Offshore Renewable Energy Development Plan (OREDP) for Ireland: Natura Impact Statement (NIS)

Volume 1: Main Report

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Rev No	Comments	Checked by	Approved by	Date
1	Draft OREDP Natura Impact Statement (NIS)	SE	IAB	21 Feb 2011
2	Draft OREDP Natura Impact Statement (NIS) v2	SE	IAB	22 Feb 2011
3	Draft OREDP Natura Impact Statement (NIS) v3	SE	IAB	01/04/2011

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Job No Reference Date Created: 01 April 2011

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OREDP Natura Impact Statement

1 Introduction

1.1 Background

The Department of Communications, Energy and Natural Resources (DCENR), with input from the Sustainable Energy Authority of Ireland (SEAI) is in the process of developing the Offshore Renewable Energy Development Plan (OREDP), which will shape the exploitation of offshore wind and renewable energy resources in Ireland's marine territory. The main aim of the OREDP is to establish scenarios for the development of offshore renewable resources in Irish waters up to 2030 and to provide a description of developing policy, which will affect the context within which they may develop.

The OREDP area covers all Irish waters from the Mean High Water Mark out to the 200m water depth contour off the west and south west coast of Ireland and the Exclusive Economic Zone (EEZ) off the north, east and south east coast of Ireland. The spatial extent of the plan is shown on Figure 1.1.

As required by the Planning and Development (Strategic Environmental Assessment) Regulations 2004, the OREDP is subject to a Strategic Environmental Assessment (SEA), which has been undertaken by AECOM/Metoc/CMRC[1].

In addition, as the plan may affect sites designated as being of European importance (collectively, Natura 2000 sites), an Appropriate Assessment is required to establish whether there will be significant effects on such sites.

In order for an Appropriate Assessment to be made an appraisal of the OREDP has been undertaken in relation to its potential effects on the interest features of European sites. This Natura Impact Statement (NIS) presents the findings of this appraisal, which includes a summary of the initial screening phase and the subsequent and more detailed appraisal, the findings of which will inform the Appropriate Assessment that will be made by DCENR in relation to the OREDP.

1.2 Regulatory Context

Under the provisions of S.I. No. 94/1997 - European Communities (Natural Habitats) Regulations, 1997 (as amended), which translate the requirements of the Habitats Directive 1992 and Birds Directive 1979[2] into Irish law, a 'competent authority' (in this context the plan-making body, DCENR), is required to undertake an Appropriate Assessment of any plan or project (where the plan does not relate directly to management of the site)[3], and where the plan or project is likely to have a significant effect on a Natura 2000 site, in relation to the site's conservation objectives.

The plan-making body can only agree to the plan after having ascertained that the plan will not adversely affect the integrity of any Natura 2000 site, unless in exceptional circumstances, the provisions of Article 6(4) of the Habitats Directive are met. Article 6(4) provides for the situation that if in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, the plan must nevertheless be carried out for imperative reasons of overriding public interest (IROPI), where compensatory measures must be implemented.

All stages of the Appropriate Assessment have to be completed before the plan can be adopted or consents or permissions for a project can be granted.

Natura 2000 sites that have to be considered include Special Areas of Conservation (SAC) and Special Protection Areas (SPA). Such consideration extends to candidate or proposed sites, or extensions to existing sites, all of which are afforded the same level of protection as fully adopted sites. Therefore, with regard to the OREDP an Appropriate Assessment is required in relation to such protected sites where the plan will cause 'Likely Significant Effects', and forms a material consideration in the finalisation of the plan.

[1] Coastal and Marine Resources Centre, Cork.

[2] The original Birds Directive has since been replaced by Directive 2009/147/EC comprising the consolidated (or 'codified') version of Council Directive 79/409/EEC which originally came into force in 1979 and was amended on a number of occasions before being replaced by the current version.

[3] Specifically this is a requirement of Article 6(3) of the Habitats Directive.

The legislation, as well as the guidance published by the Department of Environment, Heritage and Local Government (DEHLG),[4] makes it clear that a plan or project which may affect a Natura 2000 site cannot be approved until the Appropriate Assessment has been concluded and the findings of the Appropriate Assessment used to influence or change the plan or programme, where appropriate.

