 |
| | Ultra-short baseline (USBL) positioning sonar | 207 |
| UXO clearance | High order detonation | 284.9 – 296.2 |
| | Low order deflagration | 266.7 – 276.7 |
| Vessel movements | Cable-laying | 197 |
| | Project vessel (large) | 180 |
| | Project vessel (medium) | 170 |
| Cable installation | Jet trenching | 181 |
| | Backhoe dredging | 165 |
| | Suction dredging | 186 |
| | Rock emplacement | 172 |
| Turbine construction and installation | Impact piling for a 3 m diameter pile | 234.8 |
| | Drilling | 170.1 |
| Turbine operation | Wind turbine operational | 167.2 |

396. Propagation modelling was carried out using a total of 36 transects radiating from the source modelling site, using the speed of sound profiles for February and August. The assessment in **Appendix 21B: Marine Mammals Noise Modelling** concluded that sound would propagate furthest in February, with the shortest distance in August due to the oceanographic conditions in these months. The modelling approach was therefore to present the maximum and minimum conditions and in doing so would 'bracket' propagation conditions for any intermediate month.

397. Potential effects from underwater noise generated by pre-construction and construction activities are assessed using agreed auditory injury and disturbance threshold criteria (NRW, 2023; Southall, et al., 2019); **Appendix 21C: Marine Mammal Underwater Noise Assessment**). In the UK, a permanent threshold shift (PTS) in hearing ability (PTS-onset) is considered injury (JNCC, 2010). PTS-onset is the level at which there is a risk of a permanent loss of hearing sensitivity; however, this does not equate to total deafness across the full range of hearing, but to a loss of hearing ability within a certain range of frequencies resulting from the volume and frequency content of the source (Booth & Heinis, 2019).

398. Disturbance is assessed using acoustic thresholds thought to reflect the noise level at which a behavioural response is observed and are based on the best available information. Behavioural responses are varied and are highly context specific. Factors such as the individual's prior experience to the noise source, the sex and age of the individual, and the activity of the individual at that time (e.g., foraging, travelling) can all influence the degree of response. The thresholds are used to identify levels at which a behavioural response may be observed and are assumed to result in a biological meaningful effect such that there could be an impact to the individual's health and fitness. Due to the highly varied nature of disturbance, there is no one disturbance threshold. This assessment has therefore used multiple thresholds relevant to each noise type as recommended in NRW (2023).

399. Marine mammal hearing ability is classified in Functional Hearing Groups (**Table 8-16**) (NMFS, 2018; Southall, et al., 2019). Any noise source emitting sound within these frequencies has the potential to impact marine mammals. The **Appendix 21C: Marine Mammal Underwater Noise Assessment** assessed noise impact to marine mammals using the injury thresholds and nomenclature as detailed in Southall *et al.* (2019).

*Table 8-16. Marine mammal hearing groups for harbour porpoise and grey seal features (NMFS, 2018)*

| Functional hearing group | | Example species | Generalised Hearing Range | Range of best hearing |
|---|---|---|---|---|
| **Southall *et al.*** (2019) | **NMFS** (2018) | | | |
| Very high-frequency cetaceans (VHF) | High-frequency cetaceans (HF) | Harbour porpoise | 275 Hz to 160 kHz | 12 kHz to 140 kHz |
| Phocid carnivores in water (PCW) | Phocid pinnipeds (PW) underwater | Grey seal | 50 Hz to 86 kHz | 1.9 kHz to 140 kHz |

400. Injury through Permanent Threshold Shift-onset is assessed using the dual criteria of 'instantaneous' PTS-onset ($SPL_{peak}$) and 'cumulative' PTS-onset ($SEL_{cum;}$ weighted and unweighted), as outlined in **Appendix 21C: Marine Mammal Underwater Noise Assessment**. The cumulative PTS-onset is a metric representing noise accumulated during a length of time (up to a max of 24 hours) and modelled using a static and fleeing animal approach (**Appendix 21B: Marine Mammals Noise Modelling; Appendix 21C: Marine Mammal Underwater Noise Assessment).**

401. The assessment of disturbance has used thresholds relevant for each of the noise generating activities informed by NRW guidance (2023) (**Table 8-17**).

*Table 8-17. Summary of disturbance thresholds used in quantitative assessment*

| Disturbance threshold | Activity |
|---|---|
| NMFS (2005) – Level B Harassment 120 dB re 1µPa (rms) | Other construction activities<br>Vessel activity<br>Turbine operational noise |
| NMFS (2005) – Level B Harassment 160 dB re 1µPa (rms) | Pre-installation geophysical surveys<br>Impact piling |
| JNCC (2020)– Effective Deterrent Range (EDR) 5 km | Pre-installation geophysical surveys |
| Southall *et al.* (2019) – TTS | Unexploded Ordnance Clearance |
| NRW (2023) Fixed – 143 dB re 1µPa$^2$.s | Impact piling (harbour porpoise) |
| Whyte *et al.* (2020) Dose response curves* | Impact piling (grey seals) |

** Dose response curves apply the probability of a response, at certain noise levels, and thus the proportion of animals that experience a behavioural response*

### Species Accounts and Conservation Objectives

*Conservation objectives*

402. The conservation objectives of the three closest SACs to the proposed Project are detailed in **Table 8-18.**

*Table 8-18. Summary of site Conservation Objectives*

| Site name | Qualifying feature | Conservation Objectives |
|---|---|---|
| West Wales Marine / Gorllewin Cymru Forol SAC (UK0030397) | Harbour porpoise | To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained, and the site makes an appropriate contribution to maintaining Favourable Conservation Status (FCS) for the UK harbour porpoise. |

| Site name | Qualifying feature | Conservation Objectives |
|---|---|---|
| Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC (UK0030396) | | To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term:<br>1. The species is a viable component of the site;<br>2. There is no significant disturbance of the species; and<br>3. The supporting habitats and processes relevant to harbour porpoises and their prey are maintained. |
| Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | Grey seal | 1. The population is maintaining itself on a long-term basis as a viable component of its natural habitat;<br>2. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and<br>3. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance, and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include distribution, extent, structure, function and quality of habitat, and prey availability and quality. |

*Species Account*

*Harbour Porpoise*

403. Several sources identified harbour porpoise within the Llŷr marine megafauna survey area, and the surrounding Celtic and Irish seas (**Appendix 21A: Marine Mammals and Megafauna Baseline**). During the site-specific Digital Aerial surveys (DAS), harbour porpoise was identified as the second most abundant species observed following common dolphin.

404. Harbour porpoise SACs are single feature sites (i.e. harbour porpoise only) where harbour porpoise is the primary reason for site selection and have common conservation objectives. Harbour porpoise SAC designation was based on the sites identified as having persistently higher densities in comparison to the wider MMMU region (Heinänen & Skov, 2015). There is therefore, no specific number or population of harbour porpoise associated with SACs, and so, it can be considered that harbour porpoise throughout the MMMU may be connected to the site. Harbour porpoise SACs are thought to represent good quality habitat, likely related to foraging and / or breeding. The highest number of harbour porpoise births typically occur during June and July (although currently there is limited information as to where calves are born (JNCC, 2024)). Therefore, assessment on site integrity focusses on activities that have the potential to affect harbour porpoise usage of each protected area.

405. Harbour porpoise SACs are part of the UK's European site network of protected areas designated under the Habitats Regulations. SACs should aim to contribute to maintaining or restoring favourable conservation status (FCS). The current conservation status of harbour porpoise overall trend is 'unknown' (JNCC, 2019).

406. The West Wales Marine SAC, is a large site approximately 7,376 km$^2$ stretching from the Llŷr peninsula in the north down to the Pembrokeshire coast, extending into Cardigan Bay. The site, designated in 2019, is designated solely for harbour porpoise. There are several overlapping SACs

with West Wales Marine SAC, including the Pen Lŷn a'r Sarnau SAC in the north and the Pembrokeshire Marine SAC to the south. West Wales Marine SAC contains both deeper offshore waters and shallower inshore waters of up to 50 m deep with most of the site within 12 nautical miles of the Welsh coastline. The whole area of the SAC has been identified as an important summer area for the species and a smaller section in the south of the SAC has been identified as an important area during the winter for harbour porpoise (approximately 1,460 $km^2$). The SAC supports an estimated 5.4% of the UK Celtic and Irish Seas Management Unit population (JNCC, 2023). This estimate was based on abundance estimates from the SCANS-III project, from surveys conducted in July 2016 (Hammond, et al., 2021).

407. The Bristol Channel Approaches SAC lies along the south-west coast of Wales and England crossing over the Bristol Channel and is approximately 5,850 $km^2$ in size (JNCC, 2023). Harbour porpoise occurs within the site year-round; however, in the identification of site was based on higher densities during the winter season in comparison to other areas of the Management Unit (Heinänen & Skov, 2015). Therefore, the Bristol Channel Approaches SAC has been designated as a winter site only. The SAC overlaps with the Pembrokeshire Marine SAC in the north as well as the Camarthen Bay and Estuaries SAC. The Bristol Channel Approaches SAC is estimated to support 4.7% of the UK Celtic and Irish Seas Management Unit population of harbour porpoise (JNCC, 2023). This estimate was based on abundance estimates from the SCANS-III project, from surveys conducted in July 2016 (Hammond, et al., 2021).

*Grey Seal*

408. Several sources identified grey seal within the Llŷr marine megafauna survey area, and the surrounding Celtic and Irish seas (**Appendix 21A: Marine Mammals and Megafauna Baseline**).

409. Pembrokeshire Marine SAC is a multiple feature site selected for the presence of eight marine habitats and associated wildlife, and seven Annex II species. This section of the RIAA is focused on the potential impact to one of these features, the grey seal. Pembrokeshire Marine SAC is a regionally important site for grey seals, as it has the highest number of pups in Welsh waters born within the site. Grey seals show site fidelity during the breeding season but disperse widely outside this season. However, the Welsh site's conservation objectives apply to the species in general, rather than to the breeding season alone.

410. Grey seal SACs are part of the UK's European site network of protected areas designated under the Habitats Regulations. SACs should aim to contribute to maintaining or restoring FCS. The current conservation status of grey seal overall trend is 'improving' (JNCC, 2019).

411. The Pembrokeshire Marine SAC is located on the south-west coast of Wales extending from the shore into deeper waters and is approximately 1,380 $km^2$. A large proportion of the SAC overlaps with the south of the West Wales Marine SAC while only a small section in the east overlaps with the north of the Bristol Channel Approaches SAC.

412. The number of seal pups born on the southwest coast of Wales near the proposed Project are increasing annually (**Appendix 21A: Marine Mammals and Megafauna Baseline**). Grey seals are one of two resident seal species in the UK and are present year-round in the Pembrokeshire Marine SAC. The estimated grey seal population in Wales at the start of the 2022 breeding season was estimated as 5,4000 adults (SCOS, 2022). Pup production in 2019 was 2,250 animals (SCOS, 2022). Pembrokeshire Marine SAC, contains the largest breeding colony in Wales, comprising over 2% of the UK annual pup production (NRW, 2018e). Unlike other areas in the UK, in Wales, grey seals tend to use secluded coves and caves for pupping rather than establishing large groups of pupping females in open areas; this presents challenges for obtaining complete counts of seals as they can be hidden from view.

**Potential identified impact pathways**

413. The following section summarises the information used to estimate the magnitude of the potential impacts on the relevant qualifying species of the SACs. This section does not duplicate the detailed analysis contained within **Chapter 21: Marine Mammals** and associated appendices but provides a concise summary of the relevant data used to inform the RIAA. The realistic worst-case scenarios used within the assessment for the proposed Project **Chapter 21: Marine Mammals (Table 8-19**), are reproduced here from **Chapter 21: Marine Mammals.** The worst-case scenarios are relevant for the RIAA because it is also necessary to consider the risk of impacts occurring to Annex II species outside the SAC sites due to the highly mobile nature of marine mammals.

*Table 8-19. Realistic worst-case parameters considered for the assessment of potential impact pathways (**Chapter 21: Marine Mammals**)*

| Potential Impact | Realistic worst-case scenario | Justification |
|---|---|---|
| **Construction** | | |
| Effects of underwater noise (permanent Threshold Shift (PTS-onset) and disturbance) – geophysical surveys | Indicative acoustic characteristics used to assess level of impact were:<br><br>*Sound pressure levels (dB re 1µPa):*<br>• MBES - 221 $SPL_{peak}$<br>• SSS – 226 $SPL_{peak}$<br>• SBP – 238 $SPL_{peak}$<br>• USBL – 207 $SPL_{peak}$<br>Likely worst case in terms of survey duration of activity is 20 days for the Offshore Export Cable Corridor, and 10 days for the array area. | There is potential for PTS-onset (injury) and disturbance from geophysical surveys, dependant on the equipment used. The specific equipment which will be used during geophysical surveys is currently unknown. Therefore, indicative sound pressure levels and operating frequencies have been collated from specification sheets for equipment which is comparable to what is anticipated to be used, as detailed in **Appendix 21B: Marine Mammals Noise Modelling** and **Appendix 21C: Marine Mammal Underwater Noise Assessment**. |
| Effects of underwater noise (PTS-onset and disturbance) - UXO | The presence of UXOs that will require clearance is not known at the time of writing. Therefore, it has been assumed for the purposes of assessment that there would be one clearance event for the proposed Project based on Erebus assessment (Barham & Mason, 2021).<br><br>*Low-order (realistic worst-case):*<br>• Up to 2 kg Net Explosive Quantity (NEQ)<br><br>*High-order (unrealistic worst-case):*<br>• Up to 794 kg NEQ<br>A range of charge weights up to these amounts have been modelled and are presented in **Appendix 21B: Marine Mammals Noise Modelling**. | Potential for PTS-onset (injury) and disturbance. Predicted worst-case for UXO is based on the Erebus offshore wind farm underwater noise impact study (Barham & Mason, 2021), which is in close proximity to the proposed Project and has a partially overlapping Offshore Export Cable Corridor. A detailed UXO survey will be completed prior to construction.<br><br>In line with advice from BEIS (2022), low noise alternatives to high-order clearance will be prioritised and implemented where possible. Therefore, the realistic worst-case scenario modelled is considered to be UXO clearance via low-order methods. High-order clearance up to a 794 kg device has also been modelled, assessed, and presented although this is considered to be an unrealistic worst-case scenario. |

| Potential Impact | Realistic worst-case scenario | Justification |
|---|---|---|
| | The Applicant is committed to the utilisation of low-order clearance methodology. | |
| Effects of underwater noise (PTS-onset and disturbance) – Piling | *Driven Pile Anchors:*<br>• Eight driven pile anchors per WTG (up to 80 piles)<br>• Maximum pile diameter 3 m<br>• Maximum hammer energy 800 kJ<br>• Piling in one location at a time (no concurrent piling)<br>• Approximately four hours to drive one pile to the design the maximum penetration depth of 9-32 m<br>• Max 10 piling days within 20 months of offshore installation<br><br>*Estimated source levels (***Appendix 21B: Marine Mammal Underwater Noise Modelling***):*<br>• $SPL_{peak}$ - 235 dB re 1 µPa @ 1 m<br>• $SEL_{single\ strike}$ - 218 dB re 1 $\mu Pa^2$.sec @ 1 m | Impact piling (if utilised) represents the worst-case scenario for assessment of both PTS (injury) and disturbance.<br><br>Other types of anchors within the PDE (i.e. drag embedment anchors, suction bucket anchors or drilled and grouted piles) are expected to result in reduced impact to marine mammals than driven pile anchors. |
| Effects of underwater noise (disturbance) – Other construction activities (including route clearance, cable laying and seabed preparation) | *Source levels ($SPL_{peak}$ dB re 1 µPa):*<br>• Cable laying – 197 dB<br>• Jet trenching – 181 dB<br>• Backhoe dredging – 165 dB<br>• Suction dredging – 186 dB<br>• Rock placement – 172 dB<br>Overall offshore construction duration 20 months | Indicative source levels for the proposed construction activities have been collated from the literature (see **Appendix 21B: Marine Mammals Noise Modelling** and **Appendix 21C: Marine Mammal Underwater Noise Assessment**). |

| Potential Impact | Realistic worst-case scenario | Justification |
|---|---|---|
| Effects of underwater noise – vessel disturbance | *Estimated source levels $SPL_{peak}$ dB re 1 µPa:*<br>• Large vessel (>100m)- 180 dB<br>• Small vessel(<100m) - 170 dB<br>• Maximum number of vessels working offshore at any one time estimated at 12. | Indicative source levels for the proposed Project vessels have been collated from the literature, these represent the noise levels for vessels that are typically used for offshore wind construction. Indicative levels for large and small have been used to provide the noise envelope of potential vessel use (see **Appendix 21B: Marine Mammals Noise Modelling**). |
| Airborne sound and visual disturbance (pinnipeds only) | *Cable landfall:*<br>• HDD up to 800 m offshore and 500 m onshore<br>• Duration of HDD up to 64 weeks<br>• Total duration of construction at landfall up to 136 weeks.<br>*Construction vessels:*<br>• Maximum number of vessels working offshore at any one time estimated at 12. | Construction activity at the cable landfall has the potential to result in disturbance to hauled-out seals, in addition to an increase in vessel traffic from construction vessels near seal haul-out sites Assessed in |
| Collision with Project vessels | Construction of up to 20 months. Up to 12 construction vessels on site simultaneously | Greatest number of simultaneous vessel activities and duration resulting in the maximum scenario considered for collision risk (**Chapter 28: Shipping and Navigation**) |
| Accidental pollution or contamination | As per 'Collision with Project Vessels' | The worst-case scenario for accidental release of pollutants would be accidental release of vessel fuel from large vessels. |
| Potential for indirect effects through impacts to prey species | Potential impacts which are applicable to fish and shellfish (which represents many marine mammal prey species) may have an indirect effect on marine mammals. Therefore, the assessment is based on the worst-case parameters presented in **Chapter 20: Fish and Shellfish Ecology**. | |
| **Operation and maintenance** | | |
| Effects of underwater noise (disturbance) – WTG operational noise | *Estimated WTG operational noise source levels:*<br>• $SPL_{peak}$ – 167.2 dB re 1 µPa @ 1 m<br>• $SEL_{rms}$ - 161 dB re 1 µPa @ 1 m | There may be potential for disturbance from the noise generated by the turbines in operation. Indicative underwater noise source levels for operational WTGs have been estimated from the best available |

| Potential Impact | Realistic worst-case scenario | Justification |
|---|---|---|
| | | information in the literature, as presented in **Appendix 21B: Marine Mammals Noise Modelling**). |
| Effects of underwater noise (disturbance) – maintenance activities – vessel noise | Considered to be analogous with or less than those in the construction stage. | |
| Barrier effects from mooring lines and cables between platform and anchor<br>Entanglement with mooring lines and cables | • 10 WTGs (minimum spacing 1140 m)<br>• 49,900 $m^2$ array area<br>• maximum 8 mooring lines per turbine<br>• 17.31 km total inter-array cables length | The maximum scale of the mooring lines and inter-array cables represents the maximum potential for barrier effects, entanglement, and collision.<br>There is no potential for barrier effects or entanglement with the offshore export cable, as this will be buried or laid along the seabed and subject to cable protection. |
| Effects of electromagnetic field (EMF) emissions | EMF emissions will occur for the operational lifetime of the proposed Project.<br>• up to two electricity export cables transmitting electricity from the wind turbines to the shore over a distance of 49 km.<br>• The export cables will be within separate trenches that are 10 m apart and with a target depth of 1.2 m.<br>• Inter-array cables with a total length of 17.31 km linking the turbines | The highest EMF emissions are expected to occur where the cable crossings are located. However, elevated EMF emissions are expected to be highly localised and cable protection will be used, which will mitigate effects. Dynamic cabling are exposed in the water column; however, it is anticipated that EMF effects are reduced to negligible at a distance of 2m from the cable (**Chapter 20: Fish and Shellfish Ecology**). |
| Airborne sound and visual disturbance (pinnipeds only) | *Maintenance vessels:*<br>• As per 'Collision with Project vessels' | Maintenance activities may result in increased vessel activity near seal haul-out sites. |
| Collision with Project vessels | Construction of up to 20 months. Up to 12 construction vessels on site simultaneously | Greatest number of simultaneous vessel activities and duration resulting in the maximum scenario considered for collision risk (**Chapter 28: Shipping and Navigation**) |

| Potential Impact | Realistic worst-case scenario | Justification |
|---|---|---|
| Accidental pollution or contamination | As per 'Collision with Project Vessels'. | The worst-case scenario for accidental release of pollutants would be accidental release of vessel fuel from large vessels. |
| Potential for indirect effects through impacts to prey species | Potential impacts which are applicable to fish and shellfish (which represents many marine mammals prey species) may have an indirect effect on marine mammals. Therefore, the assessment is based on the worst-case parameters presented in **Chapter 20: Fish and Shellfish Ecology**. | |
| **Decommissioning** | | |
| The impacts during the decommissioning of the proposed Project are anticipated to be analogous with, or likely less than, those of the construction phase as decommissioning of proposed project infrastructure will be similar to construction but in reverse. The decommissioning phase is expected to be complete within 12 months. All infrastructure is assumed as a worst-case scenario to be removed. A DEMP will be required in consultation with NRW. | | |

*Potential Impact Pathway Refinement*

414. The assessment of impact pathways in Chapter 21: Marine Mammals and Appendix 21C: Marine Mammal Underwater Noise Assessment enables the following conclusions of which impact pathways identified at screening (Appendix 08D: Habitats Regulations Assessment Screening) are relevant for further consideration in the Appropriate Assessment i.e;

- Effects of underwater noise; accidental pollution;
- Airborne sound and visual disturbance (grey seals only);
- collision with project vessels;
- potential for indirect effects through impacts to prey species;
- effects of EMF emissions,
- Barrier effects from mooring lines and cables between platform and anchors; and
- Entanglement with mooring lines and cables.

415. The conclusions of this further consideration of appropriate impacts pathways taken forward for assessment, for both harbour porpoise and grey seal are summarised in **Table 8-20** below.

*Effects of Underwater Noise*

416. The potential effects from underwater noise span all phases of the proposed Project, however for harbour porpoise and grey seals, noise impacts during the operational and decommissioning phases are of lower magnitude than the potential impacts during construction. During the operational period, noise sources include radiated noise from the rotating turbines, together with vessel activity during maintenance visits. Noise effects from the decommissioning phase will be much less than for construction, particularly as this is a floating offshore wind project. Therefore, should the conclusion of construction and operational activities be no AEoSI then this will also apply for the decommissioning phase.

417. The potential effects of underwater noise during construction and operation have been scoped in for further assessment for both Annex II harbour porpoise and grey seal features.

*Accidental Pollution or Contamination*

418. There is the potential for pollutants, such as hydrocarbons from fuel to be accidentally released from vessels, equipment, and machinery; however, the amount of fuel that may be accidentally released from the proposed Project vessels is small (**Chapter 28: Shipping and Navigation**). Further, the Applicant has committed to employing a Vessel Management Plan (VMP) (**Appendix 04A: Outline CEMP**), which will include adherence to a Marine Pollution Contingency Plan. This will include proper storage and containment of chemicals and hazardous substances, planning for accidental spills and accidental contaminant releases, among other legal requirements and good industry practice measures from OSPAR, IMO and MARPOL requirements for preventing pollution at sea. If pollution were to occur, then the SOPEP will be implemented to minimise the environmental risk. Therefore, in the unlikely event of an accidental release of pollutants, it is expected that this would be localised, of short-term duration and low intensity. Therefore, the activity related to the proposed Project presents no greater risk that from the existing vessel activity in the region.

419. The potential effects of accidental pollution or contamination have been scoped out for further assessment for both Annex II harbour porpoise and grey seal features.

*Airborne Sound and Visual Disturbance (Grey Seals Only)*

420. Airborne sound and visual disturbance from vessels and cable installation within Pembrokeshire Marine SAC has the potential to affect seals hauled out along the coastline.

421. The potential effects of airborne sound and visual disturbance have been scoped in for further assessment for Annex II grey seal features.

*Collision with Project Vessels*

422. During construction (including pre-construction), operation and decommissioning, there is a potential risk of injury or mortality from vessel strike. Injury or mortality can result from blunt force trauma or propeller strike, with the severity influenced by factors such as the type and size of vessel, and the speed at which the vessel is travelling (Laist, et al., 2001; Peltier, et al., 2019; Schoeman, et al., 2020).

423. Harbour porpoise is highly mobile and has been observed to avoid vessel activity (Erbe, et al., 2019; Palka & Hammond, 2001). It is likely that harbour porpoise, if close to any vessel, will be able to take evasive action to avoid collision. Likewise, the likelihood of seals being struck by vessels is low. Seals are also highly mobile and agile and are likely to respond to any vessel's presence. In the Moray Firth, harbour seals were shown to utilise waters occupied by vessels when moving between foraging and haul-out sites; however, animals tended to remain beyond 20 m from vessels with only three instances of seals coming within 20m of vessels over 2,241 days (Onoufriou, et al., 2016).

424. Most of the vessels to be used during the construction (including pre-construction) stage are relatively small (e.g. tugs, vessels carrying ROVs, Crew Transfer Vessels (CTVs), barges and Rigid Hulled Inflatable Boats (RIBs)). These have higher speeds than larger vessels but are also manoeuvrable so can more easily stop or move to avoid any animals, when detected. Larger vessels (e.g. cable lay vessel), whilst less manoeuvrable, will be travelling at lower speeds meaning they have more time to detect and avoid animals, and for any animals themselves to take evasive action (Schoeman, et al., 2020).

425. **Chapter 21: Marine Mammals** concluded that the likelihood of a vessel strike was negligible for both harbour porpoise and grey seal. Furthermore, the Applicant has committed to employing a VMP (**Appendix 04A: Outline CEMP**)which will ensure that all vessels move along predictable routes when transiting and will also define how vessels should be handled in the presence of marine mammals in order to minimise the risk of collision. This will allow animals to safely take evasive action if required.

426. Potential effects of collision with project vessels have been scoped out for further assessment for both Annex II harbour porpoise and grey seal features.

*Potential for Indirect Effects Through Impacts to Prey Species*

427. Activities carried out during construction, operation, and maintenance, and decommissioning of the proposed Project, may cause changes to prey availability that could impact on harbour porpoise and/or grey seal. Potential activities of relevance include those that physically disturb the seabed, as well as those activities generating underwater noise.

428. Harbour porpoise eat a varied diet in the UK relating to the local availability of food. Prey typically include clupeids (e.g. herring and sprat), gadoids (e.g. cod and whiting), sandeels and flatfish (Pierce, et al., 2004; Canning, et al., 2008; Tetley, et al., 2008; Jansen, et al., 2010; Evans & Hinter, 2013; Leopold, et al., 2018). Grey seals are generalist feeders, foraging mainly on the seabed taking a wide variety of prey including sandeels, gadoids (mainly whiting) and flatfish (mainly sole) (NRW, 2018e).

429. There were no significant effects identified to any fish species (**Chapter 20: Fish and Shellfish Ecology**); however, should prey availability or distribution be affected, individuals may have to forage for different prey, or increase the time spent foraging. Which would result in adverse energetic consequences and a reduction in available time for resting or reproduction (Ransijn, 2022). However, harbour porpoise is highly mobile and wide-ranging, and it is anticipated individuals would be able to forage in alternative areas if required. Given the expected adaptability of harbour porpoise to find alternative prey species or locations, and the lack of impacts identified to any fish species, this impact is not anticipated to negatively affect prey availability for harbour porpoise.

430. Likewise grey seal is highly mobile and wide-ranging, it is anticipated individuals would be able to forage in alternative areas, if required. Grey seals forage in the open sea, and frequently forage over 100 km between haul-out sites. Foraging trips can last anywhere between 1 and 30 days (SCOS, 2022). Therefore, it is likely that grey seals can supplement their diet with other available species if required, making them resilient to changes in prey availability.

431. During the operational phase, the presence of floating WTG structures could function as an artificial reef potentially resulting in increased foraging opportunities. At the Dutch windfarm, Egmond aan Zee, echolocation activity of harbour porpoise was noted to be higher during the operational phase than pre-construction (Scheidat, et al., 2011). A tracking study undertaken by Russell *et al*. (2014) demonstrated that harbour and grey seals move between WTGs in a grid-like pattern, and often repeatedly returning to the array area potentially for foraging. Therefore, there is the potential for a positive effect on the availability of prey species. Any potential impact to prey species from the construction phase of the proposed Project is therefore likely to be short term and reversible.

432. The potential for indirect effects through impacts to prey species have been scoped out for further assessment for both Annex II harbour porpoise and grey seal features.

*Effects of EMF Emissions*

433. EMFs have the potential to alter the behaviour of marine organisms able to detect these fields. The design of the proposed Project includes up to two electricity export cables transmitting electricity from the wind turbines to the shore over a distance of 49 km. The export cables will be within separate trenches that are 10 m apart and with a target depth of 1.2 m. In addition, there will be inter-array cables with a total length of 17.31 km linking the turbines.

434. Some cetacean species may be able to detect variations in magnetic fields (Normandeau, et al., 2011; OSC, 2022), however, marine mammals in general, are considered to be less sensitive to EMFs than electro-receptive species, such as elasmobranchs, which may utilise natural EMFs during migration, orientation and prey location (Copping & Hemery, 2020). Whilst there is limited evidence of marine mammals' detection (Taormina, et al., 2018), there is no evidence to suggest EMFs from marine renewable energy devices or subsea cables have any adverse impact on marine mammals. Any detection of EMF is likely to only occur in close proximity to the cables (approx. 50 m) (OSC, 2022), and given the highly mobile nature of both harbour porpoise and grey seal, individuals are unlikely to remain in close proximity to the cables or array for any significant length of time (Copping & Hemery, 2020; OSC, 2022). Therefore, impact from EMF emissions for all marine mammals is expected to be minimal.

435. The potential effects of EMF emissions have been scoped out for further assessment for both Annex II harbour porpoise and grey seal features.

*Barrier Effects from Mooring Lines and Cables Between Platform and Anchors*

436. The Array Area is located 13.65 km from the West Wales Marine SAC, 12.11 km from the Bristol Channel Approaches SAC and 23.04 km from Pembrokeshire Marine SAC. Therefore, there is no risk of barrier effects within the SACs. However, it is worth considering whether the presence of the structures may affect the movement of harbour porpoise / grey seal to and / or from any SAC. There is a lack of information specific to barrier effects resulting from floating WTG structures; however, there are several studies which have examined the impact on marine mammals in fixed-turbine wind farms. Long-term monitoring at the Horns Rev and Nysted offshore windfarms in Denmark, frequently recorded harbour porpoise within the array area of the operational wind farms, with populations comparable to pre-construction levels within two years of operation (Diederichs, et al., 2008). A tracking study undertaken by Russell *et al*. (2014) demonstrated that harbour and grey seals move between WTGs in a grid-like pattern, and often repeatedly returning to the array area. Studies from parallel industries enable the conclusion that the physical presence of floating WTG is unlikely to cause a barrier effect (OSC, 2022). The proposed Project's infrastructure may therefore enable additional foraging opportunities instead of representing a barrier to movement.

437. Furthermore, at 0.05 $km^2$ the proposed Project Array Area is small. Should individuals' transit around the Array Area, it is highly unlikely that the increased distance travelled will have any impact on their energy budgets are affected to the extent that an individual might experience a loss of fitness. The risk of the proposed Project being a barrier to movement is therefore negligible.

438. The potential barrier effects from mooring lines and cables between platforms and anchors have been **scoped out for further assessment for both Annex II harbour porpoise and grey seal features**.

*Entanglement with mooring lines and cables*

439. There is the concern that inter-array cables and mooring lines connected to the floating WTG may present a primary entanglement risk to harbour porpoise and grey seal, and therefore a risk of death or injury. However, the risk to small marine mammals from the moorings and lines is thought to be minimal because the cables and mooring lines are often taut and of a diameter large enough to preclude entanglement (Benjamins, et al., 2014; Maxwell, et al., 2022).

440. A secondary entanglement risk is considered to exist should lost or discarded fishing gear ('ghost gear') become caught on the moorings or cables. The conclusion in **Chapter 21: Marine Mammals** was that the anticipated likelihood of this occurring is low. Further, the Applicant has committed to regular inspections of the moorings and cables, and the removal of any ghost gear found. Therefore, when considering the regular inspection commitment, entanglement is not likely to affect the species viability in the SAC or the wider region.

441. The potential risk of entanglement with mooring lines and anchors has been scoped out for further assessment for Annex II harbour porpoise and grey seal features.

*Table 8-20. Summary of impact pathway refinement)*

| Potential Impact Pathway | Construction | Operation and Maintenance | Decommissioning | Scoped in / out |
|---|---|---|---|---|
| Effects of underwater noise | ✓ | ✓ | ✓ | In |
| Accidental pollution or contamination | ✓ | ✓ | ✓ | Out |

| Potential Impact Pathway | Construction | Operation and Maintenance | Decommissioning | Scoped in / out |
|---|---|---|---|---|
| Airborne sound and visual disturbance (pinnipeds only) | ✓ | ✓ | ✓ | In |
| Collision with project vessels | ✓ | ✓ | ✓ | Out |
| Potential for indirect effects through impacts to prey species | ✓ | ✓ | ✓ | Out |
| Effects of Electromagnetic field (EMF) emissions | | ✓ | | Out |
| Barrier effects from mooring lines and cables between platform and anchors | | ✓ | | Out |
| Entanglement with mooring lines and cables | | ✓ | | Out |

**Information for Appropriate Assessment**

*Harbour Porpoise – Assessment of Adverse Effects Alone*

*Conservation Objective 1 – The species is a viable component of the site*

442. Harbour porpoise is a viable component of the site if able to live successfully within the site. There is no site abundance estimate (as noted above) to enable a quantitative assessment of site population viability. Therefore, consideration of effects under this conservation objective focuses on the risk of any activity associated with the proposed Project that may kill, injure, or significantly disturb harbour porpoise.

***Mortality***

443. There was no risk of mortality identified from any activity associated with the proposed Project. The only impact pathways identified that have the potential to result in mortality are collision with project vessels, and entanglement (**Table 8-12**). These impact pathways have been assessed as a negligible risk, and not likely to occur (as presented above in the 'Impact pathway refinement' section above).

***Auditory injury (PTS-onset)***

444. PTS as defined in Southall *et al.,* (2019; 2007) is the minimum threshold for noise exposure for the onset of permanent hearing loss.

445. The risk of PTS-onset from pre-construction geophysical site surveys, UXO clearance events, and impact piling is presented in **Chapter 21: Marine Mammals** and **Appendix 21C: Marine Mammal Underwater Noise Assessment**. A summary of worst-case PTS-onset ranges predicted are reproduced in **Table 8-21.**

*Table 8-21 PTS-onset ranges and resulting number of harbour porpoise predicted to be at risk*

| Activity | PTS-onset range (km) | | Number individuals impacted | |
|---|---|---|---|---|
| Pre-construction geophysical survey | <0.01 | (static model) | <1 | |
| UXO clearance | 19.25<br>2.6 | (high-order)<br>(low-order) | 160<br><1 | (high-order)<br>(low-order) |
| Impact piling | 0.04 | (Instantaneous) | <1 | |

| Activity | PTS-onset range (km) | | Number individuals impacted |
|---|---|---|---|
| | 5.8 | (static model) | 15 |
| | 0.1 | (fleeing model) | <1 |
| Operational turbine | <0.01 | (static model) | <1 |

446. Noise modelling was conducted (see **Appendix 21B: Marine Mammals Noise Modelling** for detail), using the dual exposure criteria (Southall, et al., 2019) relating to both the instantaneous PTS-onset and accumulated PTS-onset risk. The cumulative PTS-onset risk was assessed using two model scenarios, a static model, which assumes the individual does not move throughout the noise exposure, and a fleeing model, which simulates the individual swimming away in response to the noise exposure.

447. Noise assessment (**Appendix 21C: Marine Mammal Underwater Noise Assessment**) found that there was a negligible risk to harbour porpoise of developing PTS-onset from geophysical activities, and that the risk of PTS-onset from impact piling is low. Modelling has predicted that an instantaneous injury is only possible within 40 m, and that an individual would need to be within 100m at the start of piling to accrue PTS-onset under the fleeing model scenario (**Appendix 21C: Marine Mammal Underwater Noise Assessment**). The static model is considered to be unrealistic, in that it assumes an individual remains stationary for 24 hours which is highly unlikely (Benhemma-Le Gall, et al., 2021). Should PTS-onset occur however, it is important to note that PTS-onset does not result in complete deafness for the individual, but rather a decrease in hearing sensitivity at the frequency ranges of the noise exposure. The Booth and Heinis (2019) technical workshop report, concluded that the effect of PTS-onset due to piling was unlikely to affect foraging (and therefore vital rates) because the frequencies used for echolocation (~ 130 kHz) are well above the PTS-onset frequency band for impact piling (2-10 kHz).

448. The PTS-onset risk from UXO clearance requires further consideration, particularly should this be required within the Offshore Export Cable Corridor which crosses the West Wales Marine SAC. The predicted range for a high-order detonation was 19.25 km which is not a range that can be mitigated using the typical methods in JNCC guidance (2010); therefore, should high-order detonation be required there is a risk of an adverse effect. Although guidance requires for the risk related to a high order detonation to be assessed (BEIS, 2022), the applicant has committed to prioritise the use of low-order clearance methods, which reduce the risk significantly. In addition to JNCC mitigation guidance, i.e., the use of marine mammal observers (MMO), passive acoustic monitoring (PAM) (**Appendix 04A: Outline CEMP**) and an Acoustic Deterrent Device (ADD), pre-detonation would actively deter harbour porpoise from within the low order PTS-onset range of 2.6 km (Thompson, et al., 2020).

449. The maximum PTS-onset range predicted in **Chapter 21: Marine Mammals** for all other construction activities was 421 m for harbour porpoise using the static animal approach (i.e., cable laying vessel). This would only be a risk if the individual was within this limited range for the full 24 hours, which is a highly unlikely scenario given both the vessel and the individual will be moving. Furthermore, as Benhemma-Le Gall *et al.* (2021) found when monitoring harbour porpoise responses to offshore wind construction (Moray Firth, Scotland) harbour porpoise are likely to avoid construction vessel activity out to 4 km, supporting the conclusion that potential for individuals to be within 421 m for 24 hours is highly unlikely.

450. The predicted noise PTS-onset ranges for operational noise impacts suggest there is no risk to harbour porpoise (PTS-onset, within 10 m for 24 hrs).

451. All cetaceans are EPS and as such are protected under Article 12 from deliberate killing, injury, and disturbance. The Applicant has committed to employing marine mammal mitigation

(**Appendix 04A: Outline CEMP**) that will minimise the risk of injury to negligible. The level of risk will be revisited in the risk assessment that will accompany the EPS and Marine Licences once the proposed Project's build out parameters are refined (Piling Strategy) and the presence (or lack of) UXO targets are clarified pre-construction.

***Disturbance***

452. The population model Interim Population Consequences of Disturbance (iPCoD) (Harwood, et al., 2014; King, et al., 2015) (see **Chapter 21: Marine Mammals** for model details) was used to assess whether the predicted levels of disturbance predicted for the proposed Project would be sufficient to result in a negative population level effect. IPCoD considers the difference in population trajectory between an impacted (with construction) and an unimpacted (no construction) population, known as counterfactual assessment Modelled results highlighted that there was no difference in the population trajectory when an unimpacted (no construction) scenario was compared to an impacted (with construction) scenario (**Figure 8-9**).

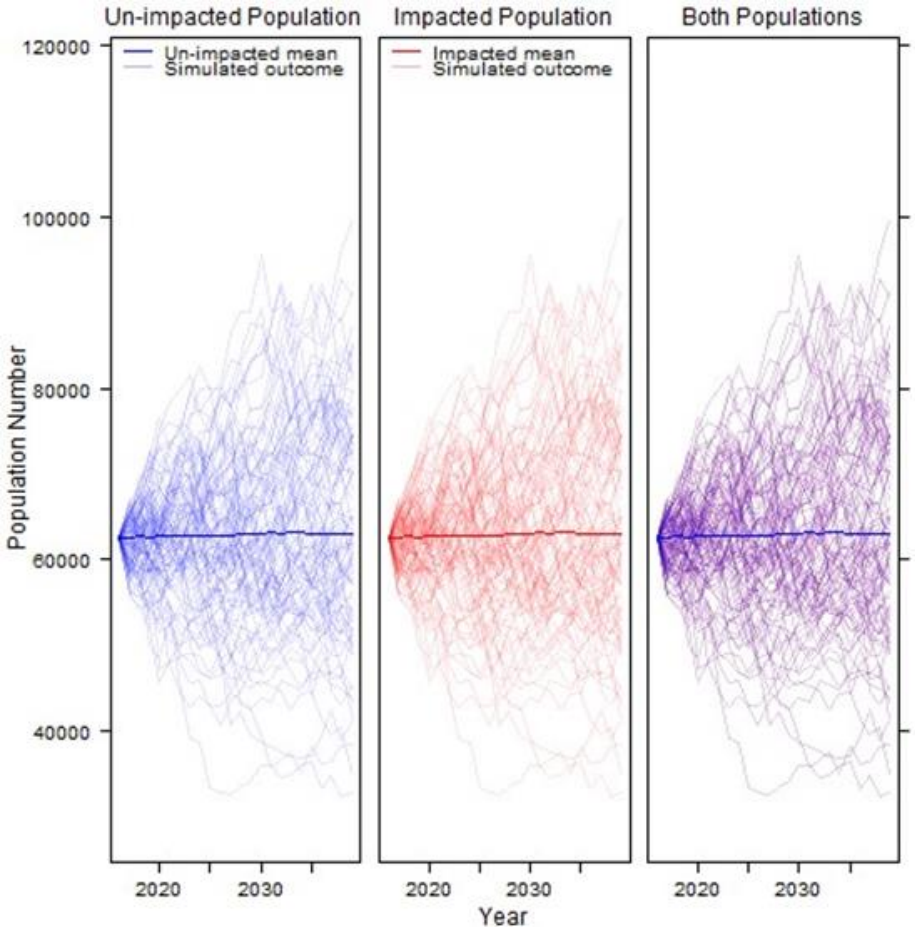


*Figure 8-9. Population trajectory counterfactual, un-impacted and impacted harbour porpoise (iPCoD)*

453. Therefore, provided appropriate mitigation is employed as developed and agreed with the Regulator, the proposed Project will not hinder Conservation Objective 1, relating to the Annex II harbour porpoise as a viable component of either West Wales Marine or Bristol Channel Approaches SACs.

