# Morlais Project
# Environmental Statement

# Chapter 11: Marine Ornithology

# Volume I

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## GLOSSARY OF ABBREVIATIONS

| Acronym | Term |
|---|---|
| BDMPS | Biologically Defined Minimum Population Size |
| BoCC | Birds of Conservation Concern |
| CEMP | Construction and Environment Management Plan |
| CFP | Common Fisheries Policy |
| CIEEM | Chartered Institute of Ecology and Environmental Management |
| CPGR | Counterfactual of Population Growth Rate |
| CPS | Counterfactual of Population Size |
| CRM | Collision Risk Modelling |
| DECC | Department of Energy and Climate Change |
| ECC | Export Cable Corridor |
| EcIA | Ecological Impact Assessment |
| EIA | Environmental Impact Assessment |
| EMEC | European Marine Energy Centre |
| ERM | Encounter Rate Modelling |
| ES | Environmental Statement |
| EU | European Union |
| JNCC | Joint Nature Conservation Committee |
| MDZ | Morlais Development Zone |
| MMO | Marine Management Organisation |
| MW | Megawatt |
| NERC | Natural Environment and Rural Communities |
| NPS | National Policy Statement |
| NRW | Natural Resources Wales |
| NSIP | Nationally Significant Infrastructure Project |
| OfDA | Offshore Development Area |
| PVA | Population Viability Analysis |
| RSPB | Royal Society for the Protection of Birds |
| SAC | Special Area of Conservation |
| SMP | Seabird Monitoring Programme |
| SNH | Scottish Natural Heritage |
| (p)(d)SPA | (proposed) (draft) Special Protection Area |
| SSSI | Site of Special Scientific Interest |
| TEC | Tidal Energy Converter |
| TWG | Technical Working Group |
| UK SNCBs | United Kingdom Statutory Nature Conservation Bodies |
| ZoI | Zone of Influence |

## GLOSSARY OF TERMINOLOGY

| | |
|---|---|
| Density dependent | Where population growth rates are regulated by the density of a population. |

| | |
|---|---|
| Density independent | Where the growth of a population does not depend on the population density. |
| Deterministic | Where the values for the dependent variables of the system are completely determined by the parameters of the model. |
| Offshore Development Area | Morlais Demonstration Zone (MDZ) and Export Cable Corridor (ECC) combined. |
| Stochastic | Having a random probability distribution or pattern that may be analysed statistically but may not be predicted precisely. |

# 11. MARINE ORNITHOLOGY

## 11.1. INTRODUCTION

1. This chapter of the Environmental Statement (ES) considers the potential impacts of the proposed Morlais project (the Project) on marine ornithology. It provides an overview of the existing baseline environment in respect to marine ornithology within a Zone of Influence (ZoI) around relevant elements of the Project. An Ecological Impact Assessment (EcIA) of the potential impacts of construction, operation / repowering, and decommissioning of the Project based on this baseline environment is then provided. This EcIA also considers transboundary impacts and cumulative impacts of existing and proposed projects in respect of marine ornithology.

2. The Project also has the potential to impact terrestrial ecology, marine mammals and fish receptors. These potential impacts are covered in **Chapter 19, Onshore Ecology** (which also covers terrestrial ornithology), **Chapter 9, Benthic and Intertidal Ecology**, **Chapter 10, Fish and Shellfish Ecology** and **Chapter 12, Marine Mammals**. A range of indirect impacts on marine ornithology receptors are possible; information from Chapter 9, Chapter 10 and Chapter 12 has been used to support assessments of those impacts where relevant.

3. This chapter has been prepared by Royal HaskoningDHV, supported by two years of boat-based ornithological surveys undertaken for the Project by Natural Power.

4. A Habitats Regulations Assessment (HRA) has also been compiled separately to determine whether the Project has the potential to have an adverse effect on the integrity and features of Natura 2000 sites (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**).

## 11.2. POLICY, LEGISLATION AND GUIDANCE

### 11.2.1. Legislation

5. An overview of the relevant legislative context for the Project is provided in **Chapter 2, Policy and Legislation**.

6. Legislation relevant to marine ornithology is identified in **Table 11-1** along with a summary of relevant measures derived from it.

**Table 11-1 Summary of Legislation and Relevant Measures**

| Legislation | Relevant Measures |
|---|---|
| Birds Directive - Council Directive 2009/147/EC on the Conservation of Wild Birds | This Directive provides a ‘General System of Protection’ for all species of naturally occurring wild birds in the EU. The most relevant provisions of the Directive are the identification and classification of Special Protection Areas (SPAs) for rare or vulnerable species listed in Annex I of the Directive and for all regularly occurring migratory species (required by Article 4). It also establishes a general scheme of protection for all wild birds (required by Article 5). The Directive requires national Governments to establish SPAs and to have in place mechanisms to protect and manage them. The SPA protection procedures originally set out in Article 4 of the Birds Directive have been replaced by the Article 6 provisions of the Habitats Directive.<br>The UK has triggered article 50 of the Treaty of European Union and is currently in the process of withdrawing from the European Union (EU). Recent UK Government Guidance |

| Legislation | Relevant Measures |
|---|---|
| | (September 2018) states that 'The EU Withdrawal Act 2018 will ensure all existing EU environmental law continues to operate in UK law, providing businesses and stakeholders with certainty as we leave the EU.' |
| Wildlife and Countryside Act 1981, as amended | The Wildlife and Countryside Act 1981 (as amended) is the principal mechanism for the legislative protection of wildlife in Great Britain. It provides protection for all species of wild birds and their nests and establishes the system of Sites of Special Scientific Interest (SSSI). |
| The Conservation of Habitats and Species Regulations 2017 | The Conservation of Habitats and Species Regulations 2017 (hereafter called the 'Habitats Regulations'), transposes the Birds Directive and the Habitats Directive into national law in the onshore environment and territorial waters out to 12 nautical miles, operating in conjunction with the Wildlife and Countryside Act 1981. The Habitats Regulations place an obligation on 'competent authorities' to carry out an appropriate assessment of any proposal likely to affect a SAC or SPA, to seek advice from Statutory Nature Conservation Bodies (SNCBs), in this case Natural Resources Wales (NRW), and to not approve an application that would have an adverse effect on the integrity of a SAC or SPA (except under very tightly constrained conditions). |
| The Environment (Wales) Act 2016 | This Act replaces Section 40 and Section 42 in the Natural Environment and Rural Communities (NERC) Act 2016. It enables the planning and management of Wales' natural resources in a more proactive, sustainable and joined up way.<br>The Section 7 List of Species and Habitats of Principal Importance for Conservation of Biological Diversity in Wales is used as an input to determine the value of marine ornithology receptors. |
| The Wellbeing of Future Generations (Wales) Act 2015 | The Act establishes seven wellbeing goals, the second of which "A resilient Wales" is described as "*A nation that maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change)*." |

### 11.2.2. Guidance

7. The impact assessment has been prepared with reference to the following guidance:

- CIEEM, 2018. Guidelines for Ecological Impact Assessment in the UK and Ireland. CIEEM, Winchester (CIEEM, 2018);
- SNH, 2016. Assessing collision risk between underwater turbines and marine wildlife (Guidance note). Scottish Natural Heritage (SNH, 2016); and
- UK SNCBs, 2017. Joint SNCB Interim Displacement Advice Note: Advice on how to present assessment information on the extent and potential consequences of seabird displacement from offshore wind farm developments (UK SNCBs, 2017).

### 11.2.3. Policies and Plans

8. National (UK and Wales) planning policy relevant to marine ornithology is identified in **Table 11-2** along with a summary of relevant measures derived from it.

**Table 11-2 Summary of National (UK and Wales) Policies, Plans and Relevant Measures**

| Legislation | Relevant Measures |
|---|---|
| Overarching National Policy Statement (NPS) for Energy (NPS | Paragraph 5.3.3 states that the Applicant should ensure that the ES clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. |

| Legislation | Relevant Measures |
|---|---|
| EN-1) (July 2011) | Paragraph 5.3.4 states that the Applicant should also show how the proposed Project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests. Paragraph 5.3.18 states that the Applicant should include appropriate mitigation measures as an integral part of the proposed development. |
| National Policy Statement for Renewable Energy Infrastructure (NPS EN-3) (July 2011) | EN-3, taken together with the Overarching National Policy Statement for Energy (EN-1), provides the primary basis for decisions by the Infrastructure Planning Commission (IPC) on applications it receives for nationally significant renewable energy infrastructure. Paragraph 1.2.2. states that Applicants should, therefore, ensure that their applications and any accompanying supporting documents and information are consistent with the instructions and guidance in this NPS (EN-3), EN-1 and any other NPSs that are relevant to the application in question. |
| Planning Policy Wales (updated periodically) | The Welsh Government's objectives for conserving and improving the natural environment are: promote the conservation of landscape and biodiversity, in particular the conservation of native wildlife and habitats, ensure that action in Wales contributes to meeting international responsibilities and obligations for the natural environment, ensure that statutorily designated sites are properly protected and managed, safeguard protected species, and promote the functions and benefits of soils, and in particular their function as a carbon store'<br>There is a clear requirement for pre-planning consent consultation with Natural Resources Wales (NRW) where a planning application or proposal may be 'likely to have a significant effect on sites of more than local importance or on a designated area' or would be 'likely to result in disturbance or harm to a protected species.'<br>Pre-application discussions are recommended for any development proposal likely to have an effect on the wildlife of a given area whether designated or not. For example, paragraph 5.5.1 identifies that the effect of a development proposal on the wildlife 'of any area can be a material consideration' and that 'in such instances and in the interests of achieving sustainable development it is important to balance conservation objectives with the wider economic needs of local business and communities.' There is a requirement for development proposals to include reasonable steps to safeguard or enhance the environmental quality of the land should development take place.<br>Planning Policy Wales requires local planning authorities to 'have regard to the relative significance of international, national and local designations in considering the weight to be attached to nature conservation interests and should take care to avoid placing unnecessary constraints on development.' Statutory designations do not necessarily prohibit development taking place, however, paragraph 5.5.5 states that development proposals 'must be carefully assessed for their effect' on the interests for which the designation is made.<br>There is a presumption against development that is likely to damage a SSSI and it is noted that SSSIs can be damaged by developments that lie either within or beyond the SSSI boundaries and that this could be 'some distance away.' There is specific reference to the duty on all public bodies under the Wildlife and Countryside Act 1981 (as amended by the Countryside Rights of Way Act 2000) to further conserve and enhance the features and reasons for a SSSI being of special interest in the exercise of public body functions which includes local planning authorities.<br>Paragraph 5.4.4. acknowledges that non-statutory designations carry less weight than statutory designations and that at a policy level, local authorities are required to be clear that a non-statutory designation does not 'preclude appropriate socio-economic activities' and if certain features or component characteristics of sites specifically need to be conserved and, as such, require additional protection, this should be explained at a policy level.<br>Species protected under European or UK legislation are identified as a material consideration when considering a development proposal where protected species are present and if the development would 'be likely to result in disturbance or harm to the species or its habitat.' The potential need for ecological survey and assessment of likely |

| Legislation | Relevant Measures |
| --- | --- |
| | impact of a proposed development on a protected species to inform planning decisions is highlighted in paragraph 5.5.11. |
| TAN-5- Nature Conservation and Planning | Technical Advice Note (TAN) 5 supplements Planning Policy Wales and provides advice about how the land use planning system in Wales 'should contribute to protecting and enhancing biodiversity and geological conservation.'<br>The TAN provides guidance to local planning authorities on: 'the key principles of positive planning for nature conservation; nature conservation and Local Development Plans; nature conservation in development management procedures; development affecting protected internationally and nationally designated sites and habitats; and, development affecting protected and priority habitats and species.'<br>In section 2.4 when deciding planning applications that may affect nature conservation, 'local authorities should contribute to the protection and improvement of the environment…seeking to avoid irreversible harmful effects on the natural environment; ensure that appropriate weight is attached to designated sites of international, national and local importance; protect wildlife and natural features in the wider environment, with appropriate weight attached to priority habitats and species in Biodiversity Action Plans; ensure that all material considerations are taken into account and decisions are informed by adequate information about the potential effects of a development on nature conservation; ensure that the range and population of protected species is sustained; and adopt a stepwise approach to avoid harm to nature conservation, minimise unavoidable harm by mitigation measures, offset residual harm by compensation measures and look for new opportunities to enhance nature conservation; where there may be significant harmful effects local planning authorities will need to be satisfied that any reasonable alternative sites that would result in less or no harm have been fully considered.'<br>At section 3.3.2 regarding Local Development Plans policies the guidance states that a policy should be included in respect of the application of the precautionary principle.<br>Section 4 includes specific and detailed guidance, expanding on the principles set out in 2.4, in respect of the development control process including pre-application discussions, preparing planning applications, requests for further information and ecology in respect of EIA. The broad principles of development control requirements are set out as follows: 'adopting the five-point approach to decision-making – information, avoidance, mitigation, compensation and new benefits; ensuring that planning applications are submitted with adequate information, using early negotiation, checklists, requiring ecological surveys and appropriate consultation; securing necessary measures to protect, enhance, mitigate and compensate through planning conditions and obligation; carrying out effective planning enforcement; and identifying ways to build nature conservation into the design of new development.' |
| Renewable Energy Policy Wales | The 2012 Welsh Government policy document, Energy Wales: A Low Carbon Transition, updated in 2016, outlines the Welsh Government's approach to utilising the marine environment for renewable energy deployment. The Policy includes the following aim:<br>"*we want to carefully plan and manage the relationship between energy development and our natural environment in line with the ambition of 'Sustaining a Living Wales'.*" |
| UK Post-2010 Biodiversity Framework | The 'UK Post-2010 Biodiversity Framework' succeeds the UK Biodiversity Action Plan. The Framework demonstrates how the work of the four countries and the UK contributes to achieving the Aichi Biodiversity Targets, and identifies the activities required to complement the country biodiversity strategies in achieving the targets. |
| UK Marine Policy Statement (MPS) | New systems of marine planning are being introduced in the UK. The MPS, adopted under section 44 of the Marine and Coastal Access Act 2009, is the framework for developing and implementing regional Marine Plans. It will contribute to the achievement of sustainable development in the United Kingdom marine area. High level objectives are for the protection, conservation and where appropriate recovery of biodiversity; healthy, resilient and adaptable marine and coastal ecosystems across their natural range; and oceans supporting viable populations of representative, rare, vulnerable and valued species. |

| Legislation | Relevant Measures |
|---|---|
| Natural Environment White Paper 2011 | The paper was the first White Paper produced by the government in 20 years. The paper contains plans to reconnect nature, connect people and nature for better quality of life and capture and improve the value of nature. |
| A Green Future: Our 25 Year Plan to Improve the Environment 2018 | The plan sets out 10 goals and a range of high-level policies aimed at helping "*the natural world regain and retain good health*". The key policies within the plan relevant for this chapter are:<br>Embedding an 'environmental net gain' principle for development, including housing and infrastructure;<br>Protecting and recovering nature (including improving biosecurity to protect and conserve nature). |

9. **Table 11-3** sets out the Marine Policy Statement (MPS) and draft Welsh National Marine Plan (WNMP) policies which are particularly relevant to Marine Ornithology.

**Table 11-3 National l Policy Requirements Relevant to Marine Ornithology**

| Policy Description | Reference | ES Reference |
|---|---|---|
| **MPS** | | |
| Renewable energy developments can potentially have adverse impacts on marine fish and mammals, primarily through construction noise and may displace fishing activity and have direct or indirect impacts on other users of the sea, including mariners. Certain bird species may be displaced by offshore wind turbines, which also have the potential to form barriers to migration or present a collision risk for birds. Their foundation designs are likely to have an effect on hydrodynamics and consequent sediment movement. This includes potential scouring of sediments around the bases of turbines. These and other potential adverse impacts, together with potential mitigation measures, are considered in the National Policy Statement for Renewable Energy Infrastructure (EN-3). | Section 3.3.24 | Potential impacts of displacement, collision risk and entanglement are discussed in **Sections 11.6.4.2**, **11.6.5.3** and **11.6.5.4.** |
| Marine energy deployments, that is wave and tidal deployments, may pose potential risks to the environment if inappropriately sited. However, the level of risk and ecological significance is largely unknown since, in particular, tidal stream and wave technologies are at a relatively early stage of development. Studies of tidal range technologies, including barrages, have indicated that these structures can have adverse impacts on migratory fish and bird species and on the hydrodynamics of the estuarine environments in which they are situated.<br>To underpin the marine planning process further research is needed to develop a better understanding of the potential impacts that marine technologies might have on potentially sensitive environmental features. For example, adaptation and mitigation methods for such impacts may be supported by detailed monitoring programmes and co-ordinated research initiatives, including post deployment of devices. | Section 3.3.25 | The potential significance of displacement of birds from the Project site is assessed in **Section 11.6.5.1**. |
| **Draft WNMP** | | |
| Proposals should demonstrate how they: · avoid adverse impacts on individual Marine Protected Areas (MPAs) and | ENV_02: Marine Protected Areas | The conservation statuses of bird species |

| Policy Description | Reference | ES Reference |
|---|---|---|
| the coherence of the network as a whole; · have regard to the measures to manage MPAs; and · avoid adverse impacts on non-marine designated sites. | | present within the MDZ are presented in **Table 11-9**. Information to Support an HRA is provided in **Document MOR/RHDHV/DOC/0067, Information to Support HRA**. |
| Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged. | GOV_01: Cumulative effects | Cumulative impacts are assessed in **Section 11.6.7** and in **Chapter 26** |

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

- Overarching NPS for Energy (EN-1);
- NPS for Renewable Energy Infrastructure (EN-3); and
- NPS for Electricity Networks Infrastructure (EN-5) (DECC, 2011c).

11. Although NPS EN-3 states "*this NPS does not cover other types of renewable energy generation that are not at present technically viable over 50 MW onshore or over 100 MW offshore such as schemes that generate electricity from tidal stream or wave power*", the relevant requirements of EN-3 have been referred to until a revision to this NPS or a separate NPS is provided for tidal range schemes greater than 100 MW.

12. The specific assessment requirements for marine ornithology, as detailed in NPS EN-1 and EN-3, are summarised in **Table 11-4**, together with an indication of the paragraph numbers of the chapter where each is addressed. Where any part of the NPS has not been followed within the assessment, an explanation as to why the requirement was not deemed relevant, or has been met in another manner, is provided.

**Table 11-4 NPS EN-1 and EN-3 Assessment Requirements**

| EN-1 and EN-3 Assessment Requirements | NPS Reference | ES Reference |
|---|---|---|
| 'Where the development is subject to EIA [Environmental Impact Assessment] the applicant should ensure that the ES [Environmental Statement] clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on | **NPS EN-1 Section 5.3 Paragraph 5.3.3** | **Section 11.6** |

| EN-1 and EN-3 Assessment Requirements | NPS Reference | ES Reference |
|---|---|---|
| protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the Infrastructure Planning Commission (IPC) consider thoroughly the potential effects of a proposed project.' | | |
| 'The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests.' | **NPS EN-1 Section 5.3 Paragraph 5.3.4** | **Section 11.6** |
| 'When considering the application, the IPC will have regard to the Government's biodiversity strategy as (sic) set out in 'Working with the grain of nature', which aims to halt or reverse declines in priority habitats and species; accept the importance of biodiversity to quality of life. The IPC will consider this in relation to the context of climate change.<br>As a general principle, and subject to the specific policies below, development should aim to avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives (as set out in section 4.4 above); where significant harm cannot be avoided, then appropriate compensation measures should be sought.<br>In taking decisions, the IPC should ensure that appropriate weight is attached to designated sites of international, national and local importance; protected species; habitats and other species of principal importance for the conservation of biodiversity; and to biodiversity and geological interests within the wider environment.' | **NPS EN-1 Section 5.3 Paragraph 5.3.5-5.3.8** | **Table 11-12**, **Section 11.6** |
| 'The IPC will have the same regard to potential Special Protection Areas (pSPAs) and Ramsar sites as those sites identified through international conventions and European Directives.' | **NPS EN-1 Section 5.3 Paragraph 5.3.9** | **Document MOR/RHDHV/DOC/0067, Information to Support HRA** |
| 'Many SSSIs are also designated as sites of international importance and will be protected accordingly. Those that are not, or those features of SSSIs not covered by an international designation, should be given a high degree of protection.' | **NPS EN-1 Section 5.3 Paragraph 5.3.10** | **Table 11-12** |
| 'Where a proposed development on land within or outside an SSSI is likely to have an adverse effect on an SSSI (either individually or in combination with other developments), development consent should not normally be granted.<br>Where an adverse effect, after mitigation, on the site's notified special interest features is likely, an exception should only be made where the benefits (including need) of the development at this site, clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest and any broader impacts on the national network of SSSIs.' | **NPS EN-1 Section 5.3 Paragraph 5.3.11** | **Table 11-12**, **Section 11.6** |
| 'The IPC will have regard to sites of regional and local biodiversity and geological interest, which include Regionally Important Geological Sites, Local Nature Reserves and Local Sites when considering applications | **NPS EN-1 Section 5.3 Paragraph 5.3.13** | **Table 11-12**, **Section 11.6** |

| EN-1 and EN-3 Assessment Requirements | NPS Reference | ES Reference |
|---|---|---|
| since they are recognised to have a fundamental role in meeting overall national biodiversity targets.’ | | |
| The applicant should include appropriate mitigation measures as an integral part of the proposed development and demonstrate that:<br>▪ During construction, they will seek to ensure that activities will be confined to the minimum areas required for the works;<br>▪ During construction and operation best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements;<br>▪ Habitats will, where practicable, be restored after construction works have finished; and<br>▪ Opportunities will be taken to enhance existing habitats and, where practicable, to create new habitats of value within the site landscaping proposals. | **NPS EN-1 Section 5.3 Paragraph 5.3.18** | **Section 11.6** |
| ‘The scope, effort and methods required for ornithological surveys should have been discussed with the relevant statutory advisor’. | **NPS EN-3 Section 2.6 Paragraph 2.6.102** | **Section 11.3** |
| ‘Relevant data from operational offshore wind farms should be referred to in the applicant’s assessment’. | **NPS EN-3 Section 2.6 Paragraph 2.6.103** | **Section 11.4.2 and 11.4.3** |
| ‘It may be appropriate for assessment to include collision risk modelling for certain species of birds. Where necessary, the assessments carried out by applicants should assess collision risk using survey data collected from the site at the pre-application EIA stage. The IPC will want to be satisfied that the collision risk assessment has been conducted to a satisfactory standard having had regard to the advice from the relevant statutory advisor’. | **NPS EN-3 Section 2.6 Paragraph 2.6.104** | **Appendix 11.3 (Volume III)** |
| ‘Aviation and navigation lighting should be minimised to avoid attracting birds, taking into account impacts on safety’. | **NPS EN-3 Section 2.6 Paragraph 2.6.107** | **Section 11.6.4 and 11.6.5** |
| ‘Subject to other constraints, wind turbines should be laid out within a site, in a way that minimises collision risk, where the collision risk assessment shows there is a significant risk of collision’. | **NPS EN-3 Section 2.6 Paragraph 2.6.108** | **Section 11.6.5.3** |
| ‘Construction vessels associated with offshore wind farms should, where practicable and compatible with operational requirements and navigational safety, avoid rafting seabirds during sensitive periods’. | **NPS EN-3 Section 2.6 Paragraph 2.6.109** | **Section 11.6.4. and 11.6.5** |
| ‘The exact timing of peak migration events is inherently uncertain. Therefore, shutting down turbines within migration routes during estimated peak migration periods is unlikely to offer suitable mitigation’. | **NPS EN-3 Section 2.6 Paragraph 2.6.110** | **Section 11.6.5.3** |

13. The Project onshore electrical infrastructure falls within the Isle of Anglesey County Council local authority boundaries. **Table 11-5** provides details of the local planning policy documents and the relevant policies in respect of marine ornithology.

**Table 11-5 Joint Local Development Plan (Anglesey and Gwynedd) Relevant Policy and Guidance Requirements**

| Policy/Guidance | Policy/Guidance Purpose |
|---|---|
| Policy ISA 4: Safeguarding Existing Open Space | To protect open spaces as an invaluable amenity resource |
| Policy AND 3: Other Renewable Energy and Low Carbon Technologies | Proposals for renewable and low carbon energy technologies, other than wind or solar, which contribute a low carbon future will be permitted, provided that the proposal conforms to the following criteria… "All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced". |
| Strategic Policy PS 19: Conserving and where appropriate enhancing the Natural Environment | The Councils will manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline, and proposals that have a significant adverse effect on them will be refused unless the need for and benefits of the development in that location clearly outweighs the value of the site or area and national policy protection for that site and area in question. When determining a planning application, consideration will need to be given to the following:<br>1. Safeguard the Plan area's habitats and species, geology, history, the coastline and landscapes;<br>2. Protect or where appropriate enhance sites of international, national, regional and local importance and, where appropriate, their settings in line with National Policy;<br>3. Have appropriate regard to the relative significance of international, national or local designations in considering the weight to be attached to acknowledged interests, ensuring that any international or national responsibilities and obligations are fully met in accordance with National Policy;<br>4. Protect or enhance biodiversity within the Plan area and enhance and/or restore networks of natural habitats in accordance with the Local Biodiversity Action Plans and Policy AMG 5;<br>5. Protect or enhance biodiversity through networks of green/ blue infrastructure;<br>6. Safeguard internationally, nationally and locally protected species;<br>7. Protect, retain or enhance the local character and distinctiveness of the individual Landscape Character Areas (in line with Policy AMG 2) and Seascape Character Areas (in line with Policy AMG 4);<br>8. Protect, retain or enhance trees, hedgerows or woodland of visual, ecological, historic cultural or amenity value |
| Policy AMG 4: Coastal Protection | In considering a proposal on the coast, including the Heritage Coast, there will be a need to ensure that the proposal conforms to the following criteria:-… It does not cause unacceptable harm to:.. "the area's biodiversity interests (including European Protected Areas such as marine Special Areas of Conservation and Special Protected Areas) due to their location, scale, form, appearance, materials, noise, or emissions or due to an unacceptable increase in traffic…" |
| Policy AMG 5: Local Biodiversity Conservation | Proposals must protect and, where appropriate, enhance biodiversity that has been identified as being important to the local area by: |

| Policy/Guidance | Policy/Guidance Purpose |
|---|---|
| | Avoiding significant harmful impacts through the sensitive location of development.<br>. Considering opportunities to create, improve and manage wildlife habitats and natural landscape including wildlife corridors, stepping stones, trees, hedges, woodlands and watercourses.<br>A proposal affecting sites of local biodiversity importance will be refused unless they can conform with all of the following criteria:-<br>▪ That there are no other satisfactory alternative sites available for the development.<br>▪ The need for the development outweighs the importance of the site for local nature conservation;<br>▪ That appropriate mitigation or compensation measures are included as part of the proposal.<br>Where necessary, an Ecological Assessment which highlights the relevant local biodiversity issues should be included with the planning application. |
| Policy AMG 6: Protecting Sites of Regional or Local Significance | Proposals that are likely to cause direct or indirect significant harm to Local Nature Reserves (LNR), Wildlife Sites (WS) or regionally important geological / geomorphologic sites (RIGS) will be refused, unless it can be proven that there is an overriding social, environmental and/or economic need for the development, and that there is no other suitable site that would avoid having a detrimental impact on sites of local nature conservation value or local geological importance.<br>When a development is granted, it will be necessary to ensure that there are appropriate mitigation measures in place. It will be possible to use planning conditions and/or obligations in order to safeguard the site's biodiversity and geological importance. |

## 11.3. CONSULTATION

14. An extensive consultation process has occurred prior to and during the preparation of this chapter. This is summarised in **Table 11-6**, with greater detail provided in **Table 11-7**.