1.3 Limitations of the Assessment

The main aim of the OREDP is to establish scenarios for the development of offshore renewable resources in Irish waters up to 2030 and to provide a description of developing policy, which will affect the context within which they may develop. The OREDP is a very high plan which outlines policy in many areas that will influence future development, many of which are still under consideration. As such the plan covers large non-specific areas and does not identify specific areas for development. This puts a limitation on the appropriate assessment as to what can be reasonably assessed at this level. It would not be appropriate at this stage to conclude either way (that the plan will have a significant effect or won't have a significant effect) as in doing so this could preclude future developments from areas without an appropriate evidence base.

Recently developed guidance[5] describes certain circumstances where it may be acceptable for a Plan level Appropriate Assessment to rely on a later Project level Appropriate Assessment to ensure no adverse effect on the integrity of a European site. This is considered to be permissible because important information about the effects of the Plan may only become evident once specific proposals and projects are brought forward.

The guidance indicates that, where a high level assessment 'cannot reasonably assess the effects on a European site in a meaningful way' because of the high level nature of the Plan, reliance on the lower tier Project (or a more detailed lower tier Plan) assessment may be more appropriate, provided that such lower tier assessments can influence the details of how the Projects are implemented, where it cannot otherwise be demonstrated that there will no Likely Significant Effects on interest features.

Indeed, the draft OREDP at Section 10.1 says that should a developer be interested in developing within a designated site it is highly likely that a number of surveys would be required, in addition to extensive monitoring and research in order to provide sufficient evidence that a particular development would not have a significant adverse effect on the integrity of that site. Section 10.5 of the draft OREDP notes that individual developers may seek to develop within these protected sites. Where this is the case it would be the responsibility of the individual developer as part of the Foreshore Lease Consenting Process and in accordance with the Habitats Directive to provide the necessary evidence to the regulatory authorities to demonstrate that a specific project or number of projects in a certain location would not have a significant adverse effect on the integrity or conservation objectives of a given site. Furthermore the Project Level Mitigation Measures included at Appendix 2 of the draft OREDP (which the draft OREDP indicates are expected to be turned into National Guidance) propose a number of project level mitigation measures, specifically in relation to protected sites.

1.4 Structure of the Natura Impact Statement

The following sets out the structure of this NIS.

Chapter 1 – Introduction
Chapter 2 – Description of the Plan
Chapter 3 – Methodology
Chapter 4 – Screening Summary
Chapter 5 – Potential effects of the OREDP
Chapter 6 – Assessment
Chapter 7 – Sites at the highest risk
Chapter 8 – In-combination effects
Chapter 9 – Mitigation
Chapter 10 – Conclusions / Appropriate Assessment

[4] DEHLG (December 2009) Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities
[5] SNH/David Tyldesley and Associates (August 2010) Habitats Regulations Appraisal of Plans: Guidance for Plan-Making Bodies in Scotland

2 Description of the Plan

2.1 Introduction

The international drive to develop renewable energy sources has increased significantly in response to growing concerns over the security of supply of energy from fossil fuels and the awareness of their impact on the environment and climate. Since the Kyoto Agreement of 1997, climate change has become a focal point of both international and domestic political agendas, with targets and long term strategies for reducing CO_2 emissions being implemented through a series of Directives, Bills and Acts.

In 2007 the European Union (EU) agreed new climate and energy targets by 2020. These were based on a 20% reduction in greenhouse gas emissions, 20% energy efficiency and 20% of the EU's energy consumption from renewable sources. The recently implemented EU Renewable Energy Directive 2009/28/EC (repealing Directive 2001/77/EC and Directive 2003/30/EC) has set individual and legally binding targets on each Member State for increasing the level of renewable energy across the European Union in order to achieve the targets set in 2007.

Under Directive 2009/28/EC, Ireland's target is that 16% of all energy (heat, transport and electricity) consumed will be derived from renewable sources by 2020. Ireland's National Renewable Energy Action (NREAP) sets out how this target is to be achieved through 10% renewables in the transport sector, 12% in the heat sector and over 42.5% in the electricity sector.

In addition to providing support at the technology/industry development level, the Government, through the Department of Communications, Energy and Natural Resources (DCENR) is also working on the delivery of offshore renewables at a strategic level through the preparation of the OREDP.