*Conservation Objective 2 – No significant disturbance of the species within the site*

454. Underwater noise is the key pressure that could result in potential significant disturbance. JNCC (2020) guidance on noise management in harbour porpoise SACs provides the framework for assessment of the risk of an adverse effect to site integrity.

455. JNCC (2020) states that: "Noise disturbance within an SAC from a plan/project, individually or in combination, is considered to be significant if it excludes harbour porpoises from more than:

1. 20% of the relevant area[4] of the site in any given day, or
2. an average of 10% of the relevant area of the site over a season[5]"

456. Underwater noise disturbance may occur from pre-construction geophysical surveys, UXO clearance activities, impact piling, and other construction activities (including vessel activity). The disturbance ranges predicted for harbour porpoise, together with the impact threshold metric used in this assessment are listed in **Table 8-22** (reproduced from **Appendix 21C: Marine Mammal Underwater Noise Assessment**). As recommended in NRW (2022e), only fixed noise thresholds have been used.

*Table 8-22. Predicted disturbance ranges from noise generating activities for the proposed Project*

| Activity | Range (km) | | Threshold metric[#] |
|---|---|---|---|
| Pre-construction geophysical survey | 5 | | EDR |
| UXO clearance | High order | Low order | TTS-onset ($SPL_{peak}$) |
| | 37.5 | 5.1 | |
| Impact piling | Summer | Winter | Fixed (143dB re 1 $mPa^2.s$) |
| | 20 | 39.2 | |
| Cable laying activity (as worst case 'other' activities) | 21.9 | | Fixed (NMFS 120 dB rms) |
| Vessel noise | 4.5 | | Fixed (NMFS 120 dB rms) |
| Operational noise | 0.588 | | Fixed (NMFS 120 dB rms) |

457. Operational noise does not have a spatial overlap with either of the harbour porpoise SACs; therefore, is not taken any further forward for assessment (see **Table 8-14** above for distance to SACs).

458. Geophysical survey, cable laying and UXO clearance activities all have the potential to be carried out within the offshore export cable corridor, and therefore the area of overlap has been calculated using the location within the OfECC) that predicts the worst-case overlap, for each SAC independently **(Figure 8-10**; **Table 8-22**).

459. Impact piling has potential overlap with both SACs; therefore, the area of overlap has been calculated based on locations that represent the worst-case piling location for overlap (**Figure 8-10**; **Table 8-22**). For clarity, nominal locations have been chosen that result in the largest overlap with each SAC, and therefore represent the absolute worst-case scenario.

460. All SAC overlap calculations were performed in ArcGIS (version 10.8.1). For the Array Area a point was tested in the north-east corner and also in the south corner (**Figure 8-10**). A buffer was created around each of the two points using the disturbance ranges for each activity (**Table 8-22**). For both the West Wales Marine SAC and Bristol Channel Approaches SAC, the point with the most overlap was used to assess worst case overlap with each SAC.

[4] The relevant area is defined as that part of the SAC that was designated on the basis of higher persistent densities for that season (summer defined as April to September inclusive, winter as October to March inclusive)
[5] Summer defined as April to September inclusive, winter as October to March inclusive

461. Where large areas of an SAC were blocked by land, this was removed from the overlap area (although all SAC overlap was below 20% with the entire area included). The same process was carried out for the cable corridor testing 6 locations along the cable route (**Figure 8-10**).

462. Again, these steps were repeated for both the Array Area and Cable corridor for Erebus. Any additional overlap of the SACs that resulted from the Erebus ranges, was summed into that calculated for Llyr, to produce the total cumulative SAC overlap from the two projects.

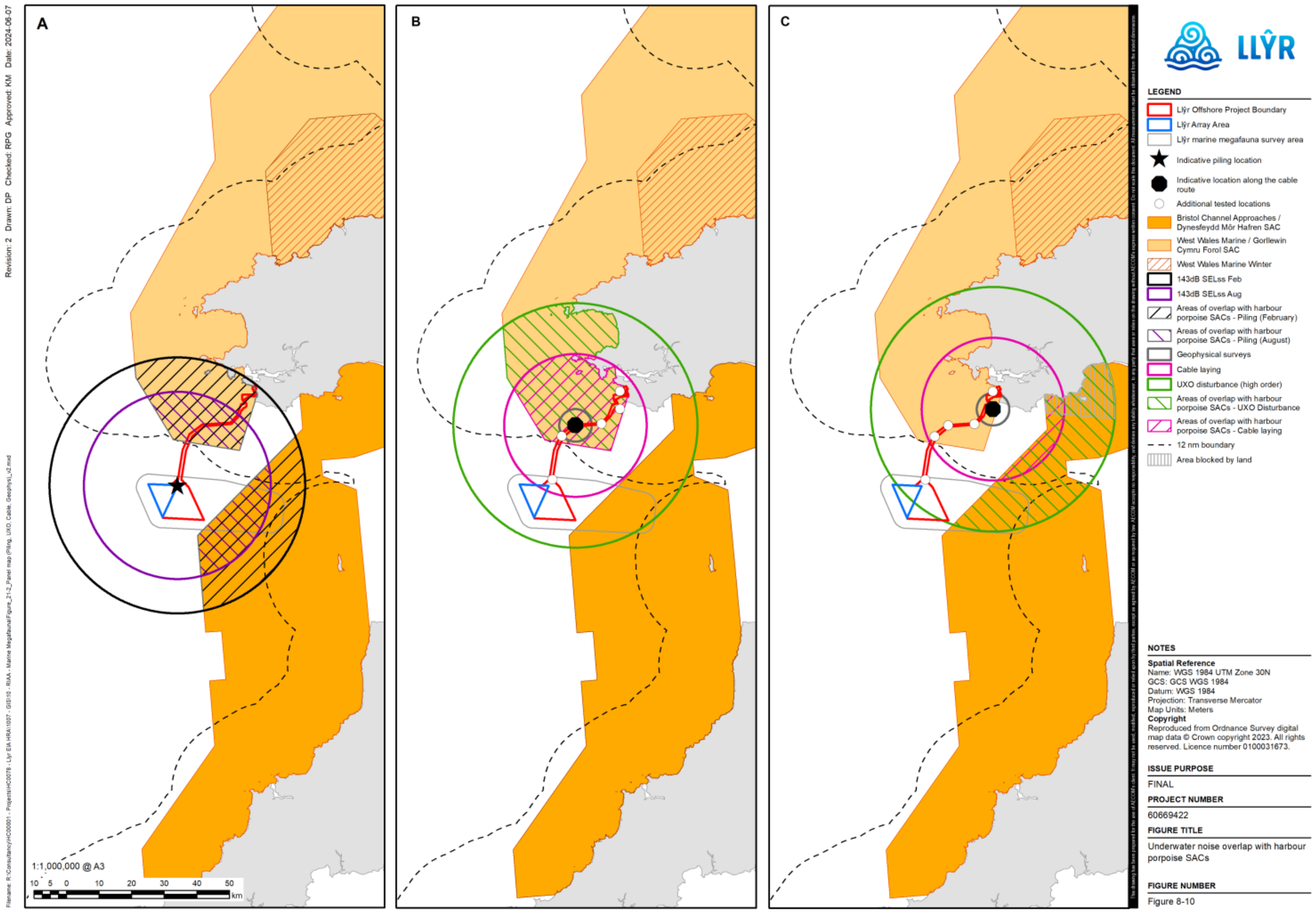


*Figure 8-10. Underwater noise overlap from (A) impact piling and (B) & (C) geophysical surveys, cable laying and UXO clearance activities, (B) worst-case location for West Wales Marine, and (C) worst-case location for Bristol Channel Approaches*

***Percentage daily footprint overlap with harbour propoise SACs***

463. Assessment of the overlapping area (**Figure 8-10** and **Table 8-23**) indicates that none of the noise generating activities breach the spatial threshold of 20% of any relevant area, in any given day.

464. In the summer season, the maximum spatial overlap for the West Wales Marine SAC is 16.83% as a result of an UXO clearance event occurring in the worst-case location within the OfECC. There is no possibility of an overlap from any activity relating to the winter season protected area (**Table 8-23**Table 8-26).

465. Bristol Channel Approaches SAC is a winter site and so the overlap has been assessed using the winter worst-case noise modelling parameters (**Appendix 21B: Marine Mammals Noise Modelling**; **Appendix 21C: Marine Mammal Underwater Noise Assessment**). However, construction activities usually occur during the clement weather conditions in the summer months, thus, if there were no activities during the winter season, the area of overlap would in effect be zero.

*Table 8-23. Worst-case percentage daily footprint overlap with the Harbour porpoise SACs*

| SAC | Season | Area ($km^2$) | Percentage overlap with SAC (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Geophys | | UXO | | Piling | | Cable laying | |
| | | | OfECC | Array Area | OfECC | Array Area | OfECC | Array Area | OfECC | Array Area |
| West Wales Marine | Summer | 7376 | 1.07 | 0.00 | 16.83 | 9.34 | N/A | 4.93 | 9.72 | 2.03 |
| | Winter | 1461 | 0.00 | 0.00 | 0.00 | 0.00 | N/A | 0.00 | 0.00 | 0.00 |
| Bristol Channel Approaches | Winter | 5845 | 0.00 | 0.00 | 18.1 (14.42*) | 14.63 | N/A | 16.66 | 2.74 (2.02*) | 2.45 |

* *With area blocked by land removed from percentage footprint*

***Seasonal percentage overlap with harbour porpoise SACs***

466. The seasonal percentage coverage (the 10% threshold of the relevant area of a site) has been calculated using JNCC (2020) guidance using the following equation:

$$\frac{\text{Daily Footprint (\%) x number of days}}{\text{Number of days in the season}} = \text{\% seasonal coverage}$$

467. The worst-case number of days currently considered for each of the activities included in this assessment, are detailed in **Table 8-24**, together with the resulting seasonal percentage site coverage. The number of days may be refined once project build out information is further defined. Vessel noise has been assumed to be incorporated within the cable laying installation activity as this is greater than the vessel disturbance estimates alone. It has been assumed that there could be one UXO clearance event (in line with Erebus (2019)). The worst-case seasonal coverage has been calculated using worst-case source locations for each of the pressures; however, it is worth noting that the actual location of the activity during the season is unlikely to be the worst-case location for overlap throughout. Therefore, the season percentage overlap with the SACs as presented, is likely to be an overestimate.

*Table 8-24. Season percentage noise impact overlap with West Wales Marine and Bristol Channel Approaches SACs*

| Activity | Number of days | | | Seasonal percentage overlap with SAC (%) | |
|---|---|---|---|---|---|
| | OfECC | Array area | Total | West Wales Marine (summer) | Bristol Channel Approaches (winter) |
| Pre-construction geophysical survey | 20 | 10 | 30 | 0.12 | 0.00 |
| UXO clearance | 1* | 0 | 1 | 0.09 | 0.08 |
| Impact piling | 0 | 10 | 10 | 0.27 | 0.91 |
| Cable laying | 100 | 95 | 195 | 6.36 | 2.77 |
| **Total seasonal percentage coverage** | | | | **6.84** | **3.76** |

* *Assessment based on one high-order UXO clearance event in worst case-location*

468. The seasonal percentage overlap for both the West Wales Marine, and the Bristol Channel Approaches are lower than the 10% seasonal threshold, therefore no AeoSI can be concluded when considered against Conservation Objective 2. Further, it is worth reiterating, should construction occur within the summer season, the Bristol Channel Approaches overlap would be zero.

*Conservation Objective 3 – The supporting habitats and processes relevant to harbour porpoise and their prey are maintained*

469. The activities considered in relation to any potential impact to the supporting habitats and prey availability for harbour porpoise within this conservation objective are: accidental pollution or contamination; indirect impacts to prey species; EMF emissions; and barrier effects from the offshore structures. These impact pathways have been scoped out of further assessment due to minimal potential effects.

*Conclusion*

470. Provided appropriate mitigation is employed as developed and agreed with the Regulator (**Appendix 04A: Outline CEMP**), there is no potential for an AeoSI during any phase of the proposed Project, on the West Wales Marine SAC, or the Bristol Channel Approaches SAC in response to:

- underwater noise (including geophysical surveys, UXO clearance, impact piling, cable installation, operational and vessel traffic);
- accidental pollution or contamination;
- collision with project vessels;
- indirect effects through impacts to prey species;
- effects of EMF emissions;
- barrier effects from mooring lines and cables between platform and anchors; or
- entanglement with mooring lines and cables.

*Grey Seal – Assessment of Adverse Effects Alone*

*Conservation Objective 1 – The population is maintaining itself on a long-term basis as a viable*

*component of its natural habitat.*

471. Grey seals associated with Pembrokeshire Marine SAC are not a discrete population. This assessment has therefore followed NRW guidance (NRW, 2022) and considered the OSPAR region III as the Management Unit for grey seal, with a reference population of 62,358 (see **Chapter 21: Marine Mammals**). According to SCOS (2022), the latest population estimate in Wales is 5,400 grey seals, and 162,000 across the entire UK; the latter of which equates to approximately 35% of the world population. UK wide population monitoring, suggests that there has been a significant increase in grey seal pup production between 2016 and 2019 in Wales, resulting in an increasing population trend (SCOS, 2022). Further, regularly monitored colonies in Pembrokeshire are increasing by around 6% (SCOS, 2021),. Grey seal conservation status is currently assessed as 'favourable', and the overall trend is 'improving' in the latest Article 17 Reporting (JNCC, 2019).

472. Elements that require consideration under this conservation objective include all activities that have the potential to negatively impact the population size, structure, production, and condition of species within the site. Therefore, activities that have the potential to result in mortality, auditory injury (within and outside) the SAC have been considered, together with the population modelling conducted in **Chapter 21: Marine Mammals**. These are the elements most likely to impact any conclusion of whether this proposed Project is capable of affecting the population maintaining itself on a long-term basis.

***Mortality***

473. There was no risk of mortality identified from any activity associated with the proposed Project. The only impact pathways identified that have the potential to result in mortality are collision with project vessels, and entanglement (**Table 8-12**). These impact pathways have been assessed as a negligible risk, and not likely to occur (as presented above in the 'Impact pathway refinement' section above).

***Auditory injury (PTS-onset)***

474. Noise modelling (**Chapter 21: Marine Mammals**; **Appendix 21C: Marine Mammal Underwater Noise Assessment**) has indicated that the risk of auditory injury (PTS-onset) for grey seals is low (**Table 8-25**). For all activities modelled, the predicted number of individuals at risk of PTS-onset is less than one. The implementation of the activity specific Marine Mammal Management Plan (MMMP) (**Appendix 04A: Outline CEMP)** will further reduce any residual risk.

*Table 8-25. Summary of grey seal PTS-onset ranges and corresponding predicted number of individuals within this range*

| Activity | PTS-onset range (km) | Number individuals impacted |
|---|---|---|
| Pre-construction geophysical survey | <0.01 (static model; 24 hrs) | <1 |
| UXO clearance | 3.4 (high-order)<br>0.4 (low-order) | <1 (high-order)<br><1 (low-order) |
| Impact piling | <0.01 (Instantaneous)<br>3.3 (static model; 24 hrs)<br>0.06 (fleeing model) | 0<br><1<br><1 |

***Disturbance***

475. The population model Interim Population Consequences of Disturbance (iPCoD) (**Chapter 21: Marine Mammals**) was run to assess whether a population impact was anticipated from the project alone. The absolute worst-case prediction of 848 individuals at risk of disturbance was used in the model. **Chapter 21: Marine Mammals** presented a range of estimated numbers of

individuals; the worst-case estimate arose from the dose response methodology. This methodology applies the probability of an individual response to certain noise levels throughout the range of noise, extending to levels that can be found in background noise levels. This method is therefore considered to be highly precautionary (see **Chapter 21: Marine Mammals** for further details). IPCoD considers the difference in population trajectory between an impacted (with construction) and an unimpacted (no construction) population, known as counterfactual assessment. The results, using 848 individuals, support the conclusion that there is no impact on the grey seal population from the proposed Project (**Figure 8-11**).

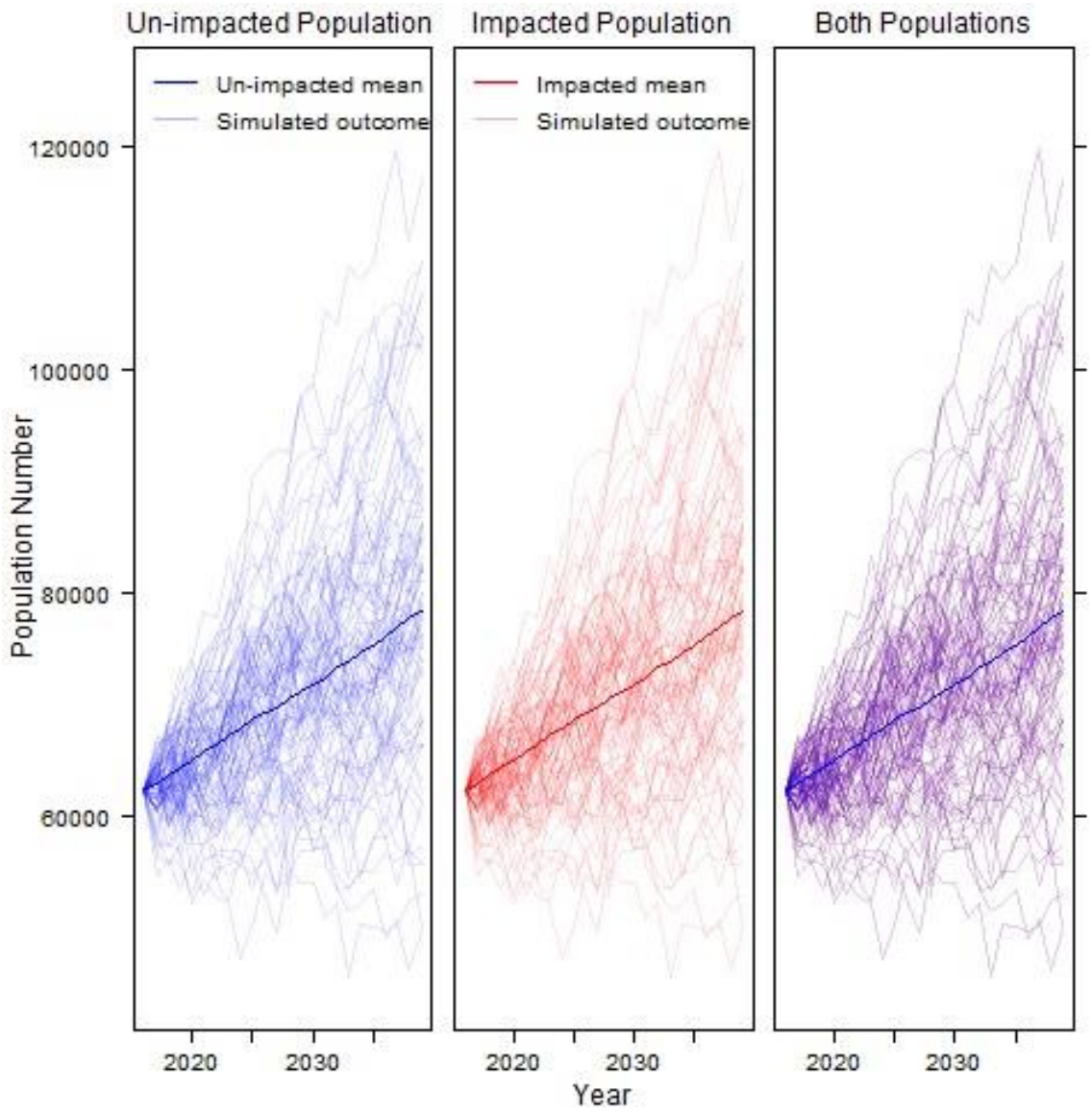


*Figure 8-11 Population trajectory for both the impacted and unimpacted grey seal population modelling*

476. It can be concluded therefore, that there is no risk of the proposed Project contravening Conservation Objective 1 for Pembrokeshire Marine SAC.

*Conservation Objective 2 – The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.*

477. To consider whether the range within the SAC and adjacent inter-connected areas is not constrained, hindered or reduced, the results from noise disturbance, visual disturbance,

population modelling (iPCoD) and barrier effects are discussed in this section (**Chapter 21: Marine Mammals**).

***Noise disturbance***

478. Disturbance ranges for pre-construction geophysical survey, UXO clearance, impact piling, cable laying (included as worst-case to cover all 'other' activities), vessel noise and operational noise are detailed in **Table 8-26**. Also detailed are the number of grey seals predicted to be impacted and the percentage of the management reference population this relates to. This information has been reproduced from **Chapter 21: Marine Mammals**.

*Table 8-26. Summary of disturbance ranges, together with threshold used, predicted number of grey seal individuals at risk of disturbance together with the percentage of the reference population affected (**Chapter 21: Marine Mammals; Appendix 21C: Marine Mammal Underwater Noise Assessment**)*

| Activity | Range (km) | Threshold metric | Number impacted | %MU reference population |
|---|---|---|---|---|
| Pre-construction geophysical survey | 5 | EDR | <1 | 0.001 |
| UXO clearance | 25.5 | High order TTS-onset ($SEL_{ss}$) * | 17 | 0.028 |
| | 1.4 | Low order TTS-onset ($SEL_{ss}$) | <1 | 0.000 |
| Impact piling | 9.27 | Fixed (NMFS Level B 160 dB) | 3 | 0.005 |
| | 115.82 | Dose response curve (120 dB $SEL_{ss}$) | 848 | 1.360 |
| | 42.98 | Dose response curve (clipped to 143 dB $SEL_{ss}$) | 121 | 0.190 |
| Cable laying activity (as worst case 'other activities) | 21.9 | Fixed (NMFS 120 dB rms) | 91 | 0.146 |
| Vessel noise | 4.5 | Fixed (NMFS 120 dB rms) | <1 | 0.001 |
| Operational noise | 0.588 | Fixed (NMFS 120 dB rms) | N / A | N / A |

[#] *SELss – single strike Source Energy Level*

479. Most activities are predicted to be of low impact. The worst-case numbers impacted result from the predictions from the impact piling and cable laying activities. The wide range of predicted disturbance ranges and number of individuals potentially at risk of noise disturbance due to the impact piling activity, emphasize that these predictions are highly dependent on the methodology used. Therefore, all are presented for context. For all activities, apart from impact piling (using dose response curve metric) assessment indicates that there are low numbers of individuals at potential risk of disturbance. The highest being 91 individuals predicted for the cable laying activity; however, this relates to well under 1% of the management population and therefore does not present a risk to the population. Furthermore, any disturbance that occurs as a result of construction (or decommissioning) activity will be short term and reversible.

***Population modelling***

480. As noted above, population impact modelling (iPCoD) has shown that there is no negative impact at the population level, using the worst-case estimate of 848 individuals at risk of disturbance. This number is estimated using the dose response curve methodology, and these

include regions where noise levels fall to 120-125 dB re 1 $\mu Pa^2s$ (SELss). Noise levels in this range are likely to be close to background, ambient noise levels (**Appendix 21B: Marine Mammals Noise Modelling**) and therefore the area used to estimate the total number of individuals at risk of disturbance may relate to audibility rather than representing levels that elicit a disturbance response and is therefore highly precautionary.

481. It can be concluded therefore, that noise disturbance from the noise generating activities considered (**Table 8-26**) will not result in a reduction of range for the grey seal in the foreseeable future.

***Visual or airborne disturbance at haul-outs***

482. During the construction phase, there is the possibility that vessels and construction activities close to the coast along the offshore export cable corridor route may disturb grey seals hauled out on the shore. When disturbed, animals may flush into the water, potentially resulting in energy losses or impacts on breeding success.

483. Although seals may be present throughout the SAC, important areas within the SAC are the offshore islands (Skomer, and Ramsey). Pupping in Welsh waters occurs from August to December, with September and October being the busiest months. Adult seals congregate in large numbers on beaches between December and February to moult. August through to February are therefore key sensitive months.

484. According to SCOS (2021; 2022), the three main haul-out sites utilised by breeding grey seals located close to the proposed Project are Ramsey Island, Skomer MCZ and north Pembrokeshire, with the closest being Skomer MCZ (approximately 38.39 km from the Array Area, 11.57 km from the OfECC and 13 km from the landfall at Freshwater West respectively). Given the distances from these key grey seal haul-outs / breeding sites to the Array Area, OfECC and landfall site, it is unlikely that airborne sound from the pre-construction and construction works (e.g. pin-piling, UXO clearance, cable laying), will disturb hauled-out seals at these key haul-out sites.

485. A study of grey seal mothers found that increased boat speed was a significant factor in whether animals displayed a disturbance response or flushed into the water and observed movement into the water generally when boats were between 20 m and 70 m offshore, with no detectable disturbance at 150 m (Strong & Morris, 2010; Wilson, 2014). Although, grey seals have also been reported to move into the water when vessels are at a distance of approximately 200 - 300 m (Wilson, 2014).

486. At Ramsey Island, there are frequent tour boats which regularly transit near hauled-out seals; however, there has not been any reduction in reproductive rate observed in association with this which may indicate habituation to vessels (Strong & Morris, 2010). There is therefore the potential for vessels transiting from the port to the array area to cause disturbance to grey seal haul-outs. However, it is not expected that any vessels would pass close enough (within 200 – 300m) or be travelling at sufficient speed to result in any disturbance to hauled-out animals at these key sites. Additionally, there is no evidence that disturbance at haul-out sites is currently a concern at the population level (SCOS, 2021).

487. Therefore, general vessel construction activity is unlikely to contravene Conservation Objective 2. However, the OfECC and landfall are within the SAC and so need to be considered further.

488. The proposed HDD landfall site is Freshwater West, and construction is anticipated to take between 24 and 64 weeks. Although the landfall location does not appear to be a key location within the SAC for grey seals to haul out, as mentioned above, seals could be present anywhere along the Pembrokeshire coastline. All vessel crew will be made aware of seal disturbance indicators via toolbox talks and will adhere to good practice movement when close to shore.

Furthermore, the cable laying vessel will be moving slowly when cable laying and therefore unlikely to cause flushing to any hauled-out seals.

489. Furthermore, as additional mitigation, the Applicant will investigate whether a seasonal restriction is able to be put in place if required, such that activity on the shoreline would not take place between August and February. Alternatively, should construction be necessary during this period, the Applicant will commit to winter surveys of the landfall site post submission to obtain greater detail on the number of mother-pup pairs likely to be in that specific location.

490. Provided a seasonal restriction is implemented during breeding season for the cable landfall activity, or pre-construction surveys indicate the landfall site is not used for grey seal pupping, then it can be concluded that there is no risk of the proposed Project contravening Conservation Objective 2 for Pembrokeshire Marine SAC.

*Conservation Objective 3 - The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance, and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include; distribution, extent, structure, function and quality of habitat, and prey availability and quality.*

491. Consideration of Conservation Objective 3 involves assessment of the habitats and species that support grey seals within the site and the wider area. Therefore, the broad conclusions from **Chapter 19: Benthic Ecology** and **Chapter 20: Fish and Shellfish Ecology** are included here.

492. The export cable route crosses the Pembrokeshire Marine SAC. The total habitat loss in the entire OfECC is 0.055 $km^2$. This is a small percentage area in comparison to the Pembrokeshire Marine SAC total area of 1,380 $km^2$. **Chapter 19: Benthic Ecology** has concluded that the significance of effect for all potential impacts assessed (including temporary loss and physical disturbance to benthic habitats and species) to be not significant. Therefore, there is no possibility for the proposed Project's construction within the Pembrokeshire Marine SAC to impact the presence, condition and diversity of habitats and species relevant for the grey seal.

493. There were no significant effects to fish and shellfish ecology identified as a result of the proposed Project (**Chapter 20: Fish and Shellfish Ecology**).

494. NRW's indicative site condition assessment of Pembrokeshire Marine SAC (NRW, 2018d), suggest that the growth of pup production within the site indicates that the supporting habitat is functioning well. The loss and/or physical disturbance to the seabed habitats and benthic species from the proposed Project's activities, has been concluded as temporary, with a rapid recovery of seabed habitats and species (**Chapter 19: Benthic Ecology**). Therefore, it can be concluded that there is no lasting impact to the presence, abundance, condition and diversity of habitats required to support the population of grey seals in the SAC.

*Conclusion*

495. There is no potential for an AEoSI during any phase of the proposed Project, on the Pembrokeshire Marine SAC in response to:

- underwater noise (including geophysical surveys, unexploded ordnance (UXO) clearance, impact piling, cable installation, operational and vessel traffic);
- accidental pollution or contamination;
- collision with project vessels;
- indirect effects through impacts to prey species;
- effects of EMF emissions;

- barrier effects from mooring lines and cables between platform and anchors; or
- entanglement with mooring lines and cables.

496. The **potential for an AEoSI from airborne sound and visual disturbance** from the export cable construction near the shore, and the HDD operations at the landfall location, can be **reduced to no AEoSI by employing a seasonal restriction** during the grey seal breading / pupping season, such that activity on the shoreline would not take place between August and February. Alternatively, should construction be necessary during this period, the Applicant will commit to winter surveys of the landfall site post submission to obtain greater detail on the number of mother-pup pairs likely to be in that specific location.

497. Provided a seasonal restriction is implemented during breeding season for the cable landfall activity, or pre-construction surveys indicate the landfall site is not used for grey seal pupping, then it can be concluded that there is no risk of the proposed Project contravening Conservation Objective 2 for Pembrokeshire Marine SAC.

**Information for Assessment of Adverse Effects In-Combination**

498. The plans and projects selected as relevant to the in-combination assessment of impacts to harbour porpoise and grey seal are based on the screening exercise undertaken for the cumulative effects assessment (**Chapter 21: Marine Mammals**).

499. For those projects in Tier 4 the timing of construction is particularly uncertain. The in-combination assessment is therefore unable to predict the potential impact of the project with any certainty. Therefore only Tier 1-3 projects are considered within the following in-combination assessment. However, an indication in the level of risk for these projects is presented in **Chapter 21: Marine Mammals**.

500. The Tier 1 – 3 plans and projects considered for inclusion for the assessment of adverse effects in-combination were identified within the harbour porpoise Celtic and Irish Sea Management Unit (IAMMWG, 2022) and the OSPAR Region III for grey seals. These include:

- **Erebus** is a floating offshore wind project in the Celtic Sea, approximately 35 km southwest from the Pembrokeshire coastline, and is the closest project to this proposed Project at 5 km NW.
  - Erebus project consists of **up to ten** floating WTG;
  - Installation is expected to be between June 2026 and October 2026; and
  - Tier 2 – consented.
- **White Cross** is a floating offshore wind project, situated approximated 52 km off the North Devon coast.
  - 17 km SE of the proposed Project;
  - The intention is for **five to eight** floating WTGs;
  - Offshore construction 2026 / 2027; and
  - Tier 3 – application submitted.
- **TwinHub** is a floating offshore wind project in the Celtic Sea and will be deployed in the existing WaveHub site, approximately 16 km off the Cornish coast.
  - 102 km SW of the proposed Project;
  - The site will host **two** floating offshore wind platforms;
  - Construction and commissioning are expected in 2026; and

- Tier 2 – consented.

- **South Irish Sea Array** is a fixed foundation project, situated at a minimum 10 km off the coast of Wexford and south Wicklow.
  - 119 km NW of the proposed Project;
  - Construction anticipated post 2026 and between two and four years to complete;
  - Indicative capacity of 600-800 MW, **40 – 60 turbines**; and
  - Tier 3 – application submitted.
- **Awel y Môr** is a fixed foundation offshore wind farm project, with a maximum number of turbines between **34** - **50**.
  - 214 km NE of the proposed project;
  - Situated off the coast of north Wales, to the west of the existing Gwynt y Môr;
  - Not known at this stage if the foundations will be multi-legged pin piles or monopile;
  - Expected to commence construction in 2027 and be completed by 2029; and
  - Tier 2 – consented.

*Harbour Porpoise – Assessment of Adverse Effects In-Combination*

*Conservation Objective 1 - The species is a viable component of the site*

501. In the project alone assessment, the following impact pathways were identified relative to Conservation Objective 1. These were the risk of:

- auditory injury (PTS-onset);
- potential for population impact in response to disturbance;
- collision with project vessels; and
- entanglement from the floating offshore wind structures.

502. This section builds on the findings for the project alone section above (**Paragraph 453**).

503. The risk of PTS-onset for all projects will be required via consent conditions to be minimised to negligible using JNCC marine mammal mitigation guidelines (JNCC, 2010; JNCC, 2010; JNCC, 2010). Each marine mammal mitigation plan will be tailored to the project specific predicted impacts and agreed during the post consent dialogue with NRW. The use of mitigation measures (including MMOs; PAMs; and ADDs) will result in no risk of an in-combination auditory injury pathway for harbour porpoise within the Celtic and Irish Seas MMMU.

504. There is the potential for an accumulated risk of disturbance to harbour porpoise within the Celtic and Irish Seas MMMU from the identified projects. This was assessed in **Chapter 21: Marine Mammals** using a population model (iPCoD). The results from this model indicated that there was no accumulated risk to the harbour porpoise population, with no difference in population trajectory between the impacted (with construction) and the un-impacted populations.

505. The collision risk from any project vessel movement is considered to be negligible. All projects will be required to implement a Vessel Management Plan and adhere to good practice wildlife guidelines (e.g. the WiSE scheme (2018)). The population model run for the assessment, included consideration of vessel disturbance, from all projects included in the **Chapter 30: Inter-related and Cumulative Effects**. As noted in the paragraph above, there was no accumulated risk to the harbour porpoise population predicted from the model. Therefore, although an increase in vessel movements from a number of developments in the MMMU is possible, there is no potential of an in-combination effect.

506. The risk of entanglement is only an impact pathway for floating offshore wind projects. This is a potential risk throughout each of the project's operational phase. This applies therefore to three of the five identified projects in addition to the proposed Project (i.e., Erebus, White Cross and TwinHub). The total number of floating offshore wind platforms from these projects in-combination is a maximum of 30 WTGs. This scale of development will not cover a significant area in comparison to the Celtic and Irish Seas MMMU. The proposed project is predicted to cover 0.05 $km^2$. If multiplied by 3 (as a proxy for the area covered by 30 WTGs) an area of 0.15 $km^2$ can be estimated, which in comparison to the area covered by the Celtic and Irish Seas MMMU is 516,893 $km^2$ is negligible. Regardless, the risk of entanglement for harbour porpoise is considered to be negligible from the cables and moorings themselves (**Chapter 21: Marine Mammals**). Although considered unlikely, there is uncertainty related to the potential for ghost gear becoming caught on the moorings / dynamic inter-array cables and then become a hazard for entanglement. In view of this uncertainty, it is likely that all floating offshore wind developments will be required to monitor the cables and moorings and to commit to removal of any ghost gear present thus reducing the potential for harbour porpoise becoming entangled.

507. Provided appropriate mitigation and / or monitoring is employed as agreed with the Regulator, the proposed project in-combination will not compromise Conservation Objective 1, relating to the species as a viable component of the site at either West Wales Marine or Bristol Channel Approaches SACs.

*Conservation Objective 2 - No significant disturbance of the species within the site*

508. The in-combination assessment for Conservation Objective 2, applies the same spatial/temporal threshold approach for the proposed Project alone assessment, in terms of area of impact overlapping the harbour porpoise SACs. The in-combination assessment has focused on the potential for disturbance from underwater noise.

509. The only project from the plans and projects identified above that could have a noise impact overlap in-combination is Erebus; at approximately 5 km from this proposed Project. It is also possible that Erebus will be constructing within the same period as this proposed Project (2025 - 2026). The daily percentage overlap in combination with this proposed Project was estimated using disturbance ranges obtained from MarineSpace Ltd. (2021) and detailed in **Table 8-27**.

*Table 8-27. Summary of disturbance ranges for Erebus (reproduced from MarineSpace Ltd. (2021))*

| Activity (Erebus) | Range (km) | | Threshold metric |
|---|---|---|---|
| Pre-construction geophysical survey | 5 | | Not specified – used EDR as per this proposed Project |
| UXO clearance | High order | Low order | [1]TTS-onset ($SPL_{peak}$)<br>[2]EDR |
| | 23[1] | 5[2] | |
| Impact piling | 34.46 | | Dose response curve area up to 145 $SEL_{ss}$ contour |
| Cable laying activity (as worst case 'other activities) | 5 | | EDR |

510. As with the project alone assessment, operational noise from either project does not have a spatial overlap with any harbour porpoise SAC; therefore, is not taken any further forward for in-combination assessment.

511. Geophysical survey, cable laying and UXO clearance activities from Erebus, all have the potential to be carried out within the offshore export cable corridor, and therefore the area overlap has been calculated using the location within the export cable route that predicts the worst-case overlap, for each SAC independently (**Figure 8-12; Figure 8-13**; **Table 8-28**).

512. Based on locations that represent the worst-case piling location within the Erebus array area, impact piling from Erebus has a potential overlap with West Wales Marine SAC only, (**Figure 8-12; Figure 8-13**; **Table 8-28**).

513. **Table 8-28** shows that the project Erebus adds very little to the daily percentage overlap for West Wales Marine SAC, and due to its location further to the west, Erebus does not add any daily percentage overlap to the Bristol Channel Approaches SAC.

514. The combined daily percentage overlap has been used to determine the potential seasonal percentage overlap, using the same methodology as for the project alone assessment (**Table 8-29**).