**Table 11-6 Summary of Consultation Responses**

| Consultee | Date | Document/Meeting | Agenda/Comments |
|---|---|---|---|
| Natural Resources Wales (NRW) and Sea Mammal Research Unit (SMRU) | 16/06/2016 | Project overview and PDE | Advice fed into production of 2017 scoping report |
| RSPB (Royal Society for the Protection of Birds) | 17/06/2016 | Project overview and PDE | Advice fed into production of 2017 scoping report |
| NRW | 02/08/2016 | Seabird and marine mammal survey scope | Advice letter fed into development of survey scopes for seabirds and marine mammals |
| NRW | 24/05/2017 | Project update and proposed new consenting route | Project update, summary of survey work undertaken to date, no substantive feedback |

| Consultee | Date | Document/Meeting | Agenda/Comments |
|---|---|---|---|
| RSPB | 26/05/2017 | Project update and proposed new consenting route | Project update, summary of survey work undertaken to date, no substantive feedback |
| Isle of Anglesey County Council (IoACC) | 14/06/2017 | Scoping Opinion | Advice fed into EIA process |
| Welsh Government (WG)/NRW | 11/07/2018 | Scoping Opinion | Advice fed into EIA process |
| NRW | 29/09/2017 | Update on progress with bird surveys, discussion regarding further survey effort | Feedback built into the EIA approach for **Chapter 11, Marine Ornithology**. |
| RSPB | 13/12/2017 | Update on progress with bird surveys | Feedback built into the EIA approach for **Chapter 11, Marine Ornithology**. |
| RSPB | 24/01/2018 | Project update | Project update, no substantive feedback |
| NRW | 13/12/2018 | TWG First Meeting | Assessment Approach<br>▪ Project background (recap)<br>▪ Review of project design envelope<br>▪ Species, conservation sites and populations to be included<br>▪ Appropriate spatial scale for assessment<br>▪ Review species parameters and vulnerability by species/group:<br>  ▪ Above water<br>  ▪ Submerged<br>  ▪ Foraging distances<br>▪ Approach to CRM/ERM<br>  ▪ Appropriate avoidance rates<br>▪ Potential Biological Removal<br>▪ Approach to assessment / potential impacts<br>▪ Cumulative assessment<br>▪ Summary |
| NRW | 19/02/2019 | TWG Second Meeting | Assessment Parameters<br>▪ Overview of Collision Risk Modelling (CRM) and Encounter Rate Modelling (ERM):<br>▪ Methods, limitations, interpretation, role in EIA<br>▪ Device parameters and overview of modelling scenarios<br>▪ Bird input parameters (densities and diving behaviour) and sources of information<br>▪ Avoidance rates |

| Consultee | Date | Document/Meeting | Agenda/Comments |
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| | | | ▪ Presentation and review of preliminary results<br>▪ Plans for future work<br>▪ Obtaining feedback on work already undertaken and planned |
| RSPB | 17/04/2019 | RSPB Project update | Key EIA elements presented:<br>▪ Key species distribution predicted based on baseline surveys and other existing data<br>▪ Disturbance at breeding sites<br>▪ Collision – models, parameters, avoidance rates, data sources – No outputs as yet<br>▪ Population Viability Analysis (PVA) – No outputs as yet<br>▪ Habitats Regulations Assessment screening – preliminary outcomes only<br>▪ Terrestrial Ornithology EIA Key points<br>▪ Chough distribution<br>▪ Disturbance at breeding sites<br>▪ HRA screening – preliminary outputs<br>Key marine ornithology impacts covered in call:<br>▪ Airborne noise and visual disturbance<br>▪ Disturbance at breeding sites<br>▪ Collison risk |
| NRW | 03/05/2019 | TWG Third Meeting | Updated on:<br>▪ Device parameters and grouping<br>▪ ERM/CRM<br>▪ Apportioning<br>▪ Non-breeding season guillemot data<br>▪ Uncertainty around diving behaviour<br>▪ PVA for razorbill and guillemot<br>▪ EIA approach update<br>▪ Airborne noise and visual disturbance<br>▪ Monitoring approach<br>▪ HRA<br>▪ Terrestrial ornithology |
| RSPB | 31/05/2019 | RSPB Project update | Issues discussed included:<br>▪ Deployment strategy<br>▪ EIA overview<br>▪ Airborne noise and visual disturbance<br>▪ Collision risk<br>▪ PVA<br>▪ Monitoring post consent |

| Consultee | Date | Document/Meeting | Agenda/Comments |
|---|---|---|---|
| | | | ▪ HRA<br>▪ Onshore ornithology<br>▪ Seascape, Landscape and Visual Impact Assessment (SLVIA) |

**Table 11-7 Detailed Consultation Responses**

| Consultee | Date/Document | Comment | Response |
|---|---|---|---|
| NRW | First TWG Meeting December 2018 | NRW agrees in principle with the list of species to be included in the assessment, but we would need to see the raw data from the two years' worth of survey undertaken. | Whilst not part of this chapter, this has been issued to NRW for review and included in processed form within **Appendices 11.1 and 11.2** (**Volume III**). |
| NRW | First TWG Meeting December 2018 | We advise that the applicant could also use Wildfowl and Wetlands Trust (WWT) & European Seabirds At Sea (ESAS) combined data set, Future of the Atlantic Marine Environment (FAME), Biologically Defined Minimum Population Scales (BDMPS) and there will be various other papers and data sources available that show the movement of birds from sites. | The full list of data sources used during the assessment is presented in **Section 11.4**. |
| NRW | First TWG Meeting December 2018 | The applicant needs to consider not just HRA issues bit also EIA issues which will include SSSIs and which features are potentially affected | SSSIs are explicitly referred to in **Sections 11.2** and **11.4.4** and where appropriate, care has been taken to appropriately classify the value of such receptors according to this comment. |
| NRW | First TWG Meeting December 2018 | The list of potential impacts seems comprehensive although the potential impact of lighting on seabirds is missing. We recommend that this potential impact is included for assessment. | This has been considered in impact assessments for construction, operation / repowering and decommissioning in **Section 11.6**. |
| NRW | First TWG Meeting December 2018 | Here the applicant produces definitions for magnitude of effect. These may well not be applicable to sites, with magnitude of effect on an SPA being assessed by looking at the conservation objectives and SSSIs being looked at by levels of population for that SSSI. Also, the magnitude of change could well depend on the rarity of the population, in terms of its status in the UK, Europe or world. | The assignment of values of receptors in **Table 11-8** and **Table 11-10** has taken this comment into account. |

| Consultee | Date/Document | Comment | Response |
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| NRW | First TWG Meeting December 2018 | We believe that the mean- maximum distances provided in Thaxter *et al*. (2012) should be used as a coarse screening filter for sites in the breeding season and that data from papers and FAME/STAR should then be used to provide a more detailed look at where the birds come from. Furness (2015) should be used where applicable to try and allocate birds in non-breeding months. | This approach has been used where more recent information was not available. See **Table 11-11** |
| NRW | First TWG Meeting December 2018 | NRW believes that both the Encounter Rate Model (ERM) and the Collison Risk Model (CRM) should be used, similar to the approach being taken for the marine mammal work. | Noted, both models have been utilised within the assessment. These impacts are assessed in **Section 11.6.6.3** and further detail on the methodology is outlined in **Appendix 11.3** (**Volume III**). |
| NRW | First TWG Meeting December 2018 | NRW does not agree with the different groupings and would like to see more groups which may well have a similarity in the collision risk models. For instance, floating devices may have more contact with diving birds as closer to the surface. NRW feels that the groupings need further consideration. | Noted, the categorisation of devices has been updated and is shown in full in **Chapter 4, Project Description**. |
| NRW | Second TWG Meeting February 2019 | The SNH guidance, Page 3; 2.1 Encounter Rate Model; "states that the resulting encounter rate is expressed in terms of number of animals per month or year which would encounter a turbine." Therefore, month should be used. | Both ERM and CRM calculate a number of collisions per second, which can be multiplied up to any time period that requires assessment. To maximise ecological relevance, collision rates are presented for breeding and non-breeding seasons rather than by month. |
| NRW | Second TWG Meeting February 2019 | As stated in the SNH guidance document (2016); page 14, a range of avoidance rates should be applied to the results of both ERM and CRM to generate a range of estimates of potential collision rates. These are advised to be avoidance rates 0 %, 50 %, 90 %, 95 %, 98 % and 99 %. | Noted, the results of the ERM and CRM have been presented against this range of avoidance rates, with a further two added. (see **Section 11.6.6.3**) |
| NRW | Second TWG Meeting February 2019 | Where there isn't adequate data it is ok to use the correction factors in Stone *et al*. (1995) | Noted, Stone et al. (1995) have been used to correct on-sea species densities where relevant, as outlined in **Appendix 11.2** (**Volume III**). |

| Consultee | Date/Document | Comment | Response |
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| NRW | Second TWG Meeting February 2019 | However, we would like to see information concerning the model selection and also, as stated above, the applicant needs to consider and show how availability bias and watch time has been used. | Noted, information on the methodology is presented in **Appendix 11.3** (**Volume III**). |
| NRW | Second TWG Meeting February 2019 | Could the Guillemot and Razorbill be divided out before the distance analysis and then the correction factors for the area be used? This work should then be worked up into monthly/seasonal population estimates, for the entire development zone plus the buffer explaining how this was extrapolated from the densities and look at how the heterogeneity in densities may affect the estimate. | Area-specific correction factors have been used to generate densities for the entire development zone and 2 km buffer by relevant biological season for guillemot, razorbill and herring gull. These are presented in **Appendix 11.2** (V**olume III**), along with confidence intervals. Other species were not recorded sufficiently frequently during surveys to enable this to occur, so generic correction factors have been used instead. |
| NRW | Second TWG Meeting February 2019 | As stated previously, the applicant has left out a number of significantly large colonies for various species including some SSSIs. They will not be able to allocate birds to colonies until they have done a thorough review of this looking at the up to date data on the Seabird Monitoring Programme (SMP). | This comment has been addressed; see apportioning in **Table 11-11**. |
| NRW | Second TWG Meeting February 2019 | This vulnerability for Manx shearwater was worked out before Shoji's paper showed that Manx shearwaters do dive to greater depths than thought previously and therefore it should be considered to have a higher sensitivity than "Low". | Manx shearwaters have been classified as having medium sensitivity with respect to collision risk (**Section 11.6.6.3.2**). |
| NRW | Second TWG Meeting February 2019 | In terms of the CRM and ERM is the applicant looking at the density of gannets from flight (as gannets most often dive from flight for food) or from birds on the water, or a mixture of both? | Flying densities have been used for ERM/CRM for gannet. |
| NRW | Third TWG Meeting May 2019 | NRW advise that the applicant needs to look not just at Minesto but all other plans or projects that could have an additive effect on a site. | All appropriate plans and projects have been included in **Section 11.6.8**. |
| NRW | Third TWG Meeting May 2019 | Avoidance rates will be presented using the range outlined in SNH (2016). | Noted, the results of the ERM and CRM have been presented against this range of avoidance |

| Consultee | Date/Document | Comment | Response |
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| | | Outcomes of PVA indicate that avoidance of 99% and higher will be important based upon PVA for guillemot and razorbill. For other species lower values are indicated. | rates (see **Section 11.6.6.3**). PVA is included in **Appendix 11.3** (**Volume III**). |
| NRW | Third TWG Meeting May 2019 | NRW requested that all sites should be screened in initially and taken through to AA. | The HRA is presented in **Document MOR/RHDHV/DOC/0067** (**Information to Support HRA**). |
| NRW | Third TWG Meeting May 2019 | NRW raised the potential for active sonar to be used and advise that the applicant needs to consider whether other monitoring could also be available to be used. | A deployment and monitoring strategy will be produced for consultation with the SNCBs. |
| NRW | Third TWG Meeting May 2019 | RHDHV confirmed that an AA will be carried out for chough. | The HRA is presented in **Document MOR/RHDHV/DOC/0067** (**Information to Support HRA**). |
| Planning Inspectorate | Scoping Report 2018 | In accordance with Rule 16 of the EIA Regulations, the ES should provide a description of the likely significant transboundary effects, where relevant. | This is included within **Section 11.7**. |
| Planning Inspectorate | Scoping Report 2018 | It is recommended that the Applicant makes efforts to agree the relevant study areas with NRW and that they are appropriate to ensure any likely significant effects are identified in the ES. | These have been agreed with NRW throughout the TWG meetings. |
| Planning Inspectorate | Scoping Report 2018 | There are number of errors in the Table 8-1 including incorrectly named designated sites and features. The Applicant should ensure that any such errors are omitted from information in the ES. There are a greater number of designated sites listed in Table 8-1 of the Scoping Report than shown on Figure 8-1. The ES should include figures identifying the location of all designated sites discussed in the text and also identify the distance of the designated sites from the Proposed Works | This has been incorporated into this chapter and the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). |
| Planning Inspectorate | Scoping Report 2018 | The potential impacts are duplicated in Table 8-2, although do not always correlate with the potential impacts identified in Table 8-1 (e.g. effects of lighting are noted in Table 8-1 but not Table 8-2). Where relevant the Applicant should ensure consistency between information presented in the ES. | The full list of potential impacts for marine ornithology are presented in **Section 11.6.2**. |

| Consultee | Date/Document | Comment | Response |
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| Planning Inspectorate | Scoping Report 2018 | The ES should provide details of any models used, the input parameters and any assumptions made in the models. Any guidance used to inform the assessment should be detailed within the ES. | A detailed assessment methodology has been presented. |
| Planning Inspectorate | Scoping Report 2018 | Cumulative impacts should be assessed for all aspect chapters where significant effects are likely to occur. | Cumulative impacts for marine ornithology are presented in **Section 11.6.8**. |
| Planning Inspectorate | Scoping Report 2018 | It is recommended that the other projects to be included within the cumulative assessment are discussed, and ideally agreed, with relevant consultees. | The list of projects included within the CIA are available within **Section 11.6.8**. |
| Planning Inspectorate | Scoping Report 2018 | Although produced for Nationally Significant Infrastructure Projects, the Applicant is advised to utilise the approach set out in Planning Inspectorate Advice Note Seventeen: Cumulative effects assessment. | The methodology for CIA in terms of marine ornithology receptors is presented in **Section 11.6.8**. |
| NRW (for PINS) | Scoping Report 2018 | It is important that there is distinction between the EIA and HRA processes; however, the information contained within the ES may be of relevance and may be used within the HRA. We therefore recommend that the ES should include a section containing 'information to inform the HRA'. | This comment has been noted. However, as HRA and EIA issues are distinctly different for the Project, no such section has been incorporated into the ES chapter or wider ES. |
| NRW (for PINS) | Scoping Report 2018 | Without wishing to prejudice the HRA or consenting process, a package of measures that would avoid or mitigate the effects of the proposal and avoid adverse effects on the integrity of European protected sites would appear challenging to achieve in this instance. If this is the case it may be necessary to consider the proposal under Regulation 64 of the above regulations, where the possibility of alternatives to the proposal that would not give rise to adverse effects on the integrity of European protected sites are considered. | The HRA demonstrates that no adverse effect on the integrity of the relevant designated sites is predicted (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**) |
| NRW (for PINS) | Scoping Report 2018 | In our previous EIA scoping responses to Anglesey County Council and NRW's Marine Licensing Team we stated that we agreed with the designated sites, species and receptors identified within section 7 of the scoping report (table 8.1 in current EIA scoping report) to be included within the EIA and HRA. We noted that the Anglesey Terns SPA was not included within the scoping report and | Noted, these errors have been corrected and Anglesey Tern SPA has been assessed in detail within the HRA process (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). The qualifying species of this SPA are of low sensitivity to the |

| Consultee | Date/Document | Comment | Response |
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| | | should be considered as part of any subsequent ES. Table 8.1 has since been changed and now contains numerous errors. We strongly advise that these are rectified prior to the submission of any ES. | Project, though are considered within the EIA. |
| NRW (for PINS) | Scoping Report 2018 | A number of the designated sites included in table 8.1 (and throughout the report) are incorrectly named and there are several examples of duplication, possibly stemming from the fact that some sites have both a Welsh and an English name. Where sites are duplicated, such as is the case for Llyn Dinam SAC, Glannau Ynys Gybi/Holy Island Coast SPA, Glannau Rhoscolyn/Rhoscolyn Coast SSSI and Porth Diana SSSI to name a few, differing (conflicting) levels of potential impacts are often reported. | These errors have been corrected. |
| NRW (for PINS) | Scoping Report 2018 | The 'features' column text for the Anglesey Terns SPA in table 8.1 suggests a single island colony, however, please note that the site comprises 3 separate breeding colonies and extensive areas of surrounding sea. The numbers of breeding pairs provided for the site should be checked for accuracy. | This detail is included within the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). |
| NRW (for PINS) | Scoping Report 2018 | The new power station at Wylfa is mentioned in relation to potential onshore cumulative impacts (see section 10.1.2). We advise that offshore aspects of the power station also need to be considered, including HNP's plans for sediment and rock disposal at Holyhead Deep (this is in addition to the existing use of the disposal ground from Holyhead Port), increased boat traffic / shipping movements and biosecurity. It should also be noted that the HNP Wylfa Newydd development will mostly sit adjacent to the existing power plant rather than use the same site footprint. | Noted, however, due to the suspension of the Wylfa Newydd project, this has not been considered within the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). Should further updates become available, this will be revisited. |
| NRW (for PINS) | Scoping Report 2018 | It's important to note that, in addition to inter-project effects outlined in Section 10, intra-development effects, where multiple development elements have the potential to impact the same receptor, need to be considered throughout the relevant ES chapters and wider EIA process. | Noted, such effects on marine ornithology have been considered in **Section 11.8**. |
| IACC 2017 | Scoping Report 2018 | The list of projects to be assessed in terms of cumulative and in- | Noted, the list of projects to be considered for |

| Consultee | Date/Document | Comment | Response |
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| | | combination impacts appears limited. The EIA should consider an agreed list of proposals at an agreed cut-off date before submission of the planning application. | ornithology for CIA are presented in **Section 11.6.8**, and an in-combination assessment has been completed as part of the HRA process (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). |
| IACC 2017_Revised Scheme | Scoping Report 2018 | The proposed development is intended to be located in a sensitive area from the perspective of landscape and biodiversity with a number of European and nationally delegated areas either covering or adjacent to the application site. The whole of the application site is contained within the North Anglesey Marine SAC and Anglesey Terns SPA with the landfall site contained within the Holy Island SSSI. As such, any development proposed in this area must have regard to the sensitive environment and must therefore provide sufficient mitigation where impacts are identified. | The impacts of the Project on these designated sites is presented within this chapter and the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). |
| NRW | Scoping Report 2018 | Guidance provided to the applicant by NRW Technical Experts (TE) to assist with scoping the proposal and EIA does not appear to have been fully used to inform all aspects of the EIA scoping report. We also note that the scoping report has not drawn upon information collated within the Crown Estate's plan level Habitats Regulation Appraisal for their 2013/14 wave and tidal leasing round. NRW TE has previously provided a guidance note to you on how we considered that this information could be used at an individual demonstration zone level. | Updated guidance provided within the TWG meetings has been used to inform this chapter of the ES. The HRA takes into consideration the plan level HRA compiled on behalf of the Crown Estate (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). |
| NRW | Scoping Report 2018 | We draw your attention to the requirement of Article 6 of Schedule 3 of the MWR which requires you to consider the potential transboundary effects of the project. | Noted, these effects have been considered within **Section 11.7**. |
| NRW | Scoping Report 2018 | In Table 8.2 the potential for underwater noise to directly disturb seabird and diving bird interest features should be assessed in the ES. | Noted, this is not expected to be a critical impact, but is covered within **Section 11.6**. |

| Consultee | Date/Document | Comment | Response |
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| NRW | Scoping Report 2018 | The cumulative assessment should include other proposed and existing Marine Licence applications such as disposal at Holyhead North disposal site. Information on marine licence applications can be found on the Welsh Government Marine Planning Portal or downloaded from Lle. The assessment should also include developments allocated within the statutory development plan, proposals in the ANOB management plan and in the draft Wales National Marine Plan (each of which is supported by an Environmental Report and Habitats Regulations Assessment). Regard should also be given to Natural Resources Wales' emerging Area Statements (Marine and North-West Wales Areas), when published. | Noted, a list of all projects and planned considered within the CIA for marine ornithology is included in **Section 11.6.8**. |
| NRW | Scoping Report 2018 | The consideration of underwater noise cumulative effects should include activities in the wider area, such as navigation and fishing, as well as any other project developments. | Underwater noise from the Project alone was assessed to have negligible impact significance, and was therefore screened out of CIA. |
| NRW | Scoping Report 2018 | It should be noted that the Habitats Regulations Assessment for the Draft Welsh National Marine Plan, which was published in December 2017, was unable to rule out Adverse Effect on Integrity for multiple SPA, SAC and Ramsar sites and features. These conclusions should be taken into account when screening relevant plans or projects under the Habitats Regulations that could have an in-combination effect on those sites and when considering cumulative and synergistic effects under the Environmental Impact Assessment and Strategic Environmental Assessment Regulations. | This has been taken into account during the preparation of the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). |
| Planning Inspectorate | Scoping Report 2018 | The ES should detail the foraging distances used for migratory species, along with references to justify the distances used. | A range of literature has been utilised for the purpose of identifying the likely origin of birds recorded during baseline surveys (**Table 11-11**) |

| Consultee | Date/Document | Comment | Response |
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| Planning Inspectorate | Scoping Report 2018 | Displacement from vicinity of turbine: Table 8-9 of the Scoping Report states that displacement is expected to be both minor and localised, however the report also acknowledges a "lack of understanding on whether operation / repowering of devices cause displacement". The ES should therefore provide further justification to support the conclusions reached. If necessary, further assessment should be undertaken to ensure the validity of the findings.<br>The potential indirect effects from displacement should also be assessed in the ES e.g. energy expenditure from species avoiding the area. | Displacement due to tidal devices is considered in detail in relation to available evidence, and is expected to be minimal (**Section 11.6.6.1**) |
| Planning Inspectorate | Scoping Report 2018 | Statements such as "these species are relatively tolerant of vessel activity" should be corroborated by relevant evidence. | Evidence is provided throughout **Section 11.6**. |
| Planning Inspectorate | Scoping Response 2018 | The ES should consider and assess any potentially significant indirect effects on ornithological receptors, including those resulting from impacts to prey species. | This is covered for construction, operational / repowering and decommissioning Project phases within **Section 11.6** |
| NRW (for PINS) | Scoping Response 2018 | We recommend that the applicant first reviews available baseline data to ascertain which species have been found within the areas of sea/coastal areas potentially affected. For the offshore areas this may include ESAS data (ESAS/WWT in the past). | A full list of the baseline information utilised to inform the assessment of the Project on marine ornithology is presented in **Section 11.5.** |
| NRW (for PINS) | Scoping Response 2018 | We advise that the mean maximum foraging ranges detailed within Thaxter et al (2012) are utilised to determine which breeding colonies could be affected by the proposed development, with particular emphasis on colonies that are features of SPAs and SSSIs. There is no mention of Skomer and Skokholm SPA and the Glannau Aberdaron and Ynys Enlli / Aberdaron Coast and Bardsey Island SPA, for example, designated for Manx shearwater. We would welcome a map which shows the seabird features of designated sites within mean maximum foraging range of the proposed demonstration zone. | This reference has been used, along with others, in assessing the potential origin of marine ornithology receptors (**Table 11-11**). |
| NRW (for PINS) | Scoping Response 2018 | The ES should consider the potential for displacement of food sources from the area in addition to displacement of birds themselves; to date the EIA | This is covered for construction, operational / repowering and decommissioning Project |