2.2 Aim and Objectives of the OREDP

The draft OREDP sets out the evolving policy context in Ireland and identifies scenarios for the generation of electricity from offshore wind and from wave and tidal technologies in Irish waters up to 2030, whilst setting out a longer term view for the growth of the offshore renewable energy sector in Ireland. The specific objectives of the plan are to:

- Describe the policy context for development of the offshore marine renewable energy sector;
- Provide information on the current status of activities and initiatives that are underway in that sector;
- Define some development scenarios for the period 2030; and
- Set out the long term vision for the sector.

2.3 Overview of the Main Proposals within the OREDP

The main proposals set out in the OREDP include a series of scenarios for the development of up to 4,500MW of offshore wind and 1,500MW of wave and tidal energy within Irish waters. These development scenarios, summarised in Table 3.1 below, are based on the following:

- **Low**: this scenario consists of the 800 MW of offshore wind to receive a grid connection offer under Gate 3 as follows:
    - The Kish Consortium part of Dublin Array (364 MW)
    - Oriel Windfarm (330 MW)
    - Fuinneamh Sceirde Teoranta (FST) (100.8 MW)

  The Low Scenario also includes 75MW of wave and tidal development, which is included in the Table 10 modelled scenario in the National Renewable Energy Action Plan (NREAP)[6].

[6] http://www.dcenr.gov.ie/NR/rdonlyres/C71495BB-DB3C-4FE9-A725-0C094FE19BCA/0/2010NREAP.pdf

- **Medium**: this development scenario consists of 2,300MW of offshore wind, which comes from the Table 10 non-modelled scenario of the NREAP (broadly based on the combination of offshore wind projects with either foreshore lease or grid connection) and the 500MW of wave and tidal energy in the same table (the Government's 2020 ocean energy target).
- **High**: this development scenario consists of 4,500MW of offshore wind and 1,500MW of wave and tidal current. These figures come from the SEA Scoping document.[7]

Table 3.1 Summary of OREDP Development Scenarios

Development Scenarios to 2030			
	Low Scenario (MW)	***Medium Scenario (MW)***	***High Scenario (MW)***
Wind	800	2,300	4,500
Wave and Tidal	75	500	1,500

2.4 Evolving Policy Context and Longer Term Vision for the Growth

Factors that will influence how the offshore renewable energy industry in Ireland develops are described in the plan. These include future policy on foreshore leasing, use of the co-operation mechanisms provided for in the Directive, the evolution and development of an offshore grid or further interconnection, grid connection policy and grid build etc.

The plan also provides information on the other areas that will potentially influence the establishment and long term growth of the offshore renewable energy industry but which are outside the scope of the plan. These areas for growth or future investment therefore do not form part of the assessment but are important factors that could influence the effectiveness with which the growth of the offshore renewable energy sector is taken forward. These areas include:

- Development and successful operation of the grid connected test facilities, as appropriate;
- The evolving planning for the development of offshore and onshore grid infrastructure;
- The evolution of the regulatory, consenting and trading environment and mechanisms that will allow for electricity export; and
- The establishment and operation of effective foreshore leasing and consenting process.

In addition to identifying these key areas for growth of the offshore renewable energy industry, the plan also outlines a longer term vision for the offshore renewable energy sector. This has been split down into six groups comprising wave, tidal, wind, offshore grid developments, infrastructure (ports) and the regulatory framework.

Essentially, the plan concludes that to be able to exploit the full natural resource offered within Ireland's ocean territory and to become an exporter of energy to the rest of Europe, the following factors need to be addressed in the period up to 2030:

- Technological advances generally in wave and tidal devices;
- Advances in wave, tidal and wind technology in order to harvest/exploit the natural resources in more arduous conditions, in particular deeper waters off the west coast;
- Grid developments to facilitate increased capacity;
- Increased joined-up working with Northern Ireland, the rest of the UK and Europe on the development of the offshore grid;
- Development and provision of onshore sites (ports) for the construction and maintenance of offshore devices; and
- An improved and streamlined regulatory framework.

[7] http://www.seai.ie/Renewables/Ocean_Energy/Offshore_Renewable_SEA/Environmental_Report/

Again the mechanisms for addressing these factors fall outside the scope of the OREDP and therefore are not subject to this assessment, but will have to be addressed within the Appropriate Assessments that will be undertaken of these lower tier plans and projects.