*Table 8-28. In-combination (Erebus and this proposed Project) total daily percentage overlap with West Wales Marine and Bristol Channel Approaches SACs*

| SAC | Season | In-combination percentage overlap with SAC (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Geophys | | UXO | | Piling | | Cable laying | |
| | | OfECC | Array Area | OfECC | Array Area | OfECC | Array Area | OfECC | Array Area |
| West Wales Marine / Gorllewin Cymru Forol SAC (UK0030397) | Summer | **2.13** | 0.00 | 16.83 | 9.34 | N/A | **6.81** | 9.72 | 2.02 |
| | Winter | 0.00 | 0.00 | 0.00 | 0.00 | N/A | 0.00 | 0.00 | 0.00 |
| West Wales Marine / Gorllewin Cymru Forol SAC (UK0030397) | Winter | 0.00 | 0.00 | 18.20 | 18.15 (14.42*) | N/A | 16.66 | 2.74 | 2.45 |

* *With area blocked by land removed*

***Bold*** *numbers indicate where Erebus has increased the percentage of SAC overlap*

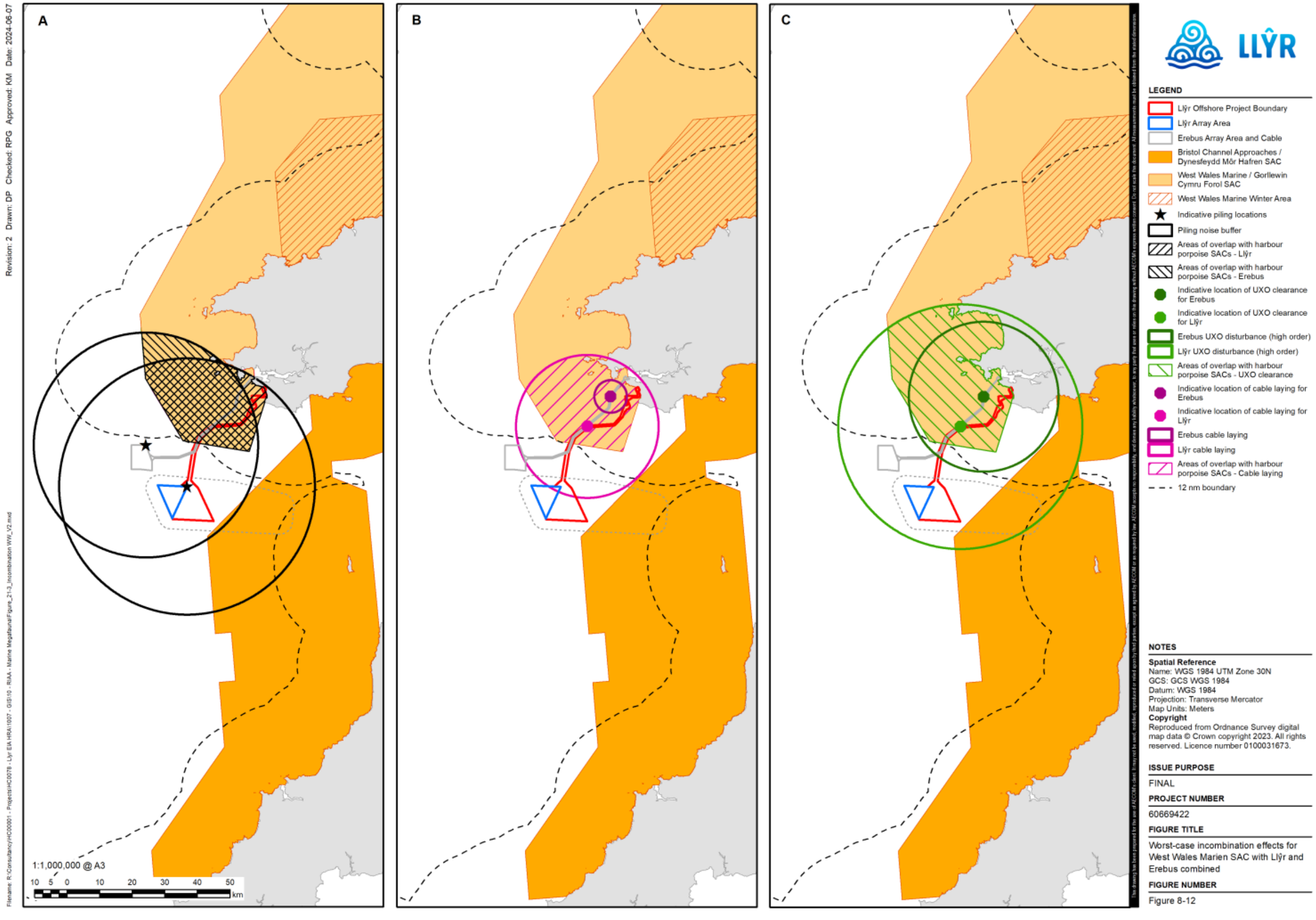


*Figure 8-12. (A) Impact piling, (B) cable laying and (C) UXO clearance noise overlap with harbour porpoise SACs from this proposed Project and Erebus in-combination – worst-case locations for West Wales Marine SAC*

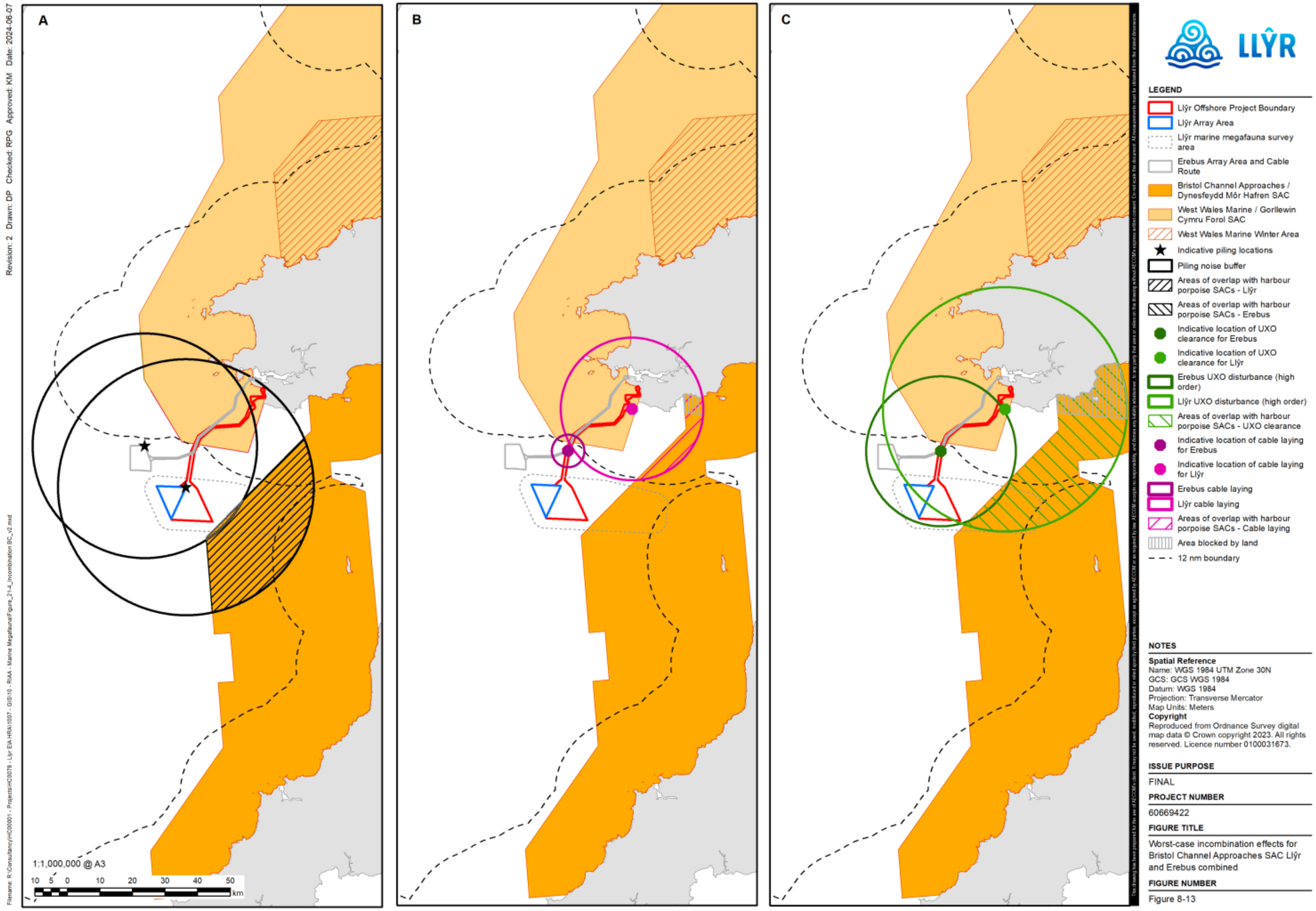


*Figure 8-13. (A) Impact piling, (B) cable laying and (C) UXO clearance noise overlap with harbour porpoise SACs from this proposed Project and Erebus in-combination – worst-case locations for Bristol Channel Approaches SAC*

*Table 8-29. In-combination (Erebus and this proposed Project) total seasonal percentage overlap with West Wales Marine and Bristol Channel Approaches SACs*

| Activity (proposed Project in-combination with Erebus) | Total number of days[1] | | | Seasonal percentage overlap with SAC (%) | |
|---|---|---|---|---|---|
| | OfECC | Array area | Total | West Wales Marine (summer) | Bristol Channel Approaches (winter) |
| Pre-construction geophysical survey | 20 | 10 | 30 | 0.23 | 0.00 |
| UXO clearance* | 2 | 0 | 2 | 0.18 | 0.10 |
| Impact piling | 0 | 10 (18) | 18 | 0.67 | 1.50 |
| Cable laying (Llyr & Erebus) | 100 (152) | 95 (88) | 195 | 6.36 | 2.77 |
| Cable laying (Erebus – excess†) | 52 | 0 | 52 | 0.30 | 0.00 |
| Total seasonal percentage coverage | | | | 7.75 | 3.78 |

[1] *the number of days for Erebus was obtained from MarineSpace Ltd* (2021)

**Assessment based on two high-order UXO clearance events in worst case-location, one for each Project*

*† The excess days detailed here are calculated on the Erebus ES estimation of the disturbance range from cable laying vessels (see **Table 8-27**.)*

*() Numbers in brackets represent the number of days estimated for Erebus. Total is calculated assuming there is an overlap in activity*

515. The results presented in **Table 8-29** suggest that the activities assessed (geophysical survey; UXO clearance; impact piling, cable laying) for the proposed Project in-combination with Erebus will not compromise the 10% seasonal threshold and therefore no AEOSI can be concluded for in-combination effects when considered against Conservation Objective 2.

*Conservation Objective 3 - The supporting habitats and processes relevant to harbour porpoise and their prey are maintained*

516. In the project alone assessment, the following impact pathways were identified relative to Conservation Objective 2. These were, accidental pollution or contamination, indirect impacts to prey species, EMF and barrier effects. These impact pathways were scoped out of the project alone assessment. They are included here to consider if there is an in-combination effect.

517. All projects will be required to implement a VMP, which will include adherence to international requirements for the prevention of pollution at sea. Therefore, there is no realistic pathway or in-combination effects from accidental pollution and contamination.

518. There were no potential impacts to prey species identified in (**Chapter 20: Fish and shellfish Ecology**) for the proposed Project alone, and the conclusion from Erebus (Marine Space Ltd, 2019b), was also that there were no significant cumulative effects identified. In the event of any potential impact during construction or decommissioning, this is likely to be short term, and fully reversible. During the operational period, it is likely that the offshore wind structures may increase prey availability for harbour porpoise due to the artificial reef and fish aggregation device effect. This effect could increase foraging opportunities and therefore be a positive effect on harbour porpoise (Galparsoro, et al., 2022).

519. The project alone assessment found that any detection of EMF is likely to only occur in close proximity to the cables once in operation (approx. 50 m) (OSC, 2022), and given the highly mobile nature of marine mammals, animals are unlikely to remain in close proximity to the cables or array

for any significant length of time (Copping & Hemery, 2020; OSC, 2022). Therefore, impact from EMF emissions for all marine mammals is expected to be minimal. With any potential detection being limited to 50 m, it can therefore be concluded that there is no pathway to an in-combination impact.

520. The project alone concluded that there was no risk of a barrier effect due to the presence of the offshore wind structures. Harbour porpoise have been shown in frequent offshore wind farm locations during construction (Graham, et al., 2019) and post construction (Diederichs, et al., 2008). It is therefore unlikely that there is an in-combination barrier effect from all projects considered in this assessment.

*Conclusion*

521. The information presented in this section in relation to the harbour porpoise Conservation Objectives, enables the conclusion that there is **no potential for an AEoSI during any phase of the proposed Project in-combination, on the West Wales Marine SAC, or the Bristol Channel Approaches SAC** in response to:

- underwater noise (including geophysical surveys, UXO clearance, impact piling, cable installation, operational and vessel traffic);
- accidental pollution or contamination; collision with project vessels;
- indirect effects through impacts to prey species;
- effects of EMF emissions;
- barrier effects from mooring lines and cables between platform and anchors; or
- entanglement with mooring lines and cables.

*Grey Seal – Assessment of Adverse Effects In-Combination*

*Conservation Objective 1 - The population is maintaining itself on a long-term basis as a viable component of its natural habitat.*

522. The following impact pathways were identified in the proposed Project alone in relation to Conservation Objective 1. These were the risk of auditory injury (PTS-onset), the potential for population impact in response to disturbance, the risk of collision with project vessels and the risk of entanglement from the FLOW structures. This section builds on the findings for the project alone section above.

523. The risk of PTS-onset for all projects will be required via consent conditions to be reduced to negligible using standard JNCC marine mammal mitigation guidelines. The mitigation ultimately employed will be tailored to the project specific predicted impacts and agreed during post consent dialogue with NRW. The use of mitigation measures (i.e., MMOs; PAM; ADDs) to reduce the risk of injury to negligible at the project level, will mean that there is no risk of an in-combination auditory injury pathway for grey seal within the OSPAR Region III.

524. The potential for a cumulative risk of disturbance to grey seal within OSPAR Region III MMMU from the identified projects was assessed in **Chapter 21: Marine Mammals** and concluded that the impacts to grey seal from accumulated disturbance was negligible. This conclusion was based on the maximum overall percentage of the MU population predicted to be at risk of disturbance of less than 1% (0.29%) (**Table 8-30**). This conclusion also applies to the in-combination assessment.

525. The collision risk from project vessel movement is considered to be negligible (as detailed above and scoped out from the project alone assessment). All projects will be required to

implement a VMP and adhere to good practice wildlife guidelines (e.g. the WiSE scheme (2018)). Therefore, all potential projects' vessel movements to and from each project area, will be along existing vessel routes. Due to the existing baseline level of vessel activity (**Chapter 28: Shipping and Navigation**), it is likely that grey seals are accustomed to vessel movement and can easily detect and avoid. There is no likelihood of the in-combination increase in vessel activity, will increase the collision risk for grey seal. Therefore, there is no potential of an in-combination effect.

526. The risk of primary or secondary entanglement, is only an impact pathway for floating offshore wind projects and is a potential risk throughout each project's operational phase (scoped out from project alone assessment). This risk therefore applies to three of the five identified projects; Erebus, White Cross; TwinHub in addition to the proposed Project. The risk of primary entanglement for grey seal is considered to be negligible (**Chapter 21: Marine Mammals**). There is a lack of evidence in relation to the potential risk from secondary entanglement (ghost gear). However, it is likely that all floating offshore wind developments will deploy monitoring of the cables and moorings and will commit to removal of any ghost gear present, which will reduce the potential for grey seals to become entangled. An in-combination effect therefore is not anticipated.

527. Provided appropriate mitigation and / or monitoring is employed as agreed with the Regulator, the proposed project in-combination will not compromise Conservation Objective 1, relating to the species as a viable component of the Pembrokeshire Marine SAC.

*Table 8-30. Cumulative number of grey seals at risk of disturbance. Includes vessel activity, UXO clearance (x1), piling activity and, seismic survey (x1 annually). Bold indicates piling activity for the projects. Tier 1-3 projects*

| Project | Tier | Density | Number of days piling | Year | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2024 | | 2025 | | | | 2026 | | | | 2027 | | |
| | | | | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 |
| Llŷr | | 0.012 | 10 | | | | | 1 | 1 | 1 | **8** | **8** | | | | |
| Erebus | 2 | 0.005 | 10 | | | | | | | 1 | **8** | **8** | 1 | | | |
| White Cross | 3 | 0.005 | 8 | | | | | | | 1 | **8** | **8** | 1 | 1 | 1 | 1 |
| Twinhub | 2 | 0.245 | 2 | | | | | | | 1 | **8** | **8** | 1 | | | |
| South Irish Sea Array | 3 | 0.047 | 60 | | | | | | | | | | 1 | 1 | **29** | **29** |
| Awel y Mor | 2 | 0.256 | 50 | | | | | | | | | | | 1 | **19** | **19** |
| Seismic survey (x1) | | | | 133 | 133 | 133 | 133 | 133 | 133 | 133 | 133 | 133 | 133 | 133 | 133 | 133 |
| Total number | | | | 133 | 133 | 133 | 133 | 134 | 134 | 137 | 165 | 165 | 137 | 136 | 182 | 182 |
| % of MU | | | | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 | 0.22 | 0.26 | 0.26 | 0.22 | 0.22 | 0.29 | 0.29 |
| % of MU excluding Llŷr | | | | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 | 0.22 | 0.25 | 0.25 | 0.22 | 0.22 | 0.29 | 0.29 |

*Conservation Objective 2 - The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.*

528. Relevant impact pathways for consideration under Conservation Objective 2 are whether the natural range of the population is reduced by in-combination effects of noise disturbance, of visual or airborne disturbance, and / or barrier effects. Only the visual and airborne disturbance impact pathways was scoped into the project alone assessment.

529. As detailed above, the population modelling conducted for cumulative impact assessment shows that there is no in-combination effect from underwater noise.

530. Both the proposed Project and Erebus' export cables will be located within the Pembrokeshire Marine SAC and therefore the proposed Project and Erebus are the only two projects that could potentially have an in-combination effect on the site. However, for both projects, the installation of the export cables will be carried out in a relatively localised area and for a relatively short duration, and therefore there is no potential for this activity to reduce the natural range of grey seal for the foreseeable future. Any disturbance to hauled out seals, would therefore not be permanent and would be recoverable (SCOS, 2021).

531. Although the landfall locations do not appear to be a key location within the SAC for grey seals to haul out, as mentioned above, seals could be present anywhere along the Pembrokeshire coastline. The proposed Project has committed to investigate whether a seasonal restriction is able to be put in place if required, such that activity on the shoreline would not take place between August and February. Alternatively, should construction be necessary during this period, the Applicant will commit to winter surveys of the landfall site post submission to obtain greater detail on the number of mother-pup pairs likely to be in that specific location.

532. Provided a seasonal restriction is implemented during breeding season for the cable landfall activity, or pre-construction surveys indicate the landfall site is not used for grey seal pupping, then it can be concluded that there is no risk of the proposed Project contravening Conservation Objective 2 for Pembrokeshire Marine SAC.

533. No other in-combination effects are considered likely for visual or airborne disturbance at seal haul-outs within the SAC, based on the locations and distances to other projects.

534. The assessment above (**Paragraph 436** to **438**) scoped out any potential adverse effect from any potential barrier effect, due to the evidence that seals have been observed transiting within offshore wind turbines (Russell, et al., 2014). It is therefore not anticipated that multiple projects within the OSPAR Region III MMMU will combine to any greater barrier risk, than the project alone.

*Conservation Objective 3 - The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance, and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include; distribution, extent, structure, function and quality of habitat, and prey availability and quality.*

535. The consideration under Conservation Objective 3 would be whether the combined construction and operation of the plans or projects identified in this section would have a negative impact on the condition and diversity of habitats required to support grey seals. The evidence provided in the project alone assessment applies for multiple projects. It is likely that once constructed the developments identified would provide increased foraging opportunities. This assessment has shown that the grey seal population is stable or increasing and that the loss and/or physical disturbance to the seabed habitats and benthic species from the plans and projects identified will be temporary, with a rapid recovery of seabed habitats and species (**Chapter 19: Benthic Ecology**). Therefore, it can be concluded that there is no lasting impact to the presence,

abundance, condition and diversity of habitats required to support the population of grey seals at the SAC.

*Conclusion*

536. The information presented in this section in relation to the grey seal Conservation Objectives, enables the conclusion that there is **no potential for an AEoSI during any phase of the proposed Project in-combination, on the Pembrokeshire Marine SAC** in response to:

- underwater noise (including geophysical surveys, UXO clearance, impact piling, cable installation, operational and vessel traffic);
- accidental pollution or contamination;
- collision with project vessels;
- indirect effects through impacts to prey species;
- effects of EMF emissions;
- barrier effects from mooring lines and cables between platform and anchors; or
- entanglement with mooring lines and cables.

537. The **potential for an AEoSI from airborne sound and visual disturbance** from the export cable construction near the shore, and the HDD operations at the landfall location, can be **reduced to no AEoSI by employing a seasonal restriction** during the grey seal breading / pupping season such that activity on the shoreline would not take place between August and February. Alternatively, should construction be necessary during this period, the Applicant will commit to winter surveys of the landfall site post submission to obtain greater detail on the number of mum-pup pairs likely to be in that specific location.

538. Provided a seasonal restriction is implemented during breeding season for the cable landfall activity, or pre-construction surveys indicate the landfall site is not used for grey seal pupping, then it can be concluded that there is no risk of the proposed Project contravening Conservation Objective 2 for Pembrokeshire Marine SAC.

**Summary**

539. The information provided considers the potential for impact pathways associated with the proposed Project to hinder the conservation objectives of the Annex II marine mammal features of West Wales Marine SAC, Bristol Channel Approaches SAC, and Pembrokeshire Marine SAC.

540. Provided mitigation measures, are developed and agreed with the statutory nature conservation bodies (SNCB) and Regulators (for the avoidance of injury PTS-onset) (**Appendix 04A: Outline CEMP**) is adhered to, it is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II marine mammals features of West Wales Marine SAC, Bristol Channel Approaches SAC, or Pembrokeshire Marine SAC (**Table 8-31**). Therefore, it is concluded that there is **no potential for an AEoSI on West Wales Marine SAC, Bristol Channel Approaches SAC, and Pembrokeshire Marine SAC due to the proposed Project** (**Table 8-31**)**, either alone or in-combination.**

*Table 8-31. Summary of AEoSI for designated sites with Annex II marine mammal features due to potential impact pathways associated with the OfECC of the proposed Project (✓- potential to hinder conservation objectives; X – no potential to hinder conservation objectives)*

| Designated site | Annex II marine mammal features screened into assessment | Potential Impact Pathways identified with an AEoSI | | | | | | | | | | AEOSI / Screened into Stage 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | | | Operation and maintenance | | | | Decommissioning | |
| | | Effects of underwater noise | Accidental pollution or contamination | Airborne sound and visual disturbance (pinnipeds only) | Collision with project vessels | Potential for indirect effects through impacts to prey species | Effects of underwater noise | Effects of EMF emissions | Barrier effects from mooring lines and cables between platform and anchor | Entanglement with mooring lines and cables | Decommissioning effects | |
| West Wales Marine / Gorllewin Cymru Forol SAC (UK0030397) | Harbour porpoise *Phocoena phocoena* (1351) | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II marine mammal feature.<br>Therefore, there is **no potential for an AEoSI on West Wales Marine SAC either alone or in-combination.** |
| Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC (UK0030396) | Harbour porpoise *Phocoena phocoena* (1351) | X | X | X | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II marine mammal feature.<br>Therefore, there is **no potential for an AEoSI on Bristol Channel Approaches SAC either alone or in-combination.** |
| Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | Grey seal *Halichoerus grypus* (1364) | X | X | ✓ | X | X | X | X | X | X | X | The potential for an AEoSI from airborne sound and visual disturbance from the export cable construction near the shore, and the HDD operations at the landfall location, can be reduced to no AEoSI provided a seasonal restriction is implemented during breeding season for the cable landfall activity, or pre-construction surveys indicate the landfall site is not used for grey seal pupping.<br>Provided these measures are implemented, it is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II marine mammal features, and it may be concluded that there is **no potential for an AEoSI on Pembrokeshire Marine SAC either alone or in-combination.** |

### *8.5.4. Annex I Marine Ornithology*

541. This section assesses the risk of any adverse effects arising from the proposed Project on SPAs designated for breeding seabird populations, plus any marine SPAs identified as requiring consideration through the HRA screening process. This section presents:

- A summary of the initial HRA screening outcomes for SPA qualifying interests, and further refinement of the long list of SPAs based on colony apportioning;
- A summary of the SPAs requiring appropriate assessment, the qualifying interests being addressed and the Conservation Objectives which apply;
- Consideration of the impact pathways identified for marine ornithological interests through the EIA scoping and HRA screening processes, and determination of those relevant to assess in this HRA RIAA;
- Identification of the other projects from the development long list which have been screened in for cumulative assessment in-combination with the proposed Project; and
- An assessment for each SPA (and its qualifying interests) of the risk of AEoSI arising from the proposed Project alone, or in combination with other developments.

542. While the HRA Screening report was not formally consulted on during pre-application, this is presented in **Appendix 08D:Habitats Regulations Assessment Screening** and follows the advice on HRA given by NRW and JNCC as the statutory nature conservation bodies, while addressing RSPB comments. Matters raised during scoping are recorded in **Table 22-4** of **Chapter 22: Marine Ornithology**, with further advice on approaches and technical methods provided during pre-application dialogue as recorded in **Table 22-5** of the Chapter.

**Summary of initial HRA Screening and further refinement**

543. **Table 8-32** presents the SPAs identified as having LSE through the initial HRA screening process (as set out in **Appendix 08D: Habitats Regulations Assessment Screening**). Initial HRA screening is a 'coarse filter' usually undertaken at an early stage in the pre-application process.

544. **Table 8-32** therefore presents a refinement of the long list of SPAs that was initially derived, considering whether or not there is LSE now that impact modelling has been completed. Most of these SPAs are coastal or island breeding seabird colonies, some of which have associated marine areas designated. There is only one 'stand-alone' marine SPA to consider (not directly adjacent to any breeding seabird colony) and this is the Irish Sea Front SPA, as included in **Table 8-32**.

545. For the long list of SPA breeding colonies, the further refinement has been based on the outcome of marine ornithological impact modelling undertaken for the proposed Project (the collision mortalities estimated in **Appendix 22C: Marine Ornithology Collision Risk Modelling**, and the displacement matrix mortalities estimated **Appendix 22D: Marine Ornithology Displacement Assessment**), as assigned against each SPA (using the colony apportioning weightings calculated in **Appendix 22B: Marine Ornithology Colony Apportioning**).

546. The refinement, as presented, is based on the 'worst case' breeding season mortalities (collision risk and / or displacement matrix) and uses the breeding season colony apportioning weightings. If the proposed Project will not give rise to LSE against a breeding SPA seabird population from potential mortalities during the breeding season when the seabirds are more restricted in foraging range (i.e., provisioning their chicks), then it is fair to assume that there will be no LSE in the non-breeding season either.

547. **Table 8-32** indicates which of the SPAs need to be progressed to the AA stage and those which can be screened out because it can be concluded there is no LSE (either zero breeding season mortalities to be assigned against the SPA populations, or non-significant levels of such mortality).

*Table 8-32. Refinement of the screened SPA long list based on apportionment of breeding season impacts against SPA breeding colonies and also including relevant marine SPAs*

| Site | Country | Distance to Llŷr Array Area (km) | SPA qualifying interests for which the proposed Project is located within foraging range | Apportioning weighting | Apportioned breeding season impacts (estimated mortalities) | Appropriate Assessment required? |
|---|---|---|---|---|---|---|
| Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA (UK9014051) | Wales | 37.16* | storm petrel | Qualitative assessment | | Yes |
| | | | lesser black-backed gull | 0.951 | 1.05 | Yes |
| | | | Manx shearwater | 0.983 | 168.78 | Yes |
| | | | puffin | 0.980 | 10.43 | Yes |
| | | | kittiwake | 0.636 | 0.70 | Yes |
| | | | guillemot | 0.487 | 69.07 | Yes |
| | | | razorbill | 0.639 | 0.94 | Yes |
| Grassholm / Ynys Gwales SPA (UK9014041) | Wales | 37.29* | gannet | 0.969 | 21.98 | Yes |
| Saltee Islands SPA (IE004002) | Ireland | 110.05 | kittiwake | 0.059 | 0.06 | No |
| | | | lesser black-backed gull | 0.004 | 0.00 | No |
| | | | razorbill | 0.054 | 0.08 | No |
| | | | puffin | 0.002 | 0.00 | No |
| | | | gannet | 0.014 | 0.32 | No |

| Site | Country | Distance to Llŷr Array Area (km) | SPA qualifying interests for which the proposed Project is located within foraging range | Apportioning weighting | Apportioned breeding season impacts (estimated mortalities) | Appropriate Assessment required? |
|---|---|---|---|---|---|---|
| Glannau Aberdaron ac Ynys Enlli / Aberdaron Coast and Bardsey Island SPA (UK9013121) | Wales | 156.11* | Manx shearwater | 0.003 | 0.52 | No |
| Helvick Head to Ballyquin SPA (IE004192) | Ireland | 172.49* | kittiwake | 0.004 | 0.00 | No |
| Isles of Scilly SPA (UK9020288) | England | 170.49* | lesser black-backed gull | 0.009 | 0.01 | No |
| | | | storm petrel | Qualitative assessment | | No |
| Wicklow Head SPA (IE004127) | Ireland | 187.66* | kittiwake | 0.019 | 0.02 | No |
| Old Head of Kinsale SPA (IE0040210) | Ireland | 211.01 | kittiwake | 0.009 | 0.01 | No |
| Howth Head Coast SPA (IE004113) | Ireland | 222.15 | kittiwake | 0.053 | 0.06 | No |
| Ireland's Eye SPA (IE004117) | Ireland | 226.69 | kittiwake | 0.026 | 0.03 | No |
| Lambay Island SPA (IE004069) | Ireland | 235.29 | kittiwake | 0.050 | 0.06 | No |
| | | | puffin | 0.000 | 0.00 | No |
| Irish Sea Front SPA (UK9020328) | UK Offshore / England | 248.49 | Manx shearwater | Marine SPA – qualitative assessment at the request of JNCC | | Yes |

| Site | Country | Distance to Llŷr Array Area (km) | SPA qualifying interests for which the proposed Project is located within foraging range | Apportioning weighting | Apportioned breeding season impacts (estimated mortalities) | Appropriate Assessment required? |
|---|---|---|---|---|---|---|
| Deenish Island and Scariff Island SPA (IE004175) | Ireland | 327.31 | Manx shearwater | 0.000 | 0.00 | No |
| The Bull and The Cow Rocks SPA (IE004066) | Ireland | 330.33 | gannet | 0.002 | 0.05 | No |
| Puffin Island SPA (IE004003) | Ireland | 341.30 | Manx shearwater | 0.000 | 0.00 | No |
| Skelligs SPA (IE004007) | Ireland | 347.88 | Manx shearwater | 0.000 | 0.00 | No |
| | | | gannet | 0.008 | 0.18 | No |
| Blasket Islands SPA (IE004008) | Ireland | 353.01 | Manx shearwater | 0.000 | 0.00 | No |
| Cruagh Island SPA (IE004170) | Ireland | 397.30 | Manx shearwater | 0.000 | 0.00 | No |
| Ailsa Craig SPA (UK9003091) | Scotland | 428.20 | gannet | 0.007 | 0.16 | No |
| Rum SPA (UK9001341) | Scotland | 615.41 | Manx shearwater | 0.001 | 0.17 | No |
| St Kilda SPA (UK9001031) | Scotland | 733.97 | Manx shearwater | 0.000 | 0.00 | No |

** Distances were calculated from the closest edge of the proposed Project to the closest land part of the SPA*

**Site Descriptions and Conservation Objectives**

548. Three marine ornithological SPAs have been progressed to appropriate assessment, as follows:

- Skomer, Skokholm and the Seas off Pembrokeshire SPA;
- Grassholm SPA; and
- Irish Sea Front SPA.

549. **Figure 8-14** illustrates these SPAs in relation to the proposed Project, both the proposed Array Area in which the WTGs would be located, as well as the OfECC which connects the Array Area to shore.

*Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA*

550. This SPA is located off the south-west tip of Pembrokeshire and covers a total area of 1,668 $km^2$ (JNCC, 2019). The water depth within the SPA ranges from mean low water to 100 m along parts of the seaward boundary. Part of the SPA is within the 12 NM boundary of the Welsh territorial water and part extents out into the UK offshore waters (JNCC, 2019).

551. The site was first classified as Skokholm and Skomer SPA in August 1982. The site was extended in October 2014 and then again in January 2017 to what it is today, with the SPA also being renamed to Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA.

552. The islands of Skomer and Skokholm are one of the five core seabird monitoring sites for the Seabird Monitoring Programme (SMP). The islands have the largest colony of breeding Manx shearwaters in the world and one of the largest colonies in Britain for lesser black-backed gulls. The islands also support the largest concentration of breeding seabirds in England and Wales (over 394,000 birds), supporting species such as razorbill, kittiwake, puffin, and guillemot.

553. **Table 8-33** presents the marine ornithological qualifying interests and associated conservation objectives to be addressed in relation to Skomer, Skokholm and the Seas off Pembrokeshire SPA.

*Table 8-33. Summary of the relevant qualifying interests and Conservation Objectives for Skomer, Skokholm and the Seas off Pembrokeshire SPA*

| Qualifying Feature |
|---|
| 1. Breeding population of storm petrel *Hydrobates pelagicus* |
| 2. Breeding population of lesser black-backed gull *Larus fuscus* |
| 3. Breeding population of Manx shearwater *Puffinus puffinus* |
| 4. Breeding population of Atlantic puffin *Fratercula arctica* |
| 5. Breeding seabird assemblage; includes black-legged kittiwake *Rissa tridactyla*, common guillemot *Uria aalge* and razorbill *Alca torda.* |
| **Conservation Objectives** |
| **Conservation Objective 1. The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term** |

| |
|---|
| 1. Storm petrel: at least 3,500 pairs, stable or increasing.<br>2. Lesser black-backed gull: at least 20,300 breeding adults, with a productivity rate and adult survival rate that allows this number to be maintained/increased.<br>3. Manx shearwater: population stable or increasing with no measured decrease in numbers (based on a population count of 150,968), based on annual study plots.<br>4. Atlantic puffin: at least 9,500 individuals, stable or increasing.<br>5. Breeding seabird assemblage: the breeding populations should be stable or increasing based on a total population of 394,260. |
| **Conservation Objective 2. The distribution of the population should be being maintained, or where appropriate increasing** |
| 1. Storm petrel, 3. Manx shearwater and 5. breeding seabird assemblage: Should not be constrained by anthropogenic factors, including disturbance to and possible loss suitable of nesting sites.<br>2. Lesser black-backed gull: Should not be constrained by anthropogenic factors. Range restriction is only acceptable if there is significant risk of detriment to the FCS of priority features.<br>4. Atlantic puffin: Should be not constraints from anthropogenic factors, particularly to the distribution of nesting sites. |
| **Conservation Objective 3. There should be sufficient habitat, of sufficient quality, to support the population in the long term** |
| 1. Storm petrel and 5. breeding seabird assemblage: The foraging habitat area should be stable or increasing and the quality remaining unaffected. There should be no resulting contraction of nesting site distribution.<br>2. Lesser black-backed gull, 3. Manx shearwater and 4. Atlantic puffin: The breeding and foraging habitat areas should be stable or increasing and the quality remaining unaffected. |
| **Conservation Objective 4. Factors affecting the population, or its habitat should be under appropriate control** |
| 1. Storm petrel: The breeding success should remain unaffected by human influence, with factors affecting the species in the site under control.<br>2. Lesser black-backed gull: There should be no mammalian land predators present in the SPA, with measures in place to avoid accidental introduction. Access beyond designated footpaths and other factors effecting the species should be under control.<br>3. Manx shearwater: Rafting birds should be unaffected by anthropogenic factors including boat use. Factors affecting the species within the site should be under control.<br>4. Atlantic puffin and 5. breeding seabird assemblage: There should be no mammalian land predators present in the SPA, with measure in place to avoid accidental introduction. Access beyond designated footpaths should be under control. Rafting birds should be unaffected by anthropogenic factors including boat use. Factors affecting the species within the site should be under control. |

554. As shown by **Table 8-12**, the proposed Project Array Area lies outwith Skomer, Skokholm and the Seas off Pembrokeshire SPA, at 37.16 km distance. Due to this distance, it is only conservation objective 1 (population viability) which is relevant to consider (under AA) for seabirds which may forage in, or otherwise fly through, the proposed Array Area.

555. AA against conservation objective 1 addresses those potential impacts where the estimated mortalities arising from WTGs located in the proposed Array Area could potentially lead to a population consequence for the SPA qualifying interests under consideration.

556. As shown by **Figure 8-14**, the OfECC directly impacts the marine section of Skomer, Skokholm and the Seas off Pembrokeshire SPA, where the cable will run through the SPA *en route* to landfall. In this regard, it is conservation objective 2 (distribution of birds within the SPA) and conservation objective 3 (maintenance of supporting habitat) which are relevant to consider under Appropriate Assessment.

557. Table 8-36 provides the further detail on this screening of all the impact pathways from Appendix 08D: Habitats Regulations Assessment Screening identified for consideration. Then, from Paragraph 569, the appraisal and information for AA is provided, in relation to Table 8-36 outcomes for Skomer, Skokholm and the Seas off Pembrokeshire SPA.

*Grassholm / Ynys Gwales SPA*

558. Grassholm island is located about 16 km off the Pembrokeshire coast, and is roughly 38 km from the proposed Project Array Area. It was first classified in 1986 and has since been extended to include the surrounding waters (mainly within 1 NM of the island, with a small section lying just beyond that) (NRW, 2014).

559. Gannet is the only qualifying feature for which the SPA supports 12.5% of the breeding North Atlantic population (NRW, 2014).

560. **Table 8-34** presents the marine ornithological qualifying interests and associated conservation objectives to be addressed in relation to Grassholm SPA.

*Table 8-34. Summary of the relevant qualifying interests and Conservation Objectives for Grassholm SPA*

| **Qualifying Feature** |
|---|
| 1. Breeding population of Northern Gannet |
| **Conservation Objectives** |
| **Conservation Objective 1. The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term.** |
| 1. The population will not fall below 30,000 pairs in three consecutive years and will not drop by more than 25% of the previous year's numbers. Any decline in the population will not be greater than the decline in the North Atlantic population as a whole. |

561. This conservation objective for gannet at Grassholm SPA (**Table 8-34**) requires consideration only of those impact pathways associated with the proposed Project which could give rise to mortality of the birds**,** potentially resulting in a population consequence. **Table 8-36** screens the list of impact pathways identified for the proposed Project, in relation to Grassholm gannet alongside the other SPA interests from Skomer, Skokholm and the Seas off Pembrokeshire SPA and the Irish Sea Front SPA.

*Irish Sea Front SPA*

562. The Irish Sea SPA is located around 36 km north-west of Anglesey within the UK offshore waters. It covers a total area of 180 $km^2$ and is located over a part of a large tidal sea front. The front that forms each spring creates a highly productive region which benefits many species. The abundant prey supports a large number of Manx shearwaters (more than 12,000 at a time) from at least six different breeding colonies (see **Table 8-35**), making up one of the largest marine aggregations of breeding Manx shearwaters in the UK (JNCC, 2023).

563. The SPA was classified in 2016 with Manx shearwater as the only qualifying feature (JNCC, 2023).

564. **Table 8-35** presents the marine ornithological qualifying interests and associated conservation objectives to be addressed in relation to the Irish Sea Front SPA.

*Table 8-35. Irish Sea Front SPA; relevant qualifying interests and conservation objectives*

| Qualifying Feature |
|---|
| 1. Manx shearwater |
| **Conservation Objectives** |
| **Conservation Objective 1. Avoid significant disturbance of the qualifying feature within the site, so that the ability of the species to use the site is maintained in the long-term** |
| 1. Manx shearwater: There should be no significant disturbance that could lead to long-term declines in the feature within the site. This protects the feature from activities both within and outside of the site.<br><br>The viability of the Irish Seas Front SPA and equally the ability of the Irish Sea Front SPA to support breeding adult survival and chick rearing, is linked to the ability of the Manx shearwaters to access breeding habitat in areas of functionally linked land outside the site.<br><br>There is no site-specific population target for the site and therefore effects should be apportioned to the following breeding colonies: Rum, Copeland Islands, Skomer Island, Skokholm Island, Bardsey Island and Lundy Island. |
| **Conservation Objective 2. Maintain the habitats, processes and food resources of the qualifying feature in favourable condition** |
| 1. Manx shearwater: The prey species should be maintained at a level that is able to materially contribute to supporting healthy populations. This may involve management measure to maintain the quality and extend of prey habitat. |
| **Conservation Objective 3. Ensure connectivity between the site and its supporting habitats and Manx shearwater breeding colonies is maintained** |
| 1. Manx shearwater: the species should continue to have access to the site for foraging within the breeding season. ensuring safe movements between the site and spatially disjointed breeding colonies and ensuring no significant increase in energetic costs for the birds in those movements. |

565. Due to the distance between the proposed Project Array Area and the Irish Sea Front SPA (a distance of about 248.49 km), only conservation objective 3 is relevant to consider in respect of the proposed Project.

566. Conservation objective 1 relates to any disturbance of Manx shearwater while they are within the SPA, and conservation objective 2 relates to impacts on prey within the frontal mixing area, located within and protected by the SPA designation.

**567.** Therefore only conservation objective 3 is relevant, relating to access of the SPA from the identified breeding colonies, where there may be a pathway to impact arising from the proposed Project. **Table 8-36** sets out this screening consideration in more detail.