| Consultee | Date/Document | Comment | Response |
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| | | scoping report has not addressed this point. | phases within **Section 11.6**. |
| RSPB | Scoping Response 2018 | We note the reference to Thaxter *et al* (2012) who initially set the standard of mean-maximum foraging ranges based on seabird tracking data. However, updated foraging distances are now available and greater than those used by Thaxter. These derive from the Future of the Atlantic Marine Environment (FAME) and Seabird Tracking and Research (STAR) projects. We recommend that reference be made to the FAME/STAR data | This reference has been used, along with others, in assessing the potential origin of marine ornithology receptors (**Table 11-11**). |
| RSPB | Scoping Response 2018 | We understand the on-going offshore ornithological surveys follow an adapted ESAS methodology for tidal development sites. It would be helpful to get confirmation of the distance sampling correction method to deal with reduced visibility of diving birds further from the boat transects. In particular, if there is the intention to use program Distance (or similar) to correct the estimates of density of birds on the water.<br>There is potential to supplement the above information with the use of GPS tags, applied to target species. This technology which has been trialled at a number of seabird colonies in the UK can incorporate remote download systems and thus remove the need to recapture birds. | Full details of the baseline data collection is presented in **Appendix 11.1** (**Volume III**).<br>Distance sampling was carried out using program Distance 7.2.<br>GPS tagging data was not used during baseline data collection. However, tracking data and associated publications have been used in the assessment where relevant. |
| RSPB | Scoping Response 2018 | The potential impact of collision risk between diving birds and moving parts of devices is mentioned in the document. We consider that this operational risk needs further consideration through robust collision risk modelling. Guidance is available from SNH and we would recommend that further advice be sought from NRW on this matter. | ERM and CRM have been used within the assessment, as detailed in **Section 11.6.6.3** and **Appendix 11.3** (**Volume III**). |

| Consultee | Date/Document | Comment | Response |
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| RSPB | Scoping Response 2018 | The scope of the Cumulative Impact Assessment is project focused, although the temporal or 'time frame' boundary is not clearly defined.<br>We recommend the scoping should include developments allocated within the statutory development plan, proposals in the ANOB management plan and in the draft Wales National Marine Plan (each of which is supported by an Environmental Report and Habitats Regulations Assessment). Regard should also be had to Natural Resources Wales' emerging Area Statements (Marine and North-West Wales Areas). | The full list of projects considered within the CIA for marine ornithology are presented in **Section 11.6.8.** |
| NRW | Scoping Response 2018 | There is no mention in the scoping report of potential disturbance and displacement effects of underwater noise on seabird and diving bird species as a result of the project. | Noted. This is not expected to be a critical impact but is covered within **Section 11.6** for marine ornithology and **Chapter 12, Marine Mammals**. |
| IoACC | Scoping Response 2017 | Anglesey Terns SPA was not included in the Scoping Report and should be considered as part of subsequent planning application, along with other identified sites | Anglesey Terns SPA has been considered within the HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**), and the qualifying features are considered within the EIA as appropriate. |
| IoACC | Scoping Response 2017 | Consider impact on protected species and demonstrate will not impact on Favourable Conservation Status of European and Nationally protected species<br>Propose and deliver appropriate mitigation /compensation schemes to ensure favourable conservation status. | The HRA demonstrates that no adverse effect on the integrity of the relevant designated sites is predicted (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**) |
| NRW | Scoping Response 2015 | Proposed developments likely to significantly affect European Sites (Special Areas of Conservation (SACs), Special Protection Areas (SPAs), either alone or in combination with other plans or Projects, require special consideration by the Competent Authority (typically the licensing authority) under Regulation 61 of the Habitats Regulations. As a matter of Government policy, the same applies to Ramsar sites. | The HRA demonstrates that no adverse effect on the integrity of the relevant designated sites is predicted (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). |

| Consultee | Date/Document | Comment | Response |
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| NRW | Scoping Response 2015 | The HRA is a two stage process, the first stage being a 'Test of Likely Significant Effect' to establish whether the proposals are likely to result in significant effects on any European sites (and Ramsar sites). If this establishes that significant effects are likely, or there is uncertainty whether significant effects are likely to result, then an appropriate assessment of the effects of the activity in view of the conservation objectives of the site(s) is required. The HRA also needs to consider in-combination effects of the proposed Project with other projects. | For full details of the HRA Screening and Appropriate Assessment, where relevant, see the Project HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). |
| NRW | Scoping Response 2015 | It is difficult to determine from the information provided in the scoping report the potential impacts and the significance of potential impacts, for protected sites. The EIA should concentrate on impacts both direct and indirect on marine and coastal sites and those adjacent to the cable route and any land-based infrastructure. | The full list of potential impacts on marine ornithology are presented in **Section 11.6.2**. |
| NRW | Scoping Response 2015 | The scoping report appears to have gone beyond the stated 50km area of search by including seabird SPAs as far as Pembrokeshire. We agree that these SPAs should be included as they are within the mean maximum foraging range of some of the classified features, especially gannet (640km) and Manx shearwater (400km). | The full list of the potential origin of marine ornithology receptors is presented in **Table 11-11**, and the European sites included in the HRA is presented in that document (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). |
| NRW | Scoping Response 2015 | Within Table 7.1 Habitats Directive sites in Ireland and also in other areas around the Irish Sea are not mentioned in the table. In view of the international nature of the Habitats Directive, designated sites in other countries should also be considered. | The full list of the potential origin of marine ornithology receptors is presented in **Table 11-11**, which includes SPAs from the Republic of Ireland. The list of European sites included in the HRA is presented in that document (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**). |
| NRW | Scoping Response 2015 | The largest guillemot colony in North Wales, namely Carreg y Llam SSSI has been omitted from the list of protected sites. This SSSI with its notified feature of breeding guillemot should be added for consideration. | This site has not been included in the baseline environment, because the latest information on the at-sea distribution of guillemots and razorbills |

| Consultee | Date/Document | Comment | Response |
|---|---|---|---|
| | | | (Cleasby *et al*., 2018) indicates that 100 % of birds at the site of the Project originate from the South Stack and Penlas Seabird Monitoring Programme Master Site sub-colonies. |
| NRW | Scoping Response 2015 | The EIA should include assessment of the potential for birds to collide with structures that are lit at night | Noted, this is not expected to be a critical impact, but is covered within **Section 11.6.5.1.3**. |
| NRW | Scoping Response 2015 | We consider that the use of boat-based surveys would enable true densities of seabirds to be ascertained to enable accurate predictions of impact to satisfy the requirements of both EIA and HRA. | Boat-based surveys were carried out monthly for two years, as detailed in **Appendix 11.1** (**Volume III**). |
| NRW | Scoping Response 2015 | In the first row of Potential Impacts Table 7.8, we consider that there is also potential for birds to impact structures in normal flight at night or (especially) in strong winds/ storms. This potential impact should be included in the EA. | This impact pathway has not been screened into the EIA as there is no evidence that suggests marine ornithology receptors would be susceptible to collisions in flight with the surface elements of tidal device. |
| NRW | Scoping Response 2015 | Key areas of concern for ornithology which must be assessed in the EIA include:<br>▪ Collision risk<br>▪ Disturbance/Habitat Exclusion/Displacement<br>▪ Sedimentary Processes and Pollution<br>▪ Indirect impacts (i.e. to birds, fish and marine mammals due to habitat loss for prey, depletion, displacement or aggregation of prey) | A full list of the potential impacts considered for marine ornithology is presented in **Section 11.6**, and includes all these areas of concern. |
| NRW | Scoping Response 2015 | RSPB research into potential effects of wave and tidal stream devices on birds recommends that, due to the paucity of systematic data, the longevity of birds, inter-annual and weather dependant variations, at least two years of pre-application data are collected, covering all seasons and including both breeding and non-breeding populations. | Boat-based surveys were carried out monthly for a two year period, as detailed in **Appendix 11.1** (**Volume III**). |

| Consultee | Date/Document | Comment | Response |
|---|---|---|---|
| NRW | Scoping Response 2015 | We recommend early engagement with all of those organisations with an interest in ornithology to gain advice on survey methods. | Details of consultation undertaken is presented in this section of the chapter. |
| NRW | Scoping Response 2015 | There is potential not only to mitigate for the adverse impacts of the development, but also to enhance the biodiversity of the development site and its vicinity. This should be addressed in the ES. Mitigation/enhancement measures if required could include:<br>▪ Time-related restrictions on construction, in relation to nesting periods.<br>▪ The use of sympathetic land management | Where required, mitigation is presented in **Section 11.6**. |

## 11.4. METHODOLOGY

### 11.4.1. Study Area

15. The study area for the boat-based bird surveys (**Section 11.4.3**), was the Morlais Demonstration Zone (MDZ) plus a 2 km buffer, including the Export Cable Corridor (ECC) (**Appendix 11.1, Volume III**). This reflects the fact that most effects that occur during the construction, operation / repowering and decommissioning of the Project will be localised in nature, with the ZoI of the majority of effects predicted to occur within the MDZ and ECC.

16. For breeding seabirds, mean maximum foraging ranges (Thaxter et al., 2012) were used to identify the colonies that birds recorded within the MDZ and 2 km buffer during the boat-based bird surveys could have originated from. For birds recorded outside their respective breeding seasons (**Table 11-9**), when many species of seabird disperse and/or migrate from their breeding colonies, Furness (2015) was used to identify the populations from which individuals recorded during surveys at this time of year originated.

### 11.4.2. Data Sources – Desk Study

17. A desk study has drawn on both peer reviewed scientific literature and “grey literature” such as project submissions and reports. It includes information on seabird ecology and distribution, and the potential impacts of tidal stream development on marine ornithology. The key topics for which the literature has been examined include (but are not limited to):

- Bird population estimates (Banks et al., 2007; Frost et al., 2018; Furness, 2015; Musgrove et al., 2011; NRW, 2015a; O’Brien et al., 2010; Perrins et al., 2012; Stroud et al., 2016; Wernham et al., 2002);
- Bird ecology (Coulson, 2011; Cramp, 1985; Cramp and Simmons, 1983, 1977; Dean, 2012; Furness et al., 2018; Harris and Wanless, 2011; Robinson, 2019; Thaxter et al., 2010);

- Bird distribution, foraging and migration (Cleasby et al., 2018; Clewley et al., 2017; Cox et al., 2016; Dean et al., 2012, 2015; Frederiksen et al., 2012b; Guilford et al., 2008; Hobson and Welch, 1992; Oppel et al., 2018; Perrow et al., 2011; Schwemmer and Garthe, 2008; Shoji et al., 2015; Thaxter et al., 2012; Wakefield et al., 2013, 2017; Wernham et al., 2002; Wilson et al., 2014);
- Bird diving behaviour (including nocturnal activity) (Cox et al., 2016; Garthe et al., 2000; MBIEG, 2019; Regular et al., 2010, 2011; Robbins, 2017; Shoji et al., 2016, 2015; Thaxter et al., 2009); and
- Potential impacts of marine development on birds (APEM, 2017; Dierschke et al., 2016; Furness et al., 2012; Furness and Wade, 2012; Garthe and Hüppop, 2004; Gill et al., 2018; Harwood et al., 2017; Leopold et al., 2013; MMO, 2018; Vallejo et al., 2017; Vanermen et al., 2015).

18. Information on statutory sites and their interest features has been drawn from the web-based resource Multi-Agency Geographic Information for the Countryside (MAGIC).

### 11.4.3. Data Sources – Site-Specific Surveys and Reports

19. Two years of baseline seabird surveys of the MDZ and 2 km buffer were undertaken between November 2016 and October 2018. This comprised of 24 surveys which provided coverage of all ecological seasons.

20. Surveys were undertaken by means of boat-based visual surveys, using a transect method. Thirteen parallel transects were followed on all surveys. The survey methodology was based on published guidance (Camphuysen et al., 2004).

21. Full details of the survey programme and the data collected are available in **Appendix 11.1** (**Volume III**). Density estimates derived from these surveys that are used in the assessment are available in **Appendix 11.2** (**Volume III**).

### 11.4.4. Impact Assessment Methodology

22. The generic methodology utilised for impact assessment in this chapter is described in detail in **Chapter 5, EIA Methodology**. Where required, the methodology has been adapted to make it more specific to marine ornithology receptors and aligned with the key guidance document produced for the impact assessment of ecological receptors (CIEEM, 2018).

23. The impact assessment uses the “source-pathway-receptor” model. The model identifies likely environmental impacts resulting from the proposed construction, operation /repowering and decommissioning of the offshore infrastructure associated with the Project. This process provides a transparent impact assessment route between impact sources and potentially sensitive receptors. The parameters of this model are defined as follows:

- Source – the origin of a potential impact (noting that one source may have several pathways and receptors) e.g. an activity such as cable installation and a resultant effect such as re-suspension of sediments;
- Pathway – the means by which the effect of the activity could impact a receptor e.g. for the example above, re-suspended sediment could settle and smother the sea bed; and

- Receptor – the element of the receiving environment that is impacted e.g. for the above example, bird prey species living on or in the sea bed are unavailable to foraging birds.

24. The information presented in **Table 11-8** has been used to determine the importance of marine ornithology receptors recorded in the MDZ and 2 km buffer, and where relevant, the breeding colonies or other populations from which these receptors may originate.

**Table 11-8 Definitions of Receptor Importance Levels for Marine Ornithology Receptors**

| Importance Level | Definition |
|---|---|
| High | A regularly occurring, nationally significant population / number of any internationally or nationally important species<br>Internationally protected species (e.g. listed on Annex I of the Birds Directive) that are listed as a qualifying interest feature of an internationally protected site<br>An internationally designated site (SPA and/or Ramsar site) or candidate site or an area (e.g. pSPA or dSPA) |
| Medium | Species which are regionally important or internationally rare<br>Species listed on Section 7 List of Species of Principal Importance for Wales<br>Species on Birds of Conservation Concern (BoCC) Red List (Eaton et al., 2015)<br>A nationally designated site (SSSI) |
| Low | Species which are locally important or nationally rare<br>Species on BoCC Amber List (Eaton et al., 2015)<br>Species that are occasionally recorded within the study area in low numbers compared to other regions |
| Negligible | Species which are not considered to be particularly important or rare<br>Species that are infrequently recorded within the study area in very low numbers compared to other areas or regions |

25. There are no further deviations from the methodology described in **Chapter 5, EIA Methodology**.

## 11.5. EXISTING ENVIRONMENT

### 11.5.1. Species Recorded

26. In total, 34 species of bird were recorded within the MDZ and 2 km buffer during the boat-based surveys, of which 16 were seabirds recorded on the sea and in flight. These were Arctic tern *Sterna paradisaea*, Atlantic puffin *Fratercula arctica* (“puffin”), black-headed gull *Chroicocephalus ridibundus*, black-legged kittiwake *Rissa tridactyla* (“kittiwake”), common gull *Larus canus*, common tern *Sterna hirundo*, great black-backed gull *Larus marinus*, common guillemot *Uria aalge* (“guillemot”), herring gull *Larus argentatus*, lesser black-backed gull *Larus fuscus*, Manx shearwater *Puffinus puffinus*, northern fulmar *Fulmarus glacialis* (“fulmar”), northern gannet *Morus bassanus* (“gannet”), razorbill *Alca torda*, red-throated diver *Gavia stellata* and shag *Phalacrocorax aristotelis*. In addition, one seaduck species was recorded on the sea and in flight; eider *Somateria mollissima*.

27. There were a further five species of seabird recorded in flight only. These were cormorant *Phalacrocorax carbo*, Mediterranean gull *Larus melanocephalus*, great skua *Stercorarius skua*, sooty shearwater *Puffinus griseus* and Sandwich tern *Thalasseus sandvicensis*, along with a single species of seaduck; common scoter *Melanitta nigra*.

28. Great skua and sooty shearwater have been scoped out of further assessment. These species were observed on a single survey each across 24 boat-based surveys, and this, along with the fact that these species are not known to breed or winter in the area in which the Project is situated (Stroud et al., 2016), means that they will not be susceptible to impacts during the construction, operation / repowering or decommissioning of the Project.

29. There were a further 11 bird species recorded during the boat-based surveys that were recorded in flight only, irregularly, and are not species that would be routinely expected to utilise the subtidal habitat within the MDZ or 2 km buffer in the course of their normal behaviour. These are seven species of passerine, house martin *Delichon urbicum*, meadow pipit *Anthus pratensis*, pied wagtail *Motacilla alba*, redwing *Turdus iliacus*, starling *Sturnus vulgaris*, swallow *Hirundo rustica* and sand martin *Riparia riparia*, one species of swan, whooper swan *Cygnus cygnus*, one species of raptor, peregrine *Falcus peregrinus* and two species of wader, dunlin *Calidris alpina* and whimbrel *Numenius phaeopus*. All of these species are excluded from further assessment as they are not considered to be sensitive to impacts due to the construction, operation / repowering or decommissioning of the Project.

30. The remaining species (the marine ornithology receptors) will be assessed for impacts due to the construction, operation / repowering and decommissioning of the Project as they are considered to be at potential risk either due to their abundance or potential sensitivity to the predicted impacts.

### 11.5.2. Marine Ornithology Receptors Breeding and Non-Breeding Seasons

31. Impacts on the marine ornithology receptors have been assessed in relation to relevant biological seasons (Furness, 2015). These include overlapping months in some instances due to variation in the timing of migration for birds which breed at different latitudes (i.e. individuals from breeding sites in the north of the species' range may still be on spring migration when individuals farther south have already commenced breeding). For each species, the assessment of impacts in different seasons used the full "breeding" and "non-breeding" periods listed in **Table 11-9**.

**Table 11-9 Definition of the Breeding, Migration and Winter Seasons for Marine Ornithology Receptors included in the EcIA, as per Furness (2015) unless otherwise stated**

| Species | Breeding | Migration-free breeding | Migration - autumn | Migration-free winter | Migration - spring | Non-breeding |
|---|---|---|---|---|---|---|
| Arctic tern | May-early Aug | June | Jul-early Sept | Oct-Mar | Apr-May | Sept-Apr |
| Black-headed gull (Cramp and Simmons, 1983) | - | Apr-Aug | - | - | - | Sept-Mar |
| Common gull (Cramp and Simmons, 1983) | - | Apr-Aug | - | - | - | Sept-Mar |
| Common scoter (Cramp and Simmons, 1977) | May-Aug | - | - | - | - | Sept-Apr |
| Common tern | May-Aug | Jun-mid Jul | Late Jul-early Sept | Oct-Mar | Apr-May | Sept-Apr |

| Species | Breeding | Migration-free breeding | Migration - autumn | Migration-free winter | Migration - spring | Non-breeding |
|---|---|---|---|---|---|---|
| Cormorant | - | Apr-Aug | - | - | - | Sept-Mar |
| Eider (Cramp and Simmons, 1977) | Apr-Jun | - | - | - | - | Jul-Mar |
| Fulmar | Jan-Aug | Apr-Aug | Sep-Oct | Nov | Dec-Mar | Sept-Dec |
| Gannet | Mar-Sept | Apr-Aug | Sept-Nov | - | Dec-Mar | Oct-Feb |
| Great black-backed gull | Late Mar-Aug | May-Jul | Aug-Nov | Dec | Jan-Apr | Sept-Mar |
| Guillemot | Mar-Jul | Mar-Jun | Jul-Oct | Nov | Dec-Feb | Aug-Feb |
| Herring gull | Mar-Aug | May-Jul | Aug-Nov | Dec | Jan-Apr | Sept-Feb |
| Kittiwake | Mar-Aug | May-Jul | Aug-Dec | - | Jan-Apr | Sept-Feb |
| Lesser black-backed gull | Apr-Aug | May-Jul | Aug-Oct | Nov-Feb | Mar-Apr | Sept-Mar |
| Manx shearwater | Apr-Aug | Jun-Jul | Aug-early Oct | Nov-Feb | Late Mar-May | Sept-Mar |
| Mediterranean gull (assumed as per black-headed gull) | - | Apr-Aug | - | - | - | Sept-Mar |
| Puffin | Apr-early Aug | May-Jun | Late Jul-Aug | Sept-Feb | Mar-Apr | Mid Aug-Mar |
| Razorbill | Apr-Jul | Apr-Jun | Aug-Oct | Nov-Dec | Jan-Mar | Aug-Mar |
| Red-throated diver | Mar-Aug | May-Aug | Sept-Nov | Dec-Jan | Feb-Apr | Sept-Feb |
| Sandwich tern | Apr-Aug | June | Jul-Sept | Oct-Feb | Mar-May | Sept-Mar |
| Shag | Feb-Aug | Mar-Jul | Aug-Oct | Nov | Dec-Feb | Sept-Jan |

### 11.5.3. Marine Ornithology Receptors Conservation Status

32. The conservation status of the identified marine ornithology receptors is summarised in **Table 11-10**.

**Table 11-10 Conservation Status of Marine Ornithology Receptors Recorded in the MDZ and 2 km Buffer to be Considered by EcIA**

| | Conservation status | | | | |
|---|---|---|---|---|---|
| **Species** | **Annex 1 (EU Birds Directive)** | **Schedule 1 (Wildlife & Countryside Act)** | **BoCC Amber (Eaton et al. 2015)** | **BoCC Red (Eaton et al. 2015)** | **Section 7 (Environment (Wales) Act)** |
| Arctic tern | ✓ | | ✓ | | |
| Black-headed gull | | | ✓ | | ✓ |
| Common gull | | | ✓ | | |
| Common scoter | | ✓ | | ✓ | ✓ |
| Common tern | ✓ | | ✓ | | |
| Cormorant | | | | | |
| Eider | | | ✓ | | |
| Fulmar | | | ✓ | | |
| Gannet | | | ✓ | | |

| | Conservation status | | | | |
|---|---|---|---|---|---|
| **Species** | **Annex 1 (EU Birds Directive)** | **Schedule 1 (Wildlife & Countryside Act)** | **BoCC Amber (Eaton et al. 2015)** | **BoCC Red (Eaton et al. 2015)** | **Section 7 (Environment (Wales) Act)** |
| Great black-backed gull | | | ✓ | | |
| Guillemot | | | ✓ | | |
| Herring gull | | | | ✓ | ✓ |
| Kittiwake | | | | ✓ | |
| Lesser black-backed gull | | | ✓ | | |
| Manx shearwater | | | ✓ | | |
| Mediterranean gull | ✓ | ✓ | ✓ | | |
| Puffin | | | | ✓ | |
| Razorbill | | | ✓ | | |
| Red-throated diver | ✓ | ✓ | | | |
| Sandwich tern | | | ✓ | | |
| Shag | | | | ✓ | |

### 11.5.4. Species Densities

33. Species densities and 90 % confidence intervals for breeding and non-breeding seasons (**Table 11-9**) are presented in **Appendix 11.2** (**Volume III**). These were calculated using Distance correction (Buckland et al., 2001) for those species where the numbers of observations made this possible; guillemot, razorbill and herring gull. For species where this was not possible, generic published corrections to account for missed birds were applied (Stone et al., 1995). Any observations made to group level (e.g. auk species for guillemot and razorbill) were proportionally allocated to a species.

### 11.5.5. Connectivity of Breeding and Wintering Sites to MDZ

34. Sites which may have connectivity to the MDZ and ECC include colonies supporting breeding seabirds and coastal and/or marine bird interests, which are typically overwintering aggregations.

35. For the breeding period (**Table 11-9**), the potential for connectivity to known breeding populations has been considered. Published mean maximum foraging distances (Thaxter et al., 2012) have been used in conjunction with data from the Seabird 2000 and Seabird Monitoring Programme (SMP) databases (JNCC, 2018, 2010) to identify colonies that are within the mean maximum foraging range of the MDZ/ECC. For some species for which hundreds (or more) of small breeding locations within the mean maximum foraging range are known (e.g. herring gull), the search for breeding locations was restricted to the Gwynedd area. Where relevant, other datasets have also been consulted to provide further insight into the distribution of foraging seabirds at sea. In particular, work concerning the at-sea distributions of four species (guillemot, razorbill, kittiwake and shag) (Cleasby et al., 2018; Wakefield et al., 2017) is considered the best available information for these species and is used to assess connectivity in preference to other methods where clear associations to particular colonies were detected in the datasets. Published methodology on apportioning (SNH, 2018) has also been used where appropriate to

estimate the proportions of species recorded in the MDZ likely to originate from particular breeding colonies.

36. **Table 11-11** provides an overview of this information for the marine ornithology receptors. The location of designated sites relative to the MDZ is shown on **Figure 11-1** (**Volume II**).