2.5 Location and Scope of the OREDP

Based on information presented in the SEA Scoping Report, prepared by SEI (now SEAI) in July 2009 and comments received following consultation on the Scoping Report as summarised in Chapter 4 of the SEA Environmental Report (AECOM/METOC October 2010), the scope of the OREDP includes:

- Timescale for the SEA and OREDP as 2030 horizon – *this has been extended from 2020 following feedback from consultation of the scope of the SEA.*
- Inclusion of assessment scenarios for the production of up to 4,500 MW from offshore wind and 1,500 MW from wave/tidal.
- The OREDP area has been more clearly defined and includes:
  - All Irish waters from the Mean High Water Mark out to the 200m water depth contour off the west and south west coast of Ireland and the Irish Exclusive Economic Zone (EEZ) off the north, east and south east coast of Ireland.
  - The study area includes a number of zones (referred to as Assessment Areas in the SEA Environmental Report) which focus on the main areas of resource identified for offshore wind (fixed and floating), wave and tidal energy.

- These zones include:
  - Those areas below Mean High Water Mark that encompass the main resource for offshore wind (fixed and floating), wave and tidal energy, although potential effects above the Mean High Water Mark have been considered for particular SEA issues/subjects e.g. seascape.
  - Piled offshore wind, wave and tidal developments to a depth of 60m – *this was identified during consultation with developers as being the maximum depth for piled offshore wind, wave and tidal based on current and known future technologies and other operational parameters (e.g. installation etc).*
  - Floating wind structures to a distance of 100km from the shoreline - *this distance from the shoreline reflects the upper length limit of Alternating Current (AC) cable technology (for greater distances (beyond 100km) Direct Current (DC) cables would be required with convertor stations on land to convert to AC).*
  - Tidal devices in areas where tidal stream velocities are 1.2m/s or greater - *this has been reduced from 1.5m/s following scoping to reflect operating parameters for a wider range of technologies in particular lower to mid stream technologies.*

The study area as illustrated in Figure 3.1 has been divided into seven separate assessment areas (see Table 3.2), the main purpose being to refine the extent of the OREDEP into a number of smaller more manageable areas within which to undertake the assessment.

The key factors used to define the location and extent of each assessment area were the location of offshore wind, wave and tidal resource as discussed in Chapter 8 of the SEA Environmental Report and the development parameters and constraints associated with each of the technologies.

However, it should be noted that, at this stage, whilst broad areas of resource and development interest may have been identified, the precise location of individual developments within each of the Assessment Areas is currently unknown and the type of development e.g. type of tidal or wave device deployed as part of a commercial scale development is also unknown as this is dependent on the results of detailed survey, technological factors, future demand and other factors, including marine spatial planning, that lie outside the scope of the OREDP and therefore this assessment.

Table 3.2: Assessment Areas

Assessment Area	Technology	Location
1	Offshore Wind	East Coast - North
2	Offshore Wind & Tidal[1]	East Coast - South
3	Offshore Wind[2]	South Coast
4	Offshore Wind & Wave	West Coast - South
5	Offshore Wind & Wave	West Coast
5a	Tidal	Shannon Estuary
6	Offshore Wind & Wave & Tidal[1]	West Coast - North

Note 1: Only those areas of significant tidal resource suitable for the development of commercial tidal arrays have been considered in the assessment.

Note 2: Wave is not considered in Assessment Area 3 because although there is some offshore technical resource here, it was considered to be too far offshore for development within the timeframe of the OREDP. It was decided to only consider wave in the more accessible near shore wave resource areas on the southwest, west and northwest coast where developer interest is predicted to be focussed initially (Assessment Areas 4, 5, 6).

2.6 Technologies

Information on the characteristics and main technical operating parameters of devices that are likely to be constructed as a consequence of the OREDP are included in Appendix A of this report.

3 Methodology

3.1 Introduction

The overall aim of this NIS is to present the findings of a focussed assessment to ascertain whether the OREDP is likely to have a significant adverse effect on the integrity of any European site, in terms of interest features and relevant conservation objectives.