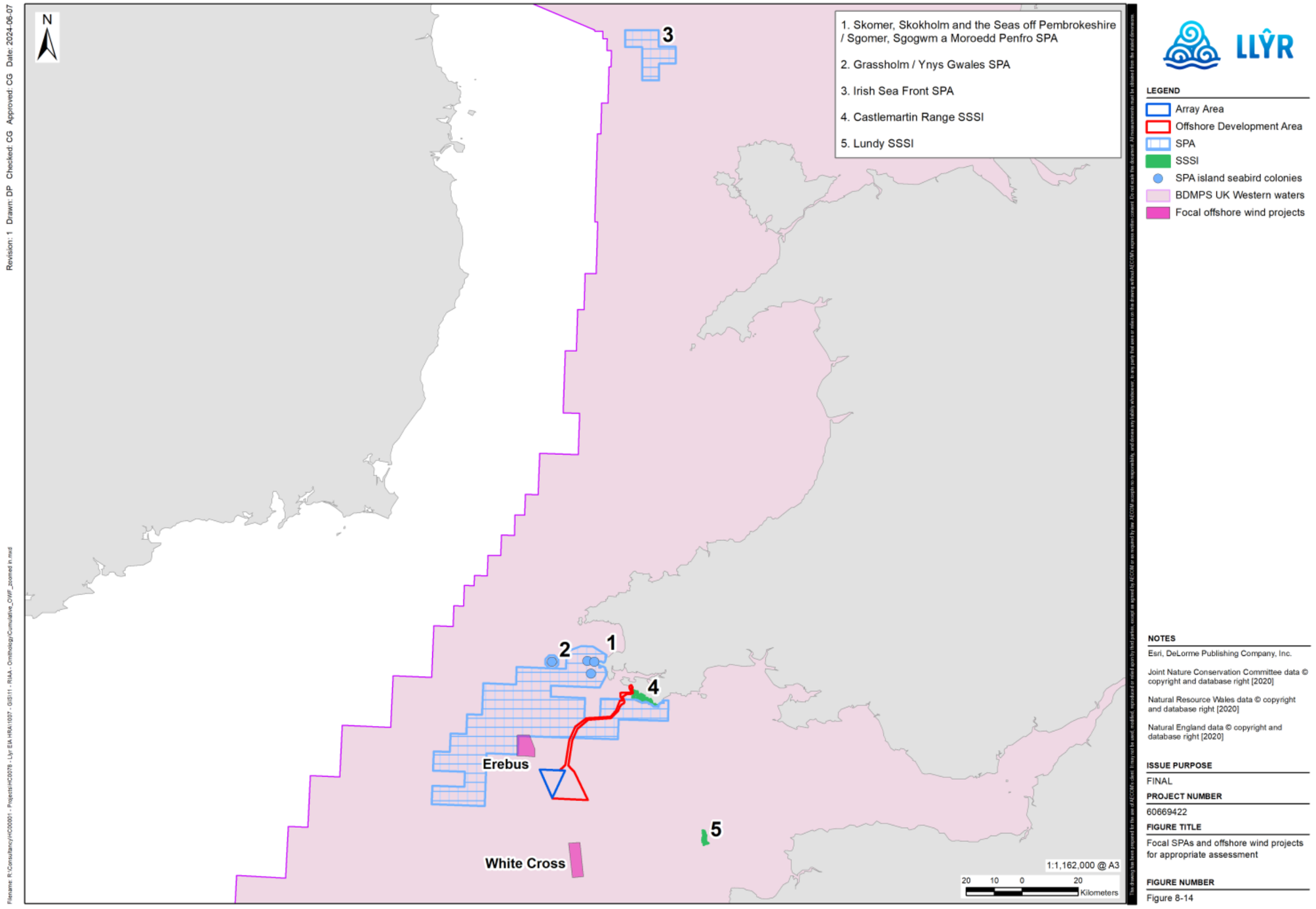


*Figure 8-14. Breeding seabird and marine SPAs included for appropriate assessment in relation to the proposed Project*

**Impact pathways relevant to consider for marine ornithological interests, screened against the focal SPAs and their conservation objectives**

568. **Table 8-36** presents a summary of the potential impact pathways relevant to the proposed Project (as determined during the HRA screening process set out in Appendix 8D: HRA Screening) and the associated 'worst case scenarios' for each. The table considers each identified impact against each marine ornithological receptor (species), and then scopes the issues in relation to appropriate assessment for the three SPAs that have been identified for assessment and their qualifying interests.

*Table 8-36. Potential impact pathways to the protected sites with marine ornithology features throughout the different phases of the proposed Project*

| Potential Impact Pathway | Worst-case Scenario | Rationale | Species Screening Outcomes | Consideration for Appropriate Assessment |
|---|---|---|---|---|
| **Construction** | | | | |
| Disturbance and / or displacement associated with vessels and other offshore activities | Project construction activities for installation of up to ten WTGs;<br>*Driven Pile Anchors:*<br>• Eight driven pile anchors per WTG (80 piles max);<br>• Maximum pile diameter 3 m;<br>• Maximum hammer energy 800 kJ;<br>• Piling in one location at a time (no concurrent piling);<br>• Maximum four hours to drive one pile to the maximum penetration depth of 9-32 m;<br>• Max 10 piling days within 20 months of offshore installation; and<br>• Maximum numbers of construction vessels on-site at any one time: 12 vessels. | Birds may be disturbed and / or displaced from foraging or resting areas, which could lead to a reduction in foraging opportunities or an increase in energy expenditure, resulting in a decrease in survival or productivity. Disturbance and / or displacement may be caused by the presence of vessels, as well as above water noise and visual disturbance associated with other construction and decommissioning activities including pre-installation surveys, route preparation, UXO clearance, cable installation and piling or drilling.<br>As set out in **Chapter 22: Marine Ornithology** the species concern index from Furness *et al.*, (2013), has been used to determine species-specific vulnerability to this impact. | **Potential for impact for guillemot, puffin and razorbill** | **Relevant to assess for these qualifying interests at Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to the OfECC with reference to conservation objective 2** |
| | | | No potential for impact for storm-petrel, kittiwake, lesser black-backed gull, gannet and Manx shearwater | No need to include in any assessment |
| Effects of underwater sound on diving seabirds | Underwater noise methodologies focus on marine mammals and fish because diving birds spend much less time underwater that these other receptor groups and so this impact pathway is of lesser concern for marine ornithology. | Underwater sound may be generated by a range of proposed Project activities, including geophysical surveys, UXO clearance, piling or drilling, cable installation and vessel traffic. Diving seabirds may be temporarily displaced or disturbed by underwater noise generating activities, which could result in behavioural changes, such as changes in swimming | **Potential for impact for gannet, guillemot, Manx shearwater, puffin and razorbill** | **Relevant to assess for these qualifying interests at Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to the** |

| Potential Impact Pathway | Worst-case Scenario | Rationale | Species Screening Outcomes | Consideration for Appropriate Assessment |
|---|---|---|---|---|
| | Assessment is qualitative, based on the literature and application of expert judgement. The WCS is Installation of up to ten WTG (see disturbance and / or displacement impact above). | direction, diving duration, possible avoidance of the area and reduce foraging success.<br><br>There is potential for impact on seabirds which typically dive for prey as part of their foraging behaviour, which includes gannet, Manx shearwater, common guillemot, razorbill, and puffin **Invalid source specified.**.<br><br>Kittiwake, lesser black-backed gull, and European storm-petrel typically feed at the water surface so are unlikely to be affected by underwater noise impacts. | | **OfECC with reference to conservation objective 2** |
| | | | No potential for impact for storm-petrel, kittiwake, and lesser black-backed gull | No need to include in any assessment |
| Indirect effects due to changes in habitat and / or prey availability and distribution | Potential impacts which are applicable to fish and shellfish (which represent many ornithological prey species) may have an indirect effect on offshore ornithological receptors. Therefore, the assessment is based on the worst-case parameters presented in **Chapter 20: Fish and Shellfish Ecology**. | There is potential for changes to the abundance and distribution of prey from activities which disturb the seabed, resulting in an increase in suspended sediment, or generation of underwater noise. This may reduce the foraging success of seabirds, which could result in reduced survival and productivity. There is potential for impact from this impact on all seabird species which have been screened in. | **Potential for impact for all seabird species** | **Relevant to include in assessment for Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to conservation objective 3** |
| | | | | No need to include in assessment for Grassholm or Irish Sea Front SPAs due to the distances involved. |
| **Operation and maintenance** | | | | |

| Potential Impact Pathway | Worst-case Scenario | Rationale | Species Screening Outcomes | Consideration for Appropriate Assessment |
|---|---|---|---|---|
| Disturbance and / or displacement due to the presence of wind turbines and associated maintenance activities | Assessment of seabird displacement impacts (including barrier effects) is based on the Array Area + 2 km buffer as per SNCB guidance (SNCB, 2022). See **Appendix 22D: Marine Ornithology Displacement Assessment** for further details.<br><br>Potential disturbance may arise from wind farm operation and maintenance activities and associated vessel movements.<br><br>Maintenance will be required for:<br>• Up to ten WTGs, floating substructures, up to 11 associated inter array cables and up to eight moorings per WTG;<br>• Up to 80 driven pile anchors (eight per WTG);<br>• Up to two offshore export cables; and<br>• Up to 5 cable repairs for the operational life of the proposed Project.<br><br>Maintenance can be both planned (which will usually occur in the summer months) and unplanned (which can't be foreseen, so may take place at any time of the year and may require urgent intervention to rectify any critical issues as quickly as possible). | Birds may be disturbed or displaced from foraging or resting areas, which could lead to a reduction in foraging opportunities or an increase in energy expenditure, resulting in a decrease in survival or productivity. Disturbance and / or displacement may be caused by the presence of wind turbines, or by associated maintenance activities such as the presence of vessels.<br><br>Gull species, such as lesser black-backed gull are not considered to be sensitive to the effects of displacement from offshore wind farms (Furness *et al.*, 2013). There is, however, evidence that gannets, Manx shearwaters and storm-petrels may be displaced or otherwise avoid offshore wind farms (Wade, et al., 2016; SNCB, 2022). | **Potential for impact for storm-petrel, gannet, guillemot, Manx shearwater, puffin and razorbill** | **Relevant to assess for these qualifying interests at Skomer, Skokholm and the Seas off Pembrokeshire and Grassholm SPAs in relation to conservation objective 1 on potential population-level effects** |
| | | | No potential for impact for kittiwake and lesser black-backed gull | No need to include in any assessment, although information on estimated kittiwake displacement presented at the request of JNCC |
| Barrier effect due to presence of wind turbines | | The presence of the WTGs may result in a barrier effect to bird movements, which could lead to a reduction in foraging opportunities or an increase in energy expenditure, resulting in a decrease in survival or productivity. | **Potential for impact for all seabird species** | **Relevant to include in assessment for Skomer, Skokholm and the Seas off Pembrokeshire SPA and Grassholm SPA (under** |

| Potential Impact Pathway | Worst-case Scenario | Rationale | Species Screening Outcomes | Consideration for Appropriate Assessment |
|---|---|---|---|---|
| | | | | **conservation objective 1) and the Irish Sea Front SPA (under conservation objective 3)** |
| Collision risk with wind turbines | Assessment of seabird collision risk is detailed in **Appendix 22C: Marine Ornithology Collision Risk Modelling** for which the key WTG parameters are as follows:<br>• 10 WTGs (each with 3 blades);<br>• 142.5 m rotor radius;<br>• 22 m air gap; and<br>• 637,939.7 $m^2$ rotor swept area. | Birds in flight are at direct risk of injury or mortality due to collision with the offshore wind turbines. The risk is greatest for species which fly at higher altitude (e.g., kittiwake, gulls, and gannet) as they are more likely to fly at a height that overlaps with the rotor blade swept area, while species that remain at low altitude in flight (e.g., shearwaters) have a very low risk of collision.<br>As set out in **Chapter 22: Marine Ornithology,** the species-specific vulnerability to this impact has been determined using the collision risk values calculated in Furness *et al.*, (2013). | **Potential for impact for gannet, kittiwake, and lesser black-backed gull** | **Relevant to assess for these qualifying interests at Skomer, Skokholm and the Seas off Pembrokeshire and Grassholm SPAs in relation to CO1 on potential viability** |
| | | | No potential for impact for European storm petrel, guillemot, Manx shearwater, puffin, and razorbill | No need to include in any assessment |
| Entanglement with mooring lines and cables | The maximum requirements for mooring and intra-array cables are based on the following:<br>• 10 WTGs (minimum spacing 1,140 m);<br>• maximum 8 mooring lines per turbine; and | Floating offshore wind farms require mooring lines to connect turbines with their anchors, potentially posing an entanglement risk for diving seabirds, primarily from derelict fishing gear which may have become caught on the moorings. | **Potential for impact for gannet, guillemot, Manx shearwater,** | **Relevant to assess for these qualifying interests at Skomer, Skokholm and the Seas off Pembrokeshire and** |

| Potential Impact Pathway | Worst-case Scenario | Rationale | Species Screening Outcomes | Consideration for Appropriate Assessment |
|---|---|---|---|---|
| | • 17.31 km total inter-array cables length<br>NB. There is no potential for entanglement with the offshore export cable as this will be buried or laid along the seabed and subject to cable protection. | In this regard, there is potential for impact on seabirds which typically dive for prey as part of their foraging behaviour, including gannet, Manx shearwater, common guillemot, razorbill, and puffin.<br>Kittiwake, lesser black-backed gull, and storm-petrel typically feed at the water surface and so are unlikely to be subject to this risk. | **puffin, and razorbill** | **Grassholm SPAs in relation to conservation objective 1 on population viability** |
| | | | No potential for impact for storm-petrel, kittiwake, or lesser black-backed gull | No need to include in any assessment |
| Attraction of nocturnal seabirds to proposed Project infrastructure lighting | All ten WTGs (maximum) will be fitted with MOD accredited aviation lighting as detailed in **Chapter 26: Aviation and Radar.**<br>They will also be fitted with marine navigation lighting as detailed in **Chapter 28: Shipping and Navigation.** | Nocturnal seabirds, such as shearwaters and petrels, may be attracted to the offshore proposed Project infrastructure lighting causing them to become disorientated and / or increase their risk of collision with the offshore arrays. Therefore, there is potential for impact on Manx shearwater and storm petrel from this impact. | **Potential for impact for storm petrel and Manx shearwater** | **Relevant to assess for these qualifying interests for Skomer, Skokholm and the Seas off Pembrokeshire SPA in respect of conservation objective 2 and for Manx shearwater accessing the Irish Sea Front (conservation objective 1)** |
| | | | No potential for impact for gannet, | No need to include in any assessment |

| Potential Impact Pathway | Worst-case Scenario | Rationale | Species Screening Outcomes | Consideration for Appropriate Assessment |
|---|---|---|---|---|
| | | | kittiwake, lesser black-backed gull, guillemot, razorbill, or puffin | |
| Creation of roosting habitat for birds due to presence of floating platforms and associated infrastructure | The WCS is up to ten WTGs with associated floating platforms. | The introduction of floating platforms and associated infrastructure presents the opportunity for new roosting habitat and may provide easier access to foraging grounds. The floating platform may also provide a perching and resting location during foraging or in storm conditions.<br>While NRW, JNCC and RSPB have raised the possibility of increased collision risk (with WTGs) if birds are attracted into the wind farm in this manner; such risk only relates to kittiwake and lesser black-backed gull and is encompassed by the level of precaution already inherent in collision risk modelling. | **Potential positive impact for all seabird species from perching opportunities. Increased collision risk only relevant to kittiwake and lesser black-backed gull** | **No greater risk of collision to kittiwake or lesser black-backed gull than that modelled**<br>No increased collision risk to Grassholm gannet nor to Manx shearwater |
| Indirect effects due to changes in habitat and / or prey availability and distribution | Loss of supporting habitat or other potential impacts on prey species (particularly arising from cable protection for the OfECC and/or turbine anchorage) may indirectly affect marine ornithological receptors.<br>Prey species may also be disturbed by the vessel movements associated with operational and maintenance activities. | There is potential for changes to the abundance and distribution of prey from maintenance activities which disturb the seabed, resulting in an increase in suspended sediment, or generation of underwater noise.<br>Installation of scour protection or cable protection may also lead to some habitat loss for key prey species. This may potentially reduce seabird foraging success. | **Potential for impact for all seabird species** | **Relevant to include in assessment for Skomer, Skokholm and the Seas off Pembrokeshire SPA only in relation to the OfECC, with reference to conservation objective 1 and** |

| Potential Impact Pathway | Worst-case Scenario | Rationale | Species Screening Outcomes | Consideration for Appropriate Assessment |
|---|---|---|---|---|
| | On both aspects, assessment is based on the worst-case parameters presented in **Chapter 20: Fish and Shellfish Ecology**. | | | **conservation objective 2**<br>No need to include in assessment for Grassholm or Irish Sea Front SPAs due to the distances involved between these SPAs and the Offshore Development (both the Array Area and the OfECC). |
| **Decommissioning** | | | | |
| Potential effects the same as construction phase | Worst case scenarios are the same as for the construction phase. | Potential effects the same as construction phase. | **Potential for impact the same as construction phase.** | **Conclusions the same as for the construction phase.** |

**Information for Appropriate Assessment**

*Skomer, Skokholm and the Seas off Pembrokeshire SPA*

*Array Area*

***Conservation Objective 1: The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term.***

569. The long-term operational impacts listed in **Table 8-36** require appraisal in respect of this conservation objective; i.e. collision risk, displacement impacts (including barrier effects) and potential entanglement risk with mooring lines. In this regard, while entanglement is fatal for the individual affected, the risk of such an event occurring is very low and reduced further by regular inspection of the mooring lines (as discussed in **Chapter 22: Marine Ornithology** and to be implemented during operations and maintenance via the Project Environmental Management Plan).

570. Therefore, it is only collision risk and displacement / barrier effects which may give rise to direct mortalities which could potentially result in population-level consequences. Please see **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios** and **Appendix 22F: Marine Ornithology Population Modelling** for the supporting information in this regard, **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios** presents the calculations and determination of the modelled scenarios and itself **Appendix 22F: Marine Ornithology Population Modelling** presents the modelling itself (population viability analysis using the Natural England population viability analysis (PVA) tool).

571. Following NRW and JNCC advice, a 'threshold' has been determined based on 1% of baseline mortality, against which the collision and displacement mortalities are compared. For each SPA interest, where impacts either exceed or approach the identified thresholds, PVA has been carried out to ascertain the degree of population consequence (primarily whether population growth rate is affected, i.e., reduced, and significantly alters population size in the long term).

572. **Table 8-37** presents the comparison of project alone mortality estimates against the 1% of baseline mortality for each species.

573. In the table, the collision mortality estimates presented for lesser black-backed gull and kittiwake are those for the 'worst case' ten turbine scenario as apportioned to each of these species populations at Skomer, Skokholm and Seas off Pembrokeshire SPA (**Appendix 22C: Marine Ornithology Collision Risk Modelling**).

574. The displacement (matrix) mortalities quoted are the maximum estimates obtained from using the upper end of the impact range advised by NRW and JNCC; maximum displacement rates / mortality rates of and 50% / 10% for Manx shearwater (**Appendix 22D: Marine Ornithology Displacement Assessment**).

575. These SeabORD figures presented are the (annual) adult mortalities predicted by this modelling (**Appendix 22D: Marine Ornithology Displacement Assessment- Annex C**).

*Table 8-37. Comparison between Project-Alone Impacts and 1% Baseline Mortality Thresholds for Skomer, Skokholm and the Seas off Pembrokeshire SPA Populations*

| Species<br>1% of Baseline mortality | Project-alone apportioned annual mortalities | | | |
|---|---|---|---|---|
| | Collision | Displacement [†] | SeabORD [‡] | |
| **Storm petrel** | **Qualitative assessment** | | | |
| **Lesser black-backed gull** | 19 | 1.1 | N / A | N / A |
| **Manx shearwater** | 1,183 | N / A | 198.43 | N / A |

| Species<br>1% of Baseline mortality | Project-alone apportioned annual mortalities | | | |
|---|---|---|---|---|
| | Collision | Displacement † | SeabORD‡ | |
| **Puffin** | 32 | N / A | 11.63 | 37.17 |
| **Kittiwake** § | 4 | 0.7 | N / A | N / A |
| **Guillemot** | 27 | N / A | 92.74 | 16.33 |
| **Razorbill** | 18 | N / A | 4.17 | 7.5 |

†*The figures quoted in this table are the maximum estimates obtained from the colony-apportioned displacement matrices for each species, i.e., the upper end of the range advised by NRW and JNCC; maximum displacement rates / mortality rates of 50% / 10% for Manx shearwater (**Appendix 22D: Marine Ornithology Displacement Assessment**).*

‡*These figures are the (annual) adult mortalities predicted by SeabORD modelling, based on the energetic costs arising from displacement during the chick-rearing period, when these costs are predicted to be most significant in terms of seabird ecology. Displacement or barrier effects that occur during chick-rearing are predicted to impact directly on productivity (i.e., the chick mortalities predicted by SeabORD) as well as reduced fitness of adults entering the non-breeding season. See **Appendix 22D: Marine Ornithology Displacement Assessment - Annex C***

§*Information on kittiwake displacement has been presented in **Appendix 22D: Marine Ornithology Displacement Assessment** at the request of JNCC*

**576.** As shown by **Table 8-37**, only guillemot and puffin mortalities need to be further explored under PVA (as reported in **Appendix 22F: Marine Ornithology Population Modelling**). For lesser black-backed gull, Manx shearwater, kittiwake, and razorbill the figures in **Table 8-37** readily demonstrate that predicted mortalities do not exceed the stated thresholds (nor even come close). There will therefore be no significant or quantifiable population-level effects arising from the proposed Project on these qualifying interests either alone or in combination.

**577.** **Tables 22-7** and **Table 22-9** of **Appendix 22F: Marine Ornithology Population Modelling** report the results of population modelling for guillemot and puffin respectively, for which it can be seen that neither project alone nor cumulative impacts will significantly affect population growth rate or compromise conservation objective 1 for either species (or for guillemot as part of the seabird assemblage).

**578.** Finally, storm petrel are considered qualitatively, as requested by NRW and JNCC, because digital aerial surveys may potentially under record them (**Section 22.6.2** of **Chapter 22: Marine Ornithology**). In this regard, there is no reason to think this species is at any more risk from the proposed Project than the others for which quantitative assessment has been possible. On this basis, it seems safe to conclude that there will be no adverse population-level effects to storm petrel arising from either displacement / barrier effects or from collision risk (including in relation to nocturnal lighting).

*OfECC*

579. This section appraises the potential impacts of the OfECC on the qualifying interests of Skomer, Skokholm and Seas off Pembrokeshire SPA. The OfECC will be up to 49 km in length and will connect the Array Area to the landfall site located at Freshwater West (**Figure 8-1**). Full details of the OfECC are provided in **Chapter 04: Description of the Proposed Project**.

580. The OfECC will pass through the marine section of the Skomer, Skokholm and Seas off Pembrokeshire SPA and therefore may affect the qualifying interests - storm petrel, lesser black backed gull, Manx shearwater, puffin, and other breeding seabirds in the assemblage (kittiwake, guillemot, and razorbill) - while they are at sea.

***Conservation Objective 2: The distribution of the population should be being maintained, or where appropriate increasing.***

581. Construction impacts relating to cable installation at sea (including HDD in nearshore waters) will not disturb or affect the distribution of the birds while they are on their island nest sites, and there will be no alteration to the distribution of the nest sites themselves. Therefore only the birds 'at sea' activities and distribution need further consideration.

582. In this regard, the cable-laying vessels will be moving slowly and will be static for long periods, with limited associated noise emissions (either through the air or underwater). Any disturbance or displacement of seabirds (including when they're diving underwater) around the cable-laying activities (including placement of cable protection) will be temporary and localised. Therefore, it can be concluded there will be no significant or long-term change in the 'at sea' distribution of birds within the SPA arising from installation of the export cables for the proposed Project. Therefore, **conservation objective 2** will not be compromised.

***Conservation Objective 3: There should be sufficient habitat, of sufficient quality, to support the population in the long term.***

583. **Chapter 19: Benthic Ecology** (**Figure 8-5** in this chapter) presents the benthic mapping undertaken for the project. The sediment is primarily deep circalittoral sand offshore with circalittoral coarse sediment closer to shore, both of which are highly dynamic environments. While there may be temporary habitat disturbance during cable-laying, it will be highly localised and is not long-term.

584. It is anticipated that 79% of the cable will be buried, with 21% requiring cable protection (primarily closer to shore). As assessed in **Chapter 19: Benthic Ecology**, the long-term habitat loss associated with cable protection is negligible in relation to the wider resource and it will not materially change the available prey resource for the SPA seabirds.

585. Therefore, there will be no long-term effects on the survival rate of any of the protected SPA seabird populations under consideration and conservation objective 3 will not be compromised.

*Conclusion*

586. Based on the conclusions and appraisal provided above supports the conclusion of no AEoSI against any of the conservations objectives for the marine ornithological qualifying interests protected at Skomer, Skokholm and the Seas off Pembrokeshire SPA arising from the proposed Project alone or in combination.

*Grassholm SPA*

*Array Area*

***Conservation Objective 1: The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term.***

587. As for Skomer, Skokholm and Seas off Pembrokeshire SPA; assessment under this conservation objective for the gannet population at Grassholm SPA is supported by the information on project alone and cumulative impact scenarios presented in **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios** and the population modelling presented in **Appendix 22F: Marine Ornithology Population Modelling.**

588. **Table 8-38** presents the comparison of impacts (collision and displacement mortality estimates summed together) against the 1% threshold of baseline mortality.

589. In the table, the gannet collision mortality estimates presented are those for the 'worst case' ten turbine scenario as apportioned to Grassholm SPA (**Appendix 22C: Marine Ornithology Collision Risk Modelling**).

590. The displacement (matrix) mortalities quoted are the maximum estimates obtained from using the upper end of the impact range advised by NRW and JNCC; maximum displacement rates/mortality rates of 80% / 10% for gannet (**Appendix 22D: Marine Ornithology Displacement Assessment**).

*Table 8-38. Comparison between Project-Alone Impacts and 1% Baseline Mortality Thresholds for Grassholm SPA Populations*

| Species | 1% of Baseline mortality | Project-alone apportioned annual mortalities | | |
|---|---|---|---|---|
| | | Collision* | Displacement† | Total |
| **Gannet** | 58 | 3.0 | 27.93 | 30.93 |

**The collision mortality estimates presented are those for the 'worst case' ten turbine scenario as apportioned to Grassholm SPA (**Appendix 22C: Marine Ornithology Collision Risk Modelling**).*

*†The figures quoted in this table are the maximum estimates obtained from the colony-apportioned displacement matrices for each species, i.e., the upper end of the range advised by NRW and JNCC; maximum displacement rates / mortality rates of 80% / 10% for gannet (**Appendix 22D: Marine Ornithology Displacement Assessment**).*

591. While project alone impacts on gannet do not exceed the 1% baseline mortalities, cumulative impacts have been modelled on a precautionary basis as these do exceed the stated threshold when the upper limit of the displacement matrix impact range advised by NRW and JNCC is modelled (80% / 10%).

592. Even at such high rates for the species (particularly the 10% mortality rate) there will be no population-level consequence of concern (as evidenced by **Table 22-10** and **Figure 22-6** of **Appendix 22F: Marine Ornithology Population Modelling**) and this conservation objective 1 will not be compromised.

*Conclusion*

593. Based on the conclusions and appraisal provided above supports the conclusion of no AEoSI against any of the conservations objectives for the marine ornithological qualifying interests protected at Grassholm SPA arising from the proposed Project alone or in combination.

*Irish Sea Front SPA*

*Array Area*

594. The Irish Sea Front SPA is located over 200 km north of the offshore elements of the proposed Project (the Array Area and the OfECC). As such, this marine SPA is too far away for Manx shearwater to be directly affected as a qualifying interest while within the designated site, therefore the conservation objectives relating to the SPA's directly protective function (conservation objective 1 and conservation objective 2) are not relevant to consider further and only conservation objective 3 requires appraisal (**Table 8-35** and **Table 8-36**)

***Conservation Objective 3: Ensure connectivity between the site and its supporting habitats and Manx shearwater breeding colonies is maintained.***

595. The Irish Sea Front SPA is identified as having connectivity with several breeding colonies of Manx shearwater including Skomer and Skokholm Islands (as part of Skomer, Skokholm and Seas off Pembrokeshire SPA) as well as Lundy Island (which is a Site of Special Scientific Interest, (SSSI)). The Array Area does not stand in direct line between the Irish Sea Front and any of these connected colonies (as listed in **Table 8-35**), with Lundy SSSI being the only one located to the south of the proposed Project.

596. In this regard, it is extremely unlikely that the proposed Project will act as a barrier disrupting bird flight paths between Lundy and the Irish Sea Front (**Figure 8-14**), considering the small size of the Array Area and limited number of turbines (max 10). In this regard, there is negligible risk that project infrastructure lighting will increase collision risk to Manx shearwater flying between Lundy and the Irish Sea Front.

597. For the in-combination assessment**, Figure 8-14** also shows the locations of Erebus (floating offshore wind project, as consented, max 10 turbines) and White Cross (floating offshore wind project, at application, max 8 turbines). Even taking the three projects together, there is negligible risk of Manx shearwater flight paths from Lundy SSSI being disrupted or of access to the Irish Sea Front SPA being prevented, due to the small-scale of this development.

598. As noted in **Chapter 22: Marine Ornithology**, if each project is required to produce an agreed Lighting and Marking Management Plan (such as that proposed for the proposed Project, and the Aviation and lighting Scheme Plan required for Erebus; Section 3.26.1 of their marine licence), then there is no outstanding risk of significant cumulative impacts to Manx shearwater from project infrastructure lighting during the operational phase of these projects.

*Conclusion*

599. Based on the conclusions and appraisal provided above supports the conclusion of no AEoSI against any of the conservations objectives for the marine ornithological qualifying interests protected at Irish Sea Front SPA arising from the proposed Project alone or in combination.

**Information for Assessment of Adverse Effects In-Combination**

600. The **Appendix 8D: Habitats Regulations Assessment Screening** outlined the short-list of projects with potential to impact Annex I ornithological receptors. The following projects were considered quantitatively within **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios**:

- Erebus offshore wind project;
- Awel y Mor offshore wind project;
- Twin Hub offshore wind project;
- Morlais tidal project; and
- White Cross offshore wind project.

601. The remainder of the short-listed projects are not anticipated to have population consequences so have been considered qualitatively within **Chapter 22: Marine Ornithology** and **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios**.

**602.** The potential Impact of the proposed Project in-combination with other projects and plans on any SPAs is considered alongside the alone assessments for each SPA (**Paragraphs 569** to **599**). It has been concluded that there is **no potential for in-combination effects on the Annex I marine ornithological features of Skomer, Skokholm and the Seas of Pembrokeshire SPA Grassholm SPA, or Irish Sea Front SPA.**

**Summary**

603. The information provided considers the potential for impact pathways associated with the proposed Project to hinder the conservation objectives of the Annex I marine ornithological features of Skomer, Skokholm and the Seas off Pembrokeshire SPA, Grassholm SPA, and Irish Sea Front SPA.

604. With mitigation and best practice measures in place (**Section 8.1.2**), it is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I marine ornithology features. Therefore, it is concluded that there is **no potential for an AEoSI on Skomer, Skokholm and the Seas off Pembrokeshire SPA, Grassholm SPA, and Irish Sea Front SPA due to the proposed Project, either alone or in-combination.**

### *8.5.5. Annex I Terrestrial Habitats*

605. This section covers the assessment of risk of adverse effects of SACs designated for Annex I terrestrial habitats for the proposed Project and details:

- A summary of the HRA Screening;
- A description of each SAC and its conservation objectives; and
- An assessment for each SAC of risk of AEoSI for the proposed Project alone, and in-combination with other developments.

**Summary of HRA Screening**

606. The proposed Project's HRA Screening Report identified one SAC with Annex I terrestrial habitat features (see **Appendix 8D: Habitats Regulations Assessment Screening**). This SAC was identified based on direct overlap between the Onshore Development Area and Annex I Habitats.

607. The following potential impact pathways for all stages of the proposed Project (construction, operation and maintenance, and decommissioning) on terrestrial ecology have been screened into the HRA:

- Physical change of habitat;
- Physical disturbance;
- Physical loss of habitat;
- Pollution / contamination; and
- Introduction and spread of INNS.

**608.** Where LSE could not be excluded at the screening stage, sites have been taken forward to determine any AEoSI which will be considered during Stage 2 (AA) (

609. Table *8-39*; Figure 8-15).

Table 8-39. *Summary of the SACs designated for Annex I terrestrial habitats screened into AA*

| Site name | Annex I Habitats | Distance to Onshore Development Area (km) |
|---|---|---|
| Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) | *Screened in for:*<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130);<br>• European dry heaths (4030); and<br>• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (important orchid sites) (6210). | 0.00 |

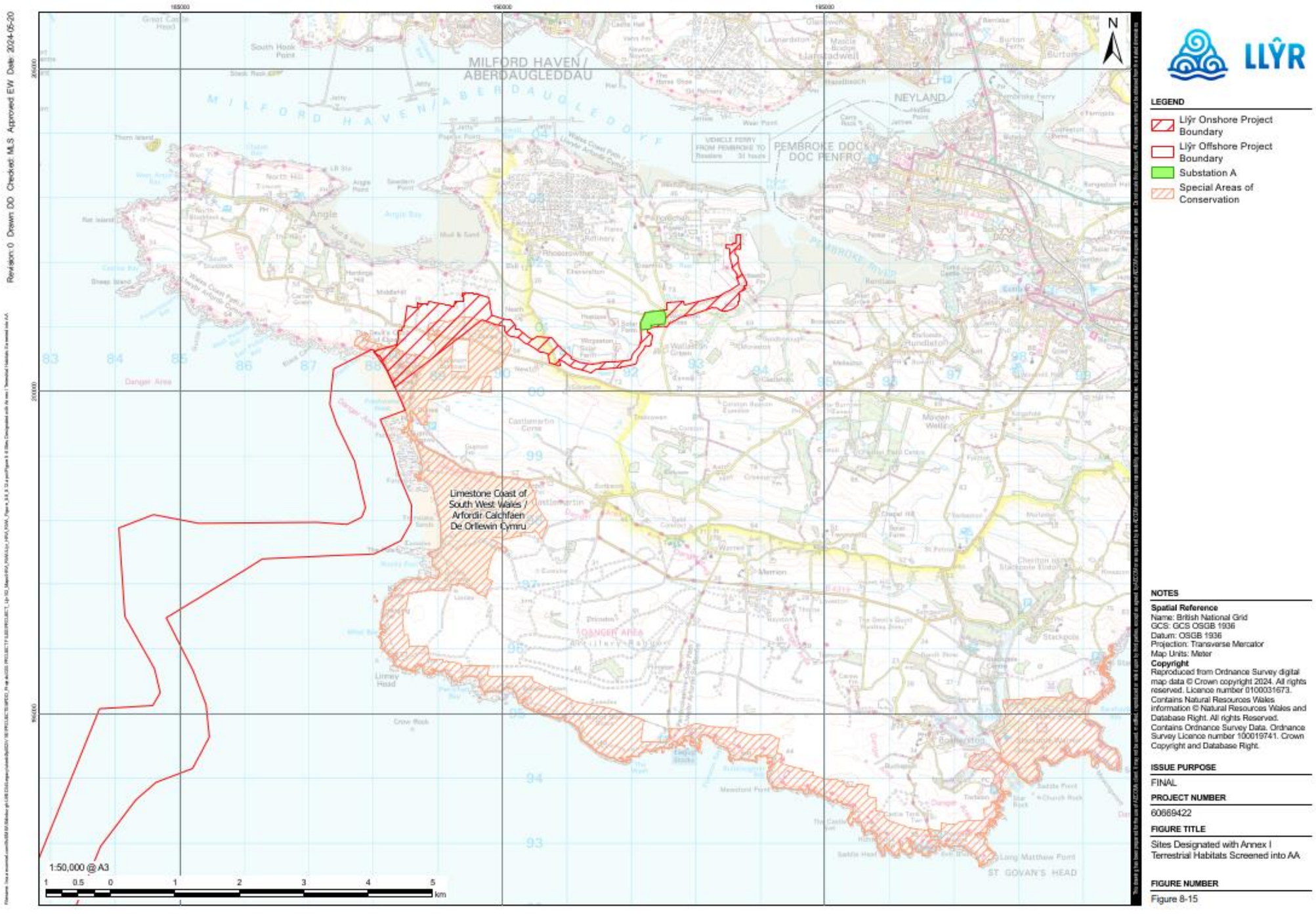


*Figure 8-15. Sites designated with Annex I terrestrial habitats screened into AA*

**Site Description and Conservation Objectives**

*Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787)*

610. The Limestone Coast of South West Wales SAC comprises a series of SSSI's and boasts a great variety of habitats and species in relatively small area. The limestone cliffs support an unusually high number of nationally rare and scarce plants within the maritime, dune and neutral / calcareous grassland, which exist on the cliffs themselves and the hinterland. The conservation objectives for the Limestone Coast of South West Wales SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes (Countryside Council for Wales, 2008a). For the habitat features, this includes maintaining the range, typical species and structure and function of the qualifying features (Countryside Council for Wales, 2008a).

611. The OnECC is 7.1 km in length and encompasses approximately 49 ha of the SAC, equating to 3% of the whole SAC (1594.53 ha). Thus, the site has been screened into the AA for potential LSE on the following Annex I terrestrial habitats:

- Fixed coastal dunes with herbaceous vegetation (grey dunes);
- European dry heaths; and
- Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (important orchid sites).

612. A review of DataMap Wales has shown the area of the SAC within the OnECC comprises of dune habitats (NRW, 2017b). This is reiterated in the Core Management Plan (CMP) where 'Fixed coastal dunes with herbaceous vegetation (grey dunes)' are specified as the key habitat type for this SSSI component (Broomhill Burrows SSSI).

613. A Phase 1 habitat survey carried out by AECOM between August and October 2023 also identified this area as 'dune grassland' and 'dune scrub' (**Appendix 08B: PEA Report).** As such, the following assessment only considers impacts on fixed coastal dunes with herbaceous vegetation (grey dunes) qualifying habitat as the other qualifying habitat types i.e., European dry heaths and semi-natural dry grasslands and scrubland facies on calcareous substrates were not recorded as being present within the OnECC.

**Information for Appropriate Assessment**

*Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC - Assessment of Adverse Effects Alone*

614. The Limestone Coast of South West Wales SAC lies 52 m (at its closest point) to the south of the landfall area at Freshwater West and approximately 2.0 km to the southwest of the proposed Substation location. As there are no apparent hydrological connections between the proposed Substation location and the qualifying terrestrial habitat, the following assessment only considers impact pathways associated with the OnECC and landfall area.

*Construction phase*

***Physical change of habitat***

615. Construction impacts have the potential to result in a change of designated habitats and supporting processes and there is the potential for both temporary and permanent habitat loss and disturbance during the proposed onshore works.

616. Landfall at Freshwater West will be achieved using HDD with onshore TJB at the HDD compound located up to 400 m inshore from Mean High Water (MHW).

617. At the landfall the export cable will utilise up to two HDD ducts to traverse the intertidal zone at Freshwater West. The maximum HDD distance will be up to 1.3 km - this will involve 960 m of offshore HDD drilling and a further 330 m of onshore HDD drilling inland.

618. Landfall HDD drilling will require one 100 m x 75 m temporary compound as part of the HDD temporary works area. Each entry point for the HDD ducts will be 16 m apart within the temporary works area.

619. At the landfall site the subsea cables will be connected to onshore cables in an underground TJB. Once constructed, the only visual sign on the TJB will be a link pillar. The link pillar for the proposed Project will be up to 1m x 1m x 0.6m.

620. A 100 m x 50 m temporary construction compound will be required adjacent to the substation location. In addition, up to four 40 m x 50 m satellite construction compounds will be used at each cable joint bay for installation activity. The area assigned for the temporary works and satellite construction compound comprises a field of improved grassland and lies approximately 52 m to the north of the Limestone Coast of South West Wales SAC. It should be noted that the exact location of the satellite compounds within this area is yet to be determined.

621. There will be no construction works within the SAC and therefore no direct physical changes to the dune habitats. A review of aerial imagery and Ordnance Survey (OS) mapping does not reveal any hydrological connection between the temporary works area and the SAC, therefore there is no pathway for indirect physical changes to the dune habitats during construction.

622. There will be up to two onshore 66 kV or 132 kV export cables from the TJB. The cables will be laid in separate trenches created by either Open Cut Trenching (OCT) or HDD. The cables will run from the TJB to the onshore substation. One single export cable will runfrom the substation to the point of connection (400 kV at Pembroke Dock power station).

623. Currently, the OnECC is up to 900 m at its widest, where it overlaps with the SAC, and 100 m at its narrowest. The aim will be to refine and microsite the route for cable installation within the export cable corridor prior to installation to avoid the SAC. Where this is not feasible, HDD will be utilised. For the purposes of the assessment, the OnECC and associated infrastructure is expected to utilise a 30 m wide corridor and an additional 10 m buffer either side of the corridor has been assumed to account for scenarios where a 30 m working width may not be feasible.

624. Therefore, it is not anticipated that the physical change of habitat will hinder the conservation objectives of the Annex I fixed coastal dunes feature of the Limestone Coast of South West Wales SAC, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to physical change of habitat**.

***Physical disturbance***

625. Potential construction phase effect on habitats relates to physical disturbance of habitats, such as damage caused by tracking by installation machinery. For the purposes of the assessment, the OnECC and associated infrastructure is expected to utilise a 30 m wide corridor and an additional 10 m buffer either side of the corridor has been assumed in terms of such disturbance to account for scenarios where a 30 m working width may not be feasible.

626. The current OnECC is at its widest (900 m) where it overlaps with the SAC. This allows, where feasible, for the cable route to be microsited in order to avoid the SAC. Where this is not feasible, HDD will be utilised.

627. Access to the temporary works and satellite compound area will be via the B4319. The area itself, as discussed above, is approximately 52 m from the SAC, allowing for a working area, plus a 10 m buffer. Access to the TJB for maintenance will be via the same route.

628. Therefore, it is not anticipated that the physical disturbance will hinder the conservation objectives of the fixed coastal dunes feature of the Limestone Coast of South West Wales SAC, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to physical disturbance**.

***Physical loss of habitat***

629. At the time of screening, the exact location of the Substation was yet to be confirmed therefore, as a precautionary approach, the potential for physical loss of Annex I habitat was screened in for AA.