**Table 11-11 Marine Ornithology Receptors and their Possible Origin**

| Species | Breeding (B) or Non-breeding (NB) | Site of Origin | Approximate % of MDZ population from site | Justification |
|---|---|---|---|---|
| Arctic tern | B | Anglesey Terns SPA | 100 | (JNCC, 2018, 2010; Thaxter et al., 2012) |
| Black-headed gull | B/NB | Non-designated local population | 100 | - |
| Common gull | B/NB | Non-designated local population | 100 | - |
| Common scoter | NB | Non-designated local population | 100 | (Natural England and Countryside Council for Wales, 2010) |
| Common tern | B | Anglesey Terns SPA | 100 | (JNCC, 2018, 2010; Thaxter et al., 2012) |
| Cormorant | B/NB | Non-designated local population | 100 | - |
| Eider | NB | Non-designated local population | 100 | - |
| Fulmar | B | South Stack and Penlas SMP sub-colonies | 66.27 | (JNCC, 2018, 2010; Thaxter et al., 2012) |
| | | Other colonies (<1 % of birds in MDZ per colony) | 33.73 | |
| | NB | UK Western Waters plus Channel BDMPS | 100 | (Furness, 2015) |
| Gannet | B | Grassholm SPA | 54.15 | (JNCC, 2018, 2010; SNH, 2018; Thaxter et al., 2012) |
| | | Ailsa Craig SPA | 34.08 | |
| | | Scare Rocks SSSI | 5.04 | |
| | | Saltee Islands SPA | 3.62 | |
| | | Ireland's Eye SPA | 3.11 | |
| Great black-backed gull | B | Puffin Island SSSI | 71.15 | (JNCC, 2018, 2010; Ratcliffe et al., 2000; SNH, 2018) |
| | | South Stack and Penlas SMP sub-colonies | 9.76 | |
| | | The Skerries SSSI | 5.75 | |
| | | Valley Wetlands | 5.05 | |
| | | Other colonies (<3 % of birds in MDZ per colony) | 8.29 | |

| Species | Breeding (B) or Non-breeding (NB) | Site of Origin | Approximate % of MDZ population from site | Justification |
|---|---|---|---|---|
| | NB | Southwest and Channel BDMPS | 100 | (Furness, 2015) |
| Guillemot | B | South Stack and Penlas SMP sub-colonies | 100 | (Cleasby et al., 2018; Wakefield et al., 2017), Ornithology TWG pers. comm |
| | NB | UK Western Waters BDMPS | 100, of which more than published % likely to be from South Stack and Penlas SMP sub-colonies | (Furness, 2015), Ornithology TWG pers. comm. |
| Herring gull | B | South Stack and Penlas SMP sub-colonies | 77.92 | (SNH, 2018; Thaxter et al., 2012) |
| | | The Skerries | 9.48 | |
| | | Other colonies (<5 % of birds in MDZ per colony) | 12.60 | |
| | NB | UK Western Waters BDMPS | 100 | (Furness, 2015) |
| Kittiwake | B | Lambay Island SPA | 16.20 | (SNH, 2018; Thaxter et al., 2012) |
| | | Howth Head Coast SPA | 12.68 | |
| | | Ynys Moelfre | 12.19 | |
| | | Carreg y Llam SSSI | 11.94 | |
| | | Bray Head North | 10.84 | |
| | | Great Orme's Head SSSI | 7.98 | |
| | | St Tudwal's Islands SSSI | 5.76 | |
| | | Orme's Head SSSI | 5.05 | |
| | | Other colonies (<5 % of birds in MDZ per colony) | 17.35 | |
| Lesser black-backed gull | B | South Stack and Penlas SMP sub-colonies | 30.49 | (JNCC, 2018, 2010; SNH, 2018; Thaxter et al., 2012) |
| | | Ynys Traws | 27.79 | |
| | | The Skerries | 15.38 | |
| | | Ribble and Alt Estuaries SPA | 9.06 | |
| | | Puffin Island | 5.18 | |

| Species | Breeding (B) or Non-breeding (NB) | Site of Origin | Approximate % of MDZ population from site | Justification |
|---|---|---|---|---|
| | | Other colonies (<5 % of birds in MDZ per colony) | 12.10 | |
| Manx shearwater | B | Skomer, Skokholm and the Seas off Pembrokeshire SPA | 55.88 | (JNCC, 2018, 2010; SNH, 2018; Thaxter et al., 2012) |
| | | Aberdaron Coast and Bardsey Island SPA | 41.56 | |
| | | Other colonies (<1 % of birds in MDZ per colony) | 2.55 | |
| Mediterranean gull | B/NB | Non-designated local population | 100 | - |
| Puffin | B | South Stack and Penlas SMP sub-colonies | 80.90 | (JNCC, 2018, 2010; SNH, 2018; Thaxter et al., 2012) |
| | | Gwylan Islands SSSI | 12.03 | |
| | | Bardsey Island SSSI | 2.61 | |
| | | Other colonies (<1 % of birds in MDZ per colony) | 4.46 | |
| Razorbill | B | South Stack and Penlas SMP sub-colonies | 100 | (Cleasby et al., 2018; Wakefield et al., 2017), Ornithology TWG pers. comm |
| | NB | UK Western Waters BDMPS | 100, of which more than published % likely to be from South Stack and Penlas SMP sub-colonies | (Furness, 2015), Ornithology TWG pers. comm. |
| Red-throated diver | NB | Non-designated local population | 100 | (Natural England and Countryside Council for Wales, 2010; NRW, 2015b) |
| Sandwich tern | B | Anglesey Terns SPA | 100 | (Thaxter et al., 2012) |
| Shag | B | South Stack and Penlas SMP sub-colonies | 100 | (Cleasby et al., 2018; Wakefield et al., 2017) |
| | NB | SW England and Wales BDMPS | 100 | (Furness, 2015) |

### 11.5.6. Anticipated Trends in Baseline Condition

37. The two key drivers of seabird population size and trends in western Europe are climate change (Burthe et al., 2014; Frederiksen et al., 2012a, 2004; JNCC, 2016; Sandvik et al., 2012, 2005), and fisheries activities (Carroll et al., 2017; Foster et al., 2017; Frederiksen et al., 2004;

Sydeman et al., 2017; Tasker et al., 2000). Pollutants including oil, persistent organic pollutants, plastics, alien mammal predators at colonies, disease, and loss of nesting habitat also affect seabird populations, but are generally much less important and often more local factors (JNCC, 2016; Votier et al., 2008, 2005).

38. Trends in breeding seabird populations and colonies are generally better known and understood than trends in numbers and distribution at sea. Breeding numbers are regularly monitored at many UK seabird colonies (JNCC, 2018), and in the British Isles there have been three comprehensive censuses of breeding seabirds (Mitchell et al., 2004), with a fourth census ongoing 2015-2019. Breeding numbers of many seabird species in the British Isles are declining, especially in the northern North Sea (Foster and Marrs, 2012; JNCC, 2016; MacDonald et al., 2015). In Wales, populations of many seabird species have seen stable or increasing trends, including guillemot, razorbill, puffin, Arctic tern and Sandwich tern (Bladwell et al., 2018). However, declines have been measured in Wales for other species, such as common tern, kittiwake, shag and gannet.

39. Climate change is likely to be the strongest influence on seabird populations in coming years, with anticipated deterioration in conditions for breeding and survival for most species of seabirds (Burthe et al., 2014; Capuzzo et al., 2017; MacDonald et al., 2015). Further declines in numbers of many UK seabird populations are therefore anticipated in the short, medium and long term under a scenario with continuing climate change due to increasing levels of greenhouse gases in the atmosphere.

40. In general, important prey fish stock for seabirds during the breeding season have been depleted by high levels of fishing effort (Lindegren et al., 2018). It is possible that differences in the levels of fishing activity, and/or the slightly different prey items favoured by some species in different locations around the UK has enabled some populations to continue to expand whilst others have declined (Anderson et al., 2014), though the mechanisms controlling population growth and decline are complex and likely influenced by a combination of many factors.

41. Fisheries management will have a strong influence on future seabird populations. The Common Fisheries Policy (CFP) Landings Obligation ("discard ban") will further reduce food supply for scavenging seabirds such as great black-backed gull, lesser black-backed gull, herring gull, fulmar, kittiwake and gannet (Bicknell et al., 2013; Foster et al., 2017; Votier et al., 2013). Other recent changes in fisheries management that aid recovery of predatory fish stock biomass are likely to further reduce food supply for seabirds that feed primarily on small fish such as sandeels, which are a key prey item of a range of predatory fish (Frederiksen et al., 2007; MacDonald et al., 2015).

42. The following paragraphs briefly consider the possible impacts of these factors on some of the marine ornithology receptors.

43. Fulmars, terns, common guillemot, razorbill and puffin appear to be highly vulnerable to climate change, and this, coupled with increasing pressure on the habitats favoured by such species, means that numbers are likely to decline over the coming decades (Burthe et al., 2014). Declines in shag numbers are likely to continue as they are adversely affected by climate change, and will also suffer due to low abundance of prey species and especially by stormy and wet weather

conditions in winter which are predicted to increase as a result of climate change (Burthe et al., 2014; Frederiksen et al., 2008).

44. Most red-throated divers and common scoters wintering in the western British Isles originate from breeding areas at high latitudes in Greenland (Furness, 2015), which may possibly decrease in future if warming conditions make other more northern areas more favourable as a wintering area for those species so that they do not need to migrate as far as UK waters.

45. Future decreases in kittiwake breeding numbers are likely to be particularly pronounced, as it has been demonstrated that kittiwakes are very sensitive to climate change (Carroll et al., 2015; Frederiksen et al., 2012a), and to fishery impacts on sandeel stocks near breeding colonies (Carroll et al., 2017; Frederiksen et al., 2004). The species will also lose the opportunity to feed on fishery discards as the discard ban comes into effect.

46. It is likely that further redistribution of breeding herring gulls and lesser black-backed gulls will occur into urban environments (Rock and Vaughan, 2013), although it is unclear how the balance between terrestrial and marine feeding by these gulls may alter over coming years.

47. Gannet numbers may continue to increase as they have in many parts of the UK over recent years, but evidence suggests that this increase is slowing (Murray et al., 2015), and it is therefore likely that numbers may peak in the near future. In Wales, declines are already apparent (Bladwell et al., 2018). While the fisheries discard ban will reduce discard availability to gannets in European waters, in recent years increasing proportions of adult gannets have wintered in west African waters rather than in UK waters, possibly because there are large amounts of fish discarded by west African trawl fisheries and decreasing amounts available in the North Sea (Garthe et al., 2012; Kubetzki et al., 2009). The apparent flexible behaviour and diet of gannets may reduce their vulnerability to changes in fishery practices or to climate change impacts on fish communities relative to other seabird species.

48. Some anthropogenic impacts on seabirds are amenable to effective mitigation (Brooke et al., 2017; Ratcliffe et al., 2009), but the scale of efforts to reduce these impacts on seabird populations has been small by comparison with the major influences of climate change and fisheries. The conclusion must therefore be that with the possible exception of gannet, numbers of almost all other seabird species across many areas of the UK will most likely be on a downward trend over the next few decades, due to population declines, redistributions, or a combination of both.

49. The EcIA of marine ornithology receptors is therefore carried out against a wider backdrop of recent declining baseline populations of a number of receptor species on a national and international level, with further declines expected in the years to come. Marine ornithology receptors that have experienced growing or stable populations in recent years are viewed by the assessment as possibly being more robust to predicted impacts. Where a receptor species is declining, the assessment considers whether a given impact is likely to exacerbate a decline in the relevant reference population and prevent a receptor species from recovery should environmental conditions become more favourable. For example, seabird populations around much of the UK are expected to experience food shortages due to depletion of fish stocks in the future, potentially affecting the robustness of those populations to environmental change.

50. Climate change has been identified as the strongest influence on future seabird population trends. In this context it is noted that a key component of global strategies to reduce climate change is the development of low-carbon renewable energy developments such as tidal stream energy.

### 11.5.7. Assignment of Value to Marine Ornithology Receptors

51. The information described above has been used to assign an importance level to each marine ornithology receptor species according to criteria outlined in **Table 11-8** This is presented in **Table 11-12**.

**Table 11-12 Importance Levels Assigned to Marine Ornithology Receptors for Project EcIA**

| Species | Importance Level Assigned |
|---|---|
| Arctic tern | High |
| Common tern | |
| Gannet | |
| Guillemot | |
| Kittiwake | |
| Manx shearwater | |
| Puffin | |
| Razorbill | |
| Sandwich tern | |
| Black-headed gull | Medium |
| Common scoter | |
| Herring gull | |
| Lesser black-backed gull | |
| Red-throated diver | |
| Shag | |
| Common gull | Low |
| Cormorant | |
| Fulmar | |
| Great black-backed gull | |
| Mediterranean gull | |
| Eider | Negligible |

## 11.6. IMPACT ASSESSMENT

### 11.6.1. Introduction

52. The following assessment provides details of all direct and indirect impacts identified during scoping and those which have been noted as the EIA has progressed. Impacts have been assessed within the stage of the Project at which they will occur (construction, operation / repowering and decommissioning).

53. At the beginning of each section relating to a particular impact pathway, pertinent information and assumptions relating to this impact which have been taken from **Chapter 4, Project Description**, are presented.

### 11.6.2. Embedded Mitigation

54. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible.

55. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process (see **Chapter 4, Project Description** for further details). A range of different information sources has been considered as part of embedding mitigation into the design of the project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

56. Embedded mitigation relevant to Marine Ornithology is as follows;

- The PDE for tidal devices defined using parameters available from established tidal device technologies, which has been assumed will be developed sufficiently for commercial use at time of deployment. These have been incorporated in the modelling outlined in **Section 11.6.6.3**.

### 11.6.3. Overview of Potential Impacts

57. Potential impacts to be included within the EcIA have been agreed through consultation on a Ornithological Assessment Approach document with NRW during Ornithology TWG meetings. They are as follows:

- During the construction, and installation phase:
  1. Direct effects due to airborne noise and visual disturbance and displacement to birds in and immediately adjacent to the MDZ due to installation of tidal device foundations and hubs (due to activities such as drilling, or installation of anchors or gravity base structures), construction activities (e.g. activities such as seabed preparation, inter array, export, and cable tail installation and protection), and vessel activity;
  2. Direct effects due to disturbance and displacement at breeding sites (e.g. by vessels moving to and from the site, along the routes of export cables and tails, and near the export cable landfall itself);
  3. Indirect effects due to changes in prey availability (due to underwater noise resulting in disturbance, temporary loss of seabed habitat due to increased suspended sediment concentrations and sediment re-deposition, or permanent loss due to installation of seabed mounted devices and other infrastructure); and
  4. Direct and indirect effects due to changes in water quality (due to increased suspended sediments, or accidental release of contaminants from vessels).
- During the operation and maintenance (O&M) and repowering phase:
  5. Direct effects due to airborne noise and visual disturbance and displacement to birds in and immediately adjacent to the MDZ due to maintenance and repowering

activities (e.g. activities such as cable reburial and additional cable protection), vessel activity and operational tidal devices (including the presence of artificial lighting during darkness);

6. Indirect effects due to changes in prey availability (due to underwater noise resulting in disturbance and displacement, temporary loss of seabed habitat due to increased suspended sediment concentrations and sediment re-deposition underwater noise, disturbance and displacement, loss of seabed habitat, introduction of hard substrate such as foundations, cable and scour protection, or changes to water quality and electromagnetic fields;
7. Direct and indirect effects due to changes in water quality (due to increased suspended sediments, or any accidental release of contaminants from tidal devices or vessels);
8. Direct effects due to collision risk with tidal devices; and
9. Direct effects due to entanglement with tidal devices or the moorings associated with them.

- During the decommissioning phase:

10. Impacts comparable to those listed for the construction and installation phase are anticipated.

58. It should be noted that due to the nature of the Project, construction and operation / repowering phases will overlap much of the time during the lifespan of the Project, meaning that potential impacts could be additive. This has been accounted for by the assessment.

### 11.6.4. Impacts Screened Out

59. A number of potential impacts were considered for inclusion in the impact assessment but were screened out on the basis that no impacts will occur on marine ornithology receptors. A summary justification is provided in the following paragraphs.

60. Direct impacts due to habitat loss following the installation of tidal devices will occur. However, the extent of direct habitat loss is typically likely to be very low in comparison to the foraging range of the marine ornithology receptors (Cleasby et al., 2018; Oppel et al., 2018; Thaxter et al., 2012). Any direct impact on marine ornithology receptors is considered to be imperceptible and this impact is therefore screened out.

61. Direct impacts due to underwater noise during construction and operation / repowering have been screened out of the assessment. Percussive piling will not be used any stage of the Project in the marine environment, and there is no suggestion from other marine projects that the levels of noise produced by other activities which may occur during the Project could produce sufficient underwater noise to result in impacts on marine ornithology receptors.

62. Barrier effects relating to offshore wind farms and birds in flight has been studied in detail (Dierschke et al., 2016; Masden et al., 2010, 2009). Because the vast majority of infrastructure associated with the Project will occur underwater, and any floating devices will only protrude a maximum of six metres from the surface of the sea (as opposed to 100 m+ in the case of offshore

wind farms), it is not predicted that the Project will cause barrier effects on marine ornithology receptors.

### 11.6.5. Potential Impacts During Construction and Installation

#### 11.6.5.1. Airborne Noise and Visual Disturbance / Displacement

11.6.5.1.1. Introduction

63. The construction and installation phase of the Project has the potential to affect marine ornithology receptors through disturbance and displacement due to airborne noise and visual disturbance, leading to displacement of birds from subtidal construction sites.

64. Any impacts resulting from this impact pathway would be spatially restricted to subtidal areas within close proximity to the activities, and temporally restricted to the duration of construction activity.

65. Impacts are based on the following predicted average levels of vessel activity, although there will variations in the level of effort over the period of works beyond the average:

- 1 x vessel group in Abraham's Bosom area (ECC) installing cable tails; one-off event of 20 days per cable, up to nine cables, assuming no more than one cable installation per year;
- 1 x vessel group in ECC installing export cables; up to nine events (one per cable) of 20 days each (simultaneous with cable protection installation); assuming no more than one cable installation per year;
- 1 x vessel group in ECC installing export cable protection; up to nine events (one per cable) of 12 days each (simultaneous with export cable installation); assuming no more than one cable installation per year;
- 1 x vessel group in MDZ installing inter-array cables; approximately 111 days per year for ten years;
- 1 x vessel group in MDZ installing hubs; active anywhere in MDZ for up to 180 days per year for up to ten years; and
- 2 x vessel groups in MDZ installing devices; active anywhere in MDZ all year round.

66. Based on information provided in **Chapter 4, Project Description**, it is assumed that up to four vessels or groups of vessels operating in close proximity to one another, could be present within the MDZ at any one time. In the ECC, it is predicted that a maximum of three groups of vessels could be present at any time. As a worst case, the EcIA assumes activity to be continuous because seabed drilling at night during construction and installation is possible.

67. As activities are expected to occur in the MDZ for much of the 37 year lifespan of the Project, this impact is considered to consist of a large number of short term, temporary and reversible impacts over an overall time period which is defined as long term.

68. As activities are expected to occur in the ECC for a small number of days each year, for up to a maximum of ten years, this impact is considered to consist of a modest number of short term, temporary and reversible impacts over an overall time period which is defined as medium term.

11.6.5.1.2. Receptor Sensitivity

69. There is substantial interspecific variation in the sensitivity of marine ornithology receptors to airborne noise and visual disturbance stimuli. In order to focus the assessment, a detailed literature review was carried out regarding susceptibility to disturbance and displacement, which fed into a screening exercise to identify those species most likely to be at risk (**Table 11-13**).

**Table 11-13 Screening Exercise Undertaken for Potential Disturbance and Displacement Impacts During Construction of the Project**

| Species | Sensitivity to Disturbance and Displacement[1] | Screening Result (In or Out) | Justification |
|---|---|---|---|
| Arctic tern | Low | Out | Low susceptibility to disturbance |
| Black-headed gull | Low | Out | Low susceptibility to disturbance |
| Common gull | Low | Out | Low susceptibility to disturbance |
| Common scoter | Very High | Out | Only recorded occasionally (5/24 surveys), always in flight, and usually in coastal locations |
| Common tern | Low | Out | Low susceptibility to disturbance |
| Cormorant | High | Out | Only recorded occasionally (2/24 surveys) in very low numbers, always in flight |
| Eider | Unknown | Out | Recorded on only one baseline survey |
| Fulmar | Low | Out | Low susceptibility to disturbance |
| Gannet | Low | Out | Low susceptibility to disturbance |
| Great black-backed gull | Low | Out | Low susceptibility to disturbance |
| Guillemot | Medium | In | Potentially susceptible to disturbance and abundant in MDZ; screened in |
| Herring gull | Low | Out | Low susceptibility to disturbance |
| Kittiwake | Low | Out | Low susceptibility to disturbance |
| Lesser black-backed gull | Low | Out | Low susceptibility to disturbance |
| Manx shearwater | Low | Out | Low susceptibility to disturbance |
| Mediterranean gull | Low | Out | Low susceptibility to disturbance |
| Puffin | Medium | In | Potentially susceptible to disturbance and abundant in MDZ; screened in |
| Razorbill | Medium | In | Potentially susceptible to disturbance and relatively abundant; screened in |
| Red-throated diver | Very High | In | Recorded infrequently (8/24 surveys) and in low numbers but screened in on a precautionary basis due to sensitivity to impact |
| Sandwich tern | Low | Out | Low susceptibility to disturbance |
| Shag | Medium | In | Recorded infrequently (8/24 surveys) and in low numbers but screened in on a |

| Species | Sensitivity to Disturbance and Displacement[1] | Screening Result (In or Out) | Justification |
|---|---|---|---|
| | | | precautionary basis due to sensitivity to impact |
| **Notes**<br>[1]based on information contained in literature | | | |

70. Based on information from the literature review, there is potential for disturbance and displacement of guillemot, puffin, razorbill, red-throated diver and shag. All other marine ornithology receptors have been assigned a "negligible" sensitivity level according to the definitions in **Chapter 5, EIA Methodology**.

71. Guillemot and razorbill both fall into the "medium" sensitivity category with respect to disturbance and displacement by boat and helicopter traffic (Bradbury et al., 2014; Furness et al., 2013, 2012; Garthe and Hüppop, 2004). Puffin is considered slightly less sensitive than guillemot and razorbill, and shag slightly more sensitive, whilst red-throated diver is considered to be very sensitive (Furness et al., 2013, 2012; Garthe and Hüppop, 2004).

72. On this basis, the following sensitivities to this impact pathway have been allocated according to the definitions in **Chapter 5, EIA Methodology**:

- **Medium** for red-throated diver and shag;
- **Low** for guillemot, puffin and razorbill; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

11.6.5.1.3. Magnitude of Impact

73. Various papers have presented scoring systems for disturbance factors applied to seabird species for offshore wind farms (Furness et al., 2013; Furness and Wade, 2012; Garthe and Hüppop, 2004) and other marine energy developments (Furness et al., 2012). The approach uses information in the scientific and 'grey' literature, as well as expert opinion to identify disturbance ratings for individual species (of which much evidence relate to disturbance from vessel activities), alongside scores for habitat flexibility and conservation importance. These factors were used to define an index value that highlights the sensitivity of a species to disturbance and displacement. In the case of several of these examples, extensive peer-review on the initial ratings was employed to ensure that consensus from the wider ornithological research community was reached.

74. Studies examining the effects of the construction and operation / repowering of a range of offshore wind farms (APEM, 2017; Dierschke et al., 2016; Gill et al., 2018; Leopold et al., 2013; Vallejo et al., 2017; Vanermen et al., 2015) have been consulted to assess potential disturbance and displacement impacts, along with a wider review of the impact of a range of marine activities (MMO, 2018).

75. Rather than resulting in direct harm to the bird and loss from the population, disturbance and displacement by airborne noise and visual disturbance will result in affected birds temporarily

redistributing at sea and moving to an area where they are undisturbed, with birds expected to return to the area once activities have ceased.

76. Lighting of construction sites, vessels and other structures at night may potentially be a source of attraction (phototaxis), for some species, or displacement in others. The areas affected would be very small and restricted to subtidal construction areas; for this reason, it is considered that in general, the marine ornithology receptors would be insensitive to this impact. Phototaxis can be a serious hazard for fledglings of some seabird species, predominantly shearwaters (Deppe et al., 2017; Raine et al., 2007; Rodríguez et al., 2017, 2014), but occurs over short distances (typically hundreds of metres) in response to bright white light close to breeding colonies, and once a year when fledglings are departing their breeding colonies. Construction sites associated with the Project would be far enough removed from any Manx shearwater breeding colonies (approximately 45 km) for as to render the likelihood of this impact occurring negligible.

77. The levels at which this impact could result in direct mortality to these species has been quantitatively assessed based on a method advocated for displacement by offshore wind farms (UK SNCBs, 2017), using the maximum recorded MDZ densities in relevant seasons presented in **Appendix 11.2** (**Volume III**). The use of maximum recorded densities ensures that this is a worst case, highly precautionary approach to the assessment of this impact.

78. On a highly precautionary basis, it is predicted that guillemot, puffin and razorbill on the sea may be disturbed or displaced from an area within 300 m of each group of construction vessels, shags on the sea from 500 m of each group of construction vessels, and red-throated divers on the sea from 2 km of each group of construction vessels. These distances are based upon the following sources: professional judgement; information on the numbers of birds recorded on the sea in the vicinity of the survey vessel during baseline surveys both here and at many projects elsewhere (i.e. within 300 m); and published literature on disturbance (Camphuysen et al., 2004; Furness et al., 2013, 2012).

79. The method of the UK SNCBs (2017) requires that estimates of % displacement from the disturbance zone and % of mortality within displaced birds are made. The assessment has been based on recent estimates used during the assessment of impacts for offshore wind farms (e.g. the East Anglia TWO offshore wind farm, (Scottish Power Renewables, 2019)), adjusted to account for the differing scale and likely impact magnitude of the activities occurring during the construction of the Project, which will utilise smaller vessels than the offshore wind projects, and will not utilise percussive piling. When selecting these values, the fact that there is existing vessel traffic using the MDZ (**Chapter 15, Shipping and Navigation**) and the wider area, which based on the results of the baseline surveys (**Appendices 11.1 and 11.2, Volume III**) and latest colony counts and population trends in the local area (JNCC, 2018), does not appear to result in high seabird mortality, has also been considered.

80. **Table 11-14** presents the average numbers of birds within the total displacement zone of four groups of construction vessels, based on maximum single density recorded in the MDZ and 2 km buffer zone for the relevant season (**Table 11-9**), along with the selected displacement and mortality values.

**Table 11-14 Numbers of Species Screened into Disturbance and Displacement Assessment that will Occur Within Construction Vessel Disturbance Zone, Assuming Seven Groups of Vessels on Site Simultaneously, Based on Maximum Densities in MDZ and 2 km Buffer (MDZ only for guillemot and razorbill), and % Displacement and Mortality Values Used for Assessment**

| Species | Disturbance distance (km) | Birds in disturbance zone (breeding) | Birds in disturbance zone (non-breeding) | % of birds in disturbance zone displaced | % of mortality in displaced birds |
|---|---|---|---|---|---|
| Guillemot | 0.3 | 100.10 | 13.16 | 30-70 | 0-5 |
| Puffin | 0.3 | 0.77 | 0 | 30-70 | 0-5 |
| Razorbill | 0.3 | 12.19 | 8.92 | 30-70 | 0-5 |
| Red-throated diver | 2 | 24.01 | | 100 | 0-5 |
| Shag | 0.5 | 2.12 | 0 | 60-100 | 0-5 |

81. Total levels of seabird mortality anticipated as a result of airborne noise and visual disturbance during the construction of the Project in both the MDZ and ECC are presented in **Table 11-15**.