The assessment has been undertaken in accordance with the published EC Methodological Guidance on the Provision of Article 6(3) and 6(4) of the Habitats Directive (2001) and the European Commission Guidance Managing Natura 2000 sites (2000). In addition, reference has been made to the approach set out in DEHLG Guidance 2009 referred to earlier as well as other recently published guidance.[8]

In accordance with the guidance the assessment has been undertaken in two stages, screening for Appropriate Assessment and Appropriate Assessment. These stages are described in the following sections.

3.2 Screening

Initially a screening exercise was undertaken which identified a number of sites upon which the OREDP could potentially have a significant effect. Chapter 4 provides a summary of the main findings from this screening assessment, provides details of the criteria used to determine potential for likely significant effect (LSE), and identifies the number of sites that were screened in for further assessment as part of this NIS to inform the Appropriate Assessment.

3.3 Natura Impact Statement (NIS) (required to inform an Appropriate Assessment)

Where the screening assessment determined potential for a likely significant effect on a site the site was screened in and taken forward to Appropriate Assessment which is detailed in this report. This stage of the process provides the information needed in the form of a NIS by the DCENR, as the competent authority, for them to be to be able to undertake the Appropriate Assessment of the OREDP.

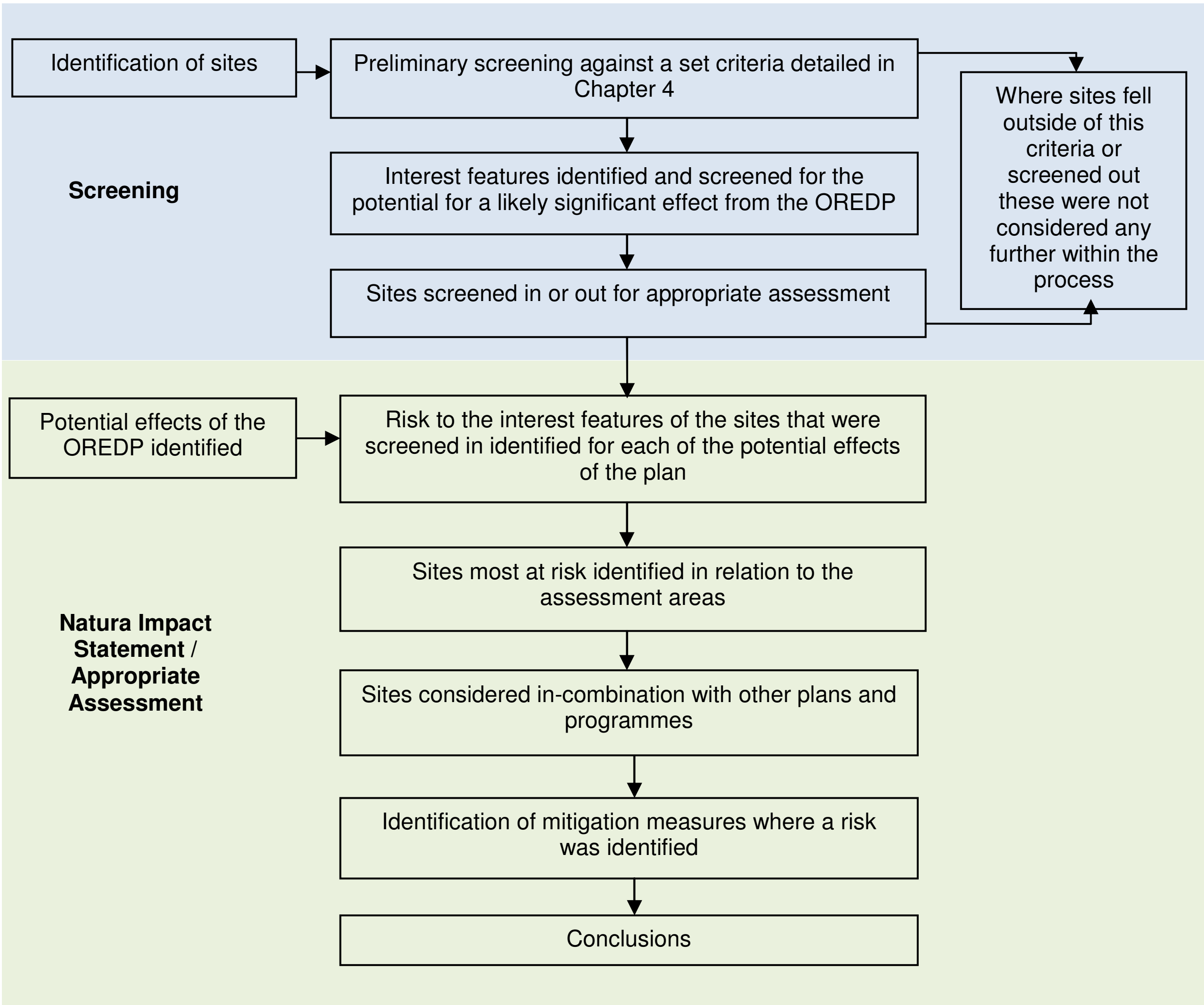
This assessment identifies the risk for a likely significant effect on the interest features of the Natura sites that were screened in from the potential effects of plan. These are also considered in-combination with other plans and projects of a similar spatial nature and where a risk is identified mitigation has been identified. This process is outlined below and the overall process is illustrated in Diagram 3.1.