630. The location has now been confirmed, and is some 2.0 km to the northeast of the SAC, as shown on **Figure 8-15**. Therefore, it is not anticipated that the physical loss of habitat will hinder the conservation objectives of the Annex I fixed coastal dunes feature of the Limestone Coast of South West Wales SAC, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to physical loss of habitat**.

***Pollution / contamination***

631. Construction activities have the potential to affect air quality. This is primarily expected due to emissions associated with exhaust emissions from construction vehicles and equipment.

632. The main pollutants of concern for Annex I terrestrial habitats are nitrogen oxides (NOx), ammonia ($NH_3$) and sulphur dioxide ($SO_2$).

633. $SO_2$ emissions overwhelmingly derive from power stations and industrial processes that require the combustion of coal and oil, as well as shipping (particularly on a local scale). There will be no material release of $SO_2$ in the construction, operational or decommissioning phases of the proposed Project. Therefore, this atmospheric pollutant is not considered further in this HRA.

634. $NH_3$ can have a directly toxic effect upon vegetation, particularly at close distances to the source such as near road verges (Defra, 2012).

635. NOx can also be toxic to vegetation at very high concentrations (far above the annual average Critical Level). Furthermore, high levels of NOx and $NH_3$ are likely to increase the total nitrogen (N) deposition, potentially leading to deleterious knock-on effects in recipient ecosystems. An increase in N deposition from the atmosphere is widely known to enhance soil fertility and to lead to eutrophication. This often has adverse effects on plant community composition and the overall quality of semi-natural, nitrogen-limited terrestrial and aquatic habitats (Wolseley, et al., 2006; WHO, 2000).

636. The B4319 and B4320, both identified as potential access routes (**Chapter 13: Traffic and Transport**), run directly through the SAC. Guidance published by the Institute of Air Quality Management (IAQM) and Environmental Protection UK (2017) proposes an initial screening step with a threshold, in terms of Annual Average Daily Traffic (AADT) flow, to warrant a detailed air quality assessment of road traffic as:

- A change of more than 500 Light Duty Vehicles (LDVs, all vehicles less than 3.5 tonnes gross weight) or 100 Heavy Duty Vehicles (HDVs) when outside of an Air Quality Management Area (AQMA); and
- A change of more than 100 Light Duty Vehicles (LDV, all vehicles less than 3.5 tonnes gross weight) or 25 Heavy Duty Vehicles (HDVs) when within or adjacent to an AQMA.

637. Based on the parameters above, **Chapter 14: Air Quality** states "The proposed Project is not expected to generate vehicle traffic on this scale during construction or operation, even if traffic is routed through the Pembroke AQMA. Emissions from road traffic can therefore be screened out at this initial stage and they will not be considered further in this assessment."

638. Construction and decommissioning activities can generate dust emissions from operating machinery that can cause localised smothering of vegetation. The effects of dust will depend on the prevailing wind direction, and the transport distance is related to particle size. Dust particle size and chemical composition is important as smaller particles can enter or block stomata and thus interfere with gas exchange, while sufficient coverage may prevent light penetration to the chloroplasts.

639. According to guidance from the Institute of Air Quality Management (2014), with respect to possible effects due to dust, *"…an assessment will normally be required where there is…an 'ecological receptor' within: 50 m of the boundary of the site; or 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s)"*. There are no ecological receptors within this distance of the onshore Project boundary.

640. Based on the findings of the air quality assessment, it is not anticipated that the potential pollution / contamination will hinder the conservation objectives of the Annex I fixed coastal dunes feature of the Limestone Coast of South West Wales SAC, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to pollution / contamination**.

***Introduction and spread of INNS***

641. An 'invasive species' is a species that is: 1) non-native (or alien) to the ecosystem under consideration, and 2) whose introduction causes or is likely to cause economic or environmental harm, or harm to human health. They can be introduced to an area by , for example, ship ballast water, accidental release, and most often, by people. Invasive species can lead to the extinction of native plants and animals, destroy biodiversity, and permanently alter habitats (House of Commons Environmental Audit Committee, 2019). Any construction project can introduce INNS if inadequate biosecurity protocols are followed.

642. There are several legislative instruments relating to INNS. The purpose of this legislation is to prevent and reduce the negative economic and environmental impacts of these species. Key legislation identifies species for which mitigation is required, specifically:

- Species listed in Schedule 9 of the WCA; and
- Species of special concern and Schedule 2 species as per the Invasive Alien Species (Enforcement and Permitting) Order (2019) (as amended) (IASO).

643. Taken together, the relevant legislation makes it an offence to plant, or otherwise cause to grow (including allowing to spread) listed species in the wild. If transported off-site, there is a duty of care with regards to the disposal of any part of the plant that may facilitate establishment in the wild and cause environmental harm (as per the Environmental Protection Act (1990)).

644. While it is not illegal to have any of the identified INNS on a property, even when growing on managed land, the spread of Schedule 9 WCA species should be kept under control such that the species is not having an appreciable adverse impact on habitats and their native biodiversity.

645. Therefore, appropriate biosecurity measures secured through the CEMP (**Appendix 04A: Outline CEMP**) and INNS Plan (**Volume 6, Appendix 04B: INNS Plan**) will be implemented during works carried out during the construction phase of the proposed Project to prevent the spread of INNS, irrespective of whether there are Habitats sites in the vicinity.

646. Therefore, it is not anticipated that the potential introduction and spread of INNS will hinder the conservation objectives of the Annex I fixed coastal dunes feature of the Limestone Coast of South West Wales SAC, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to the introduction and spread of INNS**.

*Operation and Maintenance phase*

***Physical disturbance***

647. Habitats temporarily used for construction will be reinstated. This will be secured via the CEMP, Biodiversity Management Plan (BMP), Landscape Environmental Management Plan (LEMP) and Green Infrastructure Statement.

648. Moreover, given that none of the operational areas lie within the SAC boundary, no operational or maintenance activities will take place within areas of qualifying habitat.

649. Therefore, it is not anticipated that the physical disturbance will hinder the conservation objectives of the Annex I fixed coastal dunes feature of the Limestone Coast of South West Wales SAC, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to physical disturbance**.

*Decommissioning phase*

650. At the end of the operational life of the proposed Project, there will be a DEMP in place. Other proposed Project constraints will also be taken into consideration (e.g. safety and liability), with the least environmentally damaging option chosen if possible.

651. The full details of the proposed decommissioning will not be agreed until towards the end of the 30-year operational lifetime of the proposed Project. However, the decommissioning phase is expected to largely mirror the construction process over a period of 12 months (see **Chapter 04: Description of the Proposed Project**). However, it is anticipated that upon decommissioning the onshore cable would be left in-situ and, as such, there would not be any impact resulting from excavations, which is where most effects associated with the onshore cable originate from.

652. For works in proximity to the SAC, statutory consultation would be required and an update to the HRA undertaken.

653. Therefore, the impacts of the decommissioning phase are not expected to exceed impacts of the construction phase (**Paragraphs 615 to 646**57), and it is not considered that there will be an impact to the conservation objectives of the Annex I fixed coastal dunes feature of the Limestone Coast of South West Wales SAC, and thus there is **no potential for an AEoSI on the Limestone Coast of South West Wales SAC due to the effects of decommissioning**.

**Information for Assessment of Adverse Effects In-Combination**

654. The following projects have been identified as having the potential for in-combination effects on the Annex I terrestrial habitats based on their potential impact pathways to the same European sites as the Project:

- Greenlink Interconnector;
- Erebus; and
- Valorous.

655. The potential for in-combination effects are summarised in Table 8-40, concluding that there is no potential for in-combination effects on the Annex I terrestrial habitat features of Limestone Coast of South West Wales SAC .

*Table 8-40. Summary of in-combination effects on Annex I terrestrial habitats*

| Project name | Potential for in-combination effects<br><br>Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) |
|---|---|
| **Greenlink Interconnector / Greenlink Interconnector Limited**<br>Interconnector<br>Under construction | **No.**<br>This project has been subject to its own HRA which concluded *"Although the potential for adverse effects to occur was identified through the Stage 1: Screening assessment, a range of mitigation measures have been proposed to avoid the effects of pollution and sediment run-off, and the effects of habitat severance on bat species during construction and operation. Since no effect is predicted, it is not possible to incur in-combination effects with other plans and projects. As such, there is no need to undertake an in-combination assessment for those features."* (Greenlink, 2020) |
| **Erebus / Blue Gem Wind**<br>Offshore wind farm<br>Consented | **No.**<br>This project has been subject to its own HRA which concluded *"This assessment concluded that there would be no AEoSI as a result of the construction, operation and decommissioning of the Project in-combination with the relevant and reasonably foreseeable plans and projects".* (MarineSpace Ltd, 2021) |
| **Valorous / Blue Gem Wind** NRW<br>Offshore wind<br>Planned | **No.**<br>As the proposed Project can draw the conclusion of no AEoSI with mitigation alone, it is for the Valorous / Blue Gem Wind to demonstrate no in-combination effects. |

*Summary*

656. The OnECC is 7.1 km in length and encompasses approximately 49 ha of the Limestone Coast of South West Wales SAC, equating to 3% of the whole SAC (1594.53 ha).

657. Potential impact pathways identified in relation to Annex I terrestrial habitats included physical change of habitat, physical disturbance, physical loss of habitat, pollution / contamination and the introduction and spread of INNS.

658. The OnECC is up to 900 m at its widest, where it overlaps with the SAC, which allows for the cable route to be micro-sited in order to avoid direct impacts on the qualifying habitats of the SAC.

659. Traffic modelling and air quality assessments undertaken by AECOM (**Chapter 13: Traffic and Transport; Chapter 14: Air Quality**) conclude that the expected traffic volumes would be less than that requiring air quality assessments under IAQM & Environmental Protection UK guidelines and there are no ecological receptors within the buffers specified for dust deposition.

660. In accordance with relevant legislation, appropriate biosecurity measures will be implemented during works carried out during the construction phases of any scheme to prevent the spread of INNS.

661. On this basis, it is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I terrestrial habitat features (**Table 8-41**). Therefore, it is concluded that there is **no potential for an AEoSI on Limestone Coast of South West Wales SAC due to the proposed Project** (**Table 8-41**Table 8-6)**, either alone or in-combination.**

*Table 8-41. Summary of AEoSI for designated sites with Annex I terrestrial habitat features due to potential impact pathways associated with the OfECC of the proposed Project (✓- potential to hinder conservation objectives; X – no potential to hinder conservation objectives)*

| Designated site | Annex I terrestrial habitat features screened into assessment | Potential Impact Pathways: Construction: Physical change of habitat | Construction: Physical disturbance | Construction: Pollution / contamination | Construction: Introduction and spread of INNS | Operation and Maintenance: Physical disturbance | Decommissioning: Decommissioning effects | AEoSI / Screened into Stage 3 |
|---|---|---|---|---|---|---|---|---|
| Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) | Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130) | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I terrestrial habitat features. Therefore, there is **no potential for an AEoSI on Limestone Coast of South West Wales SAC either alone or in-combination** |
| | European dry heaths (4030) | N/A | N/A | N/A | N/A | N/A | N/A | |
| | Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (important orchid sites) (6210) | N/A | N/A | N/A | N/A | N/A | N/A | |

### *8.5.6. Annex II Terrestrial Flora*

662. This section covers the assessment of risk of adverse effects of SACs designated for Annex II terrestrial flora for the proposed Project and details:

- A summary of the HRA Screening;
- A description of each SAC and its conservation objectives; and
- An assessment for each SAC of risk of AEoSI for the proposed Project alone, an in-combination with other developments.

**Summary of HRA Screening**

663. The proposed Project's HRA Screening Report identified two SAC's with Annex II terrestrial floral features, but only one where there was potential for LSE (see **Appendix 8D: Habitats Regulations Assessment Screening**). This SAC was identified based on direct overlap between the Onshore Development Area and Annex II Species.

664. The following potential impact pathways for all stages of the proposed Project (construction, operation and maintenance, and decommissioning) on terrestrial ecology have been screened into the HRA:

- Physical change of habitat;
- Physical disturbance;
- Physical loss of habitat;
- Pollution, contamination; and
- Introduction and spread of INNS

**665.** Where LSE could not be excluded at the screening stage, sites have been taken forward to determine any AEoSI which will be considered during Stage 2 (AA) (**Table 8-42**; **Figure 8-16**).

*Table 8-42. Summary of the SACs designated for Annex II terrestrial flora screened into AA*

| Site name | Annex II terrestrial flora | Distance to Onshore development Area (km) |
|---|---|---|
| Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) | *Screened in for:*<br>• Early gentian *Gentianella anglica* (1654); and<br>• Petalwort *Petalophyllum ralfsii* (1395). | 0.00 |

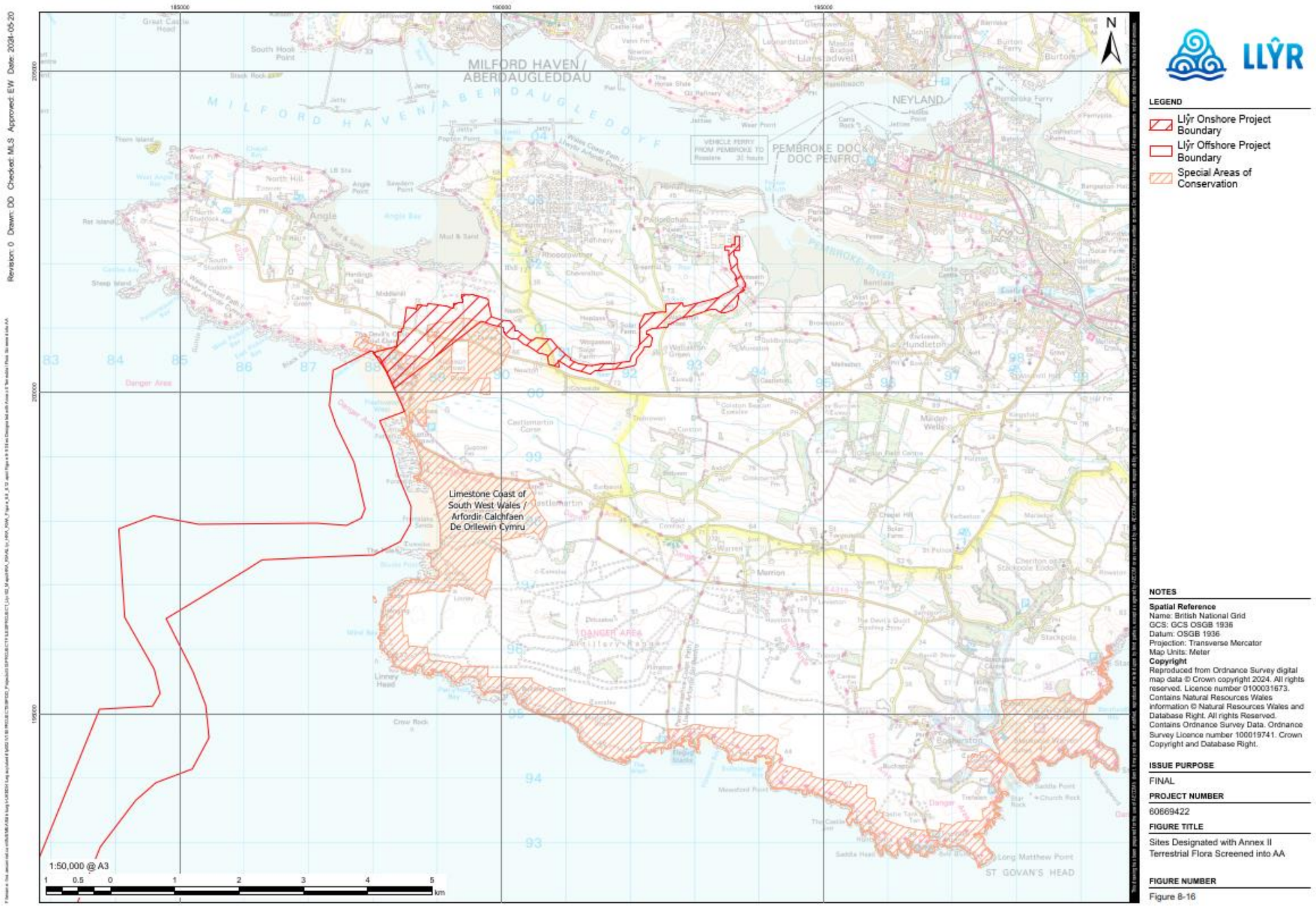


*Figure 8-16. Sites designated with Annex II terrestrial flora screened into AA*

**Site Description and Conservation Objectives**

*Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787)*

666. The Limestone Coast of South West Wales SAC comprises a series of SSSIs and boasts a great variety of habitats and species in relatively small area. The limestone cliffs support an unusually high number of nationally rare and scarce plants within the maritime, dune and neutral / calcareous grassland, which exist on the cliffs themselves and the hinterland. The conservation objectives for the Limestone Coast of South West Wales SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes (Countryside Council for Wales, 2008a). For the species features, this includes maintaining extent, distribution, and quality of the feature (Countryside Council for Wales, 2008a).

667. The OnECC is 7.1 km in length and encompasses approximately 49 ha of the SAC, equating to 3% of the whole SAC (1594.53 ha). Thus, the site has been screened into the AA for potential LSE on the following Annex II species:

- Early gentian *Gentianella anglica*; and
- Petalwort *Petalophyllum ralfsii*.

**Information for Appropriate Assessment**

*Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC - Assessment of Adverse Effects Alone*

668. The Limestone Coast of South West Wales SAC lies 52 m (at its closest point) to the south of the landfall area at Freshwater West and approximately 2.0 km to the southwest of the proposed Substation location. As there are no apparent hydrological connections between of the proposed Substation location and both of the qualifying terrestrial features, the following assessment only considers impact pathways associated with the OnECC and landfall area.

*Construction phase*

***Physical change of habitat***

669. Construction impacts have the potential to result in a change of habitats supporting qualifying species and supporting processes. There is the potential for both temporary and permanent habitat loss and disturbance during the proposed onshore works.

670. Landfall at Freshwater West will be achieved using HDD with onshore TJB at the HDD compound located up to 400 m inshore from MHW.

671. At the landfall the export cable will utilise up to two HDD ducts to traverse the intertidal zone at Freshwater West. The maximum HDD distance will be up to 1.3 km - this will involve 960 m of offshore HDD drilling and a further 330 m of onshore HDD drilling inland.

672. Landfall HDD drilling will require one 100 m x 75 m temporary compound as part of the HDD temporary works area. Each entry point for the HDD ducts will be 16 m apart within the temporary works area.

673. At the landfall site the subsea cables will be connected to onshore cables in an underground TJB. Once constructed, the only visual sign on the TJB will be a link pillar. The link pillar for the proposed Project will be up to 1 m x 1 m x 0.6 m.

674. A 100 m x 50 m temporary construction compound will be required adjacent to the substation location. In addition, up to four 40 m x 50 m satellite construction compounds will be used at each cable joint bay for installation activity. The area assigned for the temporary works and satellite construction compound comprises a field of improved grassland and lies approximately 52 m to

the north of the Limestone Coast of South West Wales SAC. It should be noted that the exact location of the satellite compound within this area is yet to be determined.

675. There will be no construction works within the SAC and therefore no direct physical changes to the dune habitats within which these species are found. A review of aerial imagery and OS mapping does not reveal any hydrological connection between the temporary works area and the SAC, therefore there is no pathway for indirect physical changes to the dune habitats during construction.

676. Given the location, outside of the SAC, and lack of hydrological connection, no impacts are envisaged during construction of the TJB's provided works are confined to the same area.

677. There will be up to two onshore 66 kV or 132 kV export cables from the TJB. The cables will be laid in separate trenches created by either OCT or HDD. The cables will run from the TJB to the onshore substation. One single export cable will run from the substation to the point of connection (400 kV at Pembroke Dock power station).

678. Currently, the OnECC is up to 900 m at its widest, where it overlaps with the SAC, and 100 m at its narrowest. The aim will be to refine and microsite the route for cable installation within the export cable corridor prior to installation to avoid the SAC. For the purposes of the assessment, the OnECC and associated infrastructure is expected to utilise a 30 m wide corridor and an additional 10 m buffer either side of the corridor has been assumed to account for scenarios where a 30 m working width may not be feasible.

679. Therefore, it is not anticipated that the physical change of supporting habitat will hinder the conservation objectives of the Annex II terrestrial flora features of the Limestone Coast of South West Wales SAC, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to physical change of supporting habitat**.

***Physical disturbance***

680. Early gentian grows on chalk grassland, favouring south-facing slopes with thin soil that are grazed to keep the vegetation cover low. Review of NBN Atlas Wales shows the closest confirmed record to be 11 km southeast (as the crow flies) (NBN Atlas Partnership, 2024). This species was not recorded during the Phase 1 habitat survey carried out by AECOM between August and October 2023 (**Appendix 08B: PEA Report**).

681. Petalwort grows primarily on moist sand dunes and a review of NBN Atlas Wales shows there to be confirmed records within the SAC, in proximity to the Landfall site (NBN Atlas Partnership, 2024). This species was not recorded during the Phase 1 habitat survey carried out by AECOM between August and October 2023 (**Appendix 08B: PEA Report**).

682. As discussed above, the current OnECC is at its widest (900 m) where it overlaps with the SAC. This allows for the cable route to be microsited in order to avoid the SAC whilst still providing a 30 m working corridor, plus a 10 m buffer if needed.

683. Access to the temporary works and satellite compound area will be via the B4319. The area itself, as discussed above, is approximately 52 m from the SAC, allowing for a working area, plus a 10 m buffer. Access to the TJB for maintenance will be via the same route.

684. Given the distance of the closest confirmed early gentian record, the habitat preferences of both species, and the fact that there will be no works within the SAC itself, it is not anticipated that the physical disturbance will hinder the conservation objectives of the Annex II terrestrial flora features of the Limestone Coast of South West Wales SAC, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to physical disturbance**.

***Pollution / contamination***

685. Construction activities have the potential to affect air quality. This is primarily expected due to emissions associated with exhaust from construction vehicles and equipment.

686. The main pollutants of concern for Habitats sites are NOx, $NH_3$ and sulphur dioxide ($SO_2$). $NH_3$ can have a directly toxic effect upon vegetation, particularly at close distances to the source such as near road verges (Defra, 2012).

687. NOx can also be toxic to vegetation at very high concentrations (far above the annual average Critical Level). Furthermore, high levels of NOx and $NH_3$ are likely to increase the total nitrogen (N) deposition, potentially leading to deleterious knock-on effects in recipient ecosystems. An increase in N deposition from the atmosphere is widely known to enhance soil fertility and to lead to eutrophication. This often has adverse effects on plant community composition and the overall quality of semi-natural, nitrogen-limited terrestrial and aquatic habitats (Wolseley, et al., 2006; WHO, 2000).

688. The B4319 and B4320, both identified as potential access routes (**Chapter 13: Traffic and Transport**), run directly through the SAC. Guidance published by the IAQM & Environmental Protection UK (2017) proposes an initial screening step with a threshold, in terms of AADT flow, to warrant a detailed air quality assessment of road traffic as:

- A change of more than 500 LDVs or 100 HDVs when outside of an AQMA; and
- A change of more than 100 LDV or 25 HDVs when within or adjacent to an AQMA.

689. **Chapter 14: Air Quality** states "The proposed Project is not expected to generate vehicles traffic on this scale during construction or operation, even if traffic is routed through the Pembroke AQMA. Emissions from road traffic can therefore be screened out at this initial stage and they will not be considered further in this assessment."

690. Construction and decommissioning activities can generate dust emissions from operating machinery that can cause localised smothering of vegetation. The effects of dust will depend on the prevailing wind direction, and the transport distance is related to particle size. Dust particle size and chemical composition is important as smaller particles can enter or block stomata and thus interfere with gas exchange, while sufficient coverage may prevent light penetration to the chloroplasts.

691. According to guidance from the IAQM (2014), with respect to possible effects due to dust, "…an assessment will normally be required where there is…an 'ecological receptor' within: 50 m of the boundary of the site; or 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s)". There are no ecological receptors within this distance of the onshore Project boundary.

692. Based on the findings of the air quality assessment, it is not anticipated that the potential pollution / contamination will hinder the conservation objectives of the Annex II terrestrial flora features of the Limestone Coast of South West Wales SAC, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to pollution / contamination**.

***Introduction and spread of INNS***

693. An 'invasive species' is a species that is: 1) non-native (or alien) to the ecosystem under consideration, and 2) whose introduction causes or is likely to cause economic or environmental harm, or harm to human health. They can be introduced to an area by ship ballast water, accidental release, and most often, by people. Invasive species can lead to the extinction of native plants and animals, destroy biodiversity, and permanently alter habitats. Any construction project can introduce INNS if inadequate biosecurity protocols are followed.

694. There are several legislative instruments relating to INNS. The purpose of this legislation is to prevent and reduce the negative economic and environmental impacts of these species. Key legislation identifies species for which mitigation is required, specifically:

- Species listed in Schedule 9 of the WCA; and
- Species of special concern and Schedule 2 species as per the IASO.

695. Taken together, the relevant legislation makes it an offence to plant, or otherwise cause to grow (including allowing to spread) listed species in the wild. If transported off-site, there is a duty of care with regards to the disposal of any part of the plant that may facilitate establishment in the wild and cause environmental harm (as per the Environmental Protection Act 1990).

696. While it is not illegal to have any of the identified INNS on a property, even when growing on managed land, the spread of Schedule 9 WCA species should be kept under control such that the species is not having an appreciable adverse impact on habitats and their native biodiversity.

697. Therefore, appropriate biosecurity measures secured through CEMP (**Appendix 04A: Outline CEMP**) and INNS Plan (**Appendix 04B: INNS Plan**) will be implemented during works carried out during the construction phases of any scheme to prevent the spread of INNS, irrespective of whether there are Habitats sites in the vicinity.

698. Therefore, it is not anticipated that the potential introduction and spread of INNS will hinder the conservation objectives of the Annex II terrestrial flora features of the Limestone Coast of South West Wales SAC, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to the introduction and spread of INNS**.

*Operation and Maintenance phase*

***Physical disturbance***

699. Habitats temporarily used for construction will be reinstated. This will be secured via the CEMP, BMP, LEMP and Green Infrastructure Statement.

700. Moreover, given that none of the operational areas lie within the SAC boundary, no operational or maintenance activities will take place within areas of qualifying habitats that support the Annex II terrestrial floral species.

701. Therefore, it is not anticipated that the physical disturbance will hinder the conservation objectives of the Annex II terrestrial flora features of the Limestone Coast of South West Wales SAC, and it can be concluded that there is **no potential for an AEoSI of the Limestone Coast of South West Wales SAC due to physical disturbance**.

*Decommissioning phase*

702. At the end of the operational life of the proposed Project, there will be a DEMP in place. Other proposed Project constraints will also be taken into consideration (e.g. safety and liability), with the least environmentally damaging option chosen if possible.

703. The full details of the proposed decommissioning will not be agreed until towards the end of the 30-year operational lifetime of the proposed Project. However, the decommissioning phase is expected to largely mirror the construction process over a period of 12 months (see **Chapter 04: Description of the Proposed Project**). However, It is anticipated that upon decommissioning the onshore cable would be left in-situ and, as such, there would not be any impact resulting from excavations, which is where most effects associated with the onshore cable originate from.

704. For works in proximity to the SAC, statutory consultation would be required and an update to the HRA undertaken.

705. Therefore, the impacts of the decommissioning phase are not expected to exceed impacts of the construction phase (Paragraphs 66957 to 698), and it is not considered that there will be an impact to the conservation objectives of the Annex II terrestrial flora features of the Limestone Coast of South West Wales SAC, and thus there is **no potential for an AEoSI on the Limestone Coast of South West Wales SAC due to the effects of decommissioning**.

**Information for Assessment of Adverse Effects In-Combination**

706. The following projects have been identified as having the potential for in-combination effects on the Annex II flora based on their potential impact pathways to the same European sites as the Project:

- Greenlink Interconnector;
- Erebus; and
- Valorous.

707. The potential for in-combination effects are summarised in Table 8-43, concluding that there is **no potential for in-combination effects on the Annex II terrestrial flora features of Limestone Coast of South West Wales SAC**.

*Table 8-43. Summary of in-combination effects on Annex II flora*

| Project name | Potential for in-combination effects<br><br>Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) |
|---|---|
| **Greenlink Interconnector / Greenlink Interconnector Limited**<br>Interconnector<br>Under Construction | **No.**<br>This project has been subject to its own HRA which concluded *"Although the potential for adverse effects to occur was identified through the Stage 1: Screening assessment, a range of mitigation measures have been proposed to avoid the effects of pollution and sediment run-off, and the effects of habitat severance on bat species during construction and operation. Since no effect is predicted, it is not possible to incur in-combination effects with other plans and projects. As such, there is no need to undertake an in-combination assessment for those features."* (Greenlink, 2020) |
| **Erebus / Blue Gem Wind**<br>Offshore wind farm<br>Consented | **No.**<br>This project has been subject to its own HRA which concluded *"This assessment concluded that there would be no AEoSI as a result of the construction, operation and decommissioning of the Project in-combination with the relevant and reasonably foreseeable plans and projects".* (MarineSpace Ltd, 2021) |
| **Valorous / Blue Gem Wind** NRW<br>Offshore wind<br>Planned | **No.**<br>As the proposed Project can draw the conclusion of no AEoSI with mitigation alone, it is for the Valorous / Blue Gem Wind to demonstrate no in-combination effects. |

*Summary*

708. The OnECC is 7.1 km in length and encompasses approximately 49 ha of the Limestone Coast of South West Wales SAC, equating to 3% of the whole SAC (1594.53 ha).

709. Potential impact pathways identified in relation to Annex II terrestrial flora included physical change of habitat, physical disturbance, pollution / contamination and the introduction and spread of INNS.

710. The OnECC is up to 900 m at its widest, where it overlaps with the SAC, which allows for the cable route to be micro-sited in order to avoid direct impacts on the qualifying Annex II species of the SAC.

711. Traffic modelling and air quality assessments undertaken by AECOM (**Chapter 13: Traffic and Transport; Chapter 14: Air Quality**) conclude that the expected traffic volumes would be less than that requiring air quality assessments under IAQM & Environmental Protection UK guidelines and there are no ecological receptors within the buffers specified for dust deposition.

712. In accordance with relevant legislation, appropriate biosecurity measures will be implemented during works carried out during the construction phases of any scheme to prevent the spread of INNS.

713. On this basis, it is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II terrestrial flora features (**Table 8-44**). Therefore, it is concluded that there is **no potential for an AEoSI on Limestone Coast of South West Wales SAC due to the proposed Project** (**Table 8-44**Table 8-42)**, either alone or in-combination.**

*Table 8-44. Summary of AEoSI for designated sites with Annex II terrestrial flora features due to potential impact pathways associated with the OnECC of the proposed Project (✓- potential to hinder conservation objectives; X – no potential to hinder conservation objectives)*

| Designated site | Annex II terrestrial flora features screened into assessment | Potential Impact Pathways | | | | | | AEoSI / Screened into Stage 3 |
|---|---|---|---|---|---|---|---|---|
| | | Construction | | | | Operation and Maintenance | Decommissioning | |
| | | Physical change of habitat | Physical disturbance | Pollution / contamination | Introduction and spread of INNS | Physical disturbance | Decommissioning effects | |
| Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) | Early gentian *Gentianella anglica* (1654) | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II terrestrial flora features. Therefore, there is **no potential for an AEoSI on Limestone Coast of South West Wales SAC either alone or in-combination** |
| | Petalwort *Petalophyllum ralfsii* (1395) | X | X | X | X | X | X | |

### *8.5.7. Annex II Terrestrial Mammals*

714. This section covers the assessment of risk of adverse effects of SACs designated for Annex II terrestrial mammals for the proposed Project and details:

- A summary of the HRA Screening;
- A description of each SAC and its conservation objectives; and
- An assessment for each SAC of risk of AEoSI for the proposed Project alone, an in-combination with other developments.

**Summary of HRA Screening**

715. The proposed Project's HRA Screening Report identified three SAC's with Annex II terrestrial mammal features (see **Appendix 8D: Habitats Regulations Assessment Screening**). These SAC's were identified based on direct overlap between the Onshore Development Area and / or the Onshore Development Area and / or related activities being within the known foraging ranges of the qualifying features.

716. The following potential impact pathways for all stages of the proposed Project (construction, operation and maintenance, and decommissioning) on terrestrial mammals have been screened into the HRA:

- Physical change of habitat;
- Physical disturbance;
- Physical loss of habitat;
- Visual and noise disturbance; and
- Pollution / contamination.

717. Where LSE could not be excluded at the screening stage, sites have been taken forward to determine any AEoSI which will be considered during Stage 2 (AA) (**Table 8-45**; **Figure 8-17**).

*Table 8-45. Summary of the SAC's designated for Annex II terrestrial mammals screened into AA*

| Site name | Annex II Terrestrial Mammals | Distance to Onshore Development Area (km) |
|---|---|---|
| Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) | *Screened in for:*<br>• Greater Horseshoe bat *Rhinolophus ferrumequinum* (1304). | 0.00 |
| Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | *Screened in for:*<br>• Otter *Lutra lutra* (1355). | 0.00 |
| Pembrokeshire Bat Sites and Bosherton Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherton SAC (UK0014793) | *Screened in for:*<br>• Lesser horseshoe bat *Rhinolophus hipposideros* (1303); and<br>• Greater Horseshoe bat *Rhinolophus ferrumequinum* (1304). | 2.80 |

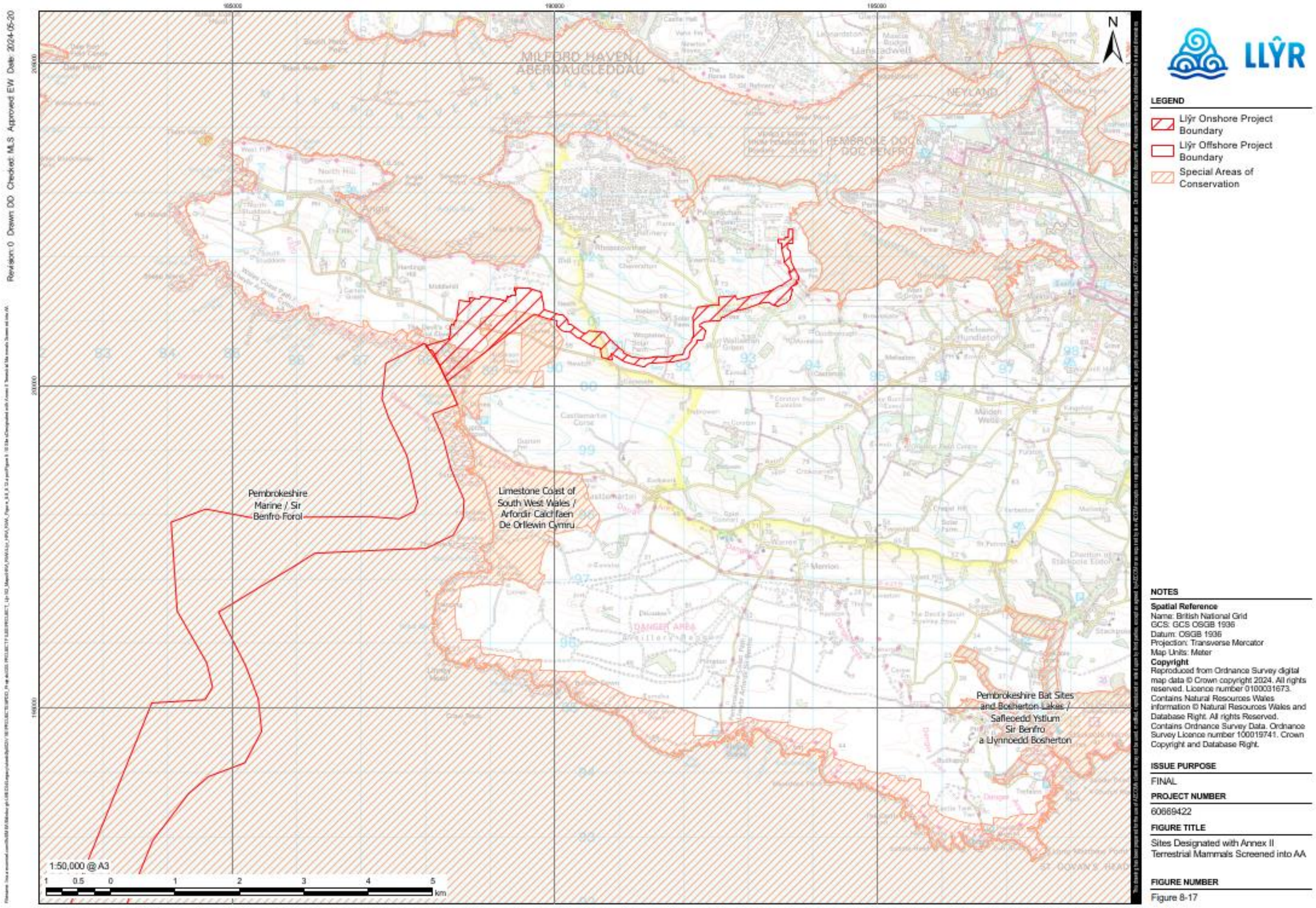


*Figure 8-17. Sites designated for Annex II terrestrial mammals screened into AA*

**Site Descriptions and Conservation Objectives**

*Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116)*

718. The SAC encompasses areas of sea, coast and estuary that support a wide range of different marine habitats and wildlife, some of which are unique in Wales.

719. There is a direct overlap between the OnECC at the Landfall area and the Pembrokeshire Marine SAC, thus the SAC has been screened into the AA for potential LSE on the Annex II Otter. The conservation objectives for the Pembrokeshire Marine SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes (NRW, 2018e). For the qualifying species features, this includes maintaining the populations, range and supporting habitats(NRW, 2008).

*Limestone Coast of South West Wales SAC / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787)*

720. The Limestone Coast of South West Wales SAC comprises a series of SSSI and boasts a great variety of habitats and species in relatively small area. The limestone cliffs support an unusually high number of nationally rare and scarce plants within the maritime, dune and neutral / calcareous grassland, which exists on the cliffs themselves and the hinterland. The conservation objectives for the Limestone Coast of South West Wales SAC are to achieve and maintain favourable conservation status for habitat and species features, subject to natural processes (Countryside Council for Wales, 2008a). For the habitat features, this includes maintaining the range, typical species and structure and function of the qualifying features (NRW, 2008). The OnECC is 7.1 km in length and encompasses approximately 49 ha of the SAC, equating to 3% of the whole SAC (1594.53 ha). Thus, the site has been screened into the AA for potential LSE on the Annex II Greater horseshoe bat feature.

721. There is direct overlap between the OnECC and the SAC. A section of the OnECC, between Broomhill and Neath Farm, runs adjacent to the SAC. The proposed construction, operation and maintenance and decommissioning works may have an adverse effect on the foraging and commuting activities of greater horseshoe bat originating from hibernacula within the SAC.

*Pembrokeshire Bat Site and Bosherton Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherton SAC (UK0014793)*

722. Pembrokeshire Bat Sites and Bosherston Lakes SAC is underpinned by a series of eight SSSIs. The lakes support a strong population of rooted submerged and floating aquatic plants, their distribution largely reflecting the differing degrees of eutrophication within the lake system. Otters are resident within and around the lake margins and have at least one breeding holt. The lake system is a stronghold for this species. Greater and lesser horseshoe bats are among at least ten species of bat utilising the surrounding woodland and swampy lakeside margins as feeding flyways connected to important summer, winter, and intermediate roost sites, which are component SSSI within the overarching SAC.

723. The OnECC lies approximately 2.78 km to the north-west of the Pembrokeshire Bat Sites and Bosherston Lakes SAC, thus the SAC has been screened into the AA for potential LSE on the following Annex II species:

- Greater horseshoe bat *Rhinolophus ferrumequinum*
- Lesser horseshoe bat *Rhinolophus hipposideros*

**Information for Appropriate Assessment**

*Pembrokeshire Marine / Sir Benfro Forol SAC - Assessment of Adverse Effects Alone*

*Construction phase*

***Physical change of habitat***

724. Otters present within the SAC are part of a wider population living around freshwater habitats in Pembrokeshire, which itself is not completely isolated but extends further afield and between which there are movements and exchanges between the SAC otter population and surrounding populations. The proportion of the otter population within the SAC at any time and its distribution is likely to be dynamic and it is not known whether the numbers of animals that use the SAC are a fixed or variable proportion of the wider population, with a preference for using marine habitat. The habitat use of otter is largely limited to river water channels and adjoining banks, where holts and couches represent the most sensitive features. Otters are widespread on, and close to, the coastline throughout the SAC, both on the open coast and within the Milford Haven waterway, particularly within the Daugleddau and Cleddau Rivers, to the north-east of the OnECC. Spraint records and analysis and distribution of suitable feeding locations indicate a wide feeding range. Distribution is mostly associated with foreshore access via small river and stream valleys with sufficient scrub or tree cover, suitable feeding locations (rock-pools, sheltered boulder shores, with freshwater pools / streams for washing off salt) and ease of access to and along the shore. Sightings records suggest that otters use both the sea and foreshore to move between freshwater watercourses (NRW, 2018e). Therefore, any watercourse within the OnECC has the potential to be functionally linked to the Pembrokeshire Marine SAC regarding roaming otter.