82. During the breeding season (**Table 11-9**), mortality due to displacement is predicted only for guillemot, a maximum of 4 birds at 70 % displacement and 5 % mortality. Outside the breeding season (**Table 11-9**), mortality is predicted only for red-throated diver (a maximum of 1 bird at 100 % displacement and 5 % mortality) due to this impact pathway.

**Table 11-15 Anticipated Seabird Mortality Levels Predicted Due to Airborne Noise and Visual Disturbance in the MDZ and ECC During Construction of the Project (based on parameters presented in Table 11-14)**

| Species | Mortality in a single breeding season | Mortality in a single non-breeding season |
|---|---|---|
| Guillemot | 0-4 | 0 |
| Puffin | 0 | 0 |
| Razorbill | 0 | 0 |
| Red-throated diver | 0 | 1 |
| Shag | 0 | 0 |

83. Due to the very low levels of mortality predicted as a result of airborne noise and visual disturbance during construction in the MDZ and ECC, an impact magnitude of **Low negative** is considered appropriate for guillemot, with a **Negligible** impact magnitude considered appropriate for all other species.

11.6.5.1.4. Impact Significance

84. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Minor adverse** for guillemot; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull puffin, razorbill, red-throated diver, Sandwich tern and shag.

#### 11.6.5.2. Disturbance at Breeding Sites

11.6.5.2.1. Introduction

85. The construction phase of the Project has the potential to affect marine ornithology receptors at nearby breeding colonies due to airborne noise and visual disturbance caused by vessels laying inter array cables and export cables working within the MDZ, and vessels working in the ECC, where array export cables will be installed. Part of the ECC is within the Abraham's Bosom bay, which is where the Project export cable tails will be installed, and the cables will make landfall. There is also potential for disturbance to occur at breeding locations due to airborne noise and visual disturbance from terrestrial and intertidal based activities at the landward side of the cable landfall.

86. Any impacts from cable laying activities (both subtidal and at the landward (including intertidal) side of the landfall) would be will be spatially restricted to areas within close proximity to the activities, and temporally restricted to the duration of construction activity.

87. Impacts are based on the following predicted levels of vessel activity:

- 1 x vessel group in Abraham's Bosom area (ECC) installing cable tails; one-off event of 20 days per cable, up to nine cables, assuming no more than one cable installation per year;
- 1 x vessel group in ECC installing export cables; up to nine events (one per cable) of 20 days each (simultaneous with cable protection installation); assuming no more than one cable installation per year;
- 1 x vessel group in ECC installing export cable protection; up to nine events (one per cable) of 12 days each (simultaneous with export cable installation); assuming no more than one cable installation per year;
- 1 x vessel group in MDZ installing inter-array cables; approximately 111 days per year for ten years;
- 1 x vessel group in MDZ installing hubs; active anywhere in MDZ for up to 180 days per year for up to ten years; and
- 2 x vessel groups in MDZ installing devices; active anywhere in MDZ all year round.

88. Based on information provided in **Chapter 4, Project Description**, it is assumed that up to four vessels or groups of vessels operating in close proximity to one another, could be present within the MDZ at any one time. In the ECC, it is predicted that a maximum of three groups of vessels could be present at any time. As a worst case, the EcIA assumes activity to be continuous because seabed drilling at night during construction and installation is possible.

89. As activities are expected to occur in the MDZ for much of the 37 year lifespan of the Project, this impact is considered to consist of a large number of short term, temporary and reversible impacts over an overall time period which is defined as long term.

90. As activities are expected to occur in the ECC for a small number of days each year, for up to a maximum of ten years, this impact is considered to consist of a modest number of short term, temporary and reversible impacts over an overall time period which is defined as medium term.

91. For the purposes of this assessment it is assumed that terrestrial and intertidal works at the landward side of the landfall could occur during a period of 18 months. All landfall locations (**Chapter 4, Project Description**) are in excess of 500 m from the nearest seabird colony (Abraham's Bosom).

11.6.5.2.2. Receptor Sensitivity

92. There are a wide range of disturbance and/or standoff distances for seabird colonies in published literature, including a standoff distance of 180 m for mixed tern/skimmer colonies disturbed by pedestrians and boats (Rodgers Jr. and Smith, 1995), a maximum flight initiation distance of 78 m for yellow-legged gull colonies to pedestrian approach (Martinez-Abrain et al., 2008), and a 100 m standoff distance between tern colonies and motor boats (Burger, 1998). A mixed colony of fulmars, shags, herring gulls, kittiwakes, guillemots, razorbills and puffins in Scotland demonstrated virtually no reaction behaviourally or reproductively to flights by fixed-wing aircraft within 100 m of the colony (Dunnet, 1977). A range of marine codes suggest that safe standoff distances for seabird colonies around the UK range from several tens of metres up to 200 m.

93. A more detailed study found that individuals within mixed seabird colonies where guillemot was the most abundant species elicited a range of disturbance responses due to close passing vessels (Rojek et al., 2007). Nearly all vessel disturbances to guillemots and cormorants occurred at vessel distances of less than 100 m from the colony. Of all recorded disturbance events, 78 % occurred when boats approached within 50 m of the colony, and all flushing events occurred due to vessels within 75 m of the colony. Heads up responses occurred occasionally when boats approached to within 200 m. This reaction does not necessarily result in the loss of eggs or chicks but can lead to flushing if the disturbance source continues or worsens.

94. Flushing during incubation or chick-rearing can lead to egg or chick loss because of displacement from the breeding site and abandonment (either temporary or permanent), egg breakage or predation. The effects of flushing on birds that are not attending eggs or chicks include disruption of courtship, nest-site defence or prospecting activities.

95. Based on the existing literature it is concluded that the presence of construction vessels will only result in effects on seabirds at breeding colonies if vessels regularly approach them to distances of less than approximately 300 m, which is considered a highly precautionary position on the basis of the information described above. There are several seabird colonies that could potentially be sensitive to this impact (based on distance to the Project), which are classified differently depending on the source material used. According to the SMP, there are sub-colonies located at Gogarth, Abrahams Bosom, and South Stack (**Table 11-8**). The RSPB reports colonies within the South Stack reserve slightly differently, with guillemots and razorbills being recorded in 2018 at Penlas North, Mousetrap Buttress, Redwall Buttress, South of Bridge, North of Bridge, and South Stack Island. Whilst not detailed here, the RSPB counts reported herring gull (338 individuals), fulmar (27 individuals), lesser black-backed gull (73 individuals), cormorant (10 individuals), kittiwake (5 individuals), and puffin (5 individuals).

96. It is considered that all breeding seabird locations on the Holy Island Coast are medium value receptors.

97. The latest counts for the three seabird colonies identified above are provided in **Table 11-16**.

**Table 11-16 Latest Colony Counts at Breeding Seabird Colonies Closest to MDZ from SMP Database and RSPB**

| Colony (and RSPB colonies that lie within it in brackets) | Approximate Central Grid Reference Based on SMP Data | Latest Count Date in SMP | Results of latest SMP Count (individuals on land) | Results of June 2018 RSPB Count (mean of minimum five counts; individuals on land) |
|---|---|---|---|---|
| Abraham's Bosom (Penlas) | SH 20907 81489 | June 2016 | Guillemot (315)<br>Razorbill (83)<br>Fulmar (2)<br>Herring gull (2) | Razorbill (11) |
| South Stack and Penlas RSPB (South of Bridge, Mousetrap Buttress, Redwall Buttress, South Stack Island) | SH 20599 82004 | May 2018 | Guillemot (5,243)<br>Razorbill (994)<br>Herring gull (106)<br>Fulmar (11)<br>Lesser black-backed gull (9)<br>Shag (8)<br>Kittiwake (7)<br>Puffin (7) | Guillemot (9,690) – of which 3,398 were on South Stack island<br><br>Razorbill (1,297) – of which 133 were on South Stack island |
| Gogarth (North of Bridge) | SH 21513 83286 | June 2016 | Herring gull (26)<br>Razorbill (18)<br>Cormorant (13)<br>Guillemot (7)<br>Fulmar (5)<br>Shag (5)<br>Lesser black-backed gull (3) | Razorbill (28) |

98. For simplicity, the JNCC SMP notation will be used for these colonies for the remainder of this assessment. However, because of the larger number of visits, it is possible that RSPB auk counts within the reserve may be more accurate than those contained within the SMP.

99. The approximate distance between the colonies and various working areas is provided in **Table 11-17**. The relative location of colonies to the nearest working areas is shown on **Figure 11-2** (**Volume II**).

**Table 11-17 Approximate Distances between MDZ, ECC, and Key Breeding Seabird Colony Locations within the South Stack and Penlas SMP Master Site**

| Colony | Approximate Distance to MDZ (m) (nearest boundary) | Approximate Distance to Export Cable Corridor (m) (nearest boundary) | Approximate Distance to Cable Tail Work Area (m) (nearest boundary) | Approximate Distance to Landward Landfall Location (m) (nearest boundary) |
|---|---|---|---|---|
| Abraham's Bosom | 950 | 0 | 0-500 | 500 (minimum) |
| South Stack and Penlas RSPB | 770 | 20 | >1000 | >1000 |
| Gogarth | 700 | 270 | >1000 | >1000 |

100. Provided that construction vessels are aware of the location of seabird colonies, do not propose to operate within 300 m of colony locations for extended periods (i.e. periods of several days without working elsewhere), and follow best practice for operating in relatively close proximity to such features, which will be included in a Construction and Environment Management Plan (CEMP), it is concluded that the Abraham's Bosom, South Stack and Penlas RSPB and Gogarth seabird colonies will have a **Negligible** sensitivity to cable laying and associated vessels working within the MDZ and ECC during the construction phase of the Project according to the definitions in **Chapter 5, EIA Methodology**.

101. If there are vessels which are involved in the installation of export cables or the export cable tails within 300 m of the Gogarth, Abrahams Bosom and South Stack seabird colonies during the breeding season for extended periods of time, then the sensitivity of the breeding colonies increases to **Medium**, based on the definitions provided in **Chapter 5, EIA Methodology**. The core breeding seasons are considered to be March to July for Abraham's Bosom (whilst breeding fulmar are present, they are present in low numbers only and are highly tolerant of vessel activity (Furness et al., 2012; Garthe and Hüppop, 2004)), and February to August for South Stack and Gogarth based on the species present at the last count (JNCC, 2018). During the non-breeding season, the sensitivity is **Negligible**, as most of the individuals associated with the colony will not be present, and the consequences of birds being flushed when not incubating an egg or raising a chick are significantly lower than in the breeding season.

102. Due to the distance between the landward landfall location and the Gogarth, Abrahams Bosom and South Stack seabird colonies (at least 500 m), these colonies will have a **Negligible** sensitivity to works at this location.

11.6.5.2.3. Magnitude of Impact

103. Any impacts resulting from the activities in the export cable corridor would be short-term, temporary and reversible in nature, lasting only for the duration of construction activity. Despite this, a severe one-off disturbance event at a seabird colony has the potential to cause a serious population-level effect.

104. Provided that construction vessels are aware of the location of seabird colonies, do not operate within 300 m of these locations during the breeding season, and follow best practice for operating in relatively close proximity to such features, which will be included in a Construction and Environment Management Plan (CEMP), it is concluded that vessels working within the MDZ and ECC will not cause any impacts on seabird breeding colonies during the construction phase of the Project. This applies to all inter array cable works, and export cable works occurring within the MDZ. The impact magnitude is therefore **Negligible**. This also applies to the non-breeding season.

105. Any vessel operating within 300 m of a breeding seabird colony during the breeding season has the potential to cause a **Medium negative** impact magnitude.

106. Due to the distance between the landward landfall location and the and the Gogarth, Abrahams Bosom and South Stack seabird colonies, along with the nature of the activities that will occur, the magnitude of impact of works at this location is **Negligible**.

11.6.5.2.4. Impact Significance

107. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Medium adverse** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating within 300 m of the colonies during the breeding season; and
- **Negligible** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating in excess of 300 m from the colonies, within 300 m during the non-breeding season, and works at the landward landfall.

11.6.5.2.5. Mitigation and Residual Impact

108. Based on the species known to breed at each of the potentially affected colonies (**Table 11-16**), and excluding any species understood to possess a "low" sensitivity to disturbance and displacement when at sea (**Table 11-13**), it is considered that it is appropriate to prohibit all vessel activities within 300 m of each of these colonies during the breeding season (**Table 11-9**) unless an ecological professional present states it is acceptable to proceed, which may be the case depending on the species present, the breeding stage, or the nature of vessel activities. This breeding period is considered to be March to July for Abraham's Bosom and February to August for South Stack and Gogarth based on the presence of shag at the last count for the latter two colonies (JNCC, 2018).

109. If this measure is adopted, then the magnitude of impact can be reduced from "medium" to "low" during the breeding season as works will not be permitted where an ecological professional considers sensitivity to be too high to enable works (e.g. works within 300 m may not be able to occur when most individuals at a colony are in the incubation stage). The residual impact significance is therefore **Minor adverse**.

### 11.6.5.3. Other Impacts

11.6.5.3.1. Introduction

110. Indirect impacts on marine ornithology receptors may occur during the construction phase if there are impacts on prey species and/or the habitats of prey species. These include those resulting from the production of underwater noise and the generation of suspended sediments that may alter the behaviour, abundance or availability of prey species for seabirds. There is also the possibility of pollution incidents due to ejection of contaminants or accidents involving construction vessels, which could result in potential indirect (prey effects) and direct (direct contact) impacts on marine ornithology receptors. Both are covered in this section.

#### 11.6.5.3.2. Receptor Sensitivity

111. Underwater noise may cause fish and mobile invertebrates to avoid construction areas and their immediate surroundings, and also affect their physiology and behaviour. Suspended sediments may cause fish and mobile invertebrates to avoid construction areas and their immediate surroundings and may smother and hide immobile benthic prey in a localised area. These mechanisms may result in less prey being available within the construction area and immediate surrounding area to foraging seabirds. Pollution events may cause localised injury or mortality to seabirds or their prey species in the immediate vicinity of the source of the pollution. All of these effects, if they occurred, would be extremely localised.

112. Generally speaking, seabirds are mobile animals. In the breeding season they adopt a central place foraging strategy from the nest, restricting their foraging areas to enable them to successfully provision their chicks. In the non-breeding season, birds may be sedentary, remaining in the area where they bred, dispersive, or fully migratory. The high mobility of seabirds means that they are able to utilise alternative areas of habitat should an area of habitat within their range become unavailable. Habitat flexibility is also an important criterion in determining the ability of a particular species to find alternative foraging habitat, and whilst a qualitative measure, it has been reviewed by several sources (Furness et al., 2012; Furness and Wade, 2012; Garthe and Hüppop, 2004).

113. **Table 11-18** presents habitat flexibility of the marine ornithology receptors (Furness et al., 2012), along with sensitivity to these impacts using the definitions in **Chapter 5, EIA Methodology**, based on expert judgement.

**Table 11-18 Habitat Flexibility and Sensitivity of Marine Ornithology Receptors to Indirect (Prey and Pollution) and Direct Pollution Impacts**

| Species | Habitat Flexibility (Scored 1-5 by Furness et al., (2012), where 1 is the most flexible) | Predicted Sensitivity to Localised Prey or Pollution Events |
|---|---|---|
| Common scoter | 4 | Low |
| Eider | 4 | |
| Red-throated diver | 4 | |
| Arctic tern | 3 | |
| Common tern | 3 | |
| Cormorant | 3 | |
| Guillemot | 3 | |
| Puffin | 3 | |
| Razorbill | 3 | |
| Sandwich tern | 3 | |
| Shag | 3 | |
| Black-headed gull | 2 | Negligible |
| Common gull | 2 | |
| Great black-backed gull | 2 | |
| Kittiwake | 2 | |
| Mediterranean gull | 2 (assumed same as black-headed gull) | |
| Fulmar | 1 | |

| Species | Habitat Flexibility (Scored 1-5 by Furness et al., (2012), where 1 is the most flexible) | Predicted Sensitivity to Localised Prey or Pollution Events |
|---|---|---|
| Gannet | 1 | |
| Herring gull | 1 | |
| Lesser black-backed gull | 1 | |
| Manx shearwater | 1 | |

11.6.5.3.3. Magnitude of Impact

114. With regard to noise impacts, **Chapter 10, Fish and Shellfish Ecology** and **Chapter 14, Commercial Fisheries** discuss the potential impacts upon fish relevant to marine ornithology as prey species. For species such as herring, sprat and sandeel, which are prey items of several marine ornithology receptors, the impact magnitude of underwater noise effects (physical injury or behavioural changes) and habitat loss during construction is considered to be minor or negligible. With regard to the definitions of impact magnitude given in **Chapter 5, EIA Methodology**, it is concluded that the magnitude of impact on seabirds occurring in or around the Project during the construction phase is **Negligible**. This applies to direct effects on the marine ornithology receptors themselves (**Section 11.6.4**), and their prey.

115. With regard to changes to the seabed and to suspended sediment levels, **Chapter 7, Metocean Conditions and Coastal Processes** and **Chapter 9, Benthic and Intertidal Ecology** discuss the nature of any change and impacts on the seabed and benthic habitats which host or support seabird prey species. The maximum envisaged effect associated with sediment plumes arising from the construction phase occurs during the foundation installation activities, which will cause only very minor increases in suspended sediment concentration; less than 1 mg/l a short distance from the release point, over a distance of several hundred metres. The effects will be temporary and fully reversible, with a return to very low background concentrations occurring rapidly upon cessation of installation activities. Other than at the immediate release point, such a change would be immeasurable. It is concluded that the magnitude of impact on seabirds occurring in or around the Project during the construction phase is **Negligible**.

116. Any pollution incidents, which are considered to be unlikely to occur, will result in the contamination of a small area (likely no more than several hundreds of metres) of subtidal habitat with a small amount of pollution. Measures will be in place to rapidly collect or disperse any such contamination, meaning that its presence will be temporary and reversible. As a result, based on the definitions of impact magnitude given in **Chapter 5, EIA Methodology**, the magnitude of impact is considered to be **Negligible**.

11.6.5.3.4. Impact Significance

117. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, guillemot, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull, puffin, razorbill, red-throated diver, Sandwich tern and shag.

### 11.6.6. Potential Impacts During Operation / Repowering

#### 11.6.6.1. Airborne Noise and Visual Disturbance / Displacement

11.6.6.1.1. Introduction

118. The operational / repowering phase of the Project has the potential to affect bird populations in the marine environment through disturbance due to airborne noise and visual disturbance, leading to displacement of birds from subtidal habitats occupied by arrays of tidal devices. This could be due to the presence of the devices themselves, or maintenance activities on the devices, inter array cables or export cables.

119. With respect to tidal devices, any impacts resulting from this impact pathway would be spatially restricted to subtidal areas within close proximity to the devices, and temporally restricted to the duration of operation / repowering (up to 37 years; long term). A maximum of 130 surface emergent devices may be deployed in total. The worst-case height above sea level for any tidal device will be 6 m.

120. It is expected that annual inspections of all cables will occur for the first three years after installation, reducing to every two years thereafter. Up to ten major cable repairs of five days each may be required throughout the Project life of 37 years. Devices will be visited up to 15 times annually. The assessment therefore assumes that during operation / repowering, approximately four groups of vessels may be present in the MDZ and ECC (the OfDA) at any one time. This is in addition to the vessel groups expected to be present fulfilling construction requirements (**Section 11.6.5.1**).

11.6.6.1.2. Receptor Sensitivity

121. There is limited information available on whether the presence of operational tidal devices causes disturbance and displacement effects on birds, although available literature suggests that either no, or very limited displacement impacts occur as a result of their presence (Lieber et al., 2019; Royal Haskoning, 2011).

122. Robbins (2017) provides an overview of five years of bird observations collected from the Fall of Warness tidal energy test site at the European Marine Energy Centre (EMEC). During that study, a number of species were frequently recorded which are also frequently present in the MDZ. It was noted that species recorded by Robbins (2017) occupied the ecological niches that would be expected based on their known ecology (e.g. guillemots and razorbills showing a preference for pelagic waters). This suggests that bird behaviour had likely remained as would be expected despite the deployment of the tidal devices. In addition, birds that have been classified as particularly susceptible to disturbance by vessel traffic on disturbance by man-made structures at sea (Furness et al., 2013, 2012; Garthe and Hüppop, 2004) such as red-throated diver and shag were also frequently recorded at the site. This suggests that disturbance and displacement effects due to the presence of tidal devices are lower than similar effects caused by vessels.

123. Furness et al. (2012) classified seabird species by their potential for disturbance by marine structures, where a score of one represented minimal risk, and five moderate risk. None of the marine ornithology receptors were scored above three.

124. Of the bird species recorded during the baseline surveys (**Appendix 11.1, Volume III**), cormorant and shag have been observed elsewhere using man-made structures as roosting platforms (Dierschke et al., 2016; Furness et al., 2012; Kahlert et al., 2004; Roycroft et al., 2004). The presence of structures effectively enables extension of the foraging range of these species, enabling them to utilise foraging areas which were previously beyond their maximum range. There is no evidence available regarding the use of surface piercing tidal devices for this purpose, but it is assumed that they will be used in a similar way. Other groups of species that may be attracted into operational arrays due to the presence of roosting platforms are gulls (Dierschke et al., 2016; Roycroft et al., 2007, 2004) and terns (Christensen et al., 2004).

125. Lighting of tidal devices and other structures at night may potentially be a source of attraction (phototaxis) or displacement. The areas affected would mainly be restricted to array areas with the exception of transiting vessels associated with the Project, which would be less common at night. Because the lighting would only affect an extremely localised area, it is considered that in general, the marine ornithology receptors would be insensitive to this impact. Phototaxis can be a serious hazard for fledglings of some seabird species, predominantly shearwaters (Deppe et al., 2017; Raine et al., 2007; Rodríguez et al., 2017, 2014), but occurs over short distances (typically hundreds of metres) in response to bright white light close to breeding colonies, and generally only once a year, when fledglings are departing their breeding colonies. Operational arrays of tidal devices within the MDZ would be far enough removed from any Manx shearwater breeding colonies (approximately 45 km) to render the likelihood of this impact occurring negligible.

126. Combining this information with the results of the screening exercise undertaken in **Table 11-13** results in the following sensitivity classifications with respect to the tidal devices themselves:

- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, guillemot, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull, puffin, razorbill, red-throated diver, Sandwich tern and shag.

127. With respect to vessel activity, it is assumed on a highly precautionary basis that exactly the same levels of impact and mortality are predicted due to operational phase activities as is the case for construction. This is detailed in **Section 11.6.5.1**. The sensitivity levels are as follows:

- **Medium** for red-throated diver and shag;
- **Low** for guillemot, puffin and razorbill; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

#### 11.6.6.1.3. Magnitude of Impact

128. Whilst the assessment of receptor sensitivity for this impact pathway draws on literature focusing on the impacts of offshore wind farms, it is not considered that the disturbance and displacement impacts caused by an array of tidal energy converters will be comparable to that of an offshore wind farm due to the obvious differences in physical characteristics between the two above the surface of the sea. Given the very small or even complete absence of tidal devices from the

surface of the sea, a more accurate comparison in terms of displacement effects is probably something more akin to a gill net or a buoy. The well documented bycatch of seabirds (Bicknell et al., 2013; Croxall et al., 2012; Žydelis et al., 2013, 2009), indicates such submerged, or largely submerged structures do not readily disturb birds sufficiently to prevent their entanglement. This assessment also considers that any very minor displacement effects that may occur would likely only be temporary as birds are expected to habituate to the presence of tidal devices.

129. It is concluded from the review of responses of the presence of man-made structures by a range of species in **Section 11.6.6.1.2** that the following magnitudes of impact are appropriate:

- **Low beneficial** for cormorant and shag; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, eider, fulmar, gannet, guillemot, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull, puffin, razorbill, red-throated diver and Sandwich tern.

130. Regarding maintenance activities, any impacts will be spatially restricted to subtidal areas within close proximity to the activities, and temporally restricted to the duration of the activity. These impacts are therefore short-term, temporary and reversible. Rather than resulting in harm to the bird or loss from the population, disturbance and displacement by airborne noise and visual disturbance will result in affected birds temporarily redistributing at sea and moving to an area where they are undisturbed, with birds expected to return to the area once activities have ceased.

131. For the purposes of the assessment it is assumed that levels of activity associated with the operation of the Project are comparable to those anticipated during construction, and as the two project phases are expected to run simultaneously for much of the Project lifespan, the magnitude of impact is the same as detailed in **Section 11.6.5.1.3**. This is:

- **Low negative** for guillemot; and
- **Negligible** for all other species.

11.6.6.1.4. Impact Significance

132. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Minor adverse** for guillemot; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, puffin, Manx shearwater, Mediterranean gull, razorbill, red-throated diver, Sandwich tern and shag.

### 11.6.6.2. Disturbance at Breeding Sites

11.6.6.2.1. Introduction

133. The operational / repowering phase of the Project has the potential to affect marine ornithology receptors at nearby breeding colonies due to airborne noise and visual disturbance caused by maintenance vessels in the MDZ and ECC.

134. It is expected that annual inspections of all cables will occur for the first three years after installation, reducing to every two years thereafter. Up to ten major cable repairs of five days each may be required throughout the Project life of 37 years. Devices will be visited up to 15 times annually. The assessment therefore assumes that during operation / repowering, approximately four groups of vessels may be present in the MDZ and ECC (the OfDA) at any one time during the lifespan of the Project.