**725.** Although the OnEeCC overlaps with the SAC, this is within the intertidal zone. Cable installation at the landfall works within the intertidal area will utilise HDD to traverse the intertidal zone as shown in **Figure 8-18.**

726. There will be no onshore works within the SAC itself, being 383 m to the south-east of the Landfall area at its closest point.

727. Analysis of the NBN Atlas Wales does show records of otter some 500 m to the south of the landfall area and in the vicinity of Brownslade Lake (NBN Atlas Partnership, 2024), however these records are historical, all being over 10 years old. The desk-study carried out by AECOM in 2023 did reveal four recent records of otter within the Study Area (the OnECC plus 2 km buffer), the closest of which is within 0.2 km west of the onshore development area at Freshwater West.

728. Surveys undertaken for the Greenlink project in 2018 identified two potential otter holts and three couches associated with a waterbody and watercourse in the northeast of the onshore development area adjacent to the Pembroke Power Station (Greenlink Interconnector Ltd, 2019a). A further potential holt was identified during the 2018 surveys along a watercourse north of Vine Cottage, near Hoplass and multiple field signs including spraint, footprints, and feeding remains were identified throughout the area.

729. Surveys undertaken in 2021 for the Erebus onshore cable route (Barham, R. & Mason, T., 2021) recorded 21 areas of habitat with high potential for otter holt / resting sites, four spraints, seven slides and one set of feeding remains (ITPEnergised, 2021).

730. Although no evidence of otter was found during the walkover survey carried out by AECOM in 2023, identified habitats suitable for use by otter including standing water, broadleaved woodland, and marsh / marshy grassland (**Appendix 08B: PEA Report**).

731. The open cut trenching proposed to be used for installation of the export cables within the OnECC will result in a temporary physical change in habitats. The onshore cable trenches will be excavated, typically utilising tracked excavators. Three potential watercourses will be crossed

along the OnECC. The most significant watercourse expected to be crossed is northeast of Neath Farm, at Neath Bridge. The other two watercourses are assessed as being minor in nature (**Chapter 04 Description of the Proposed).** Significant obstacles, such as watercourses, may be crossed by way of HDD. Occasional minor watercourse crossings may need to be carried out using dry open cut trench methodology.

732. In all cases, habitats will be reinstated following completion of the construction and therefore any physical change in habitat type will be temporary.

733. On the basis of previous surveys, monitoring data provided in the NRW Evidence Report No. 233 (NRW, 2018d), the known range of the otter population, as discussed in the NRW Regulation 37 report (NRW, 2018e), and the habitats identified as suitable within the OnECC, potential impacts of the proposed Project activities on otter cannot be discounted and mitigation will therefore be required. This mitigation may include, but is not limited to the following:

- Undertake pre-construction otter surveys in order to pin-point areas for targeted mitigation;
- Utilise trench covers and escape routes where necessary to help exclude otter from works areas, while maintaining habitat permeability for roaming otter; and
- Install suitable, otter proof, fencing around HDD launch pits.

734. These mitigation measures will be secured by **Appendix 04A: Outline CEMP**.

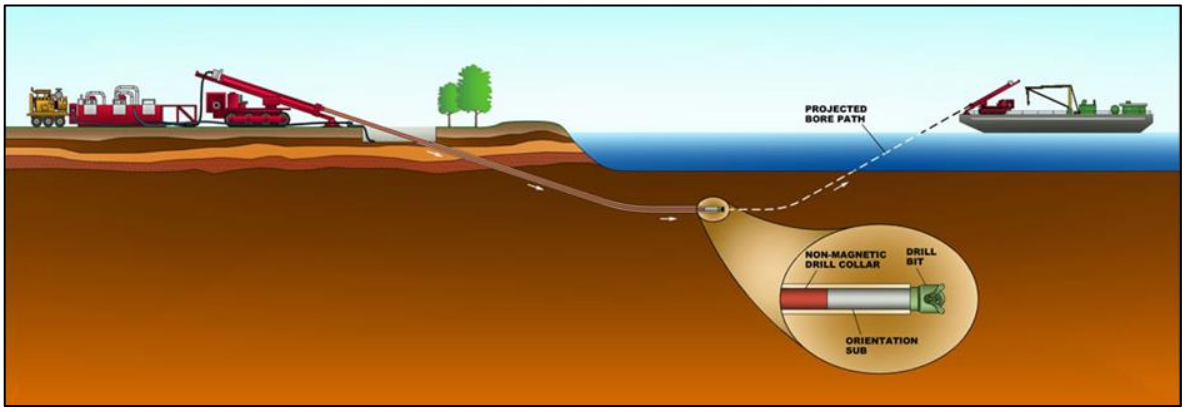


*Figure 8-18. Illustrative visualisation of a landfall HDD Installation (Hadlee & Brunton Ltd, 2019)*

**735.** Therefore, with mitigation measures in place, and habitat reinstatement secured through the LEMP, it is not anticipated that the physical change of habitat will hinder the conservation objectives of the Annex II otter feature of the Pembrokeshire Marine SAC, and it can be concluded that there is **there is no potential for an AEoSI on the Pembrokeshire Marine SAC due to physical change of habitat.**

***Physical disturbance***

736. In this instance, there is a direct overlap between physical disturbance, visual and noise disturbance so these are all considered together under the 'Visual and noise disturbance' heading below (**Paragraph 739**).

***Physical loss of habitat***

737. There is anticipated to be a temporary physical change experienced by the habitats within the Landfall area as a result of the export cables as they makes landfall, approximately 350 m to the north-east of the SAC. However, the habitat within this area comprises improved grassland (**Appendix 08B: Preliminary Ecological Assessment (PEA) Report**), which is not favoured by otter. Any loss of habitat is anticipated to be temporary and short-term, with only a very small spatial

extent (approximately 2.5 ha) given the availability of the wider Pembrokeshire coastline (along the Pembrokeshire Marine SAC boundary) and the low number of qualifying otter present in the area.

**738.** Therefore, it is not anticipated that the physical loss of habitat will hinder the conservation objectives of the Annex II otter feature of the Pembrokeshire Marine SAC, and it can be concluded that there is **there is no potential for an AEoSI on the Pembrokeshire Marine SAC due to physical loss of habitat.**

***Visual and noise disturbance***

739. Activities which are likely to be carried out can result in noise or visual disturbance of qualifying species in European sites, during the construction, operational (including maintenance) and decommissioning phases of the proposed Project. For example, noise and visual disturbance arising from construction or decommissioning may result in temporary behavioural changes in otter, such as disturbance in holts and physical displacement from specific stretches of a watercourse.

740. As already discussed under '*Physical change in habitat'* any watercourse within the OnECC has the potential to be functionally linked to Pembrokeshire Marine SAC as otters use both the sea and foreshore to move between freshwater watercourses and it is feasible for couches and holts to be present where suitable habitat exists therefore pre-construction otter surveys will be carried out. Regarding specific construction activities undertaken for the proposed Project, HDD crossings are likely to be associated with the highest disturbance potential for otter.

741. A metric that is commonly used for the assessment of noise impacts in animals is that of 'decibels above the hearing threshold' (dBht). This is species-specific, requiring knowledge of the hearing threshold of the species in question, and has been most widely investigated for marine fish species, although more data are becoming available on freshwater fish and terrestrial species.

742. There is no available research into the hearing thresholds of the European otter. However, research undertaken into the North American otter enabled a probable hearing threshold for the European otter to be determined by Postlethwaite (2010). Otters have very acute high frequency hearing sensitivity (16 kHz) but much poorer hearing sensitivity than humans at frequencies below 4kHz. This is likely to be the reason why they utilise 'noisy' environments, such as roads, industrial buildings, quarries and other sites impacted by anthropogenic activities (Postlethwaite, 2010). Overall, otters appear to be flexible in their habitat usage and do not avoid areas impacted by human disturbance.

743. Postlethwaite (2010) identified that a sound pressure level below 50 dBht *Lutra lutra* would probably result in a low likelihood of disturbance for otters as it does for humans and many marine species. Furthermore, the report established that most construction activities involving ground penetration or noise would not result in disturbance (i.e., noise levels above 50 dBht impacting on European otter) if undertaken over 30m from a watercourse. However, other types of construction activities (e.g., piling) may disturb up to 80m from source. Therefore, as a precautionary approach, highly disturbing construction noise (e.g., from driven / impact piling) is assumed to impact up to 100m from where it is carried out. It is therefore recommended that the HDD launch and receiving pits crossing watercourses will be a minimum of 30 m from the water course itself.

744. Guidelines for site works in the vicinity of active otter holts stipulate that no works should be undertaken within 150 m of such breeding sites (NRA, 2008). However, works may be undertaken closer to breeding holts provided that active mitigation measures are in place, such as restricted working hours and visual / noise screening. There is no formal guidance on the accepted construction noise levels at otter couches or holts. Otter have a similar hearing capacity to that of

humans, but there are no known noise disturbance thresholds that are proven to lead to adverse ecological impacts on this species. Unpublished observations by Kruuk and colleagues indicate that otters will rest under roads, in industrial buildings, close to quarries, and at other sites close to high levels of human activity. These observations clearly indicate that otters are very flexible in their use of resting sites and do not necessarily avoid 'disturbance' in terms of noise or proximity to human activity (Chanin, 2007).

745. Given that otter are nocturnal animals and only very limited works will be undertaken outside daylight hours (e.g., occasional evening works during winter and for the HDD cable installation activities), visual disturbance is unlikely to be an issue for this species.

746. Construction works could be associated with visual disturbance potential where lighting is used. Generally, the lighting requirements of the proposed Project in areas relevant to the SAC will be minimal as works will be limited to daylight hours. Exceptions to this are the HDD works and early morning / late evening lighting requirements at temporary compounds in winter.

747. Any lighting required in the construction phase of the proposed Project will be directional to minimise the potential for light spillage onto sensitive habitats and associated species (including otter). The measures to be implemented for minimising visual disturbance include the following:

- Minimum brightness / power rating to perform the required function;
- Light fittings that reduce light spillage above the horizontal axis;
- Direction of light to avoid light spillage on nearby watercourses; and
- Passive Infra-Red (PIR) controlled lights (motion sensors) will be deployed except where task-specific lighting is required.

Mitigation measures will be secured in **Appendix 04A: Outline CEMP**.

**748.** Therefore, with mitigation measures in place, and habitat reinstatement, it is not anticipated that visual and noise disturbance or physical disturbance will hinder the conservation objectives of the Annex II otter feature of the Pembrokeshire Marine SAC, and it can be concluded that there is **there is no potential for an AEoSI on the Pembrokeshire Marine SAC due to visual and noise disturbance or physical disturbance.**

***Pollution / contamination***

749. All aquatic ecosystems are sensitive to water pollution from a wide range of substances, including toxic contaminants, non-toxic contaminants (e.g., nutrients) and sediments. Negative changes in water quality have the potential to directly impact on SAC habitats and species. As a qualifying species, otters require adequate water quality for retaining favourable conservation status. Poor water quality can have a range of environmental impacts:

- At high levels, toxic chemicals and metals can result in immediate death of aquatic life, and can have detrimental effects even at lower levels, including increased vulnerability to disease and changes in wildlife behaviour.
- Construction activities that involve ground excavations and the stripping of topsoil are associated with a high risk of sediment release in surface runoff. Excessive sedimentation can smother aquatic habitats and plants, increase turbidity, and accelerate eutrophication. This can lead to cascading effects on invertebrate / fish communities i.e., otter food resources.
- Eutrophication, the enrichment of water with nutrients, increases plant growth and consequently results in oxygen depletion. Algal blooms, which commonly result from eutrophication, increase turbidity, and decrease light penetration. The decomposition of organic wastes that often accompanies eutrophication deoxygenates water further,

augmenting the oxygen depleting effects of eutrophication. In freshwater ecosystems, plant growth is primarily determined by phosphorus (P) concentrations, which are determined by a wide range of sources, including treated sewage effluent from Wastewater Treatment Works and urban surfaces such as roads.

- Some pesticides, industrial chemicals, and components of sewage effluent are suspected to interfere with the functioning of the endocrine system, possibly having negative effects on the reproduction and development of aquatic life.

750. Under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (HM Government, 2017), it is legally required to maintain and / or improve the ecological and chemical status of the water environment, which includes rivers, lakes, wetlands, groundwater, estuaries and coastal waters. There should be no deterioration or prevention of future improvement in the status of waterbodies. Water Framework Directive (WFD) assessments are directly linked to HRA in that consideration must also be given when undertaking a WFD assessment to the Conservation Objectives of designated sites, including SACs, SPAs and Ramsar sites.

751. The magnitude of water quality impacts primarily depends on the appropriate treatment of process water and / or surface runoff. Furthermore, the severity of potential construction and operational water quality impacts is partially determined by the distance between development sites and ecological receptor sites.

752. **Chapter 04: Description of the Proposed Project** provides an overview of the proposed Project, the infrastructure that will be installed and indicative construction, operation and maintenance, and decommissioning phase activities. As a broad overview, the main construction stages encompass site preparation, cable installation and substation construction. A wide range of construction activities will be undertaken as part of each of these construction stages, with varying potential for water quality impacts. Generally, it is considered that the majority of water quality risks are likely to arise from activities that involve the excavation of topsoil, use of heavy plant and machinery or implementation of specialised crossing methodologies, such as:

- Importing of construction materials / plant / equipment;
- Establishing construction compounds;
- Upgrading existing or constructing new site tracks / access roads;
- Upgrading or constructing crossing points over drainage ditches;
- Stripping of topsoil and trenching in sections for cable installation;
- Implementing HDD crossing methodologies; and
- Reinstating the Site (including topsoil reinstatement).

753. Noting that negative water quality impacts could arise from any of the above construction activities, it is considered essential that the proposed Project adopts measures to minimise the risk to the qualifying features of the Pembrokeshire Marine SAC.

754. **Appendix 04A: Outline CEMP** encompasses a wide range of best practice methods that are established and proven measures to protect environmental water quality. Importantly, the CEMP, once agreed post-consent, will be a fluid document that is continually reviewed, revised and updated as the proposed Project progresses towards construction, meaning that water quality mitigation responds to changes in the adopted construction methodology and other emerging evidence.

755. Mitigation secured through the CEMP is built on a range of guidance, including Good Practice Guidance (GPP) published on the NetRegs website (NetRegs, 2024), key Construction Industry

Research and Information Association (CIRIA) documents and guidance from the British Standards Institute. It is considered that the most important interventions to protect the qualifying features of the Pembrokeshire Marine SAC relate to the reduction of site runoff (particularly the mobilisation of fine sediment), spillage risk and water pollution risk from trenchless crossings. The most important measures to address each of these risk items are discussed in the following paragraphs and will be implemented where relevant to the proposed Project.

756. To protect watercourses within the onshore development area from fine sediment runoff, earthworks will be undertaken during the drier months where practical. However, since some work in wet weather will be unavoidable, a suite of further measures is required to reduce sediment runoff. A temporary drainage system will be installed to prevent the entry of particulates into surface water drains. All land drains and water features will be adequately protected using drain covers, sandbags, earth bunds and geotextile silt fences. Furthermore, any excavated topsoil will be stored a minimum of 20m from water features and for no more than two weeks. Wash-down areas for equipment and plant will be designated to allow for the retention and adequate disposal of sediment-enriched water. The Water Management Plan, which will be produced post-consent, will provide for water quality monitoring pre-, during and post-construction.

757. The CEMP (**Appendix 04A: Outline CEMP**) will secure a suite of measures to minimise the risk of accidental spillages and leakages of toxic contaminants, including fuels, oils, solvents, paints and other substances. These encompass, but are not limited to, the following:

- All toxic chemicals will be stored in self-bunded leak-proof containers or in impermeable bunded areas (with an additional 10% capacity);
- Any construction plant, machinery and vehicles will undergo daily inspections to ensure they are in good working order and without oil / fuel leaks;
- Refuelling, oiling and greasing of plant will take place above drip trays or impermeable surfaces to prevent untreated runoff to surface watercourses;
- All mobile plant to be used will be kept clean, in good working order, fitted with plant ‘nappies’ and carry spill kits;
- Spill kits and oil-absorbent material will be available in all mobile plant at sensitive locations across the Site, with all construction workers receiving spill response training;
- Facilities for concrete wash water will be adequately contained and contents prevented from entering any drains; and
- Water quality data will be collected at potentially impacted watercourses and compared to baseline conditions.

758. At the trenchless HDD crossing points there is a potential risk for direct water quality contamination through the ‘frac-out’ of drilling muds containing bentonite. Although pollution incidents associated with HDD are rare, the risk of frac-out of drilling fluid is higher where HDD crossings are poorly planned and geological strata are unconsolidated.

759. However, the proposed Project will employ measures to minimise environmental risks associated with trenchless technologies. HDD, or other trenchless techniques, will be undertaken by a specialist contractor and the water column above the drill path will be continuously monitored during drilling. Where any leakage of bentonite water is observed in the watercourse or there is an increased perceived risk (e.g., lower than expected drilling mud returns), the HDD operations will be suspended, remedial action implemented and crossing methodology re-evaluated.

760. Further potential water quality impacts are associated with the ancillary infrastructure required for the HDD, such as installation and maintenance of launch and reception pits. These pits are also a potential source of contaminants, including any returned drilling fluid, sediments and leakages / spillages. The HDD compound areas will be located as far from flood risk areas as reasonably possible within the requirements of the HDD method to reduce the potential for impacts if flooding occurs. As there is a low presence of fluvial flood risk across the onshore construction site, it is unlikely that any HDD compounds will be located within any fluvial floodplain areas.

**761.** Therefore, given the wide range of mitigation measures that will be deployed to address the risk of water quality impacts, it is not anticipated that potential pollution / contamination will hinder the conservation objectives of the Annex II otter feature of the Pembrokeshire Marine SAC, and it can be concluded that there is **there is no potential for an AEoSI on the Pembrokeshire Marine SAC due to pollution / contamination.**

*Operation and Maintenance phase*

***Visual noise and disturbance***

762. Cable systems are highly reliable and typically do not require intrusive maintenance. Maintenance of onshore export cables primarily involves annual visual inspections along the cable route to check for any potential impact from external factors such as heavy loads. It is anticipated that the annual visual inspections will occur during daytime hours and given that otter are nocturnal animals visual disturbance is unlikely to be an issue for this species.

763. Any lighting required in the operation and maintenance phase of the proposed Project will be directional to minimise the potential for light spillage onto sensitive habitats and associated species (including otter). The measures to be implemented for minimising visual disturbance include the following:

- Minimum brightness / power rating to perform the required function;
- Light fittings that reduce light spillage above the horizontal axis;
- Direction of light to avoid light spillage on nearby watercourses; and
- PIR controlled lights (motion sensors) will be deployed except where task-specific lighting is required.

764. Otter are known to have extensive home ranges having been recorded between 12 and 80 km for males (Chanin, 2007). The Substation lies approximately 1.4 km to the south-west of the Pembrokeshire Marine SAC at its closest point, well within this range. However, the Substation is inland and as discussed in **Paragraphs 724 to 735**, the habitat use of otter is largely limited to river water channels and adjoining banks with otters being widespread on, and close to, the coastline throughout the SAC.

**765.** Therefore, it is not anticipated that potential visual and noise disturbance will hinder the conservation objectives of the Annex II otter feature of the Pembrokeshire Marine SAC, and it can be concluded that there is **there is no potential for an AEoSI on the Pembrokeshire Marine SAC due to visual and noise disturbance.**

*Decommissioning phase*

766. At the end of the operational life of the proposed Project, there will be a DEMP in place. Other proposed Project constraints will also be taken into consideration (e.g. safety and liability), with the least environmentally damaging option chosen if possible.

767. The full details of the proposed decommissioning will not be agreed until towards the end of the 30-year operational lifetime of the proposed Project. However, the decommissioning phase is expected to largely mirror the construction process over a period of 12 months (see **Chapter 04: Description of the Proposed Project**). However, it is anticipated that upon decommissioning the onshore cable would be left in-situ and, as such, there would not be any impact resulting from excavations, which is where most effects associated with the onshore cable originate from.

768. Any impacts would likely be as a result of the demolition of the substation and TJB, both of which are located in what are considered to be low value habitats. As protected species may have established within the enhanced habitats surrounding the substation, prior to any demolition taking place, all mitigation proposed for the construction phase would be adhered to. This would include pre-demolition surveys for otter as well as the good practice works measures. Licencing requirements would need to be informed by the pre-demolition surveys in advance of any works commencing.

769. For works in proximity to the SACs, statutory consultation would be required and an update to the HRA undertaken.

770. Therefore, the impacts of the decommissioning phase are not expected to exceed impacts of the construction phase (**Paragraphs 724** to **761**), and it is not considered that there will be an impact to the conservation objectives of the Annex II otter feature of the Pembrokeshire Marine SAC, and thus there is **no potential for an AEoSI on the Pembrokeshire Marine SAC due to the effects of decommissioning**.

*All Other SACs with Annex II Terrestrial Mammal Features - Assessment of Adverse Effects Alone*

771. As the Greater horsehoe bats of the Limestone Coast of South West Wales SAC are linked with those of the Pembrokeshire Bat Site and Bosherton Lakes SAC and vice versa in that there is movement / interchange between the two sites (i.e., effectively the same population), it is reasonable to consider both sites simultaneously.

772. Pollution / contamination has not been assessed for these sites as the qualifying features are not as dependent on aquatic ecosystems as, for example, otters, fish, and some bird species.

*Construction phase*

***Physical change of habitat***

773. While most European sites have been geographically defined in order to encompass the key features that are necessary for coherence of their structure and function, this is not the case for all such sites. Due to the highly mobile nature of waterfowl and bats, it is inevitable that areas of habitat of crucial importance to the maintenance of their populations are outside the physical limits of the European site for which they are an interest feature. However, the SACs will still be essential for maintenance of the structure and function of the interest feature for which the site was designated and land use plans that may affect this land should still therefore be subject to further assessment. This has been underlined by a recent European Court of Justice ruling (C-461 / 17, known as the Holohan ruling[6]) which in paragraphs 37 to 40 confirms the need for an appropriate assessment to consider the implications of a plan or project on habitats and species outside the European site boundary provided that those implications are liable to affect the conservation objectives of the site.

[6] The Holohan ruling also requires all the interest features of the European sites discussed to be catalogued (i.e., listed) in the HRA.

774. The importance of non-designated land parcels may not be apparent and thus might require the analysis of existing data sources (e.g., data from records centres) to be firmly established. In many instances data may not be available at all, requiring further survey work.

775. Surveys carried out in 2018 identified the presence of at least ten bat species within the onshore development area, including as the greater and lesser horseshoe bat[7] (*Rhinolophus hipposideros*) (Greenlink, 2019b).

776. Surveys undertaken by AECOM in June, July, August and October 2023 detected at least 8 species of bat. Greater and lesser horseshoe bats were both recorded within transects surveyed in July and August 2023. Lesser and greater horseshoe bats accounted for 12.6% and 4.6% of all calls recorded by static bat detectors, respectively (**Appendix 8C: Bat Survey Report**).

777. Both greater and lesser horseshoe bats forage in landscapes containing a patchwork of fields bounded by mature hedgerows and interspersed with woodland patches. The species has a strong association with grazed pasture (Back From The Brink, 2019; Bat Conservation Trust, 2024). The Phase 1 habitat survey conducted by AECOM between 3rd August 2023 and 13th October 2023 found the habitats present within the onshore development area to be dominated by large, open agricultural fields, lined by hedgerows with pockets of woodland and scrub present throughout. Improved grassland is the most common habitat type present, the majority of this land being cut or grazed by livestock (**Appendix 08B: PEA Report**). The onshore development area therefore offers commuting and foraging opportunities for greater and lesser horseshoe bats, therefore any physical change of habitat could reduce these opportunities.

778. The greater and lesser horseshoe bats are not only dependent on their roosts and foraging habitat in the SAC's, but potentially also on habitat that lies outside the designated site boundary. Feeding areas and commuting routes (flightlines) outside the designation may therefore be integral to sustaining the bat populations. The Bat Conservation Trust (BCT) have defined 'Core Sustenance Zones' (CSZs) for different bat species (Bat Conservation Trust, 2016). A CSZ, as applied to bats, refers to the area surrounding a communal bat roost within which habitat availability and quality will have a significant influence on the resilience and conservation status of the colony using the roost. With reference to planning and development the core sustenance zone could be used to indicate:

- The area surrounding the roost within which development work can be assumed to impact the commuting and foraging habitat of bats using the roost, in the absence of information on local foraging behaviour. This will highlight the need for species-specific survey techniques where necessary.
- The area within which mitigation measures should ensure no net reduction in the quality and availability of foraging habitat for the colony, in addition to mitigation measures shown to be necessary following ecological survey work.

779. Generally, greater horseshoe bats forage within 3 km from their roost (Bat Conservation Trust, 2016). The Bat Conservation Trust identifies a weighted average CSZ of 3.34 km for greater horseshoe bats, however the CSZ figure of 3 km is rounded down from this weighted average.

[7] It is noted that some genetic interchange between the SAC populations and roosts located far beyond the CSZs is likely to occur. Although some degree of linkage is likely to exist with populations across Wales, the HRA process is concerned with identifying the core zone around bat SACs that is integral for sustaining the SAC colonies and thus for the sites to achieve their Conservation Objectives. The importance of functionally linked roosts is likely to reduce with distance because fewer bats would be expected to cover such large distances.

780. Lesser horseshoe bats forage between 2 and 3 km from their roost but they have been observed to range up to 4 km in their nightly foraging trips (Schofield, 2008). The Bat Conservation Trust identifies a weighted average CSZ of 2 km for lesser horseshoe bats.

781. It is therefore recognised that linear features (required to navigate) and permanent pasture / unimproved grassland (favoured feeding areas) and woodlands within these distances outside the SAC boundary need to be maintained.

782. The onshore cables will be installed using open cut trenching, resulting in a physical change in habitats. The onshore cable trenches will be excavated, typically utilising tracked excavators. The excavated subsoil will be stored separately from the topsoil, with the profile of the soil maintained during the storage process. Soil may be stored immediately adjacent to the trench or stored elsewhere within the development boundary at temporary construction and laydown areas.

783. Following installation, the trench is backfilled with sand and / or stabilised material to approximately 75 mm above the top of the power cable ducts. The native material, providing it is thermally suitable, that was removed during construction is replaced on top of the protective cover tiles. Finally, the trench is topped up with a minimum of 300 mm topsoil, using the native topsoil, up to the surface level, and the temporary access land is to be restored as close as possible to its original conditions (**Chapter 04: Description of the Proposed Project**). This will be secured via the CEMP.

784. A BMP will be produced, secured by the CEMP, which will include a protocol for the restoration of land which will be temporarily used for construction.

***Conclusion***

**785.** On the basis that the habitats will be reinstated upon completion of works, it is not anticipated that the physical change of habitat will hinder the conservation objectives of the Annex II terrestrial mammal features of the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC, and it can be concluded that there is **there is no potential for an AEoSI on the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC due to physical change of habitat.**

***Physical disturbance***

786. The greater horseshoe bats of the Limestone Coast of South West Wales SAC have hibernation roosts within a number of caves along the limestone within Pembrokeshire and on Gower.

787. According to the CMP**,** there is evidence of greater horseshoe bats in sea caves at Castlemartin / Stackpole (SSSI management units 2c to 2g and 3a and 3c); Lydstep to Penally (SSSI management units 5a to 5e); and Gower (SSSI management units 9) (Countryside Council for Wales, 2008a).

788. The main, and closest, greater horseshoe bat cave (Castlemartin Cave) lies some 3.78 km (at its closest point) to the south of the Landfall site. It is thought that bats using Castlemartin Cave are most likely to be linked to the Stackpole Courtyard Flats maternity roost, which is connected to the Pembrokeshire Bat Site and Bosherton SAC.

789. Onshore works are scheduled to start in January 2027, while the bats are in hibernation. Of greatest significance is the HDD work, which is scheduled to last for 24 - 64 weeks. This timeframe encompasses the hibernation period, which typically runs from November until mid-May. There is the potential to cause physical disturbance to the hibernating bats through vibration generated from the HDD works.

790. AECOM have conducted a noise and vibration assessment (**Chapter 15: Noise and Vibration**). Measured piling data in BS 5228-2 indicates that piling activities generally only generate vibration impacts when they are located less than 20 m from sensitive locations. The impact depends on the type of piling, ground conditions, and receptor distance. Vibration from auger piling

techniques, which is a typically applied piling method, are generally limited to 1 mm / s, which is considered 'tolerable', for distances up to 10 m. This level of vibration is considered representative of HDD activities and vibratory rollers used for reinstatement after cable trenching works. The known hibernation cave is over 3 km away from the Landfall area, well beyond 10 m. At this distance there will be no perceptible vibration effects. Given that there will be no works either within or adjacent to the hibernation roosts there is no potential for an AEoSI on the Limestone Coast of South West Wales SAC due to physical disturbance.

791. The greater and lesser horseshoe bats of the Pembrokeshire Bat Sites and Bosherston Lakes SAC are roosting in buildings, most notably Stackpole Courtyard Flats and Walled Garden (SSSI management units 2a and 2b); Slebech Stable Yard Loft, Cellars and Tunnels (SSSI management units 3a and 3b); Carew Castle (SSSI management unit 5); Beech Cottage Waterwynch (SSSI management unit 6); Orielton Stable Block and Cellars (SSSI management unit 7) and Park House Outbuildings (SSSI management unit 8) (Countryside Council for Wales, 2008b).

***Conclusion***

**792.** Given that there will be no works either within or adjacent to these roosts as they are beyond the OnECC boundary, it is not anticipated that physical disturbance will hinder the conservation objectives of the Annex II terrestrial mammal features of the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC, and it can be concluded that there is **there is no potential for an AEoSI on the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC due to physical disturbance.**

***Physical loss of habitat***

793. As discussed above, the greater horseshoe bats in the Limestone Coast of South West Wales SAC and the greater and lesser horseshoe bats of the Pembrokeshire Bat Sites and Bosherston Lakes SAC are not only dependent on their roosts and foraging habitat within the SAC's, but potentially also on habitat that lies outside the designated site boundary. There is the potential for loss of habitat via vegetation clearance i.e., clearance of typically hedgerows and other vegetation that prevent the construction of the substation, associated access roads and, in worst case scenarios along the onshore cable route.

794. The OnECC is wide enough to allow for micro-siting of the cable route in order to avoid obstacles such as trees and hedgerows. Where this is not feasible, habitats will be reinstated upon completion of the works e.g., hedgerows will be replaced and / or enhanced. Therefore, any loss will be temporary.

795. Construction of the transition joint bay and onshore substation / control building will result in the physical loss of habitat. Post consent, a BMP, LEMP and Green Infrastructure Statement will be produced (**Appendix 4A: Outline Construction Environmental Management Plan**). These plans will be approved by the appropriate regulatory body and will include measures to reinstate and enhance the habitats within the OnECC. As such, despite the initial loss of habitat as a result of construction and operation it is anticipated that it will be temporary and will ultimately be improved, thereby benefitting commuting and foraging bats in the long-term.

796. As discussed above, the SSSI management units supporting greater horseshoe bats are located at the upper range of CSZ for this species and the overall condition of the habitats along the OnECC are expected to improve in the long-term. However, it is acknowledged that there may be some severance of hedgerows during construction. Ransome (1996) determined that greater horseshoe bat are vulnerable to the severance of linear features when light levels are lighter (i.e. earlier and later stages of the night), with gaps of approximately 10 m wide affecting their movements under such conditions. As such, mitigation measures are presented in order to maintain linear commuting features used by bats:

- If construction works result in the removal of hedgerows within the active bat season (typically April-October, inclusive), linear connections throughout the night-time will be provided to maintain the connectivity of hedgerows for commuting bats. Installations will be at the height of the hedgerow that has been removed to maintain continuity of the linear feature.
- Sections of removed hedgerow, as well as existing gaps, will be reinstated as soon as possible. Semi-mature planting will also be installed to complement the existing species mix and additional native species of local or regional provenance, if available;
- The boundary of the proposed substation will be planted with a combination of native trees, hedgerows and meadow grass mix consisting of species typical of this part of Wales. Where possible, seeds or staves of local or regional provenance will be used in order to maintain genetic consistency. Please refer to **Chapter 21: Landscape and Visual Impact** for details on the LEMP;

***Conclusion***

797. On that basis of mitigation being secured via the CEMP, BMP and LEMP, it is not anticipated that physical loss of habitat will hinder the conservation objectives of the Annex II terrestrial mammal features of the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC, and it can be concluded that there is **there is no potential for an AEoSI on the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC due to physical loss of habitat.**

***Visual and noise disturbance***

798. Given the location of the proposed Project relative to the closest, and largest, SAC hibernation cave there will be no visual and / or noise disturbance to the hibernation roost itself. Visual and / or noise disturbance may, however, occur when the bats start to leave the hibernation roost.

799. As the closest hibernation roost is over 3 km away, the landfall area is beyond the CSZ for emerging greater horseshoe bats. Also, as the roost is associated with the maternity roosts of the Pembrokeshire Bat Site and Bosherton Lakes SAC, emerging bats are more likely to be heading east towards the maternity roosts as opposed to west, which is away from them. As such, noise and lighting from the HDD operations are not considered likely to cause an adverse effect.

800. Both lesser and greater horseshoe bats have been recorded foraging within suitable habitats in the OnECC (**Appendix 8C: Bat Survey Report**) therefore artificial lighting from construction works and operational use of the Substation has the potential to disturb foraging and commuting bats.

801. Artificial lighting can affect the feeding behaviour of bats. Many night-flying species of insect that bats hunt are attracted to light which can attract the faster-flying bat species, however, the slower-flying, broad winged species such as long-eared have been shown to avoid illuminated commuting and foraging routes (Stone, et al., 2009; Stone, et al., 2012; Stone, et al., 2015). Lesser horseshoe bats have been shown to move their flight paths which link their roosts and foraging grounds to avoid artificial light installed on their usual commuting routes. Significant effects have been recorded from as low as 3.6 lux (van Langevelde, et al., 2011). Furthermore, the average light level on hedgerows most regularly used by this species has been recorded at 0.45 lux.

802. As far as reasonably practicable, construction works will be limited to daylight hours only, with focused task specific lighting provided where this is not possible.

803. Temporary construction lighting, for example in the form of mobile lighting towers, will be required during core working hours within winter months. Artificial lighting would be provided to maintain sufficient security and health and safety for the proposed Project, whilst adopting

mitigation principles to avoid excessive glare and minimise spill of light to nearby receptors as far as reasonably practicable.

804. It is anticipated that permanent construction lighting will be required within the compounds. Where possible this lighting will be timed to be used only when required (except for instances of safety and security).

- Wherever feasible, construction works will not be undertaken after dusk. When this cannot be avoided, works will be overseen by the appointed ECoW and ensuring sensitive lighting (as per BCT and Institution of Lighting Professionals (ILP) guidance, (BCT; ILP, 2023)) will be used and the extent of the lit area will be restricted to works areas, as far as possible, to avoid light-spill on to any nearby features attractive to bats;
- The potential pressures of lighting on bats using habitats in the vicinity of the substation is to be reduced by adopting the following principles within security lighting (as per BCT and ILP, (BCT; ILP, 2023)):
  - Where and if possible, infra-red lighting will be used;
  - Low-level at the minimum intensity possible, and using diffusers and/or screening, as necessary to limit light-spill across the wider area;
  - Lighting across the planted areas of trees, hedgerow and grassland (i.e. the landscape planting at the substation) will be avoided, if possible, or maintained at a minimum.

***Conclusion***

805. On that basis of mitigation being secured via the CEMP, it is not anticipated that visual and noise disturbance will hinder the conservation objectives of the Annex II terrestrial mammal features of the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC, and it can be concluded that there is **there is no potential for an AEoSI on the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC due to visual and noise disturbance.**

*Operation and Maintenance phase*

***Visual and noise disturbance***

806. The assessment of AEoSI has focussed on construction of the landfall and underground cable route as once operational these areas will be reinstated and no AEoSI as a result of visual and noise disturbance during the operational and maintenance phase is anticipated.

***Conclusion***

807. Therefore, it is not anticipated that visual and noise disturbance will hinder the conservation objectives of the Annex II terrestrial mammal features of the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC, and it can be concluded that there is there is **no potential for an AEoSI on the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC due to visual and noise disturbance**.

*Decommissioning phase*

808. At the end of the operational life of the proposed Project, there will be a DEMP in place. Other proposed Project constraints will also be taken into consideration (e.g. safety and liability), with the least environmentally damaging option chosen if possible.

809. The full details of the proposed decommissioning will not be agreed until towards the end of the 30-year operational lifetime of the proposed Project. However, the decommissioning phase is expected to largely mirror the construction process over a period of 12 months (see **Chapter 04:**

**Description of the Proposed Project**). However, it is anticipated that upon decommissioning the onshore cable would be left in-situ and, as such, there would not be any impact resulting from excavations, which is where most effects associated with the onshore cable originate from.

810. Any impacts would likely be as a result of the demolition of the substation and TJB, both of which are located in what are considered to be low value habitats. As protected species may have established within the enhanced habitats surrounding the substation, prior to any demolition taking place, all mitigation proposed for the construction phase would be adhered to. This would include pre-demolition surveys for bats as well as the good practice works measures. Licencing requirements would need to be informed by the pre-demolition surveys in advance of any works commencing.

811. For works in proximity to the SACs, statutory consultation would be required and an update to the HRA undertaken.

***Conclusion***

812. Therefore, the impacts of the decommissioning phase are not expected to exceed impacts of the construction phase (**Paragraphs 773** to 805), and it is not considered that there will be an impact to the conservation objectives of the Annex II terrestrial mammal features of the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC, and thus there is no **potential for an AEoSI on the Limestone Coast of South West Wales SAC or Pembrokeshire Bat Sites and Bosherston Lakes SAC due to the effects of decommissioning**.

**Information for Assessment of Adverse Effects In-Combination**

813. The following projects have been considered in order to identify whether they have the potential for in-combination effects on the Annex II terrestrial mammals based on their potential impact pathways to the same European sites as the Project:

- Greenlink Interconnector;
- Erebus; and
- Valorous.

814. The potential for in-combination effects are summarised in Table 8-46, concluding that there is **no potential for in-combination effects on the Annex II terrestrial mammal features of the Pembrokeshire Marine SAC, Limestone Coast of South West Wales SAC and Pembrokeshire Bat Site and Bosherton Lakes SAC**.

*Table 8-46. Summary of in-combination effects Annex II terrestrial mammals*

| Project name | Potential for in-combination effects | | |
|---|---|---|---|
| | **Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116)** | **Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787)** | **Pembrokeshire Bat Sites and Bosherton Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherton SAC (UK0014793)** |
| **Greenlink Interconnector / Greenlink Interconnector Limited**<br>Interconnector<br>Under Construction | **No.**<br>This project has been subject to its own HRA which concluded *"Although the potential for adverse effects to occur was identified through the Stage 1: Screening assessment, a range of mitigation measures have been proposed to avoid the effects of pollution and sediment run-off, and the effects of habitat severance on bat species during construction and operation. Since no effect is predicted, it is not possible to incur in-combination effects with other plans and projects. As such, there is no need to undertake an in-combination assessment for those features."* | | |
| **Erebus / Blue Gem Wind**<br>Offshore wind farm<br>Consented | **No.**<br>This project has been subject to its own HRA which concluded *"This assessment concluded that there would be no AEoSI as a result of the construction, operation and decommissioning of the Project in-combination with the relevant and reasonably foreseeable plans and projects".* | | |
| **Valorous / Blue Gem Wind** NRW<br>Offshore wind<br>Planned | **No.**<br>As the proposed Project can draw the conclusion of no AEoSI with mitigation alone, it is for the Valorous / Blue Gem Wind to demonstrate no in-combination effects. | | |

*Summary*

815. The OnECC is 7.1 km in length and encompasses approximately 49 ha of the Limestone Coast of South West Wales SAC, equating to 3% of the whole SAC (1594.53ha). The OnECC also lies within 3 km of the Pembrokeshire Bat Sites and Bosherston Lakes SAC. The proposed Project is therefore within the uppermost CFZ for greater and lesser horseshoe bats.

816. Potential impact pathways identified in relation to Annex II terrestrial mammals included physical change of habitat, physical disturbance, physical loss of habitat, visual and noise disturbance and pollution / contamination.

817. It was concluded that any physical changes or loss to supporting habitats would be temporary and short-term as habitats would be reinstation upon the completion of works and enhanced in the long-term through improving, for example, hedgerows. This will be secured by the implementation of a LEMP, post consent.

818. The main, and closest, greater horseshoe bat cave (Castlemartin Cave) lies some 3.78 km (at its closest point) to the south of the Landfall site. It is thought that bats using Castlemartin Cave are most likely to be linked to the Stackpole Courtyard Flats maternity roost, which is connected to the Pembrokeshire Bat Site and Bosherton Lakes SAC. As there will be no works either within or adjacent to the hibernation roosts there is no potential for an AEoSI on either SAC due to physical disturbance.

819. Mitigation measures will be implemented to minimising visual disturbance that may result from lighting. These measures will be secured via the CEMP.