11.6.6.2.2. Receptor Sensitivity

135. Provided that construction vessels are aware of the location of seabird colonies, do not operate within 300 m of colony locations during the breeding season in the absence of prior ecological advice, and follow best practice for operating in relatively close proximity to such features, it is concluded that the Abraham's Bosom, South Stack and Penlas RSPB and Gogarth seabird colonies will have a **Negligible** sensitivity to cable laying and associated vessels working within the MDZ and ECC during the operational / repowering phase of the Project according to the definitions in **Chapter 5, EIA Methodology**.

136. If there are vessels which are involved in the maintenance of export cables or the export cable tails within 300 m of the Gogarth, Abrahams Bosom and South Stack seabird colonies, then the sensitivity of the breeding colonies increases to **Medium**, based on the definitions provided in **Chapter 5, EIA Methodology**. The core breeding seasons are considered to be March to July for Abraham's Bosom (whilst breeding fulmar are present, they are present in low numbers only and are highly tolerant of vessel activity (Furness et al., 2012; Garthe and Hüppop, 2004)), and February to August for South Stack and Gogarth based on the presence of shag at the last count (JNCC, 2018).

11.6.6.2.3. Magnitude of Impact

137. Any impacts resulting from the activities in the export cable corridor would be short-term, temporary and reversible, lasting only for the duration of maintenance activity. Despite this, a severe one-off disturbance event at a seabird colony has the potential to cause a serious population-level effect.

138. Provided that vessels are aware of the location of seabird colonies, do not operate within 300 m of these locations during the breeding season, and follow best practice for operating in relatively close proximity to such features, it is concluded that vessels working within the MDZ and ECC will not cause any impacts on seabird breeding colonies during the construction phase of the Project. The impact magnitude is therefore **Negligible**.

139. Any vessel operating within 300 m of a breeding seabird colony during the breeding season has the potential to cause a **Medium negative** impact magnitude.

11.6.6.2.4. Impact Significance

140. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Medium adverse** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating within 300 m from the colonies; and
- **Negligible** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating in excess of 300 m from the colonies.

11.6.6.2.5. Mitigation and Residual Impact

141. Based on the species known to breed at each of the potentially affected colonies (**Table 11-16**), and excluding any species understood to possess a "low" sensitivity to disturbance and displacement when at sea (**Table 11-13**), it is considered that it is appropriate to prohibit all vessel activities within 300 m of each of these colonies during the breeding season (**Table 11-9**) unless an ecological professional present states it is acceptable to proceed, which may be the case depending on the species present, the breeding stage, or the nature of vessel activities. This breeding period is considered to be March to July for Abraham's Bosom and February to August for South Stack and Gogarth based on the presence of shag at the last count for the latter two colonies (JNCC, 2018).

142. If this measure is adopted, then the magnitude of impact can be reduced from "medium" to "low" during the breeding season as works will not be permitted where an ecological professional considers sensitivity to be too high to enable works (e.g. works within 300 m may not be able to occur when most individuals at a colony are in the incubation stage). The residual impact significance is therefore **Minor adverse**.

### 11.6.6.3. Collision Risk with Tidal Devices

11.6.6.3.1. Introduction

143. The operational / repowering phase of the Project has the potential to affect marine ornithology receptor populations through collision between diving birds and the tidal energy convertors (TEC) within tidal devices. This is currently a theoretical risk (Furness et al., 2012; McCluskie et al., 2012; SNH, 2016), and no actual effect has yet been demonstrated.

144. For the operational / repowering phase of the Project, collision risk for all regularly diving seabird species recorded on the sea within the MDZ has been assessed using two methods, Encounter Rate Modelling (ERM) and Collision Risk Modelling (CRM), as per published guidance (SNH, 2016) and discussions with the Ornithology TWG during the preparation of this chapter. Full details of the methods, the input parameters, the tidal device deployment scenarios selected for modelling, and detailed outputs are provided in **Appendix 11.3** (**Volume III**). It should be noted that as per SNH (2016), it is acknowledged that the ERM and CRM methods will provide at best, an order of magnitude estimate of collision risk. For several reasons explored in detail in **Appendix 11.3** (**Volume III**), it is also expected that both ERM and CRM provide results that are likely to give a precautionary estimate of theoretical collision risk.

145. For each species, the possibility of a significant proportion of birds at risk of collision being from a single colony, which substantially increases the risk of population level effects on that particular colony (**Table 11-11**), was also considered if ERM/CRM outputs indicated that the species was particularly vulnerable to collision. Where this was identified as a possible issue, the outputs from ERM/CRM have then been used as an input for Population Viability Analysis (PVA) for these colonies. Details of PVA methodology, input parameters and outputs are given in **Appendix 11.3** (**Volume III**).

146. There is considerable uncertainty regarding avoidance rates for several reasons. Firstly, it is expected that animals of relatively small size such as diving seabirds might be swept past moving tidal device blades while entrained within the tidal stream (Wilson et al., 2007). Secondly, given that the rotation speed of tidal stream turbines is generally much lower than wind turbines (where collisions are assumed to result in 100 % collision mortality) (Fraenkel, 2006), and dive and swim speeds of seabirds are much lower than their flight speeds (Alerstam et al., 2007; Bruderer and Boldt, 2001; Robbins, 2017), and that the profiles of tidal device blades are generally 'blunt' in profile in contrast to those of wind turbines, it is considered highly unlikely that the strike force of a collision would result in a trauma sufficient to cause injury or death in all collision events (Wilson et al., 2007). This may be particularly applicable to collisions occurring near the centre of rotor, downward strikes occurring on dive descents, and upward strikes occurring on dive ascent. Finally, no information exists on the ability of seabirds to avoid collisions with tidal turbines at any range. It should be noted that the burst speed of some species of diving birds relative to the speed of tidal device turbine blades is thought to be much higher when compared to the equivalent relationships between flying birds and wind turbines (Fraenkel, 2006; Wilson et al., 2007). This suggests that such close-range avoidance behaviour will be more successful in diving seabirds than may be the case for flying birds at wind farms.

147. For balance, it should also be noted that some information suggests that narrow fields of view and/or inability to see great distances underwater may increase the potential vulnerability of diving birds to collision with objects underwater (Martin and Wanless, 2015; White et al., 2007). That being said, no extensive reports of underwater collisions between seabirds and underwater objects have been reported. Whilst seabird bycatch due to entanglement of seabirds in fishing nets is a widely reported issue (Žydelis et al., 2013, 2009), this is considered a separate phenomenon to the theoretical risk of underwater collision presented here.

148. It is recognised that the models used here, and the comparability of their outputs to potential real-world impacts, will be shaped enormously by the avoidance rate that is selected. As suggested by SNH (2016) and agreed with the Ornithology TWG, the avoidance rates 0 %, 50 %, 90 %, 95 %, 98 % and 99 % have been presented, along with higher rates of 99.5 % and 99.9 %. Based on the recommended default collision risk for onshore wind of 98 %, and detail provided above which indicates that higher avoidance rates are appropriate for tidal energy devices, the impact assessment focuses on avoidance rates of between 95 % and 99.9 %.

11.6.6.3.2. Receptor Sensitivity

149. Birds recorded on the water in the MDZ during boat-based surveys (**Appendix 11.1, Volume III**) during relevant seasons (**Table 11-9**), which are known to habitually dive to the depth where there is a risk of collision with TECs will be sensitive to potential collision impacts. These species have been identified by an extensive literature review into their diving capabilities and foraging

activities (**Appendix 11.3, Volume III)**. The species identified are guillemot (breeding and non-breeding), puffin (breeding), razorbill (breeding and non-breeding), red-throated diver (non-breeding), Manx shearwater (breeding), gannet (breeding) and shag (breeding). Whilst it is possible that cormorant (and possibly shag) numbers in the MDZ may increase during operation due to the roosting opportunities provided by floating infrastructure, collision risk cannot be calculated for this species due to the fact it was not recorded on the sea in the MDZ during baseline surveys. For the purposes of this assessment, sensitivity and magnitude have been set at the same level as shag, as the most similar species included in the assessment to cormorant.

150. In addition to species receptors, colonies have been assigned a sensitivity where it is expected that a high proportion of a given species that is sensitive to this impact pathway will be present within the MDZ.

151. Sensitivities to collision, according to the definitions provided in **Chapter 5, EIA Methodology** are as follows:

- **High** for the South Stack and Penlas SMP sub-colonies, as it is expected to be the origin of 100 % of MDZ populations of three diving birds (guillemot, razorbill and shag);
- **Medium** for gannet, guillemot, Manx shearwater, puffin, razorbill, red-throated diver and shag (as well as cormorant, which has not been modelled due to no birds being recorded on the water in the MDZ during boat-based surveys); and
- **Negligible** for all other marine ornithology receptors species listed in **Table 11-10**, as their diving habits identified in the literature mean that they will not routinely occur in the rotor swept zone of tidal devices.

11.6.6.3.3. Magnitude of Impact

152. Collision between a diving seabird and a TEC could occur anywhere within an operational tidal array during the operational / repowering phase, which could last for a total of up to 37 years (i.e. long term). As described above, the likelihood of collisions actually resulting in mortality is somewhat unknown, reflected in a range of avoidance rates being presented for the species of interest (SNH, 2016).

153. Whilst not presented for the purposes of keeping the chapter to a reasonable length, collision estimates using the upper and lower confidence intervals associated with each density are accounted for when assigning magnitudes of impact across the scenarios below.

11.6.6.3.3.1. 240 MW Full Deployment Scenario

154. Several tidal device parameter envelopes, identified by alphanumeric codes, have been considered, each representing a realistic worst case for that particular type of device (**Appendix 11.3, Volume III**). For a 240 MW full deployment of a variety of devices (**Appendix 11.3, Volume III**), the annual number of collisions estimated for each species by time period (breeding and non-breeding season is presented in **Table 11-19**.

**Table 11-19 Number of Predicted Collisions in a Single Season (Mean of ERM and CRM) for Diving Species Recorded in MDZ by Appropriate Time Period, at a Range of Different Avoidance Rates, for a Deployment Scale of 240 MW**

| Species | Time Period (B/NB) | Avoidance Rate (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 50 | 90 | 95 | 98 | 99 | 99.5 | 99.9 |
| Gannet | B | 14 | 7 | 2 | 1 | 1 | 1 | 1 | 0 |
| Guillemot | B | 19,362 | 9,681 | 1,936 | 968 | 387 | 194 | 97 | 19 |
| | NB | 4,663 | 2,331 | 466 | 233 | 93 | 47 | 23 | 5 |
| Manx shearwater | B | 173 | 86 | 17 | 9 | 3 | 2 | 1 | 0 |
| Puffin | B | 89 | 44 | 9 | 4 | 2 | 1 | 0 | 0 |
| Razorbill | B | 6,086 | 3,043 | 609 | 304 | 122 | 61 | 30 | 6 |
| | NB | 6,073 | 3,036 | 607 | 304 | 121 | 61 | 30 | 6 |
| Red-throated diver | NB | 562 | 281 | 56 | 28 | 11 | 6 | 3 | 1 |
| Shag | B | 14 | 7 | 1 | 1 | 0 | 0 | 0 | 0 |

155. To examine the significance of the values in **Table 11-19**, the predicted number of collisions in a season was compared to the probable reference population (**Table 11-11**). On the basis of information regarding the likely components of an avoidance rate (**Section 11.6.6.3.2** and **Appendix 11.3, Volume III**), the assessment focuses on avoidance rates between 95 % and 99.9 % (**Table 11-20**).

**Table 11-20 Collision Rates at 95-99.9 % Avoidance Rates (Mean of ERM and CRM) Relative to Relevant Reference Populations, at a Deployment Scale of 240 MW for a Single Season**

| Species | Time Period (B/NB) | Reference Population (individual birds) (Table 11-11) | Probable Number of Collisions per Season | As % of Reference Population |
|---|---|---|---|---|
| Gannet | B | 138,474 | 0 - 1 | 0 - 0.001 |
| Guillemot | B | 7,457 | 19 - 968 | 0.25 – 12.98 |
| | NB | 1,139,220 | 5 - 233 | 0 - 0.02 |
| Manx shearwater | B | 673,350 | 0 - 9 | 0 - 0.001 |
| Puffin | B | 1,746 | 0 - 4 | 0 - 0.23 |
| Razorbill | B | 1,467 | 6 - 304 | 0.41 – 20.73 |
| | NB | 341,422 (Nov-Dec)<br>606,914 (Aug-Oct and Jan-Mar) | 6 - 304 | 0.002 - 0.09 |
| Red-throated diver | NB | 1,676 | 1 - 28 | 0.06 - 1.67 |
| Shag | B | 26 | 0 - 1 | 0 - 3.85 |

156. Depending on the proportion of guillemots in the MDZ from the South Stack and Penlas SMP sub-colonies versus the wider UK Western Waters BDMPS during the non-breeding season, the upper limit of non-breeding season collisions of 233 birds (at 95 % avoidance) could represent between 0 % to 3.1 % of the South Stack and Penlas SMP sub-colonies breeding adult population, depending on the dispersal rate of birds from this colony following the breeding

season. The upper, worst case value of 3.1 % is only applicable if no guillemots disperse from the colony during the non-breeding season, and all collisions involve birds from this colony, which seems highly unlikely. This calculation is highly precautionary as it does not include the non-breeding component of the SSSI population in the overall population size, and assumes all mortalities are breeding adults.

157. Due to the potentially high number of collisions predicted for guillemot and razorbill, in addition to the fact that 100 % of the MDZ population originates from the same colony, a PVA was carried out on the population of the South Stack and Penlas SMP sub-colonies for both species during the breeding season (encompassing the Gogarth, South Stack and Abraham's Bosom sub-colonies), using the same avoidance rates presented above. PVAs considered the combined predicted effects of mortality from collisions and displacement from operational arrays. Details of this process are provided in **Appendix 11.3** (**Volume III**).

158. CPGR and the CPS after 25 years of deployment are presented for guillemot and razorbill **Table 11-21** and **Table 11-22** respectively.

159. The use of avoidance rates of between 98 % and 99.9 % suggests that the guillemot population would continue to increase from present day levels if a 240 MW array consisting of the devices listed at **Chapter 4, Project Description** and **Appendix 11.3** (**Volume III**) was deployed and operated for 25 years. At the lowest avoidance rate (95 %), at 25 years under these conditions, the model predicts an overall guillemot population of <10 % of when compared with unimpacted conditions predicted after 25 years, and also when compared to the population at the latest colony count. At 98 % avoidance, the population after 25 years would be 40.5 % of what is predicted under unimpacted conditions, which would be slightly less birds than were present at the latest colony count. Avoidance rates of 99 % or higher result in a population of at least 69.2 % the size of the predicted baseline population, and up to 95.6 % in the case of a 99.9 % avoidance rate.

**Table 11-21 CPGR and CPS (25 year) Metrics for PVA for South Stack and Penlas SMP Sub-Colonies for Guillemot During the Breeding Season, 240 MW Deployment**

| Avoidance Rate | Growth Rate | Population After 25 Years (total individual breeding adults) | Counterfactual of Growth Rate | Counterfactual of 25 Year Population | 25 Year Population Relative to Current Population |
|---|---|---|---|---|---|
| Baseline | 1.037 | 18,353 | N/A | N/A | 2.461 |
| 95 % | 0.911 | 438 | 0.893 | 0.024 | 0.059 |
| 98 % | 1.004 | 7,437 | 1.000 | 0.405 | 0.996 |
| 99 % | 1.023 | 12,691 | 1.021 | 0.692 | 1.700 |
| 99.5 % | 1.031 | 15,461 | 1.030 | 0.842 | 2.071 |
| 99.9 % | 1.035 | 17,539 | 1.035 | 0.956 | 2.350 |

160. The guillemot population of the South Stack and Penlas SMP sub-colonies has been increasing since at least the early 1980's, but there is some evidence based on more recent counts that the population is unlikely to continue to grow indefinitely at the rate seen between the 1980's and the present day (JNCC, 2018). Whilst the reason for this is unclear, if colony growth is

constrained in the medium term in its baseline state (i.e. in the absence of the Project), then it is possible that the differences between the different impact scenarios considered in the assessment and the predicted baseline may be smaller in reality than suggested by the PVA, though as stated above, CPGR and CPS are still useful indicators despite this. In addition, this model is considered precautionary because the starting population of 7,457 was that according to the latest SMP count (5,565) (**Table 11-16**) multiplied by an appropriate k-value (1.34) (Harris et al., 2015). Had the more recent RSPB count been available when the model had been run, the starting population would have been 12,984 (i.e. 9,690 x 1.34) (**Table 11-16**). This population is approximately 75 % larger than the starting population used by the PVA. The larger starting population would result in a population which may possess greater resilience with respect to additional mortality.

161. At an avoidance rate of 95 %, it is predicted that deployment of a 240 MW array consisting of the devices listed at **Chapter 4, Project Description** would result in the extinction of the razorbill population within the South Stack and Penlas SMP master site after several years of operation, with a similar outcome in terms of population level predicted at 98 % avoidance. At an avoidance rate of 99 %, the population after 25 years of deployment would be 33.6 % of that predicted under unimpacted conditions, which is less birds than were recorded at the latest colony count. The use of avoidance rates of 99.5 % and 99.9 % results in increases in populations from the last colony count after 25 years of deployment, but 69.1 % and 92.9 % of what would be expected under unimpacted conditions.

**Table 11-22 CPGR and CPS (25 year) Metrics for PVA for South Stack and Penlas SMP Sub-Colonies for Razorbill During the Breeding Season, 240 MW Deployment**

| Avoidance Rate | Growth Rate | Population After 25 Years (total individual breeding adults) | Counterfactual of Growth Rate | Counterfactual of 25 Year Population | 25 Year Population Relative to Current Population |
|---|---|---|---|---|---|
| Baseline | 1.037 | 3,430 | N/A | N/A | 2.338 |
| 95 % | 0.233 | 0 | 0.226 | 0.000 | 0.000 |
| 98 % | 0.889 | 77 | 0.859 | 0.022 | 0.052 |
| 99 % | 0.990 | 1,152 | 0.957 | 0.336 | 0.785 |
| 99.5 % | 1.019 | 2,371 | 0.985 | 0.691 | 1.616 |
| 99.9 % | 1.032 | 3,186 | 0.997 | 0.929 | 2.172 |

162. Like guillemot, the razorbill population at the South Stack and Penlas SMP sub-colonies has been increasing since at least the early 1980's, but there is some evidence based on more recent counts that the population is unlikely to continue to grow at the rate seen between the 1980's and the present day indefinitely (JNCC, 2018). Whilst the reason for this is unclear, if colony growth is constrained in the medium term in its baseline state (i.e. in the absence of the Project), then it is possible that the differences between the different impact scenarios considered in the assessment and the predicted baseline may be smaller in reality than suggested by the PVA, though as stated above, CPGR and CPS are still useful indicators despite this. As with guillemot, the latest counts from the RSPB suggest a larger starting population (1,790) than the 1,467 derived from SMP data (**Table 11-16**). This population is approximately 34 % larger than the starting population used by the PVA. The larger starting

population would result in a population which may possess greater resilience with respect to additional mortality.

163. The following magnitudes of impact due to collision at a 240 MW deployment scale are considered appropriate, based on expert opinion, considering the wider backdrop of an increasing auk population in Wales (**Section 11.5.6)**, and assuming that 95 % avoidance rates are used on a precautionary basis:

- **Very high negative** for guillemot (breeding), razorbill (breeding), and the South Stack and Penlas SMP sub-colonies;
- **Medium negative** for guillemot (non-breeding) and razorbill (non-breeding);
- **Low negative** for, puffin (breeding) and red-throated diver (non-breeding); and
- **Negligible** for gannet (breeding), Manx shearwater (breeding), shag (breeding) and cormorant (presumed), as well as all non-diving marine ornithology receptors.

164. Whilst the above magnitudes of impact are used by the assessment for precautionary reasons, a change to 99 % avoidance rate would result in the following magnitudes of impact being assigned:

- **High negative** for razorbill (breeding), and the South Stack and Penlas SMP sub-colonies;
- **Medium negative** for guillemot (breeding); and
- **Negligible** for gannet (breeding), guillemot (non-breeding), Manx shearwater (breeding), puffin (breeding), razorbill (non-breeding) and red-throated diver (non-breeding) shag (breeding) and cormorant (presumed), as well as all non-diving marine ornithology receptors (**Table 11-11**).

11.6.6.3.3.2. 40 MW Worst Case Scenario

165. A 40 MW worst case scenario has been considered in order to reflect the expected scale of a first commercial level phase of deployment within the Project. Several tidal device parameter envelopes, identified by alphanumeric codes, have been considered, each representing a realistic worst case for that particular type of device (**Appendix 11.3, Volume III**). The impact of different device envelopes varies considerably between species, depending largely on whether they are deep or shallow diving birds; the allocation of species to a particular definition is described in **Appendix 11.3** (**Volume III**). For a 40 MW single device initial phase of deployment for the Project (which is a level of deployment considered appropriate to assess for all devices except for 2F and 9F, and therefore these devices are excluded), the annual number of collisions for each species by time period (breeding and non-breeding seasons (**Table 11-9**), for the device envelope that resulted in the most collisions for that species, is presented in **Table 11-23**. It should be noted that this represents a worst case and other devices resulted in less collisions, details of which are presented in **Appendix 11.3** (**Volume III**).

**Table 11-23 Number of Predicted Collisions in a Single Season (Mean of ERM and CRM) for Diving Species Recorded in MDZ by Appropriate Time Period, at a Range of Different Avoidance Rates, for a Worst-Case Device Envelope Scenario at a Deployment Scale of 40 MW**

| Species | Time Period (B/NB) | Device | Avoidance Rate (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 50 | 90 | 95 | 98 | 99 | 99.5 | 99.9 |
| Gannet | B | 3F | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Guillemot | B | 6S | 5,743 | 2,871 | 574 | 287 | 115 | 57 | 29 | 6 |
| | NB | | 1,232 | 616 | 123 | 62 | 25 | 12 | 6 | 1 |
| Manx shearwater | B | 3F | 31 | 16 | 3 | 2 | 1 | 0 | 0 | 0 |
| Puffin | B | 3F | 22 | 11 | 2 | 1 | 0 | 0 | 0 | 0 |
| Razorbill | B | 3F | 1,517 | 758 | 152 | 76 | 30 | 15 | 8 | 2 |
| | NB | | 1,513 | 757 | 151 | 76 | 30 | 15 | 8 | 2 |
| Red-throated diver | NB | 3F | 151 | 76 | 15 | 8 | 3 | 2 | 1 | 0 |
| Shag | B | 6S | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |

166. To examine the significance of the values in **Table 11-23** in the context of relevant populations of each species, the predicted number of collisions in a season was compared to the probable reference population (the BDMPS or population of colonies in **Table 11-11**). On the basis of information regarding the likely components of an avoidance rate and the precautionary values input into the models (**Section 11.6.6.3.2** and **Appendix 11.3, Volume III**), the assessment focuses on avoidance rates between 95 % and 99.9 % (**Table 11-24**).

**Table 11-24 Collision Rates at 95 to 99.9 % Avoidance Rates (Mean of ERM and CRM) Relative to Relevant Reference Populations, for a Worst-Case Device Envelope Scenario at a Deployment Scale of 40 MW, in a Single Season**

| Species | Time Period (B/NB) | Reference Population (individual birds) (Table 11-11) | Probable Number of Collisions per Season | As % of Reference Population |
|---|---|---|---|---|
| Gannet | B | 138,474 | 0 | 0 |
| Guillemot | B | 7,457 | 6 - 287 | 0.08 - 3.85 |
| | NB | 1,139,220 | 1 - 62 | 0.0001 - 0.005 |
| Manx shearwater | B | 673,350 | 0 - 2 | 0 - 0.0003 |
| Puffin | B | 1,746 | 0 - 1 | 0 - 0.06 |
| Razorbill | B | 1,467 | 2 - 76 | 0.14 - 5.18 |
| | NB | 341,422 (Nov-Dec)<br>606,914 (Aug-Oct and Jan-Mar) | 2 - 76 | 0 - 0.02 (max) |
| Red-throated diver | NB | 1,676 | 0 - 8 | 0 - 0.48 |
| Shag | B | 26 | 0 | 0 |

167. It is recognised that the behaviour of non-breeding guillemot is dispersive rather than migratory (Furness, 2015). This means that because the MDZ is situated in close proximity to breeding colonies for these species within the South Stack and Penlas SMP sub-colonies, the proportion of non-breeding birds present in and around the MDZ that are from these colonies may be higher than suggested in Furness (2015). Depending on the proportion of guillemots in the MDZ from the South Stack and Penlas SMP sub-colonies versus the wider UK Western Waters BDMPS

during the non-breeding season, the upper limit of non-breeding season collisions of 62 birds (at 95 % avoidance) could represent between 0 % to 0.8 % of the South Stack and Penlas SMP sub-colonies breeding adult population, depending on the dispersal rate of birds from this colony following the breeding season. The upper, worst case value of 0.8 % is only applicable if no guillemots disperse from the colony during the non-breeding season and all collisions are birds from this colony, which is implausible. This calculation is highly precautionary as it does not include the non-breeding component of the population in the overall population size.

168. Due to the potentially high number of collisions predicted for guillemot and razorbill, in addition to the understanding that 100 % of the MDZ population originates from the same SMP master colony, a PVA was carried out on the population of the South Stack and Penlas SMP sub-colonies for both species during the breeding season (encompassing the Gogarth, South Stack and Abraham's Bosom sub-colonies), using the same avoidance rates presented above. PVAs considered the combined predicted effects of mortality from collisions and displacement from operational arrays and due to construction and operational / repowering vessel traffic. Details of this process are provided in **Appendix 11.3** (**Volume III**).

169. Counterfactual of Population Growth Rates (CPGR) and the Counterfactual of Population Size (CPS) after 25 years of deployment are presented for guillemot and razorbill in **Table 11-25** and **Table 11-26** respectively. Whilst this is shorter than the operational lifespan of 37 years, no array will be deployed continuously for this length of time. CPGR is the ratio of the predicted population annual growth rate with and without the Project impacts, and CPS is the ratio of the predicted end-point population size with and without the Project impacts at 25 years of operation. These metrics have been demonstrated to have low sensitivity to the mis-specification of input parameters (e.g. demographic rates) and to the underlying assumptions of the population models from which the PVAs are derived (Cook and Robinson, 2016; Jitlal et al., 2017).

170. The use of avoidance rates of between 95 % and 99.9 % suggests that the guillemot population of the South Stack and Penlas SMP sub-colonies would continue to grow (population growth rate >1) compared to the latest colony count if a 40 MW array consisting of devices which cause the largest impact on this species was deployed and operated for 25 years. At the lowest avoidance rate (95 %), after 25 years under these conditions, the PVA predicts an overall guillemot population of 63.7 % when compared with the predicted unimpacted conditions after 25 years. Avoidance rates of 98 % or higher result in a population of at least 85.1 % the size of the predicted unimpacted population, or above.

**Table 11-25 CPGR and CPS (25 year) Metrics for PVA for South Stack and Penlas SMP Sub-Colonies for Guillemot During the Breeding Season, 40 MW Worst-Case Deployment**

| Avoidance Rate | Growth Rate | Population After 25 Years (total individual breeding adults) | Counterfactual of Growth Rate | Counterfactual of 25 Year Population | 25 Year Population Relative to Current Population |
|---|---|---|---|---|---|
| Baseline | 1.037 | 18,353 | N/A | N/A | 2.461 |
| 95 % | 1.014 | 10,522 | 0.978 | 0.573 | 1.411 |
| 98 % | 1.028 | 15,034 | 0.992 | 0.819 | 2.016 |
| 99 % | 1.032 | 16,583 | 0.996 | 0.904 | 2.224 |

| | | | | | |
|---|---|---|---|---|---|
| 99.5 % | 1.034 | 17,370 | 0.998 | 0.946 | 2.329 |
| 99.9 % | 1.036 | 17,977 | 0.999 | 0.980 | 2.411 |

171. The guillemot population of the South Stack and Penlas SMP sub-colonies has been increasing since at least the early 1980's, but there is some evidence based on more recent counts that the population is unlikely to continue to grow indefinitely at the rate seen between the 1980's and the present day (JNCC, 2018). Whilst the reason for this is unclear, if colony growth is constrained in the medium term in its baseline state (i.e. in the absence of the Project), then it is possible that the differences between the different impact scenarios considered in the assessment and the predicted baseline may be smaller in reality than suggested by the PVA, though as stated above, CPGR and CPS are still useful indicators despite this. In addition, this model is considered precautionary because the starting population of 7,457 was that according to the latest SMP count (5,565) (**Table 11-16**) multiplied by an appropriate k-value (1.34) (Harris et al., 2015). Had the more recent RSPB count been available when the model had been run, the starting population would have been 12,984 (i.e. 9,690 x 1.34) (**Table 11-16**). This population is approximately 75 % larger than the starting population used by the PVA. The larger starting population would result in a population which may possess greater resilience with respect to additional mortality.

172. Regarding the PVA for razorbill, the use of avoidance rates of between 98 % and 99.9 % suggests that the population would continue to grow compared to the latest colony count if a 40 MW array consisting of devices which cause the largest impact on this species was deployed and operated for 25 years. At the lowest assessed avoidance rate (95 %), after 25 years under these conditions, the PVA predicts an overall razorbill population of 24.1 % when compared with the predicted unimpacted conditions after 25 years, or 56.4 % of the population at the latest colony count. Avoidance rates of 99 % or higher result in a population of at least 86.1 % the size of the predicted baseline population, or above, whilst at an avoidance rate of 98 %, the population is expected to be 71.3 % of the baseline prediction after 25 years of Project operation.

**Table 11-26 CPGR and CPS (25 year) Metrics for South Stack and Penlas SMP Sub-Colonies for Razorbill During the Breeding Season, 40 MW Worst-Case Deployment**

| Avoidance Rate | Growth Rate | Population After 25 Years (total individual breeding adults) | Counterfactual of Growth Rate | Counterfactual of 25 Year Population | 25 Year Population Relative to Current Population |
|---|---|---|---|---|---|
| Baseline | 1.035 | 3,430 | N/A | N/A | 2.338 |
| 95 % | 0.977 | 827 | 0.945 | 0.241 | 0.564 |
| 98 % | 1.021 | 2,446 | 0.987 | 0.713 | 1.667 |
| 99 % | 1.028 | 2,953 | 0.994 | 0.861 | 2.013 |
| 99.5 % | 1.031 | 3,140 | 0.996 | 0.915 | 2.140 |
| 99.9 % | 1.033 | 3,266 | 0.998 | 0.952 | 2.226 |

173. Like guillemot, the razorbill population at the South Stack and Penlas SMP sub-colonies has been increasing since at least the early 1980's, but there is some evidence based on more recent counts that the population is unlikely to continue to grow indefinitely at the rate seen between the 1980's and the present day (JNCC, 2018). Whilst the reason for this is unclear, if

colony growth is constrained in the medium term in its baseline state (i.e. in the absence of the Project), then it is possible that the differences between the different impact scenarios considered in the assessment and the predicted baseline may be smaller in reality than suggested by the PVA, though as stated above, CPGR and CPS are still useful indicators despite this. As with guillemot, the latest counts from the RSPB suggest a larger starting population (1,790) than the 1,467 derived from SMP data (**Table 11-16**). This population is approximately 34 % larger than the starting population used by the PVA. The larger starting population would result in a population which may possess greater resilience with respect to additional mortality.

174. The following precautionary magnitudes of impact due to collision at a 40 MW deployment scale are considered appropriate, based on expert opinion, considering the wider backdrop of an increasing auk population in Wales (**Section 11.5.6)**, and assuming that 95 % avoidance rates are used on a precautionary basis:

- **High negative** for razorbill (breeding), and the South Stack and Penlas SMP sub-colonies;
- **Medium negative** for guillemot (breeding);
- **Low negative** for guillemot (non-breeding), razorbill (non-breeding) and red-throated diver non-breeding, year round); and
- **Negligible** for gannet (breeding), Manx shearwater (breeding), puffin (breeding) and shag (breeding), as well as cormorant (presumed), and all non-diving marine ornithology receptors (**Table 11-11**).

175. Whilst the above magnitudes of impact are used by the assessment for precautionary reasons, a change to 99 % avoidance rate would result in the following magnitudes of impact being assigned:

- **Low negative** for guillemot (breeding), razorbill (breeding), and the South Stack and Penlas SMP sub-colonies; and
- **Negligible** for gannet (breeding), guillemot (non-breeding), Manx shearwater (breeding), puffin (breeding), razorbill (non-breeding) and red-throated diver (non-breeding) and shag (breeding), as well as cormorant (presumed), and all non-diving marine ornithology receptors (**Table 11-11**).

11.6.6.3.4. Impact Significance

11.6.6.3.4.1. 240 MW Full Deployment Scenario

176. The impact significance for marine ornithology receptors for this impact, assuming a 95 % avoidance rate, which has been selected due to uncertainty in whether a higher avoidance rate is applicable, is as follows:

- **Major adverse** for guillemot (breeding), razorbill (breeding) and the South Stack and Penlas SMP sub-colonies;
- **Moderate adverse** for guillemot (non-breeding) and razorbill (non-breeding);

- **Minor adverse** for gannet (breeding), guillemot (non-breeding), Manx shearwater (breeding), puffin (breeding), razorbill (non-breeding), red-throated diver (non-breeding) and shag (breeding); and
- **Negligible** for all non-diving marine ornithology receptors.

11.6.6.3.4.2. 40 MW Worst Case Scenario

177. The impact significance for marine ornithology receptors for this impact, assuming a 95 % avoidance rate, which has been selected due to uncertainty in whether a higher avoidance rate is applicable, is as follows:

- **Major adverse** for razorbill (breeding) and the South Stack and Penlas SMP sub-colonies;
- **Moderate adverse** for guillemot (breeding);
- **Minor adverse** for gannet (breeding), guillemot (non-breeding), Manx shearwater (breeding), puffin (breeding), razorbill (non-breeding), red-throated diver (non-breeding) and shag (breeding); and
- **Negligible** for all non-diving marine ornithology receptors.

11.6.6.3.5. Mitigation and Residual Impact

11.6.6.3.5.1. 240 MW Full Deployment Scenario

178. To enable the consent of a maximum deployment of 240 MW of tidal devices as described in **Chapter 4, Project Description,** surveillance of key receptors supported by empirical information is required to give confidence that no significant impacts are occurring. An important aim will be refinement of CRM / ERM models to allow demonstration that predicted collisions are at a level that would not result in an ecologically significant adverse effect on razorbill and guillemot (e.g. demonstrating avoidance rates of at least 99.5 % for breeding guillemot, and 99.9 % for breeding razorbill).

179. A phased approach to deployment will allow collection of surveillance and empirical data required to give confidence that no significant adverse effects are apparent and refine estimates of avoidance rates and other parameters of the ERM and CRM models. As the key adverse impacts which constrain deployment would be on guillemot and razorbill breeding at the South Stack and Penlas SMP sub-colonies, these colonies would be the focus of attention. A monitoring strategy, developed as part of an Environmental Mitigation and Monitoring Plan (EMMP) would include three principal aims; monitoring bird use of the MDZ area and in particular in the vicinity of TECs (e.g. coastal vantage point watches, boat or aerial surveys), monitoring seabird colonies with connectivity to the Project (recording numbers, breeding success and survival rates), and recording the behaviour of birds in the immediate vicinity of TECs (e.g. through underwater sonar/video devices attached to TECs) and/or (if possible due to practical issues such as the ability to safely access colonies for bird capture and tag deployment) deployment of tags recording locations and diving behaviour of guillemots and razorbills from the South Stack and Penlas SMP sub-colonies. The EMMP when developed, would also include mitigation and monitoring plans for marine mammal receptors, with further details discussed in **Chapter 12, Marine Mammals.**

180. The general goals of the monitoring strategy would be to provide finer scale information on distribution, densities, diving depths and bird behaviour in the vicinity of TECs, throughout the day and night, refine the accuracy of / reduce uncertainty in input parameters and avoidance rates for ERM/CRM.

181. This monitoring work would be undertaken in conjunction with SNCBs under appropriate licensing arrangements.

182. Further information on the proposed monitoring is described in **Document MOR/RHDHV/DOC/0072, Outline Environment Mitigation and Monitoring Plan**.

183. The EMMP will aim to demonstrate refinement of CRM / ERM models and use other methods and approached such as design of array location and layout to reduce risk, such that the predicted collisions are at a level that would not result in an ecologically significant adverse effect on razorbill and guillemot (e.g. setting of avoidance to at least 99.5 % for breeding guillemot, and 99.9 % for breeding razorbill), the magnitude of impact could be revised to "low adverse" for both species, as well as the South Stack and Penlas SMP sub-colonies. This would result in a residual impact significance of **Minor adverse** for all three receptors.

11.6.6.3.5.2. 40 MW Worst Case Scenario

184. To enable the consent of an initial 40 MW commercial deployment of tidal devices, it may be necessary to collect data and maintain surveillance of receptor groups in order to increase confidence in the assessments undertaken. For example, the collection of further empirical information may allow refinement of CRM / ERM models such that the predicted collisions can be demonstrated to be at a level that would not result in an ecologically significant adverse effect on razorbill and guillemot (e.g. demonstrating avoidance rates of at least 98 % or greater for guillemot, and 99 % or greater for razorbill).

185. The intention of the Project is to install a first commercial phase of development at around 40 MW, as detailed in **Chapter 25, Socio-economics, Tourism and Recreation**. To build out to that scale and beyond to 240 MW will require several years, and within that timeframe the establishment of monitoring and mitigation measures through an Environmental Mitigation and Management Plan (EMMP) is proposed. The EMMP would also support mitigation and management requirements identified within **Chapter 12, Marine Mammals**. Before the first deployment and between subsequent deployments, detailed information on the behaviour of guillemot and razorbill breeding at the South Stack and Penlas SMP sub-colonies will be collected using three principal methods; coastal vantage point watches, colony counts, and a dual deployment of bird-borne time-depth-temperature recorders and GPS recorders on as large a sample size of the South Stack and Penlas SMP sub-colonies population as is permitted (and is possible due to practical issues such as the ability to safely access colonies for bird capture and tag deployment). Other methods such as boat-based surveys will be considered.

186. The general goals of the tagging would be to provide finer scale distribution information and densities to feed into refined ERM/CRM, and the production of depth distributions for diving guillemot and razorbill, which would also feed into refined ERM/CRM. Finally, information enabling more accurate modelling of nocturnal diving behaviour, and the risk that birds undertaking these behaviours are subject to with regard to collision with tidal devices.

187. This monitoring work would be undertaken in conjunction with SNCBs under appropriate licensing arrangements. Other methods (for example the use of sonar data for diving birds) will be considered for inclusion in the monitoring programme where their deployment could provide useful information.

188. Further information on the proposed monitoring is described in **Document MOR/RHDHV/DOC/0072, Outline Environment Mitigation and Monitoring Plan**.

189. Should the proposed monitoring work be successful in justifying the setting of avoidance rates to the required levels, the magnitude of impact could be revised to “low negative” for both species, as well as the South Stack and Penlas SMP sub-colonies. This would result in a residual impact significance of **Minor adverse** for all three receptors.

#### 11.6.6.4. Entanglement with Tidal devices

##### 11.6.6.4.1. Introduction

190. The operational / repowering phase of the Project has the potential to affect bird populations in the marine environment through birds becoming entangled in tidal devices, resulting in mortality through drowning or possible injury. This could occur at considerable depth, or nearer the surface in the case of moorings of floating or surface emergent tidal devices.

191. Any impacts resulting from this impact pathway would be spatially restricted to subtidal areas adjacent to devices, and temporally restricted to the duration of operation (up to 35 years; long term). A maximum of 130 surface emergent devices may be deployed in total.

##### 11.6.6.4.2. Receptor Sensitivity

192. The sensitivity of each of the marine ornithology receptors to entanglement has been assessed using the classification of species in Furness et al. (2012) according to their apparent drowning risk. A score of one was defined as extremely low risk, whilst a score of five was defined as moderate risk. These classifications have been used to screen out species not considered susceptible to this impact pathway (**Table 11-27**).

**Table 11-27 Screening Exercise Undertaken for Potential Entanglement Impacts During the Operation / Repowering of the Project**

| Species | Drowning Risk[1] | Screening Result (In or Out) | Justification |
|---|---|---|---|
| Arctic tern | 1 | Out | Low susceptibility to drowning |
| Black-headed gull | 1 | Out | Low susceptibility to drowning |
| Common gull | 1 | Out | Low susceptibility to drowning |
| Common scoter | 4 | Out | Only recorded occasionally (5/24 surveys), always in flight, and usually in coastal locations |
| Common tern | 1 | Out | Low susceptibility to drowning |
| Cormorant | 4 | In | Only recorded occasionally (2/24 surveys) in very low numbers, always in flight, but screened in as attraction into MDZ possible |

| Species | Drowning Risk[1] | Screening Result (In or Out) | Justification |
|---|---|---|---|
| | | | due to provision of roosting platforms by tidal devices |
| Eider | 4 | Out | Recorded on only one baseline survey |
| Fulmar | 1 | Out | Low susceptibility to drowning |
| Gannet | 2 | Out | Low susceptibility to drowning |
| Great black-backed gull | 1 | Out | Low susceptibility to drowning |
| Guillemot | 4 | In | Potentially susceptible to drowning and abundant in MDZ; screened in |
| Herring gull | 1 | Out | Low susceptibility to drowning |
| Kittiwake | 1 | Out | Low susceptibility to drowning |
| Lesser black-backed gull | 1 | Out | Low susceptibility to drowning |
| Manx shearwater | 1 | Out | Low susceptibility to drowning |
| Mediterranean gull | 1 | Out | Low susceptibility to drowning |
| Puffin | 3 | In | Potentially susceptible to drowning and abundant in MDZ; screened in |
| Razorbill | 4 | In | Potentially susceptible to drowning and relatively abundant in MDZ; screened in |
| Red-throated diver | 4 | In | Recorded infrequently (8/24 surveys) and in low numbers but screened in on a precautionary basis due to sensitivity to impact |
| Sandwich tern | 1 | Out | Low susceptibility to drowning |
| Shag | 4 | In | Recorded infrequently (8/24 surveys) and in low numbers, but screened in as attraction into MDZ possible due to provision of roosting platforms by tidal devices |
| **Notes** | | | |
| [1]Furness et al., (2012) | | | |

193. Whilst the risk of drowning is less than moderate for all marine ornithology receptors according to Furness et al., (2012), there is potential for entanglement impacts on cormorant, guillemot, puffin, razorbill, red-throated diver and shag. The conclusions of the screening assessment are supported by a review of literature relating to bycatch of seabirds (Žydelis et al., 2013, 2009).

194. The following sensitivities to this impact pathway have been allocated according to the definitions in **Chapter 5, EIA Methodology**:

- **Medium** for cormorant, guillemot, puffin, razorbill, red-throated diver and shag; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

11.6.6.4.3. Magnitude of Impact

195. Any impacts resulting from this impact pathway will be spatially restricted to the areas occupied by the tidal devices themselves, and temporally restricted to the duration of their operation (i.e.

long term). The consequence of entanglement is likely to be a fatality of the bird involved and a consequent permanent reduction in the relevant population.

196. Whilst seabird bycatch in gill nets is known to be a major issue for seabird populations (Žydelis et al., 2013, 2009), the design of a tidal energy converter means that they pose a much lower risk to seabirds with respect to entanglement and drowning. There are no loose cables or lines associated with the devices, and anchor chains and cables are substantial and not light enough to loop or coil. The structures themselves are designed to be hydrodynamic, and not offer surfaces for entanglement.

197. On the basis of the available information, the magnitude of impact is therefore considered to be:

- **Low negative** for cormorant, guillemot, puffin, razorbill, red-throated diver and shag; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

11.6.6.4.4. Impact Significance

198. The impact significance for marine ornithology receptors for this impact is as follows:

- **Minor adverse** for cormorant, guillemot, puffin, razorbill, red-throated diver and shag; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

**11.6.6.5. Other Impacts**

11.6.6.5.1. Introduction

199. Indirect impacts on marine ornithology receptors may occur during the operational / repowering phase if there are impacts on prey species and the habitats of prey species. These include those resulting from the production of underwater noise and the generation of suspended sediments that may alter the behaviour or availability of prey species for seabirds. There is also the possibility of pollution incidents due to ejection of contaminants or accidents involving tidal devices, and/or vessels. As well as resulting in potential indirect effects on seabirds, direct impacts due to direct contact with contaminants is possible and is also covered in this section.

11.6.6.5.2. Receptor Sensitivity

200. Underwater noise may cause fish and mobile invertebrates to avoid the construction area and its immediate surroundings, and also affect their physiology and behaviour. Suspended sediments may cause fish and mobile invertebrates to avoid the construction area and its immediate surroundings and may smother and hide immobile benthic prey in a localised area. These mechanisms may result in less prey being available within the MDZ and immediate surrounding area to foraging seabirds. Pollution events may cause localised injury or mortality to seabirds or their prey species in the immediate vicinity of the source of the pollution.

201. Generally speaking, seabirds are mobile animals. In the breeding season they adopt a central place foraging strategy, restricting their foraging areas to enable them to successfully provision their chicks. In the non-breeding season, birds may be sedentary, remaining in the area where they bred, dispersive, or fully migratory. The mobility of seabirds means that they are able to utilise alternative areas of habitat should an area of habitat within their range become unavailable. Habitat flexibility is also an important criterion in determining the ability of a particular species to find alternative foraging habitat, and whilst a qualitative measure, it has been reviewed by several sources (Furness et al., 2012; Furness and Wade, 2012; Garthe and Hüppop, 2004).

202. The sensitivities of ornithological receptors for these impacts during construction, presented in **Table 11-18** remain relevant for the operational / repowering phase of the Project. This means that Arctic tern, common tern, common scoter, cormorant, eider, guillemot, puffin, razorbill, red-throated diver, Sandwich tern and shag are considered to have "low" sensitivity, and black-headed gull, common gull, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater and Mediterranean gull a **Negligible** sensitivity.

11.6.6.5.3. Magnitude of Impact

203. With regard to noise impacts, **Chapter 10, Fish and Shellfish Ecology** and **Chapter 14, Commercial Fisheries** discuss the potential impacts upon fish relevant to marine ornithology as prey species. For species such as herring, sprat and sandeel, which are prey items of several seabirds that are being assessed in this EcIA, the impact magnitude of underwater noise effects (physical injury or behavioural changes) and habitat loss during operation / repowering is considered to be minor or negligible. With regard to the definitions of impact magnitude given in **Chapter 5, EIA Methodology**, it is concluded that the magnitude of impact on seabirds occurring in or around the Project during the operational phase is **Negligible**. This applies to direct effects on seabirds themselves, and their prey.

204. With regard to changes to the seabed and to suspended sediment levels, **Chapter 7, Metocean Conditions and Coastal Processes** and **Chapter 9, Benthic and Intertidal Ecology** discuss the nature of any change and impacts on the seabed and benthic habitats, which host seabird prey species. The maximum envisaged effect associated with sediment plumes arising from the construction phase will cause only very minor increases in suspended sediment concentration; typically less than 1 mg/l a short distance from the release point, over a distance of several hundred metres. During the operational / repowering phase the same value has been assumed, which is considered to be a highly precautionary approach. The effects will be temporary and fully reversible, with a return to very low background concentrations occurring rapidly upon cessation of installation activities. Other than at the immediate release point, such a change would be immeasurable. It is concluded that the magnitude of impact on seabirds occurring in or around the Project during the operational / repowering phase is **Negligible**.

205. Any pollution incidents, which are considered to be unlikely to occur, will result in the contamination of a small area (likely no more than several hundreds of metres) of subtidal habitat with a small amount of pollution. Measures will be in place to rapidly collect or disperse any such contamination, meaning that its presence will be temporary and reversible. Tidal devices contain very small amounts of potential pollutant in the form of lubricant. Based on the definitions of

impact magnitude given in **Chapter 5, EIA Methodology**, the magnitude of impact is considered to be negligible.

11.6.6.5.4. Impact Significance

206. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Negligible** for Arctic tern, black-headed gull, common gull, common tern, common scoter, cormorant, eider, fulmar, gannet, great black-backed gull, guillemot, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull, puffin, razorbill, red-throated diver, Sandwich tern and shag.

### 11.6.7. Potential Impacts During Decommissioning

#### 11.6.7.1. Introduction

207. Any effects generated during the decommissioning phase of the Project are expected to be similar to those generated during the construction phase (Section 11.6.5). This is because decommissioning is assumed involve a reverse of the construction phase through the removal of some structures and materials installed. The duration of the decommissioning phase is assumed to be similar to the construction.

208. It is anticipated that any future activities would be programmed in close consultation with the relevant statutory marine and nature conservation bodies, to allow any future guidance and best practice to be incorporated to minimise any potential impacts.

209. The following sections briefly summarise the predicted impact significance of the activities proposed during decommissioning and are identical to those expected during construction. Further background and detail is provided in **Section 11.6.5**.

#### 11.6.7.2. Airborne Noise and Visual Disturbance

210. The impact significance for marine ornithology receptors for airborne noise and visual disturbance during decommissioning is as follows:

- **Minor adverse** for guillemot, puffin, razorbill, red-throated diver and shag; and
- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull and Sandwich tern.

#### 11.6.7.3. Disturbance at Breeding Sites

211. The impact significance for marine ornithology receptors for disturbance at breeding sites during decommissioning is as follows:

- **Medium adverse** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating within 300 m from the colonies; and
- **Negligible** for the Abraham's Bosom, South Stack and Gogarth seabird colonies for vessels operating in excess of 300 m from the colonies.

212. Based on the species known to breed at each of the potentially affected colonies (**Table 11-16**), and excluding any species understood to possess a “low” sensitivity to disturbance and displacement when at sea (**Table 11-13**), it is considered that it is appropriate to prohibit all vessel activities within 300 m of each of these colonies during the breeding season. This is considered to be March to July for Abraham’s Bosom and February to August for South Stack and Gogarth based on the species present at the last count (JNCC, 2018).

213. If this measure is adopted, then the receptor sensitivity can be reduced from “medium” to “low” as most of the individuals will not be present outside the breeding season. The magnitude of impact can also be reduced from “medium” to “low” based on the definitions provided in **Chapter 5, EIA Methodology**. The residual impact significance is **Minor adverse**.

#### 11.6.7.4. Other Impacts

214. On this basis, the impact significance for marine ornithology receptors for this impact is as follows:

- **Negligible** for Arctic tern, black-headed gull, common gull, common scoter, common tern, cormorant, eider, fulmar, gannet, great black-backed gull, guillemot, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, Mediterranean gull, puffin, razorbill, red-throated diver, Sandwich tern and shag.

### 11.6.8. Cumulative Impacts

#### 11.6.8.1. Screening for Cumulative Impacts

215. The potential effects from the Project that were screened in for assessment for the Project alone were further screened for the potential for cumulative effects with other projects. This process is detailed in **Table 11-28**.