820. Pembrokeshire Marine SAC lies within 400 m of the Landfall area, within the foraging range of otter. As above, habitat change and loss would be temporary and short-term and mitigation measures will be in place with regard to lighting. Pre-construction checks will identify potential holts and allow for appropriate buffers to be put in place under the supervision of the ECoW. This will be secured via the CEMP.

821. In terms of pollution / contamination, a wide range of mitigation measures that will be deployed to address the risk of water quality impacts from construction and decommissioning activities. These will be secured via the CEMP.

822. On this basis of appropriate mitigation measures being in place, it is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II marine mammal features (**Table 8-47**). Therefore, it is concluded that there is **no potential for an AEoSI on Pembrokeshire Marine, Limestone Coast of South West Wales SAC, or Pembrokeshire Bat Sites and Bosherston Lakes SAC due to the proposed Project** (**Table 8-47**Table 8-42)**, either alone or in-combination.**

*Table 8-47. Summary of AEoSI for designated sites with Annex II terrestrial mammals features due to potential impact pathways associated with the OnECC of the proposed Project (✓- potential to hinder conservation objectives; X – no potential to hinder conservation objectives)*

| Designated site | Annex II terrestrial mammals features screened into assessment | Potential Impact Pathways | | | | | | | AEoSI / Screened into Stage 3 |
|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | | | Operation and Maintenance | Decommissioning | |
| | | Physical change of habitat | Physical disturbance | Physical loss of habitat | Visual and noise disturbance | Pollution / contamination | Visual and noise disturbance | Potential effects the same as construction phase | |
| Limestone Coast of South West Wales / Arfordir Calchfaende Orllewin Cymru SAC (UK0014787) | Greater Horseshoe bat *Rhinolophus ferrumequinum* (1304) | X | X | X | X | N/A | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II terrestrial mammal features. Therefore, there is **no potential for an AEoSI on Limestone Coast of South West Wales SAC either alone or in-combination** |
| Pembrokeshire Bat Sites and Bosherton Lakes SAC / | Greater horseshoe bat *Rhinolophus ferrumequinum* (1304) | X | X | X | X | N/A | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II terrestrial mammal features. Therefore, there is **no potential for an AEoSI on Pembrokeshire** |
| | Lesser horseshoe bat *Rhinolophus* | X | X | X | X | N/A | X | X | |

| Designated site | Annex II terrestrial mammals features screened into assessment | Potential Impact Pathways: Construction: Physical change of habitat | Physical disturbance | Physical loss of habitat | Visual and noise disturbance | Pollution / contamination | Operation and Maintenance: Visual and noise disturbance | Decommissioning: Potential effects the same as construction phase | AEoSI / Screened into Stage 3 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **Bat Sites and Bosherton Lakes SAC either alone or in-combination** |
| Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | Otter *Lutra lutra* (1355) | X | X | X | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II terrestrial mammal features. Therefore, there is **no potential for an AEoSI on Pembrokeshire Marine SAC either alone or in-combination** |

### *8.5.8. Annex I Terrestrial Ornithology*

823. This section covers the assessment of risk of adverse effects of SACs designated for Annex II terrestrial ornithology for the proposed Project and details:

- A summary of the HRA Screening;
- A description of each SAC and its conservation objectives; and
- An assessment for each SAC of risk of AEoSI for the proposed Project alone, an in-combination with other developments.

**Summary of HRA Screening**

824. The proposed Project's HRA Screening Report identified one SAC with Annex II terrestrial ornithological features (see **Appendix 8D: Habitats Regulations Assessment Screening**). This SAC was identified based on direct overlap between the Onshore Development Area and known foraging ranges.

825. The following potential impact pathways for all stages of the proposed Project (construction, operation and maintenance, and decommissioning) on terrestrial ornithological features have been screened into the HRA:

- Disturbance / displacement; and
- Habitat loss / loss of functionally linked land

**826.** Where LSE could not be excluded at the screening stage, sites have been taken forward to determine any AEoSI which will be considered during Stage 2 (AA) (**Table 8-48**; **Figure 8-19**).

*Table 8-48. Summary of the SACs designated for Annex I terrestrial ornithology screened into AA*

| Site name | Annex I terrestrial ornithology | Distance to Onshore Development Area (km) |
|---|---|---|
| Castlemartin Coast SPA (UK9014061) | *Screened in for:*<br>• Chough *Pyrrhocorax pyrrhocorax* (A346). | 0.00 |

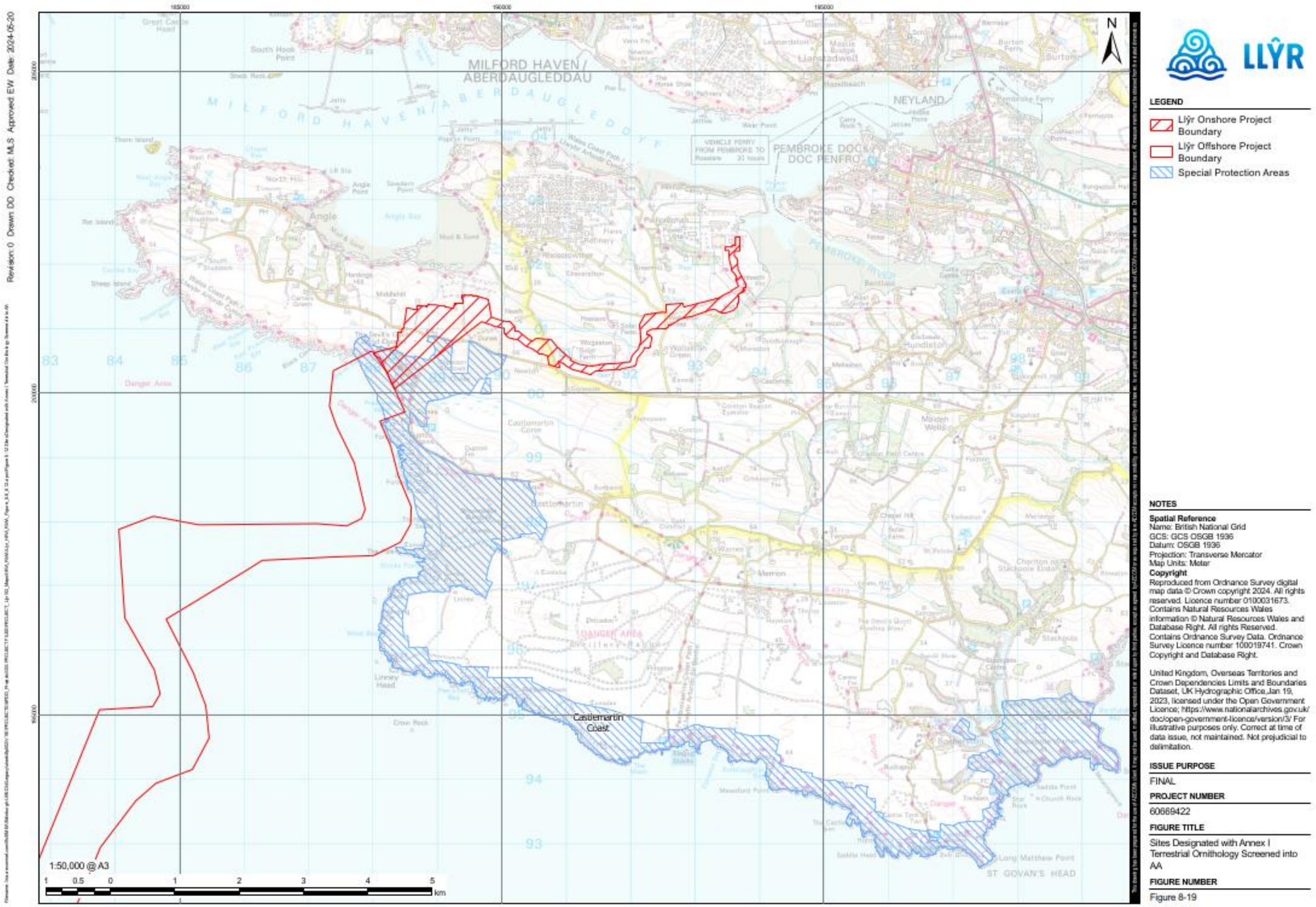


*Figure 8-19 Sites designated with Annex II terrestrial ornithological features screened in for AA*

**Site Descriptions and Conservation Objectives**

*Castlemartin Coast SPA*

827. The sea-cliffs around Castlemartin support the largest concentration of breeding seabirds on the Pembrokeshire mainland, including large and easily viewable colonies of guillemots, razorbills and kittiwakes at Stack Rocks. Rare breeding birds include chough , at one of its main breeding locations in Wales . The choughs feed along the cliffs, adjacent coastal grasslands, heath and dunes.

The OnECC is 7.1 km in length and encompasses approximately 33.2 ha of the SPA, equating to 2.9% of the whole SPA (1114 ha). Thus, the site has been screened into the AA for potential LSE on the Annex I chough feature.

**Information for Appropriate Assessment**

*Castlemartin Coast SPA - Assessment of Adverse Effects Alone*

*Construction phase*

***Disturbance / displacement***

828. Development can result in noise or visual disturbance of qualifying species in Habitats sites, during the construction, operation (including maintenance) and decommissioning phases. Disturbance from construction or decommissioning may result in temporary behavioural changes in qualifying birds (e.g., interruption or cessation foraging, minor and major flight responses). During the operational period, noise emitted from industrial developments may permanently affect site usage of foraging and roosting birds. Disturbance from site usage by operational site staff, road traffic and operational lighting might also arise. Three of the most important factors determining the magnitude of disturbance from proposed developments on ecological receptors are considered to be individual species sensitivity, proximity of the disturbance source and timing / duration of the disturbance.

829. Both noise and visual stimuli may elicit disturbance responses, potentially affecting the fitness and survival of qualifying birds (Burger & Gochfeld, 1998). Noise is a complex disturbance parameter requiring the consideration of multiple factors, including its non-linear scale, non-additive effect and source-receptor distance. Professional judgement suggests that a high level of noise disturbance constitutes a sudden noise event of over 60 dB (decibels) or prolonged noise of over 72 dB. Bird responses to high noise levels include major flight or the cessation of feeding, both of which might affect the survival of birds, particularly if other stressors are also present (e.g., cold weather, food scarcity).

830. Generally, research has shown that above noise levels of 84 dB waterfowl show a flight response, while at levels below 55 dB there is no effect on their behaviour (Cutts & Allan, 1999). Therefore, these two thresholds are considered useful as defining two extremes. The same authors have advised that regular noise levels should remain below 70dB at bird receptors, which will habituate to noise levels below this level (Cutts, et al., 2009). Generally, noise is attenuated by 6 dB with every doubling of distance from the source, with the loudest construction falling to below disturbing levels by 100 m, and certainly by 200 m, away from the source even without mitigation. Noise levels from less noisy construction activities, such as HDD (approximately 85 dB at source), are expected to dissipate over considerably shorter distances.

831. Generally, visual stimuli are considered to have a higher disturbance potential than noise stimuli as, in most instances, visual stimuli will elicit a disturbance response at much greater distances than noise (University of Hull, 2013). For example, a flight response is triggered in most species when they are approached within 150 m across a mudflat. Visual disturbance can be exacerbated by workers moving across open habitats undertaking sudden movements and using

large machinery. Several species are particularly sensitive to visual disturbance including curlew (taking flight at 275 m), redshank (at 250 m), shelduck (at 199 m) and bar-tailed godwit (at 163 m).

832. In 2022, AECOM carried out a survey for chough along a coastal transect, approximately 7.1 km in length, which follows the publicly accessible Pembrokeshire coast path between Angle Bay (National Grid Reference (NGR) SM 85314 03026) and Freshwater West Bay (NGR SM 88119 00592). The transect ended just before the OnECC boundary but did encompass a small section of the northern-most part of the SPA.

833. The survey found that chough are present between Angle Bay and Freshwater West Bay and were recorded during all four surveys with at least 19 individual birds recorded per survey. The highest number of birds recorded during the surveys was a total of 50. No chough were recorded within the section of the transect to the southeast that incorporates Castlemartin Coast SPA. One possible nesting location was recorded at approximately SM 84496 02192 during the initial survey within a sea cave. However, during the subsequent surveys, no birds were recorded at this location. Multiple instances of foraging, amongst other behaviours were recorded during the surveys (**Appendix 8A: Chough Survey Report**).

834. The survey carried out by AECOM highlighted that chough are foraging and possibly breeding within the vicinity of the OnECC, however the survey did not extend into the OnECC. As such, the CMP has been reviewed for further information regarding the locations of chough in the area (Countryside Council for Wales, 2008a).

835. The CMP identifies Broomhill Burrows SSSI (a component of the SPA) management unit 1b as a key foraging area for chough. This management unit overlaps with the OnECC and is approximately 54 m from the Landfall area, at its closest point. The habitats within this management unit have been identified as open dune, dune scrub, dune grassland, bare ground, improved and semi-improved grassland (**Appendix 08B: PEA Report**) – all of which are suitable for use by foraging choughs. The CMP also identifies all management units within Castlemartin Cliffs and Dunes SSSI, to the south of the Landfall site as being key areas for chough.

836. Chough are considered to be generally resilient to disturbance as long as the disturbing factors are regular and present prior to breeding attempts, or occur later in the breeding period after the initial setting up of breeding territories (Jacobs, 2018). A ‘new’ disturbance event during the early stages of the breeding season can cause birds to desert the nest site for the season, whereas a similar level of disturbance taking place further into the breeding season is much less likely to have an adverse effect.

837. Given that the nesting sites will be within the cliffs themselves and inaccessible, direct disturbance to nesting birds is not anticipated. Flush distances of chough from approaching people have been observed to be in the range of 75 – 100 m (Kerbitiou et al. 2009), noise and visual disturbance is therefore likely to be associated with foraging birds as the Landfall area lies within this flushing range.

838. AECOM have undertaken a noise assessment based on the average noise from all plant (set out in the

839. **Table** 8-49) operating over the course of a shift (10 hours on a weekday).

840. The anticipated *LAmax* (the instantaneous maximum sound level) and *LAeq* (a parameter describing the average sound level over time) levels during construction, based on the loudest activity i.e., HDD, are shown in **Figure 8-20** and **Figure 8-21**. **Figure 8-20** shows the predicted *LAmax* construction noise levels. Noise levels are not expected to go above the 70dB threshold for noise disturbance, even in the absence of mitigation. **Figure 8-21** shows the predicted *LAeq* construction noise levels, which shows a maximum of 60 – 65dB.

841. Based on this, disturbance to foraging chough due to construction noise levels is not anticipated, even in the absence of mitigation.

842. It has been proposed to install acoustic fencing around the HDD site boundary (**Appendix 4A: Outline Construction Environmental Management Plan**). Not only would this screen receptors from noise emission but could also provide 10 dB of attenuation when the noise screen completely hides the sources from the receiver, thereby guaranteeing levels are below 70 dB, but would also serve as a visual screen.

843. Although predicted construction levels are predicted to be below 70dB, the installation of acoustic fencing would not only guarantee this but would also act as a visual screen.

**844.** With this mitigation, it is not anticipated that disturbance / displacement will hinder the conservation objectives of the Annex I chough feature of the Castlemartin Coast SPA, and it can be concluded that there is **there is no potential for an AEoSI on the Castlemartin Coast SPA due to disturbance / displacement.**

*Table 8-49. Average noise levels of plant*

| Activity | Plant | Sound Power Level Lw dB(A) |
|---|---|---|
| HDD works | Excavator | 106 |
| | Generators | 101.7 |
| | HDD Rig | 86 |
| | Drill fluid recycling | 114 |
| | System” | 88 |
| | Mud Pump | 88 |
| | Power Pack | 88 |

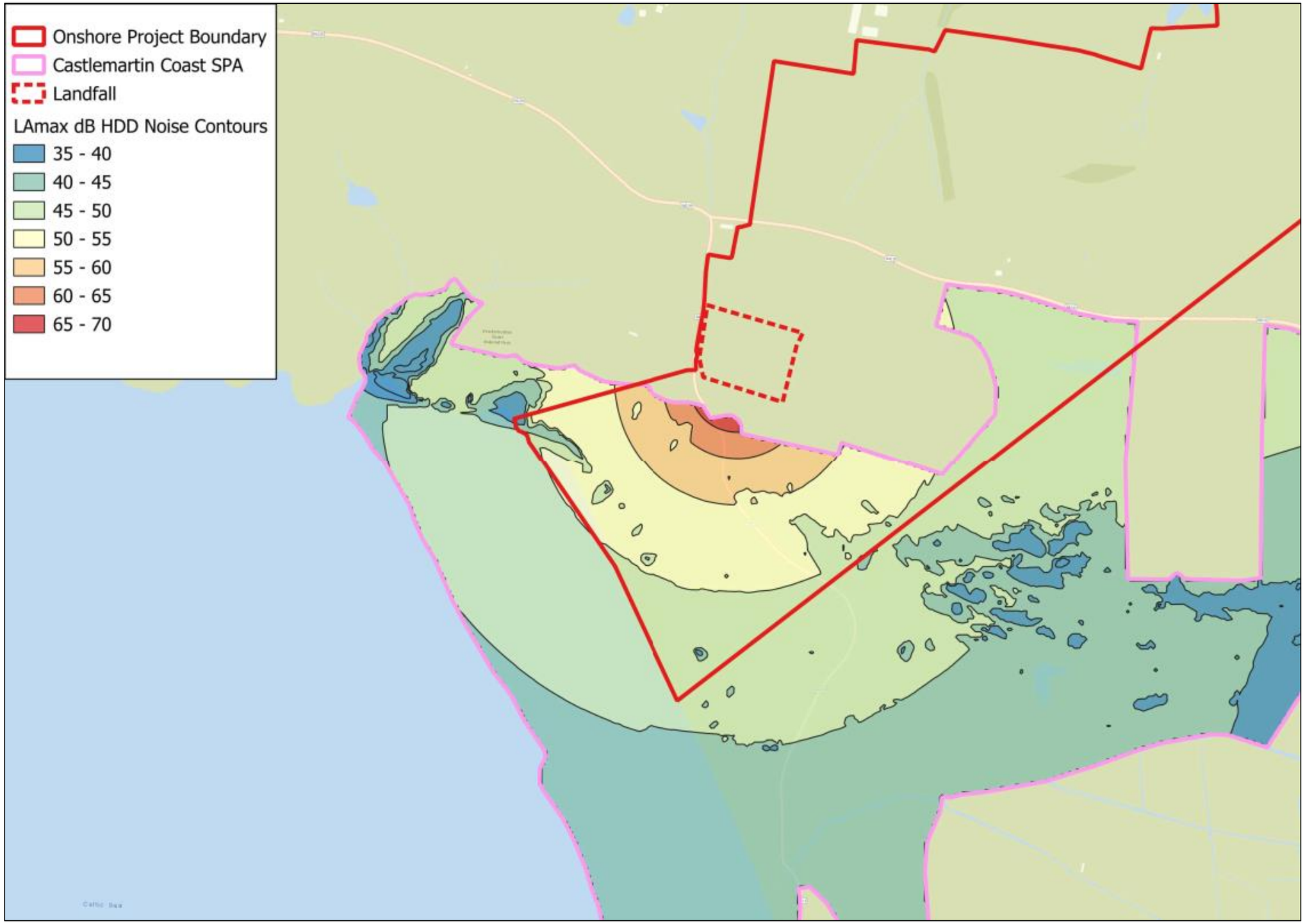


*Figure 8-20. LAmax HDD Noise Contours arising from construction activities within the Landfall area*

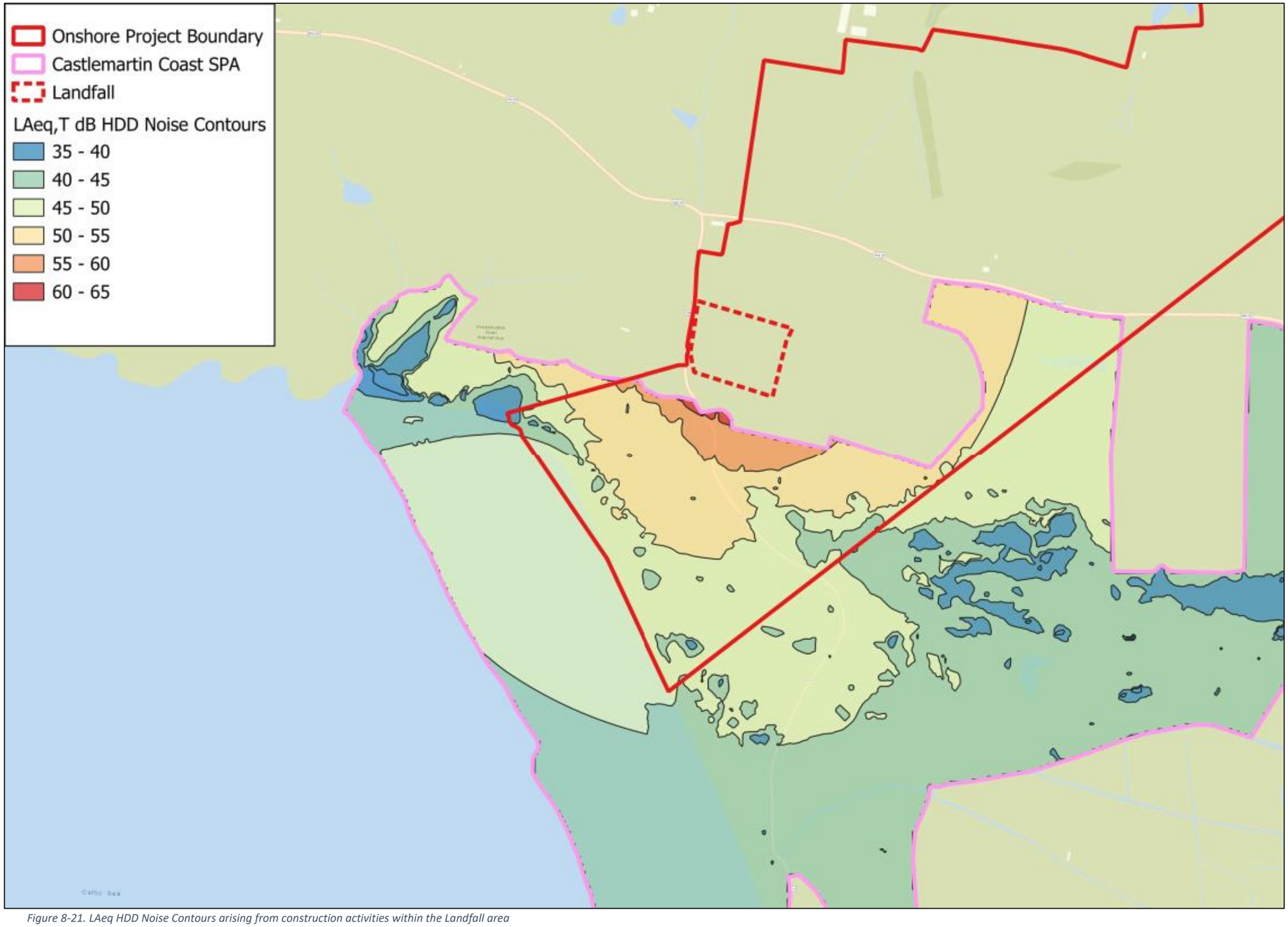


*Figure 8-21. LAeq HDD Noise Contours arising from construction activities within the Landfall area*

***Habitat loss / loss of functionally linked land***

845. While most European sites have been geographically defined to encompass the key features that are necessary for coherence of their structure and function, and the support of their qualifying features, this is not necessarily the case. A diverse array of qualifying species including birds, bats and amphibians are not always confined to the boundary of designated sites.

846. Due to the highly mobile nature of birds, it is inevitable that areas of habitat of crucial importance to the maintenance of their populations are outside the physical limits of the European site for which they are an interest feature. However, this area will still be essential for maintenance of the structure and function of the interest feature for which the site was designated and land use plans that may affect this land should still therefore be subject to further assessment. This has been underlined by a European Court of Justice ruling C-461 / 17 (paragraphs 37 to 40), known as the Holohan ruling which confirms the need for an AA to consider the implications of a plan or project on habitats and species outside the European site boundary provided that those implications are liable to affect the conservation objectives of the site.

847. There is now an abundance of authoritative examples of HRA cases on plans affecting bird populations, where Natural England recognised the potential importance of functionally linked land (Chapman & Tyldesley, 2016). For example, bird surveys in relation to a previous HRA for Hinkley Point C nuclear power station established that approximately 25% of the golden plover population in the Somerset Levels and Moors SPA were affected while on functionally linked land (Chapman & Tyldesley, 2016), and this required the inclusion of mitigation measures in the relevant plan policy wording. Another important case study originates from the Mersey Estuary SPA / Ramsar, where adjacently located functionally linked land had a peak survey count of 108% of the 5-year mean peak population of golden plover. This finding led to considerable amendments in the planning proposal to ensure that the site integrity was not adversely affected.

848. Natural England has published guidance on SSSI Impact Risk Zones (IRZ) associated with different types of development on various functional groups of birds (Knight, 2019). These IRZs provide a high-level screening tool for assessing the risk of planning applications affecting important habitats outside European site boundaries. The guidance identifies that functionally linked habitats may extend up to the maximum foraging distances from roost locations, although it also notes that the proportion of designated foraging birds will decrease with distance from the European site. Importantly, the IRZ guidance note does not define the required abundance threshold needed to meet the criterion of functional habitat linkage. However, NRW and Natural England generally advocate that usage of a land parcel by 1% of the qualifying SPA / Ramsar population is needed for that parcel to be defined as ‘functionally linked habitat’.

849. With regards to birds, areas of functionally linked land typically provide habitat for foraging or other ecological functions essential for the maintenance of the designated population (e.g. high tide roosts for coastal populations). Functionally linked land may extend up to the maximum foraging distance for the designated bird species. However, the number of birds foraging will tend to decrease further away from the protected site and thus the importance of the land to the maintenance of the designated population will decrease.

850. The identification of an area as functionally linked habitat is not always a straightforward process. The importance of non-designated land parcels may not be apparent and thus might require the analysis of existing data sources e.g., Bird Atlases or data from record centres) to be firmly established. In some instances, data may not be available at all, requiring further survey work. Generally, it is reasonable to assume that a site of under 2ha in size is unlikely to support a large enough population of birds (taking sightlines and other factors into account) to constitute 1% of an SPA / Ramsar population.

851. Whitehead *et al.* (2005) studied 15 different habitat types used by 14 pairs of choughs at four breeding sites during the breeding season. The results showed that habitats used preferentially by chough were those where grassland sward heights were less than 2 cm, and where present, bare earth paths and cloddiau were particularly strongly used. This is related to the ease with which choughs can walk on vegetation and access their invertebrate prey within the soil. These habitats are often associated with agricultural land-uses, in particular stock grazing.

852. Whitehead *et al.* (2005) also showed that most foraging during the breeding season took place within 600 m of the nest site. Johnstone *et al.* (2007) found that foraging activity usually took place close to nests and was mainly within 300 m. The quality of habitat within 300 m has also been shown to directly influence breeding success. A study from Ouessant, Brittany found that fecundity was directly related to the ratio of foraging habitat with sward heights less than 5 cm and within 300 m (Kerbiriou, et al., 2006). Thorpe and Young (2009) recommend a precautionary approach of 1 km as a typical foraging range for choughs during the breeding season, with grassland areas with swards less than 5 cm being the most valuable habitats.

853. The distribution and movements of chough during the non-breeding season are more widespread than during the breeding season (Roberts, 1985). Choughs congregate at traditional roost sites outside of the breeding season and range / forage from these locations through the winter months. Thorpe and Young (2009) show that choughs exhibit fidelity to communal roosting sites during the non-breeding season and suggest that a 6 km regular foraging range from such roosts can be used for determining potential boundaries for non-breeding SPAs. The distribution of foraging non-breeding chough at and around winter roosts can be influenced not only by available habitat quality, but also by a social overlay effect whereby young choughs learn from older choughs the location of potentially suitable foraging habitats (Adrienne Stratford, pers. comm.). Maintaining the integrity of non-breeding season roost sites and foraging habitats is therefore an essential component of chough conservation.

854. The Landfall area is approximately 2.49 ha and comprises improved grassland that is *"….farmed as grazing pasture for livestock…"* (**Appendix 08B: PEA Report**). This habitat is ideal foraging habitat and the Landfall area lies within the foraging ranges for breeding and non-breeding chough. The Landfall area is over the 2 ha threshold discussed above and can therefore be considered to be functionally linked to the SPA.

855. Construction of the TJB will result in the physical loss of habitat. Post consent, a BMP will be produced (**Appendix 04A: Outline CEMP**) which will include measures to reinstate and enhance the habitats within the proposed Project area. As such, despite the initial loss of habitat as a result of construction and operation it is anticipated that it will be temporary and will ultimately be improved.

**856.** Given the availability of other suitable, and key foraging areas within the vicinity of the Landfall area, temporary and short-term loss of this habitat is not considered to be significant. Therefore, it is not anticipated that habitat loss / loss of functionally linked land will hinder the conservation objectives of the Annex I chough feature of the Castlemartin Coast SPA, and it can be concluded that there is **there is no potential for an AEoSI on the Castlemartin Coast SPA due to habitat loss / loss of functionally linked land.**

*Operation and Maintenance phase*

***Disturbance / Displacement***

**857.** The assessment of LSE has focussed on construction of the landfall and underground cable route as once operational these areas will be reinstated and no LSE as a result of the operational and maintenance phase is anticipated.

**858.** Therefore, it is not anticipated that disturbance / displacement will hinder the conservation objectives of the Annex I chough feature of the Castlemartin Coast SPA, and it can be concluded that there is **there is no potential for an AEoSI on the Castlemartin Coast SPA due to disturbance / displacement.**

*Decommissioning phase*

859. At the end of the operational life of the proposed Project, there will be a DEMP in place. Other proposed Project constraints will also be taken into consideration (e.g. safety and liability), with the least environmentally damaging option chosen if possible.

860. The full details of the proposed decommissioning will not be agreed until towards the end of the 30-year operational lifetime of the proposed Project. However, the decommissioning phase is expected to largely mirror the construction process over a period of 12 months (see **Chapter 04: Description of the Proposed Project**). However, it is anticipated that upon decommissioning the onshore cable would be left in-situ and, as such, there would not be any impact resulting from excavations, which is where most effects associated with the onshore cable originate from.

861. For works in proximity to the SPA, statutory consultation would be required and an update to the HRA undertaken.

862. Therefore, the impacts of the decommissioning phase are not expected to exceed impacts of the construction phase (**Paragraphs 828 to 856**57), and it is not considered that there will be an impact to the conservation objectives of the Annex I chough feature of the Castlemartin Coast SPA, and thus there is **no potential for an AEoSI on the Castlemartin Coast SPA due to the effects of decommissioning**.

**Information for Assessment of Adverse Effects In-Combination**

863. The following projects have been considered in order to identify whether they have the potential for in-combination effects on the Annex I terrestrial ornithology based on their potential impact pathways to the same European sites as the Project:

- Greenlink Interconnector;
- Erebus; and
- Valorous.

864. The potential for in-combination effects is summarised in Table 8-50, concluding that there is no potential for in-combination effects on the Annex I chough feature of the Castlemartin Coast SPA.

*Table 8-50. Summary of in-combination effects associated with Annex I terrestrial ornithology*

| Project name | Potential in-combination effects<br><br>Castlemartin Coast SPA (UK9014061 |
|---|---|
| **Greenlink Interconnector / Greenlink Interconnector Limited**<br>Interconnector<br>Under Construction | **No.**<br>This project has been subject to its own HRA which concluded *"Although the potential for adverse effects to occur was identified through the Stage 1: Screening assessment, a range of mitigation measures have been proposed to avoid the effects of pollution and sediment run-off, and the effects of habitat severance on bat species during construction and operation. Since no effect is predicted, it is not possible to incur in-combination effects with other plans and projects. As such, there is no need to undertake an in-combination assessment for those features*." |
| **Erebus / Blue Gem Wind**<br>Offshore wind farm<br>Consented | **No.**<br>This project has been subject to its own HRA which concluded *"This assessment concluded that there would be no AEoSI as a result of the construction, operation and decommissioning of the Project in-combination with the relevant and reasonably foreseeable plans and projects".* |
| **Valorous / Blue Gem Wind** NRW<br>Offshore wind<br>Planned | **No.**<br>As the proposed Project can draw the conclusion of no AEoSI with mitigation alone, it is for the Valorous / Blue Gem Wind to demonstrate no in-combination effects. |

*Summary*

865. The OnECC is 7.1 km in length and encompasses approximately 33.2 ha of the SPA, equating to 2.9% of the whole SPA (1114 ha).

866. Potential impact pathways identified in relation to chough (Annex II qualifying feature) included disturbance / displacement and habitat loss / loss of functionally linked habitat.

867. The noise assessment showed that construction noise levels at the Landfall site would not go above 70 dB, even without mitigation, however visual disturbance was a possibility as the Landfall site lies within the flushing range for chough. With the installation of acoustic fencing, noise levels would be guaranteed to stay well below the 70 dB threshold and would also act as a visual screen.

868. With this mitigation in place, secured via the CEMP, it can be concluded that there will be no potential for an AEoSI on the qualifying feature of the SPA as a result of noise / visual disturbance.

869. The Landfall site comprises habitat suitable for use by foraging chough and the construction of the transition joint bay will result in the physical loss of habitat. However, will be temporary and will ultimately be improved, thereby benefitting chough in the long-term. Given the availability of other suitable, and key foraging areas within the vicinity of the Landfall area, temporary and short-term loss of this habitat is not considered to be significant.

870. On this basis of appropriate mitigation measures being in place, it is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I chough feature of Castlemartin Coast SPA (**Table 8-51**). Therefore, it is concluded that there is **no potential for an AEoSI on Castlemartin Coast SPA due to the proposed Project** (**Table 8-51**Table 8-42)**, either alone or in-combination.**

*Table 8-51. Summary of AEoSI for designated sites with Annex II terrestrial ornithology features due to potential impact pathways associated with the OfECC of the proposed Project (✓- potential to hinder conservation objectives; X – no potential to hinder conservation objectives)*

| Designated site | Annex I terrestrial ornithology features screened into assessment | Potential Impact Pathways | | | | AEoSI / Screened into Stage 3 |
|---|---|---|---|---|---|---|
| | | Construction | | Operation and Maintenance | Decommissioning | |
| | | Disturbance / displacement | Habitat loss / loss of functionally linked land | Disturbance / displacement | Potential effects the same as construction phase | |
| Castlemartin Coast SPA (UK9014061) | Chough *Pyrrhocorax pyrrhocorax* (A346). | X | X | X | X | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I terrestrial ornithology feature.<br>Therefore, there is **no potential for an AEoSI on Castlemartin Coast SPA either alone or in-combination** |

### *8.5.9. Summary of Appropriate Assessment*

871. This HRA RIAA has been produced for the proposed Project. The information to inform AA, has been provided in **Section 8.5.** The potential for an AEoSI was considered for the sites brought forward from the screening of LSE **Appendix 08D: Habitats Regulations Assessment Screening**).

872. It is considered that there is no potential for the proposed Project to have an AEoSI on any of the sites considered within the HRA. **Table 8-52** provides a summary of the conclusions from **Section 8.**5. Therefore, it is not considered appropriate to progress to Stage 3 of the HRA process – Assessment of Alternative Solutions

*Table 8-52. Summary of Appropriate Assessment and European Sites where there is an Adverse Effect on Site Integrity (AEoSI)*

| Designated site | Designated features screened into assessment | AEoSI / Screened into Stage 3 |
|---|---|---|
| Castlemartin Coast SPA (UK9014061) | Screened in for:<br>• Chough *Pyrrhocorax pyrrhocorax* (A346). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I chough feature.<br>Therefore, with appropriate mitigation in place, there is **no potential for an AEoSI on Castlemartin Coast SPA either alone or in-combination**. |
| Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA (UK9014051) | Screened in for:<br>• Kittiwake *Rissa tridac*tyla (A188);<br>• Lesser Black-backed Gull *Larus fuscus* (A183);<br>• Guillemot *Uria aalge* (A199);<br>• Razorbill *Alca torda* (A200); and<br>• Atlantic puffin *Fratercula arctica* (A204);<br>• European storm petrel *Hydrobates pelagicus* (A014); and<br>• Manx shearwater *Puffinus puffinus* (A013). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I ornithological features.<br>Therefore, with appropriate mitigation in place, there is **no potential for an AEoSI on Skomer, Skokholm and the Seas off Pembrokeshire SPA either alone or in-combination**. |
| West Wales Marine / Gorllewin Cymru Forol SAC (UK0030397) | *Screened in for:*<br>• Harbour porpoise *Phocoena phocoena* (1351). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II harbour porpoise feature.<br>Therefore, there is **no potential for an AEoSI on West Wales Marine SAC either alone or in-combination.** |
| Pembrokeshire Marine / Sir Benfro Forol SAC (UK0013116) | *Screened in for:*<br>• Estuaries (1130);<br>• Large shallow inlets and bays (1160);<br>• Reefs (1170);<br>• Sandbanks which are slightly covered by sea water all the time (1110); | Provided a seasonal restriction during the cable landfall activity is implemented, or pre-construction surveys indicate the landfall site is not used for grey seal pupping, the potential for an AEoSI from airborne sound and visual disturbance on the Annex II grey seal feature can be reduced.<br>Following the implementation of these measures, it is considered that the impact pathways associated with the proposed Project |

| Designated site | Designated features screened into assessment | AEoSI / Screened into Stage 3 |
|---|---|---|
| | • Mudflats and sandflats not covered by seawater at low tide (1140);<br>• Coastal lagoons (1150);<br>• Atlantic salt meadows Glauco-*Puccinellietalia maritimae* (1330);<br>• Submerged or partially submerged sea caves (8330);<br>• Sea lamprey *Petromyzon marinus* (1095);<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Allis shad *Alosa alosa* (1102);<br>• Twaite shad *Alosa fallax* (1103); and<br>• Grey seal *Halichoerus grypus* (1364).<br>• Otter *Lutra lutra* (1355) | will not hinder the conservation objectives of the Annex I habitat and Annex II species features.<br>Therefore, there is **no potential for an AEoSI on Pembrokeshire Marine SAC either alone or in-combination**. |
| Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (UK0014787) | *Screened in for:*<br>• Submerged or partially submerged sea caves (8330);<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130);<br>• European dry heaths (4030);<br>• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (important orchid sites) (6210);<br>• Early gentian *Gentianella anglica* (1654);<br>• Petalwort *Petalophyllum ralfsii* (1395); and<br>• Greater Horseshoe bat *Rhinolophus ferrumequinum* (1304). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I habitat and Annex II species features.<br>Therefore, with appropriate mitigation in place, there is **no potential for an AEoSI on Limestone Coast of South West Wales SAC either alone or in-combination**. |

| Designated site | Designated features screened into assessment | AEoSI / Screened into Stage 3 |
|---|---|---|
| Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC (UK0030396) | *Screened in for:*<br>• Harbour porpoise *Phocoena phocoena* (1351). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II harbour porpoise feature.<br>Therefore, there is **no potential for an AEoSI on Bristol Channel Approaches SAC either alone or in-combination.** |
| Cleddau Rivers / Afonydd Cleddau SAC (UK0030074) | *Screened in for:*<br>• Sea lamprey *Petromyzon marinus* (1095); and<br>• River lamprey *Lampetra fluviatilis* (1099). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on Cleddau Rivers SAC either alone or in-combination**. |
| Grassholm / Ynys Gwales SPA (UK9014041) | *Screened in for:*<br>• Gannet *Morus bassanus* (A016). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex I gannet feature.<br>Therefore, with appropriate mitigation in place, there is **no potential for an AEoSI on Grassholm SPA either alone or in-combination**. |
| Carmarthen Bay and Estuaries / Bae Caerfyddin ac Aberoedd SAC (UK0020020) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095);<br>• Allis shad *Alosa alosa* (1102); and<br>• Twaite shad *Alosa fallax* (1103). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on Carmarthen Bay and Estuaries SAC either alone or in-combination**. |
| Cardigan Bay / Bae Ceredigion SAC (UK0012712) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099); and<br>• Sea lamprey *Petromyzon marinus* (1095). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on Cardigan Bay SAC either alone or in-combination**. |
| Afon Teifi / River Teifi SAC (UK0012670) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095); | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on Afon Teifi SAC either alone or in-combination**. |

| Designated site | Designated features screened into assessment | AEoSI / Screened into Stage 3 |
|---|---|---|
| | • Atlantic salmon *Salmo salar* (1106);<br>• Allis shad *Alosa alosa* (1102); and<br>• Twaite shad *Alosa fallax* (1103). | |
| River Tywi / Afon Tywi SAC (UK0013010) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095);<br>• Allis shad *Alosa alosa* (1102); and<br>• Twaite shad *Alosa fallax* (1103). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on River Tywi SAC either alone or in-combination**. |
| River Usk / Afon Wysg SAC (UK0013007) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095);<br>• Atlantic salmon *Salmo salar* (1106);<br>• Allis shad *Alosa alosa* (1102); and<br>• Twaite shad *Alosa fallax* (1103). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on River Usk SAC either alone or in-combination**. |
| Severn Estuary Ramsar (UK11081) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis*;<br>• Sea lamprey *Petromyzon marinus*;<br>• Atlantic salmon *Salmo salar*;<br>• Allis shad *Alosa alosa*; and<br>• Twaite shad *Alosa fallax*. | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the migratory fish features features.<br>Therefore, there is **no potential for an AEoSI on** Severn Estuary Ramsar **either alone or in-combination**. |
| Severn Estuary / Môr Hafren SAC (UK0013030) | *Screened in for:*<br>• River lamprey Lampetra fluviatilis (1099);<br>• Sea lamprey Petromyzon marinus (1095); and | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on Severn Estuary SAC either alone or in-combination**. |

| Designated site | Designated features screened into assessment | AEoSI / Screened into Stage 3 |
|---|---|---|
| | • Twaite shad Alosa fallax (1103). | |
| River Wye / Afon Gwy SAC (UK0012642) | *Screened in for:*<br>• River lamprey *Lampetra fluviatilis* (1099);<br>• Sea lamprey *Petromyzon marinus* (1095);<br>• Atlantic salmon *Salmo salar* (1106);<br>• Allis shad *Alosa alosa* (1102); and<br>• Twaite shad *Alosa fallax* (1103). | It is considered that the impact pathways associated with the proposed Project will not hinder the conservation objectives of the Annex II migratory fish features.<br>Therefore, there is **no potential for an AEoSI on River Wye SAC either alone or in-combination** |

## 8.6 References


ABPMer, 2014. Habitats Regulations Appraisal for the Wave and Tidal Further Leasing. Reports for The Crown Estate, ABP Marine Environmental Research Ltd, Report No: R.2160a-c.