**Table 11-28 Cumulative Impact Assessment Screening**

| Impact | Potential for Cumulative Impact | Confidence of Prediction[1] | Justification |
|---|---|---|---|
| Airborne noise and visual disturbance | Yes | High | The likelihood that there would be a cumulative impact is low because the impact as a result of the Project occurs on a small spatial scale and it is dependent on a spatial co-incidence of disturbance / displacement from other plans or projects. However, one such project has been identified, therefore a more detailed assessment will be carried out for construction and operational / repowering impacts. |
| Disturbance at breeding sites | No | High | The likelihood that there would be a cumulative impact is low because it would be dependent on a spatial co-incidence of disturbance / displacement from other plans or projects during either construction or operation / repowering of the Project, of which none have been identified. |
| Collision risk with tidal devices | Yes | High | There is a sufficient likelihood of a cumulative impact to justify a quantitative cumulative impact |

| Impact | Potential for Cumulative Impact | Confidence of Prediction[1] | Justification |
|---|---|---|---|
| | | | assessment during the operational / repowering period of the Project.<br><br>Cumulative impact due to collision risk from offshore wind farms has been screened out, as the collision risk to species as a result of the project that are also susceptible to collision with wind turbines (i.e. gannet) is very low (<3 birds per year under all deployment scenarios). All other species assessed as being at risk of collision during the operation / repowering of the Project are known not to be susceptible to collision with wind turbines. |
| Entanglement with tidal devices | No | High | The likelihood that there would be a cumulative impact is low because the impact as a result of the project is small in scale and magnitude, especially when compared to the wider issue of seabird bycatch. |
| Other impacts | No | High | The likelihood that there would be a cumulative impact is low because the impact as a result of the Project occurs on a small spatial scale and it is dependent on a temporal and spatial co-incidence of similar impacts from other plans or projects, of which none have been identified or are considered likely. |
| **Notes**<br>[1]Indicates the degree of confidence; medium / low reflects lower confidence in older assessments which used variable methods. | | | |

216. Two potential effects, airborne noise and visual disturbance, and collision risk (excluding offshore wind farms), were screened in for cumulative assessment.

#### 11.6.8.2. Projects Considered for Cumulative Impacts

217. The classes of projects that could potentially be considered for the cumulative assessment of marine ornithology receptors include offshore wind farms, other marine renewable energy projects, marine aggregate extraction, oil and gas exploration and extraction, port and harbour projects, subsea cables and pipelines and commercial shipping. The identification of projects to include in the cumulative assessment of offshore ornithological receptors has been based on approved plans, constructed projects, approved but as yet unconstructed projects, projects for which an application has been made, is currently under consideration and may be consented. In addition, other “foreseeable” projects are included: those for which an application has not been made but have been the subject of consultation by the developer, or those are listed in plans that have clear delivery mechanisms. For such projects, the absence of robust or relevant data could preclude a quantitative cumulative assessment being carried out.

218. For airborne noise and visual disturbance, only projects occurring locally that involve activities in subtidal habitat are considered to have the potential to cause cumulative impacts in conjunction with the Project (**Table 11-29**). Any projects which have been ongoing since the

collection of baseline data (e.g. Holyhead Harbour Maintenance Dredging) are not considered on the basis that they form part of the baseline.

219. Only other marine energy projects (i.e. those with contributions to underwater collision risk) are considered to have potential to contribute to cumulative collision risk (**Table 11-30**). Cumulative impact due to collision risk from offshore wind farms has been screened out, as the collision risk to species as a result of the Project that are also susceptible to collision with wind turbines (i.e. gannet) is very low (approximately zero to three birds per year based on a 240 MW deployment), and the reference population very large (**Section 11.6.6.3**). All other species assessed as being at risk of collision during the operation / repowering of the Project are known to not be particularly susceptible to collision with wind turbines during flight (Dierschke et al., 2016), due mainly to the low flight heights they favour at sea (Furness et al., 2013; Garthe and Hüppop, 2004).

**Table 11-29 Summary of Projects Considered in CIA for Airborne Noise and Visual Disturbance Impact Pathway**

| Project | Status | Distance from Nearest Part of Project (km) | Data Status | Justification for Inclusion |
|---|---|---|---|---|
| Holyhead Deep Phase I | In April 2017, a Marine Licence was granted for the first 0.5 MW installation | 2 | Complete for marine ornithology receptors | Consented project that does not yet form part of the baseline |
| Holyhead Deep Phase II | Scoping Report submitted in 2017; EIA presumed to be in preparation | 2 | No information available | Possible project that does not yet form part of the baseline |
| Holyhead Port Expansion | Scoping Report submitted 28/04/17; EIA in preparation | 2 | Draft, unpublished assessment available | Possible project that does not yet form part of the baseline |

**Table 11-30 Summary of Projects Considered in CIA for Underwater Collision Risk Impact Pathway**

| Project | Status | Distance from Nearest Part of Project (km) | Data Status | Justification for Inclusion |
|---|---|---|---|---|
| Holyhead Deep Phase I | In April 2017, a Marine Licence was granted for the first 0.5 MW installation | 2 | Complete for marine ornithology receptors | Consented project that does not yet form part of the baseline |
| Holyhead Deep Phase II | Scoping Report submitted in 2017; EIA presumed to be in preparation | 2 | No information available | Possible project that does not yet form part of the baseline |
| Bardsey Sound | An Agreement for Lease was awarded pre-May 2018. The project would include up to 20 100 kW turbines | 50 | None available | Possible project that does not yet form part of the baseline |

| Project | Status | Distance from Nearest Part of Project (km) | Data Status | Justification for Inclusion |
|---|---|---|---|---|
| Argyll Tidal Demonstration | Marine licence secured in 2015, status of works unknown | 225 | Complete for marine ornithology receptors | Consented project that does not yet form part of the baseline |
| Fair Head Marine Renewable Tidal Array | Environmental Statement presented. Target to be operational by 2021 | 228 | Complete for marine ornithology receptors | Consented project that does not yet form part of the baseline |
| Sound of Islay Demonstration Site | Consented – construction programme not known | 268 | Complete for marine ornithology receptors | Consented project that does not yet form part of the baseline |
| West Islay Tidal Energy Farm | Consented – construction programme not known but scheduled for completion by 2022 | 268 | Complete for marine ornithology receptors | Consented project that does not yet form part of the baseline |

#### 11.6.8.3. Cumulative Impact of Airborne Noise and Visual Disturbance

220. The assessment for the Project alone has identified a Minor adverse impact significance for guillemot due to airborne noise and visual disturbance during the construction and operation / repowering of the Project. Although between zero and approximately six guillemots could be lost due to this impact each year, this is not considered to represent a significant proportion of the local, regional or national population of this species.

221. The Environmental Statement for the “Holyhead Deep Phase I” project suggested that disturbance of guillemot to some extent is certain to occur during the construction and installation of the Project, but due to the relatively low numbers of birds present (<1 % of the regional breeding population), the impact was judged to be of negligible significance. The same conclusion was reached for the operational / repowering phase of the Project.

222. For the “Holyhead Deep Phase II” project, no information was available.

223. For the “Holyhead Port Expansion” project, no information was available.

224. As a result of these findings, the magnitude of this cumulative impact on guillemot (judged to be of **High** value and **Low** sensitivity) is considered to be **Negligible**, resulting in a **Negligible** cumulative impact significance.

#### 11.6.8.4. Cumulative Impact of Collision Risk

11.6.8.4.1. Gannet

225. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for gannet (breeding) due to underwater collision.

226. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for gannet (breeding) due to underwater collision.

227. For the “Holyhead Deep Phase I”, “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects, the impact significance for gannet as a result of collision was defined as negligible.

228. For the “Holyhead Deep Phase II” project, no information was available.

229. For the “Bardsey Sound” project, no information was available.

230. As a result of these findings, the magnitude of this cumulative impact on gannet (judged to be of **High** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.2. Guillemot

231. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for guillemot (breeding and non-breeding) due to underwater collision subject to mitigation in the form of a deployment and monitoring strategy.

232. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for guillemot (breeding and non-breeding) due to underwater collision subject to mitigation in the form of a deployment and monitoring strategy.

233. For the “Holyhead Deep Phase I” project, it was considered that collisions of this species were likely to occur, and the impact significance was defined as negligible and not significant.

234. For the “Holyhead Deep Phase II” project, no information was available.

235. For the “Bardsey Sound” project, no information was available.

236. As the “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects are located well in excess of the known foraging range for this species (Cleasby et al., 2018; Oppel et al., 2018; Thaxter et al., 2012) at the South Stack and Penlas SMP subcolonies, cumulative impacts for these projects are not considered relevant to breeding guillemot. Whilst the impacts may be relevant to the non-breeding UK Western Waters BDMPS population, this is unlikely due to the size of that population and the scale of these developments.

237. As a result of these findings, the magnitude of this cumulative impact on guillemot (judged to be of **High** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.3. Manx Shearwater

238. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for Manx shearwater (breeding) due to underwater collision.

239. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for Manx shearwater (breeding) due to underwater collision.

240. For the “Holyhead Deep Phase I”, “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects, the impact significance for Manx shearwater as a result of collision was defined as negligible.

241. For the “Holyhead Deep Phase II” project, no information was available.

242. For the “Bardsey Sound” project, no information was available.

243. As a result of these findings, the magnitude of this cumulative impact on Manx shearwater (judged to be of **High** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.4. Puffin

244. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for puffin (breeding) due to underwater collision.

245. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for puffin (breeding) due to underwater collision.

246. For the “Holyhead Deep Phase I” project, the impact significance for puffin of collision was defined as negligible.

247. For the “Holyhead Deep Phase II” project, no information was available.

248. For the “Bardsey Sound” project, no information was available.

249. As the “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects are located well in excess of the known foraging range for this species, cumulative impacts for these projects are not considered relevant.

250. As a result of these findings, the magnitude of this cumulative impact on puffin (judged to be of **High** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.5. Razorbill

251. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for razorbill (breeding and non-breeding) due to underwater collision following mitigation.

252. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for razorbill (breeding and non-breeding) due to underwater collision following mitigation.

253. For the “Holyhead Deep Phase I” project, it was considered that collisions of this species were likely to occur, and the impact significance was defined as negligible and not significant.

254. For the “Holyhead Deep Phase II” project, no information was available.

255. For the “Bardsey Sound” project, no information was available.

256. As the “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects are located well in excess of the known foraging range for this species (Cleasby et al., 2018; Oppel et al., 2018; Thaxter et al., 2012), cumulative impacts for these projects are not considered relevant to breeding razorbill. However, the impacts may be relevant to the non-breeding UK Western Waters BDMPS population. For all projects, the impact significance for razorbill of collision was defined as negligible .As the “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects are located well in excess of the known foraging range for this species (Cleasby et al., 2018; Oppel et al., 2018; Thaxter et al., 2012), cumulative impacts for these projects are not considered relevant to breeding razorbill. However, the impacts may be relevant to the non-breeding UK Western Waters BDMPS population. For all projects, the impact significance for razorbill of collision was defined as negligible.

257. As a result of these findings, the magnitude of this cumulative impact on razorbill (judged to be of **High** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.6. Red-Throated Diver

258. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for red-throated diver (non-breeding) due to underwater collision.

259. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for red-throated diver (non-breeding) due to underwater collision.

260. For the “Holyhead Deep Phase I”, “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects, the impact significance for red-throated diver as a result of collision is assumed to be negligible as it was generally not considered as being at risk of collision and therefore not assessed in detail.

261. For the “Holyhead Deep Phase II” and “Bardsey Sound” projects, no information was available.

262. As a result of these findings, the magnitude of this cumulative impact on red-throated diver (judged to be of **Medium** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

11.6.8.4.7. Shag

263. At the 40 MW initial deployment (worst case) scenario, the assessment for the Project alone has identified a Minor adverse impact significance for shag (breeding and non-breeding) due to underwater collision. Zero collisions per year were predicted assuming an avoidance rate of 95 % or greater.

264. At the 240 MW full deployment scenario, the assessment for the Project alone has identified a Minor adverse impact significance for shag (breeding and non-breeding) due to underwater collision. Between zero and one collisions per year were predicted assuming an avoidance rate of 95 % or greater.

265. For the “Holyhead Deep Phase I” project, this species was not assessed for collision risk. It is therefore assumed that the impact significance is negligible.

266. For the “Holyhead Deep Phase II” project, no information was available.

267. As the “Bardsey Sound”, “Argyll Tidal Demonstration”, “Fair Head Marine Renewable Tidal Array”, “Sound of Islay Demonstration Site” and “West Islay Tidal Energy Farm” projects are located well in excess of the known foraging range for this species (Cleasby et al., 2018; Oppel et al., 2018; Thaxter et al., 2012), and there is no spatial overlap of the relevant BDMPS (Furness, 2015), cumulative impacts for these projects are not considered relevant for this species.

268. As a result of these findings, the magnitude of this cumulative impact on shag (judged to be of **Medium** value and **Medium** sensitivity) is considered to be **Negligible**, resulting in a **Minor adverse** impact significance.

## 11.7. TRANSBOUNDARY IMPACTS

269. With regard to the potential for transboundary cumulative impacts, there is clearly potential for underwater collisions beyond UK territorial waters. However, any proposed marine energy development in Ireland is relatively small, and/or located on the west and north coasts. Since the spatial scale and hence seabird populations sizes for a transboundary assessment would be much larger, it is apparent that the scale of development expected would make no material difference to the assessment. For this reason, a quantitative assessment has not been carried out.

## 11.8. INTER-RELATIONSHIPS

270. The construction, operation / repowering and decommissioning phases of the Project would cause a range of effects on marine ornithology receptors. The magnitude of these effects has been assessed individually using expert knowledge and judgement, drawing from a wide scientific knowledge base that includes project-specific surveys and previously acquired

knowledge of the bird ecology of the relevant geographical area (from published scientific papers and books, and 'grey' literature).

271. Impacts to marine ornithology receptors may be inter-related with other receptor groups. This is considered to be the case for impacts through effects on habitats and prey species only. For direct disturbance/displacement and collision risk there is considered to be no potential for interaction with other receptor groups.

272. Inter-relationships are summarised in **Table 11-31**, which indicates where assessments carried out in other chapters have been used to inform the offshore ornithology assessment.

**Table 11-31 Inter-Topic Relationships**

| Impact | Related Chapter(s) | Relevant Section(s) in Chapter | Justification |
|---|---|---|---|
| Impacts on prey species and their habitats during construction | Chapter 7, Metocean and Coastal Processes<br>Chapter 10, Fish and Shellfish Ecology<br>Chapter 14, Commercial Fisheries | Section 11.6.5.3 | Potential impacts on benthic ecology and fish and shellfish during construction could affect the prey resource for marine ornithology receptors |
| Impacts on prey species and their habitats during operation / repowering | | Section 11.6.6.5 | |
| Impacts on prey species and their habitats during decommissioning | | Section 11.6.7.4 | |

## 11.9. INTERACTIONS

273. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts. The worst case impacts assessed within the chapter take these interactions into account and therefore the impact assessments are considered conservative and robust. For clarity, the areas of interaction between impacts that have been classified as greater than negligible impact significance are presented in **Table 11-32** for construction and **Table 11-33** for operation / repowering. The potential for interactions of impacts anticipated during decommissioning are as per the construction impacts in **Table 11-32**.

**Table 11-32 Potential for Interactions Between Impacts During Construction**

| | Airborne Noise and Visual Disturbance | Disturbance at Breeding Sites |
|---|---|---|
| **Airborne Noise and Visual Disturbance** | - | Unlikely, due to the use of appropriate vessel standoff zones around breeding colonies during the breeding season |
| **Disturbance at Breeding Sites** | Unlikely, due to the use of appropriate vessel standoff zones around breeding colonies during the breeding season | - |

**Table 11-33 Potential for Interactions Between Impacts During Operation / Repowering**

| | Airborne Noise and Visual Disturbance | Disturbance at Breeding Sites | Collision Risk with Tidal Devices | Entanglement with Tidal Devices |
|---|---|---|---|---|
| **Airborne Noise and Visual Disturbance** | - | Unlikely, due to the use of appropriate vessel standoff zones around breeding colonies during the breeding season | Possible interaction reflected by inclusion of mortality due to both pathways in PVA; possible attraction effects on shag and cormorant causing elevated collision risk than currently reported | No potential for significant synergistic effect |
| **Disturbance at Breeding Sites** | Unlikely, due to the use of appropriate vessel standoff zones around breeding colonies during the breeding season | - | No potential for significant synergistic effect | No potential for significant synergistic effect |
| **Collision Risk with Tidal Devices** | Possible interaction reflected by inclusion of mortality due to both pathways in PVA; possible attraction effects on shag and cormorant causing elevated collision risk than currently reported | No potential for significant synergistic effect | - | Possible, but risk of collision much higher than risk of entanglement, so synergistic effect not considered significant |
| **Entanglement with Tidal Devices** | No potential for significant synergistic effect | No potential for significant synergistic effect | Possible, but risk of collision much higher than risk of entanglement, so synergistic effect not considered significant | - |

## 11.10. SUMMARY

274. This chapter provides an assessment of the potential impacts on marine ornithology receptors that may arise from marine-based activities during construction, operation / repowering and decommissioning of the Project. It describes the relevant components of the proposed Project; the consultation that has been held with stakeholders; the scope and methodology of the assessment; the avoidance and mitigation measures that have been embedded through project design; the baseline data on birds and important sites and habitats for birds acquired through desk study and survey (**Appendices 11.1 and 11.2, Volume III**) and assesses the potential impacts on marine ornithology receptors.

275. Detailed consultation with regard to the overall approach to the impact assessment on marine ornithology receptors has informed this assessment through the Ornithology TWG, which involved NRW.

276. A survey area covering the MDZ and a 2 km buffer was surveyed using a boat-based methodology over 24 months. The results of these surveys have been used to estimate the abundance and assemblage of birds using or passing across the area.

277. The impacts that could potentially arise for marine ornithology receptors during the construction, operation / repowering and decommissioning of the Project were discussed within Ornithology TWG meetings. As a result of those discussions, the potential impacts that required detailed assessment were identified as follows:

- During construction and installation:
  - Airborne noise and visual disturbance;
  - Disturbance at breeding sites; and
  - Other impacts, which consist of indirect impacts due to effects on prey and/or their habitats, as well as direct and indirect impacts through pollution events.
- During operation:
  - Airborne noise and visual disturbance;
  - Disturbance at breeding sites;
  - Collision with tidal devices;
  - Entanglement with tidal devices; and
  - Other impacts, which consist of indirect impacts due to effects on prey and/or their habitats, as well as direct and indirect impacts through pollution events.
- During decommissioning:
  - Airborne noise and visual disturbance;
  - Disturbance at breeding sites; and
  - Other impacts, which consist of indirect impacts due to effects on prey and/or their habitats, as well as direct and indirect impacts through pollution events.

278. During the construction and maintenance and decommissioning phases of the proposed Project, no impacts have been assessed to be greater than of minor adverse significance for any marine ornithology receptors.

279. During operation / repowering, underwater collision effects assessed for two scenarios have the potential to result in effects assessed to be greater than minor adverse significance, assuming a precautionary avoidance rate of 95 %. At a 40 MW worst case scenario, major adverse effects are predicted for razorbill (breeding) and the South Stack and Penlas SMP sub-colonies, and moderate adverse effects are predicted for guillemot (breeding). At an indicative 240 MW scenario, major adverse effects are predicted on guillemot (breeding), razorbill (breeding) and the South Stack and Penlas SMP sub-colonies, and moderate adverse for guillemot (non-breeding) and razorbill (non-breeding). The use of higher avoidance rates than 95 % results in

a reduction in impact significance to a minor adverse level for all of the receptors listed above. However, to justify this position, a phased deployment approach, along with a detailed, multiyear monitoring program to collect further information to support the use of a higher avoidance rate would be required.

280. No other impacts predicted for any marine ornithology receptors during the operation / repowering phase of the Project have been assessed to be greater than minor adverse impact significance.

281. Two potential effects of the Project were screened in for cumulative impact assessment; airborne noise and visual disturbance (construction and operation / repowering) and collision risk. Other potential effects were screened out due to their temporary, small scale/magnitude and/or localised nature, and given the distances to other activities in the region it was concluded that there is no pathway for cumulative interaction.

282. A screening process was also carried out for potential plans and projects that might affect marine ornithology receptors cumulatively with the Project. These projects include offshore wind farms, other marine renewable energy projects, marine aggregate extraction, oil and gas exploration and extraction, port and harbour projects, subsea cables and pipelines and commercial shipping. The risk to all marine ornithology receptors from cumulative displacement and collisions is assessed as no greater than minor adverse significance.

283. The potential for collisions and displacement from marine energy developments outside UK territorial waters (transboundary) to contribute to cumulative impacts was considered. Due to the scale of marine energy development currently proposed (both of the Project, and other projects), and the distances between them, transboundary impacts are not considered to be significant.

284. The identified impacts for the Project alone are summarised in **Table 11-34**, and no additional impact significance was found due to cumulative impacts for construction/operational airborne noise and visual disturbance, or collision.

**Table 11-34 Summary of Impacts Identified for Marine Ornithology Receptors**

| Impact | Receptor | Value/ Sensitivity | Magnitude | Significance | Additional Mitigation Measures | Residual Impact |
|---|---|---|---|---|---|---|
| **Construction & Installation** | | | | | | |
| Airborne Noise and Visual Disturbance | Guillemot | High/Med | Low | Minor adverse | None | Minor adverse |
| | All other species | Various | Negligible | Negligible | | Negligible |
| Disturbance at Breeding Sites | Abraham's Bosom | High/Negligible for activity >300 m from colony, medium if within <300 m. Low sensitivity if outside the breeding season within <300m | Negligible for activity >300 m from colony, medium if within <300 m | Medium adverse if <300 m during breeding season, otherwise negligible | No works within 300 m of any colony during breeding season | Negligible |
| | South Stack and Penlas RSPB | | | | | |
| | Gogarth | | | | | |
| Other Impacts | All species | Various/low or negligible | Negligible | Negligible | None | Negligible |
| **Operation / repowering** | | | | | | |
| Airborne Noise and Visual Disturbance | Guillemot | High/Med | Low | Minor adverse | None | Minor adverse |
| | Cormorant | Low/High | Low | Minor beneficial | | Minor beneficial |
| | All other species | Various | Negligible | Negligible | | Negligible |
| | Shag | Med/Med | Low | Minor beneficial | | Minor beneficial |
| Disturbance at Breeding Sites | Abraham's Bosom | High/Negligible for activity >300 m from colony, medium if within <300 m. Low sensitivity if outside the breeding season within <300m | Negligible for activity >300 m from colony, medium if within <300 m | Medium adverse if <300 m during breeding season, otherwise negligible | No works within 300 m of any colony during breeding season | Negligible |
| | South Stack and Penlas RSPB | | | | | |
| | Gogarth | | | | | |
| Collision risk with tidal devices (40 MW Worst | South Stack and Penlas SMP sub-colonies | High/High | High | Major adverse | Monitoring programme enabling use of higher | Minor adverse |

| Impact | Receptor | Value/ Sensitivity | Magnitude | Significance | Additional Mitigation Measures | Residual Impact |
|---|---|---|---|---|---|---|
| Case, 95 % avoidance rate) | | | | | avoidance rate, plus phased deployment | |
| | Gannet | | Negligible | Minor adverse | None | |
| | Guillemot | | Medium | Moderate adverse | Monitoring programme enabling use of higher avoidance rate, plus phased deployment | |
| | Manx shearwater | High/Med | Low | Minor adverse | None | |
| | Puffin | | | | | |
| | Razorbill | | High | Major adverse | Monitoring programme enabling use of higher avoidance rate, plus phased deployment | |
| | Red-throated diver | Med/Med | Low | Minor adverse | None | |
| | Shag | | Negligible | | | |
| | All other species | Various/Neg | | Negligible | | Negligible |
| | South Stack and Penlas SMP sub-colonies | High/High | Very High | Major adverse | Monitoring programme enabling use of higher avoidance rate, plus phased deployment | |
| | Gannet | | Negligible | Minor adverse | None | |
| Collision risk with tidal devices (240 MW Indicative Array, 95 % avoidance rate) | Guillemot | | Very High | Major adverse | Monitoring programme enabling use of higher avoidance rate, plus phased deployment | Minor adverse |
| | Manx shearwater | High/Med | Low | Minor adverse | None | |
| | Puffin | | | | | |
| | Razorbill | | Very High | Major adverse | Monitoring programme enabling use of higher | |

| Impact | Receptor | Value/ Sensitivity | Magnitude | Significance | Additional Mitigation Measures | Residual Impact |
|---|---|---|---|---|---|---|
| | | | | | avoidance rate, plus phased deployment | |
| | Red-throated diver | Med/Med | Low | Minor adverse | None | |
| | Shag | | Negligible | | | |
| | All other species | Various/Neg | | Negligible | | Negligible |
| Entanglement with Tidal devices | Cormorant | Low/Med | Low | Minor adverse | None | Minor adverse |
| | Guillemot | High/Med | | | | |
| | Puffin | | | | | |
| | Razorbill | | | | | |
| | Red-throated Diver | Med/Med | | | | |
| | Shag | | | | | |
| | All other species | Various/Neg | Negligible | Negligible | None | Negligible |
| Other Impacts | All species | Various/low or negligible | Negligible | Negligible | None | Negligible |
| **Decommissioning** | | | | | | |
| Airborne Noise and Visual Disturbance | Guillemot | High/Med | Low | Minor adverse | None | Minor adverse |
| | Puffin | | | | | |
| | Razorbill | | | | | |
| | Red-throated diver | Med/Very High | | | | |
| | Shag | Med/Med | | | | |
| | All other species | Various | Negligible | Negligible | | Negligible |
| Disturbance at Breeding Sites | Abraham’s Bosom | High/Negligible for activity >300 m from colony, medium if within <300 m. Low sensitivity if outside the breeding season within <300m | Negligible for activity >300 m from colony, medium if within <300 m | Medium adverse if <300 m during breeding season, otherwise negligible | No works within 300 m of any colony during breeding season | Negligible |
| | South Stack and Penlas RSPB | | | | | |

| Impact | Receptor | Value/ Sensitivity | Magnitude | Significance | Additional Mitigation Measures | Residual Impact |
|---|---|---|---|---|---|---|
| | Gogarth | | | | | |
| Other Impacts | All species | Various/low or negligible | Negligible | Negligible | None | Negligible |

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