Back From The Brink, 2019. Species information guide: Greater horseshoe bat *Rhinolophus ferrumequinum.* [Online]. Available at: https://naturebftb.co.uk/wp-content/uploads/2022/01/Greater-Horseshoe-Bat-BftB.pdf

Barham, R. & Mason, T., 2021. Erebus Offshore Wind: Underwater noise assessment. Subacoustech Environmental Report No. P282R0106. [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010109/EN010109-000421-6.3.10.2%20Underwater%20Noise%20Modelling%20Report.pdf.

Bat Conservation Trust, 2016. Core Sustenance Zones: Determining zone size. [Online]. Available at: https://cdn.bats.org.uk/uploads/pdf/Resources/Core_Sustenance_Zones_Explained_-_04.02.16.pdf?v=1541085349#:~:text=Following%20the%20workshop%20it%20was,bats%20tracked%20in%20each%20study.

Bat Conservation Trust, 2024. *UK Bats.* [Online]. Available at: https://www.bats.org.uk/about-bats/what-are-bats/uk-bats/lesser-horsehoe.

Bax, N., Willaimson, A., Aguero, M., Gonzales, E., and Geeves, W., 2003. Marine invasive alien species: a threat to global biodiversity. *Marine Policy,* 27(4), 313-323.

Bat Conservation Trust, 2023. Bats and Artificial Lighting. Guidance Note 08/23. [Online]. Available at: https://www.bats.org.uk/news/2023/08/bats-and-artificial-lighting-at-night-ilp-guidance-note-update-released.

BEIS, 2022. Policy paper. Marine environment: unexploded ordnance clearance joint interim position statement.

Benhemma-Le Gall, A., Graham, L. M., Merchant, N. D. ,and Thompson, P. M., 2021. Broad-Scale Responses of Harbor Porpoises to Pile-Driving and Vessel Activities During Offshore Windfarm Construction. *Fronteirs of Marine Science,* 8(664724).

Benjamins, S., Harnois, V. H., Smith, L., Johanning, L., Greenhill, C., Wilson, B., 2014. Understanding the potential for marine megafauna entanglement risk from renewable marine. Scottish Natural Hertiage Commissioned Report No. 791. [Online]. Available at: https://tethys.pnnl.gov/sites/default/files/publications/SNH-2014-Report791.pdf

Bergstedt, R. A., and Seelye, J. G., 1995. Evidence for lack of homing by sea lampreys. *Transactions of the American Fisheries Society,* 124, 235-239.

Booth, C. G., and Heinis, F., 2019. Updating the Interim PCoD Model: Workshop Report - New transfer functions for the effects of disturbance on vital rates in marine mammal species. Report Code SMRUC-BEI-2018-011. Department for Business, Energy and Industrial Strategy (BEIS). Unpublished.

Burger, J., and Gochfeld, M., 1998. Effects of ecotourists on bird behaviour at Loxahatchee National Wildlife Refuge, Florida. *Environmental Conservation,* 25(13-21).

Burns, R. D. J. Martins. S. J., Wood, M. A., Wilson, C. C., Lumsden, C. E., and Pace, F., 2022. Hywind Scotland Floating Offshore Wind Farm: Sound Source Characterisation of Operational Floating Turbines. Document 02521. Technical report by JASCO Applied Science for Equinor Energy AS. [Online]. Available at: https://cdn.equinor.com/files/h61q9gi9/global/f7e7b24cd5d4291a0c7ebb7eb17baa83f452a513.pdf?equinor-hywind-scotland-sound-source-characterisation.pdf

Canning, S. J., Santos, M. B., Reid, R. J., Evan, P. G. H., Sabin, R. C., Bailry, N., and Pierce, G. J., 2008. Seasonal distribution of white-beaked dolphins (*Lagenorhynchus albirostris*) in UK waters with new information on diet and habitat use. *Journal of the Marine Biological Association of the United Kingdom,* 88(6), 1159-1166.

Carter, M. I., Boheme, L., Cronin, M. A., Duck, C. D., Grecian, W. I., Hastei, G. D., Jessop, M., Mattiopoulos, J., M. McConnell, B. J., Miller, D. L., and Morris, C. D., 2022. Sympatric seals, satellite tracking and protected areas: habitat-based distribution estimates for conservation and management. *Fronteirs in Marine Science,* 9(875869).

Chanin, P., 2007. Ecology of the European Otter. Conserving Natura 2000 Rivers. Ecology Series No. 10. Peterborough. [Online]. Available at: https://publications.naturalengland.org.uk/publication/81053.

Chapman, C., and Tyldesley, D., 2016. Functional linkage: How areas that are functionally linked to European sites have been considered when they may be affected by plans and projects – A review of authoritative decisions. Natural England Commissioned Reports 207. [Online]. Available at: https://publications.naturalengland.org.uk/publication/6087702630891520.

CIEEM, 2018. *Guidlines for Ecological Impact Assessment in the UK and Ireland.* [Online]. Available at: https://cieem.net/wp-content/uploads/2018/08/ECIA-Guidelines-2018-Terrestrial-Freshwater-Coastal-and-Marine-V1.2-April-22-Compressed.pdf.

Copping, A. E., and Hemery, L. G., 2020. OES-Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World, Report for Ocean Energy Systems (OES). [Online]. Available at: https://tethys.pnnl.gov/publications/state-of-the-science-2020.

Countryside Council for Wales, 2008a. Core Managment Plan including Conservation Objectives for Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (incorporating Castlemartin Coast SPA). Countryside Council for Wales. [Online]. Available at: https://naturalresources.wales/media/672656/Limestone%20Coast%20of%20South%20West%20Wales%20English.pdf.

Countryside Council for Wales, 2008b. Core Management Plan including Conservation Objectives for Pembrokeshire Bat Sites and Bosherton Lakes SAC (Special Area of Conservation). [Online]. Available at: https://naturalresources.wales/media/673193/pembs-bat-sites-and-bosh-lakes-english.pdf.

Countryside Council for Wales, 2009. Carmarthen Bay and Estuaries/Bae Caerfyrddin ac Aberoedd European Marine Site. Countryside Council for Wales. [Online]. Available at: https://naturalresources.wales/media/673515/Carmarthen%20Bay%20R33%20Advice%20February%202009.pdf.

Countryside Council for Wales, 2012. Core Management Plan including Conservation Objectives for Afon Teifi / River Teifi SAC. Countryside Council for Wales. [Online]. Available at: https://naturalresources.wales/media/670702/Afon%20Teifi%20%20River%20Teifi%20Management%20Plan.pdf.

Cutts, N., and Allan, J., 1999. Avifaunal Disturbance Assessment. Flood Defence Works: Saltend. Environment Agency.

Cutts, N., Phelps, A., and Burdon, D., 2009. Construction and waterfowl: Defining sensitivity, response, impacts and guidance, Humber INCA, Institute of Estuarine and Coastal Studies, University of Hull. [Online]. Available at: https://hoverclub.org.uk/langstone/Assessments_reports/Construction%20and%20waterfowl%20Response_impact_guidance.pdf.

Defra, Natural England, Welsh Government, and NRW, 2021. *Guidance Habitats regulations assessments: protecting and European site.* [Online]. Available at: https://www.gov.uk/guidance/habitats-regulations-assessments-protecting-a-european-site.

Defra, 2012. Habitats Directive: Guidance on the application of article 6(4). Alternative solutions, imperative reasons of overriding public interest (IROPI) and compensatory measures. [Online]. Available at: https://assets.publishing.service.gov.uk/media/5a796c5ce5274a2acd18cb66/habitats-directive-iropi-draft-guidance-20120807.pdf.

Department for Levelling Up, Housing and Communities, 2012. National Planning Policy Framework. [Online]. Available at: https://assets.publishing.service.gov.uk/media/65a11af7e8f5ec000f1f8c46/NPPF_December_2023.pdf.

Diederichs, A., Nehls, G., Dähne, M. and Adler, S., 2008. Methodologies for measuring and assessing potential changes in marine mammal behaviour, abundance or distribution arising from the construction, operation and decommissioning of offshore windfarms. BioConsult SH report to COWRIE Ltd. [Online]. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Diederichs_et_al_2008.pdf.

Draget, E., 2014. Environmental Impacs of Offshore WindPower Production in the North Sea: A Literature Overview, WWF Report. [Online]. Available at: https://tethys.pnnl.gov/sites/default/files/publications/WWF-OSW-Environmental-Impacts.pdf.

Edren, S. M. C., Anderson, S. Teilmann, J., Carstensen, J., Harders, P. B., Dietz, R., and Miller, L., 2010. The effect of a large Danish offshore wind farm in harbor and grey seal haul-out behaviour. *Marine Mammal Science,* 26(3).

Emeana, C. J., Hughes, T. J., Dix, J. K., Gernon, T. M., Henstock, T. J., Thompson, C. E. L., Pilgrim, J. A., 2016. The thermal regime around buried submarine high-voltage cables. *Geophysical Journal International,* 206(2), 1051-1064.

Environmental Protection Act, 1990. [Online]. Available at: https://www.legislation.gov.uk/ukpga/1990/43/contents.

Erbe, C., Marley, S. A., Schoeman, R. P., Smith, J. N., Trigg, L. E., and Embling, C. E., 2019. The effects of ship noise on marine mammals—a review. *Frontiers in Marine Science,* 6, 606.

Evans, P., and Hinter, K., 2013. Review of the direct and indirect impacts of fishing activities on Marine Mammals in Welsh Waters. [Online]. Available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2016/02/Evans-Hintner_2010.pdf.

Farr, H., Ruttenberg, B., Walter, R. K., Wang, Y., and White, C., 2021. Potential environmental effects of deepwater floating offshore wind energy facilities. *Ocean and Coastal Management,* 207, 105611.

Fay, R. R., and Popper, A. N., 2000. Evolution of hearing in vertebrates: the inner ears and processing. *Hearing Research,* 149, 1-10.

Furness, R. W., Wade, H. M., and Masden, E. A., 2013. Assessing vulnerability of marine bird populations to offshore wind farms. *Journal of Environmental Management,* 119, 56-66.

Galparsoro, I., Menchaca, I., and Garmendia, J. M., 2022. Reviewing the ecological impacts of offshore wind farms. *npj Ocean Sustain,* 1(1).

Gov.Wales, 2021. *Habitats regulations assessments: protecting a European site.* [Online]. Available at: https://www.gov.wales/sites/default/files/pdf-versions/2021/3/4/1614860989/habitats-regulations-assessments-protecting-european-site.pdf.

Graham, I. M., Merchant, N. D., Farcas, A., Barton, T. R., Cheney, B., Bono, S., and Thompson, P. M., 2019. Harbour porpoise responses to pile-driving diminish over time. *Royal Society Open Science*, 6, 190335.

Greenlink Interconnector Ltd, 2019a. Greenlink Environmental Statement – Onshore Wales [Appendix 6.5] – Riparian Mammals Survey Report.

Greenlink, 2019b. Greenlink Environmental Statement – Onshore Wales Appendix 6.7: Bat Survey Report.

Greenlink, 2020. Greenlink Environmental Statement Onshore Wales. Appendix 6.11 Statement to Inform a Habitats Regulations Assessment (HRA).

Hadlee & Brunton Ltd, 2019. *What is Horizontal Directional Drilling.* [Online]. Available at: https://www.hadleeandbrunton.co.nz/what-is-horizontal-directional-drilling/.

Hammond, P. S., Lacey, C., Gilles, A., Viquerat, S., Börjesson, P., Herr, H., Macleod, K., Ridoux,V., Santos, M. B.m Scheidat, M., Teilmann, J., Vingada, J., and Øien, H., 2021. Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. [Online]. Available at: https://scans3.wp.st-andrews.ac.uk/files/2021/06/SCANS-III_design-based_estimates_final_report_revised_June_2021.pdf.

Harwood, J., King, S., Schnick, R., Donovan, C., and Booth, C., 2014. A protocol for Implementing the Interim Population Consequences of Disturbance (PCoD) approach: Quantifying and assessing the effects of UK offshore renewable energy developments on marine mammal

populations. Report Number SMRUL-TCE-2013-014. *Scottish Marine And Freshwater Science*, 5(2).

Hawkins, A., 1993. Underwater sound and fish behaviour. *Behavior of Teleost Fishes,* 129-169.

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. [Online]. Available at: https://data.jncc.gov.uk/data/f7450390-9a89-4986-8389-9bff5ea1978a/JNCC-Report-544-FINAL-WEB.pdf.

Hicks, N., Lui, X., Gregory, R., Kenny, J., Lucaci, A., Lenzi, L., Paterson, D. M., and Duncan, K. R., 2018. Temperature driven changes in benthic bacterial diversity influences geochemical cycling in coastal sediments. *Froteirs in Marine Science,* 9(1730).

HM Government, 2017. The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. [Online]. Available at: https://www.legislation.gov.uk/uksi/2017/407/contents.

House of Commons Environmental Audit Committee, 2019. Invasive Species. Report, together with formal minutes relating Ordered by the House of Commons. [Online]. Available at: https://publications.parliament.uk/pa/cm201919/cmselect/cmenvaud/88/88.pdf.

Hutchison, Z. L., Secor, D. H., and Gill, A. B., 2020. The Interaction between resource species and electromagnetic fields associated with electricity production by offshore wind farms. *Oceanography,* 33(4), 96-107.

IAMMWG, 2022. Updated abundance estimates for cetacean Management Units in UK waters (Revised 2022). JNCC Report No. 680, JNCC Peterborough, ISSN 0963-8091. [Online]. Available at: https://data.jncc.gov.uk/data/3a401204-aa46-43c8-85b8-5ae42cdd7ff3/jncc-report-680-revised-202203.pdf.

IAQM, EPUK, 2017. Land-Use Planning & Development Control: Planning for Air Quality. [Online]. Available at: https://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf.

IAQM, 2014. Guidance on the assessment of dust from demolition and construction. [Online]. Available at: https://iaqm.co.uk/text/guidance/construction-dust-2014.pdf.

IMO, 2017. *International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM).* [Online] Available at: https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships%27-Ballast-Water-and-Sediments-(BWM).aspx.

ITPEnergised, 2021. Project Erebus: Onshore Cable Route – Technical Appendix 20.4: Protected Species Report. BlueGem. [Online]. Available at: https://www.bluegemwind.com/wp-content/uploads/2020/07/Erebus-ES-Vol-3-Appendix-20.4-Protected-Species-Survey-Report.pdf.

Jacobs, 2018. Wylfa Newydd Project 6.4.47 ES Volume D - WNDA Development App D9-14 - Chough Baseline Report. Horizon Nuclear Power. [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010007/EN010007-001491-6.4.47%20App%20D9-14-Chough%20Baseline%20Report%20(Rev%201.0).pdf.

Jansen, O. E., Leopold, M. F., Meesters, E. H. W. G., and Smeek , C., 2010. Are white-beaked dolphins Lagenorhynchus albirostris food specialists? Their diet in the southern North Sea. *Journal of the Marine Biological Association of the United Kingdom,* 90(8), 1501-1508.

JNCC, Natural England, and Countryside Council for Wales, 2010. 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. [Online]. Available at: https://assets.publishing.service.gov.uk/media/5dea1d35e5274a06dee23a34/Draft_Guidance_on_the_Protection_of_Marine_European_Protected_Species_from_Injurt_and_Disturbance.pdf.

JNCC, 2010. JNCC guidelines for minimising the risk of disturbance and injury to marine mammals whilst using explosives. JNCC, Aberdeen [Online]. Available at: https://data.jncc.gov.uk/data/24cc180d-4030-49dd-8977-a04ebe0d7aca/JNCC-Guidelines-Explosives-Guidelines-201008-Web.pdf.

JNCC, 2010. Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise. JNCC, Aberdeen. [Online]. Available at: https://data.jncc.gov.uk/data/31662b6a-19ed-4918-9fab-8fbcff752046/JNCC-CNCB-Piling-protocol-August2010-Web.pdf.

JNCC, 2018. *Marine Activities and Pressures Evidence.* JNCC. [Online]. Available at: https://jncc.gov.uk/our-work/marine-activities-and-pressures-evidence/.

JNCC, 2019. Article 17 Habitats Directive Report 2017. JNCC. [Online]. Available at: https://jncc.gov.uk/our-work/article-17-habitats-directive-report-2019/.

JNCC, 2019. *Joint Cetacean Data Programme.* JNCC. [Online]. Available at: https://jncc.gov.uk/our-work/joint-cetacean-data-programme/.

JNCC, 2019. Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA. JNCC. [Online]. Available at: https://jncc.gov.uk/our-work/skomer-skokholm-and-the-seas-off-pembrokeshire-mpa/.

JNCC, 2020. *Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs (England, Wales & Northern Ireland).* JNCC Report No. 654. JNCC, Peterborogh. ISSN 0963-8091. [Online]. Available at: https://data.jncc.gov.uk/data/2e60a9a0-4366-4971-9327-2bc409e09784/JNCC-Report-654-FINAL-WEB.pdf.

JNCC, 2010. *JNCC guidelines for minimising the risk of disturbance and injury to marine mammals whilst using explosives.* JNCC, Aberdeen. [Online]. Available at: https://hub.jncc.gov.uk/assets/24cc180d-4030-49dd-8977-a04ebe0d7aca.

JNCC, 2023b. *8330 Submerged or partially submerged sea caves.* JNCC. [Online]. Available at: https://sac.jncc.gov.uk/habitat/H8330/.

JNCC, 2023. Irish Sea Front SPA. JNCC. [Online]. Available at: https://jncc.gov.uk/our-work/irish-sea-front-spa/.

JNCC, 2023. *The Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC.* JNCC. [Online]. Available at: https://jncc.gov.uk/our-work/bristol-channel-approaches-mpa/.

JNCC, 2023. *The West Wales Marine / Gorllewin Cymru Forol SAC.* JNCC. [Online]. Available at: https://jncc.gov.uk/our-work/west-wales-marine-mpa/.

JNCC, 2024. *1351 Harbour porpoise Phocoena phocoena.* JNCC. [Online]. Available at: https://sac.jncc.gov.uk/species/S1351/.

Johnstone, I., Thorpe, R., Moore, A., and Finney, S., 2007. Breeding status of choughs Pyrrhocorax pyrrhocorax in the UK and Isle of Man in 2002: Capsule – Choughs have increased in numbers and range in recent decades, but vary regionally in their apparent trends. *Bird Study,* 54(1), 23-24.

Kerbiriou, C., Gourmelon, F., Jiguit, F., Le Viol, I., Bioret, F., and Julliard, R., 2006. Linking territory quality and reproductive success in the Red-billed Chough *Pyrrhocorax pyrrhocorax*: implications for conservation management of an endangered population. *Ibis,* 148(2), 352-364.

King, S. L., Schick, R. R., Donovan, C., Booth, C.G., Burgman, M., Thomas, L., and Harwood, J., 2015. An interim framework for assessing the population consequences of disturbance. *Methods in Ecology and Evolution*, 6, 1150-1158.

Kjelland, M., Woodley, C., Swannack, and Smith, D., 2015. A review of the potential effects of suspended sediment on fishes: potential dredging-related physiological, behavioural, and transgenerational implications. *Environment Systems and Decisions,* 35, 334-350.

Klimley, A. P., Putman, N. F., Keller, B. A., and Noakes, D., 2021. A call to assess the impacts of electromagnetic fields from subsea cables on the movement ecology of marine migrants. *Conservation Science and Practice,* 3(436).

Knight, M., 2019. Impact Risk Zones Guidance Summary – Sites of Special Scientific Interest Notified for Birds.

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), 35-75.

Leopold, M. F., Rotshuizen, E., and Evans, P. G. H., 2018. From nought to 100 in no time: how humpback whales (*Megaptera novaeangliae*) came into the southern North Sea. *Lutra,* 61(1), 165-188.

Marine Space Ltd, 2019b. Project Erebus Environmental Statement: Chapter 10 Fish and Shellfish Ecology. [Online]. Available at: https://www.bluegemwind.com/wp-content/uploads/2020/07/Erebus-ES-Vol-1-Chapter-10-Fish-Shellfish-Ecology_final.pdf.

Marine Space Ltd, 2019. Project Erebus Environmental Statement Chapter 12: Marine Mammals. [Online]. Available at: https://www.bluegemwind.com/wp-content/uploads/2020/07/Erebus-ES-Vol-1-Chapter-12-Marine-Mammals_final.pdf.

MarineSpace Ltd, 2021. Habitats Regulations Assessment: Report to Inform Appropriate Assessment. Blue Gem Wind Ltd. [Online]. Available at: https://www.bluegemwind.com/wp-content/uploads/2020/07/Erebus-ES-Vol-3-Appendix-8.3-HRA-Report-to-Inform-Appropriate-Assessment.pdf.

Maxwell, S. M., Kershaw, F., Locke, C. C.,Conners, M. G., Dawson, C., Aylesworth, S., Looomis, R., and Johnson, A. F., 2022. Potential impacts of floating wind turbine technology for marine species and habitats. *Journal of Environmental Management,* 307(114577).

Meissner, K., Schabelon, H., Bellebaum, J., and Sordyl, H., 2006. *Impacts of submarine cables on the marine environment.* Institute of Applied Ecology for the German Federal Agency for Nature Conservation. [Online]. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Meissner-et-al-2006.pdf.

Miller, D. C., Muir, C. L., and Hauser, O. A., 2002. Detrimental effects of sedimentation on marine benthos: What can be learned from natural processes and rates? *Ecological Engineering,* 19(3), 211-232.

NBN Atlas Partnership, 2024. *NBN Atlas Wales.* [Online]. Available at: https://wales.nbnatlas.org/.

NetRegs, 2024. Guidance for Pollution Prevention (GPP) documents. [Online]. Available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/.

NFMS, 2005. Scoping Report for NMFS EIS for the National Acoustic Guidelines on Marine Mammals. National Marine Fisheries Service.

NMFS, 2018. Revision to: Technical Guidance for Assessing Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. [Online]. Available at: https://www.fisheries.noaa.gov/s3//dam-migration/tech-memo-acoustic-guidance-20-pdf-508.pdf.

Normandeau, A. I., Exponent Inc, Tricas, T. & Gill, A., 2011. Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. U.S. Department of the Interior. [Online]. Available at: https://espis.boem.gov/final%20reports/5115.pdf.

NRA, 2008. Guidelines for the treatment of otters prior to the construction of national road schemes. [Online]. Available at: https://www.tii.ie/media/312jca1a/guidelines-for-the-treatment-of-otters-prior-to-the-construction-of-national-road-schemes.pdf.

NRW, 2014. Grassholm: Entry in the Register of European Sites for Wales. NRW.

NRW, 2017a. Core Management Plan including Conservation Objectives for Afon Gwy / River Wye SAC. NRW. [Online]. Available at: https://consult.environment-agency.gov.uk/psc/ta5-1ud-nnb-generation-company-hpc-limited-2/supporting_documents/EA5%20%20River%20Wye%20SAC%20Core%20Management%20Plan%20Natural%20Resources%20Wales%20September%202017.pdf.

NRW, 2017b. *Landmap Landscape Habitats.* [Online] Available at: https://datamap.gov.wales/layers/inspire-nrw:NRW_LANDMAP_Landscape_Habitats.

NRW, 2018a. Cardigan Bay/ Bae Ceredigion Special Area of Conservation Advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the Conservation of Habitats and Species Regulations 2017. NRW. [Online]. Available at: https://naturalresources.wales/media/687993/eng-cardigan-bay-reg-37-report-2018.pdf.

NRW, 2018b. Carmarthen Bay and Estuaries / Bae Caerfyrddin ac Aberoedd Special Area of Conservation: Indicative site level feature condition assessments 2018. NRW Evidence Report No: 227. [Online]. Available at:

https://naturalresources.wales/media/686263/eng-report-227-carmarthen-bay-and-estuaries-sac-indicative-site-level-feature-condition.pdf.

NRW, 2018c. Carmarthen Bay and Estuaries/Bae Caerfyrddin ac Aberoedd European Marine Site: Advice prepared by Natural Resources Wales for the fulfilment of Regulation 37 of the Conservation of Habitats and Speceis Regualtions 2017. NRW. [Online]. Available at: https://naturalresources.wales/media/687995/eng-carmarthen-bay-and-estuaries-reg-37-report-2018.pdf.

NRW, 2018d. Pembrokeshire Marine / Sir Benfro Forol Special Area of Conservation Indicative site level feature condition assessments. NRW Evidence Report No: 233. [Online]. Available at: https://naturalresources.wales/media/684242/indicative-condition-assessment-2018-pembrokeshire-marine-sacv2.pdf.

NRW, 2018e. Pembrokeshire Marine / Sir Benfro Forol Special Area of Conservation: Advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the Conservation of Habitats and Species Regulations 2017. NRW. [Online]. Available at: https://naturalresources.wales/media/687999/eng-pembrokeshire-marine-reg-37-report-2018.pdf.

NRW, 2018f. Severn Estuary / Mor Hafren Special Area of Conservation: Indicative site level feature condition assessments 2018. NRW Evidence Report No: 235. [Online]. Available at: https://naturalresources.wales/media/686277/eng-report-235-severn-estuary-sac-indicative-site-level-feature-condition-2018.pdf.

NRW, 2022a. Core Management Plan including Conservation Objectives for Afon Teifi / River Teifi SAC. [Online]. Available at: https://naturalresources.wales/media/682845/afon-teifi-river-teifi-management-plan.pdf.

NRW, 2022b. Core Mangement Plan including Conservation Objectives for Afon Tywi / River Tywi SAC. NRW. [Online]. Available at: https://naturalresources.wales/media/670732/afon_tywi_-_man-plan-english.pdf.

NRW, 2022c. Core Managment Planincluding Conservation Objective for Afon Wysg / River Usk SAC. NRW. [Online]. Available at: https://afonyddcymru.org/wp-content/uploads/2022/11/river_usk-sac-core-plan.pdf.

NRW, 2022d. Core Management Plan Including Conservation Objectives for Afonydd Cleddau / Cleddau Rivers SAC. NRW. [Online]. Available at: https://naturalresources.wales/media/682866/afonydd-cleddau-plan-english.pdf.

NRW, 2022e. NRW's position on the use of Marine Mammal Management Units for screening and assessment in Habitats Regulations Assessments for Special Areas of Conservation with marine mammal features. Reference number: PS006. [Online]. Available at: https://naturalresources.wales/media/695250/ps006-mmmus-in-hra-position-statement-may22.pdf.

NRW, 2022. NRWs position on determining Adverse Effect on Site Integrity for marine mammal site features in Wales in relation to potential anthropogenic removals (mortality) from marine developments. PS013 Mammal mortality AEOSI Postotopn Statement Eng. [Online]. Available at: https://naturalresources.wales/media/695251/ps013-mammal-mortality-aeosi-position-statement-apr22.pdf.

NRW, 2023. NRW's position on assessing behavioural disturbance of harbour porpoise (*Phocoena Phocoena*) from underwater noise. NRW. [Online]. Available at: https://naturalresources.wales/media/696755/ps017-nrws-position-on-assessing-behavioural-disturbance-of-harbour-porpoise-phocoena-phocoena-from-underwater-noise-30.pdf.

NRW, 2023. NRW's Position on Assessing the effects of Hearing injury from underwater noise on marine mammals. NRW. [Online]. Available at: https://naturalresources.wales/media/696759/ps016-nrws-position-on-assessing-the-effects-of-hearing-injury-from-underwater-noise-on-marine-mammals-30.pdf.

Öhman, M. C., Sigray, P., and Westerberg, H., 2007. Offshore windmills and the effects of electromagnetic fields on fish. *AMBIO: A journal of the Human Environment,* 36(8), 630-634.

Onoufriou, J., Jones, E., Hastie, G., and Thompson, D., 2016. Investigations into the interactions between harbour seals (*Phoca vitulina*) and vessels in the inner Moray Firth. *Marine Scotland Science*, 7(15).

OSC, 2022. Literature review on barrier effects, ghost-fishing, and electromagnetic fields for floating windfarms. Literature Review No. 1, For Equinor ASA, by Ocean Science Consulting Ltd, Spott Road, Dunbar, Scotland, 99. [Online]. Available at: https://cdn.equinor.com/files/h61q9gi9/global/434c3452ed651ae8ac9d256794981145ce942334.pdf?osc-study-floating-windfarms-2022-equinor.pdf.

OSPAR, 2023. Environmental Impacts of Human Activites: Subsea Cables within the OSPAR Maritime Area: Background document on tachnical considerations and potential environmental impacts. OSPAR Commission.

Palka, D. L., and Hammond, P. S., 2001. Accounting for responsive movement in line transect estimates of abundance. *Canadian Journal of Fisheries and Aquatic Scientists,* 58(4),777-787.

Parvin, S., Nedwell, J., and Workman, R., 2006. Underwater noise impact modelling in support of the London Array, Greater Gabbard and Thanet offshore wind farm developments. Subacoustech Ltd..

Peltier, H., Beaufils, A., Cesarini, C., Dabin, W., Dars, C., Demaret, F., Dhermain, F., Doremus, G., Labach, H., Van Canneyt, O., and Spitz, J., 2019. Monitoring of Marine Mammal Strandings Along French Coasts Reveals the Importance of Ship Strikes on Large Cetaceans: A Challenge for the European Marine Strategy Framework Directive. *Frontiers in Marine Science,* 6, 486.

Pierce, G. J., Santos, M. B., Reid, R. J., Patterson, I. A. P., and Ross, H. M., 2004. Diet of minke whales Balaenoptera acutorostrata in Scottish (UK) waters with notes on strandings of this species in Scotland 1992–2002. *Journal of the Marine Biological Association of the United Kingdom,* 84(6), 1241–1244.

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., Lokkeborg, S., Rogers, P., Southall, B L., Zeddies, D., and Tavolga, W., 2014. ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea

Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. Cham, Switzerland: Springer and ASA Press.

Postlethwaite, B., 2010. Noise Quality Assessment Eastleigh River Side Project. Unpublished report by Bureau Veritas on behalf of Eastleigh Borough Council.

Postlethwaite, B., 2010. Noise Quality Assessment Eastleigh River Side Project.

Ransijn, J., 2022. Marine mammal predator-prey interactions in the North Sea. PhD Thesis, University of St Andrews. [Online]. Available at: https://research-repository.st-andrews.ac.uk/handle/10023/27182.

Ransome, R. D., 1996. The management of feeding areas for greater horseshoe bats. English Nature. [Online]. Available at: https://publications.naturalengland.org.uk/publication/152012.

Reijinders, P. J. H., Aguilar, A., and Borrell, A., 2009. Pollution and Marine Mammals. *Encylopedia of Marine Mammals (Second Edition).* 890-898.

Reynaud, S., and Deschaux, P., 2006. The effects of polycyclic aromatic hydrocarbons on the immune system of fish: A review. *Aquatic Toxicology,* 77(229-238).

Roberts, P. J., 1985. The Choughs of Bardsey. *British Birds,* 78, 217-232.

Robinson, S. P., Wang, L., Cheong, S., Lepper, P. A., Hartley, J. P., Thompson, P. M., Edwards, E. and Bellmann, M., 2022. Acoustic characterisation of unexploded ordnance disposal in the North Sea using high-order detonations. *Marine Pollution Bulletin,* 184.

Royal HaskoningDHV, 2023. Pembrokeshire Demonstration Zone Scoping Report. Celtic Seas Power Ltd..

Russell, D. J., Brasseur, S. M. J. M., Thompson, D., Hastie, G .D., Janik, V. M., McClintock, B. T., Mathiopoulos, J., Moss, S. E. W., and McConnell, B., 2014. Marine mammals trace anthropogenic structures at sea. *Current Biology,* 24, 638-R639.

Santos, M. B., and Pierce, G. J., 2003. The diet of harbour porpoise (*Phocoena phocoena*) in the northeast Atlantic. *Oceanography and Marine Biology,* 41, 355-390.

Scheidat, M., Tougaard, J., Brasseur, S., Cartensen,, J., Van Polenen Petel, T., Teilmann, J., and Reijnders, P., 2011. Harbour porpoises (*Phocoena phocoena*) and wind farms: a case study in the Dutch North Sea. *Environmental Research Letters,* 6(2).

Schoeman, R. P., Patterson-Abrolat, C., and Plön, S., 2020. A Global Review of Vessel Collisions With Marine Animals. *Frontiers in Marine Science,* 7, 292.

Schofield, H. W., 2008. The Lesser Horseshoe Bat Conservation Handbook.

SCOS, 2021. Scientific Advice on Matters Related to the Management of Sea Populations. [Online]. Available at: https://www.smru.st-andrews.ac.uk/files/2022/08/SCOS-2021.pdf.

SCOS, 2022. Scientific Advice on Matters Related to the Management of Seal Populations: 2022. Natural Environment Research Council Special Committee on Seals. [Online]. Available at: https://www.smru.st-andrews.ac.uk/files/2023/09/SCOS-2022.pdf.

SNCB, 2022. *Joint SNCB Interim Displacement Advice Note.* [Online]. Available at: https://data.jncc.gov.uk/data/9aecb87c-80c5-4cfb-9102-39f0228dcc9a/joint-sncb-interim-displacement-advice-note-2022.pdf.

Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. I., Gentry, R. L., Greene Jr., C. R., Katsak, 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. *Acoustics Today,* 33(4), 1-121.

Southall, B., Finneran, J. J., Reichmuth, C., Nachtigall, P. E., Ketten, D. R., Bowles, A. E., Ellison, W. T., Nowacek, D. P., and Tyack, P. L., 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals,* 45, 125-232.

Stone, E. L., Harris, S., and Jones, G., 2015. Impacts of artificial lighting on bats: A review of challenges and solutions. *Mammal Biology,* 80, 213-219.

Stone, E. L., Jones, G., and Harris, S., 2009. Street lighting disturbs commuting bats. *Current Biology,* 19, 1123-1127.

Stone, E. L., Jones, G., and Harris, S., 2012. Conserving energy at a cost to biodiversity? Impacts of LED lighting on bats. *Global Change Biology,* 18, 2458-2465.

Strong, P., and Morris, S. R., 2010. Grey seal (*Halichoerus grypus*) disturbance, ecotourism and the Pembrokeshire Marine Code around Ramsey Island. *Journal of Ecotourism,* 9(2), 117-132.

Taormina, B., Bald, J., Want, A., Thouzeau, G., Lejart, M., Desroy, M., and Carlier, A., 2018. A review of potential impacts of submarine power cables on the marine environment: Knowledge gaps, recommendations and future directions. *Renewable and Sustainable Energy Reviews,* 96, 380-391.

Taormina B., Quillien N., Lejart M., Carlier A., Desroy N., Laurans M., D'Eu J.-F., Reynaud M., Perignon Y., Erussard H., Derrien-Courtel S., Le Gal A., Derrien R., Jolivet A., Chauvaud S., Degret V., Saffroy D., Pagot J.-P. and Barillier A. Characterisation of the potential impacts of subsea power cables associated with offshore renewable energy projects. Plouzané: France Energies Marines Editions, 2020, 74 pages

Tetley, M. J., Mitchelson-Jacob, E. G., and Robinson, K. P., 2008. The summer distribution of coastal minke whales (*Balaenoptera acutorostrata*) in the southern outer Moray Firth, NE Scotland, in relation to co-occurring mesoscale oceanographic features. *Remote Sensing of Environment,* 112(8), 3449-3454.

The Crown Estate, 2024. Celtic Sea Floating Offshore Wind Leasing Round 5 Record of Habitats Regulations Assessment, London: The Crown Estate.

The Invasive Alien Species (Enforcement and Permitting) Order, 2019. [Online]. Available at: https://www.legislation.gov.uk/uksi/2019/527/contents.

The Planning Inspectorate, 2017. Advice Note Ten: Habitats Regulations Assessment relevant to nationally significant infrastructure projects. [Online]. Available at: https://www.gov.uk/government/publications/nationally-significant-infrastructure-projects-advice-note-ten-habitats-regulations-assessment-relevant-to-nationally-significant-infrastructure-pr/nationally-significant-infrastructure-projects-advice-note-ten-habitats-regulations-assessment-relevant-to-nationally-significant-infrastructure-pr.

The Planning Inspectorate, 2018. *Advice on the Rochdale Envelope.* [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/advice-note-nine-rochdale-envelope/.

The WiSe Scheme, 2018. *The WiSe Scheme: The UK's national training scheme for minimising disturbance to marine wildlife.* [Online]. Available at: https://www.wisescheme.org/.

Thompson, P. M., Graham. I. M., Cheney, B., Barton, T. R., Farcas, A., and Merchant, N. D., 2020. Balancing risks of injury and disturbance to marine mammals when pile driving at offshore windfarms. *Ecological Solutions and Evidence*, 1(12034).

Thorpe, R. I., and Young, A. J., 2009. *Chough Special Protection Areas in Wales.* Copuntryside Council for Wales, and RSPB.

University of Hull, 2013. Waterbird Disturbance Mitigation Toolkit – Informing estuarine planning & construction projects. Institute of Estuarine & Costal Studies, University of Hull.

van Langevelde, F., Ettema, J. A., Donners, M., and Groenengijk, D., 2011. Effect of spectral composition of artificial light on the attraction of moths. *Biological Conservation,* 144(9), 2274-2281.

Wade, H. M., Masden, E. A., Jackson, A. C., and Furness, R. W., 2016. Incorporating data uncertainty when estimating potential vulnerability of Scottish seabirds to marine renewable energy developments.. *Marine Policy,* 70, 108-113.

Westerberg, H., and Begout-Anras, M. L., 2000. Orientation of silver eel (*Anguilla anguilla*) in a disturbed geomagnetic field. A. Moore & I. Russell Advances in Fish Telemetry. Proceedings of the 3rd Conference on Fish Telemetry, 149-158.

Westerberg, H., and Langfelt, I., 2008. Sub-sea power cables and the migration behaviour of the European eel. *Fisheries Management and Ecology,* 15, 369-375.

White Cross, 2023. White Crooss Offshore Windfarm Environemntal Statement, Chapter 6: Environmental Impact Assessment Methology. White Cross. [Online]. Available at: https://whitecrossoffshorewind.com/wp-content/uploads/2023/09/FLO-WHI-REP-0002-06-Chapter-6-EIA-Methodology.pdf.

Whitehead, S., Johnstone, I., and Wilson, J., 2005. Choughs Pyrrhocorax pyrrhocorax breeding in Wales select foraging habitat at different spatial scales. *Bird Study,* 5(2), 193-203.

WHO, 2000. Air Quality Guidelines for Europe - Second Edition. WHO Regional Publications, European Series, No. 91. [Online]. Available at:

Whyte, K. F., Russel, D. J. F., Sparling, C. E., Binnerts, B., and Hastie, G. D., 2020. Estimating the effects of pile driving sounds on seals: Pitfalls and possibilities. *The Journal of the Acoustical Society of America,* 147, 3948-3958.

Wilson, S. C., 2014. *The impact of human disturbance at seal haul-outs. A literature review for the Seal Conservation Society.* [Online]. Available at: https://www.sealsanctuary.co.uk/apdf/sealconservationsociety2014.pdf.

Wolseley, P. A., James, P. W., Theobald, M. R., and Sutton, M. A., 2006. Detecting changes in epiphytic lichen communities at sites affected by atmospheric ammonia from agricultural sources. *Lichenologist,* 38, 161-176.

Wyman, M. T., Klimley, A., Battleson, R., Agosta, T., Chapman, E., Haverkamp, P., Pagel, M., Kavet, R., 2018. Behavioral responses by migrating juvenile salmonids to a subsea high-voltage DC power cable. *Marine Biology,* 165, 1-15.