- Identification the Natura 2000 sites potentially affected by the plan, as defined during screening, identify the interest features and geographical relationship(s) between the plan area and the sites and/or their interest features, if these can be present outwith the site boundary (i.e. in relation to indirect effects on habitats or sessile species or effects on mobile species). These have been structured according to the general categories of interest features that are sensitive to the potential effects of the plan:
    - Habitats (grouped by similar habitat types)
    - Marine Mammals;
    - Fish and Freshwater Pearl Mussel;
    - Otters;
    - Bats; and
    - Birds (differentiating between seabirds and other birds).

[8] SNH/David Tyldesley and Associates (August 2010) Habitats Regulations Appraisal of Plans: Guidance for Plan-Making Bodies in Scotland.

- Discuss the sensitivity of the interest features to the potential effects identified and considers potential impacts and pathways relating to likely activities associated with the OREDP, such as physical loss or damage, non-physical disturbance, and toxic/ non-toxic contamination effects, that may interact with or affect the interest features identified as being sensitive;
- Indication of the likelihood (or risk) of significant effects that the activities associated with the OREDP will have on interest features of the European sites, taking into account likely OREDEP activities and the sensitivity of those features, bearing in mind the precautionary principle.

Diagram 3.1: Methodology



4 Screening Summary

4.1 Introduction

This chapter summaries the screening assessment which identified all European sites that have the potential to be affected by the plan and therefore have been considered within this Appropriate Assessment.

4.2 Approach to Screening

4.2.1 Stage 1 Screening

Initially all European sites within Ireland and Northern Ireland were considered at the start of the screening assessment and details of each site were taken from the following sources as appropriate:

- National Parks and Wildlife Service;
- Joint Nature Conservation Committee (JNCC) UK; and
- European Environment Agency – Natura 2000 dataset.

Table 4.1 shows a breakdown of sites that were considered as part of the screening assessment.

Table 4.1 Number of Sites Entering Screening

Jurisdiction	SAC	SPA
Ireland	424	163
Northern Ireland	55	17

4.2.2 Stage 2 Screening

A preliminary screening assessment was then undertaken on the 659 sites above using the following criteria:

- All SAC that have a marine or coastal component and/or where the interest features comprise non-mobile species (for an SAC), or where an SPA containing habitats supporting bird interest species, were included;
- All SAC where migratory mammals (such as cetaceans, otters or seals) or fish (such as salmonids or lamprey) are an interest feature were included. This includes all SAC within 30km inland of the coast where bats are an interest feature; and
- Other SPA where birds that either forage or migrate over sea areas, which may or may not have a marine or coastal habitat element, were included.

Any site which was covered by the above criteria was taken forward to the next stage of screening and those that did not were no longer considered by the assessment.

Figures 4.1 and 4.2, respectively, show the locations of SAC and SPA in Ireland and Northern Ireland which were taken through to the next stage of the screening process.

4.2.3 Stage 3 Screening

This stage of the screening considered all of the Natura 2000 sites potentially affected by the plan and identified all of the interest features and geographical relationship(s) between the plan area and Natura 2000 sites and/or interest features, if these could be present outwith the site boundary (i.e. in relation to indirect effects on habitats or sessile species or effects on mobile species).

Interest features, conservation objectives, sensitivities and likely significant effects for each site were tabulated in detail and the result of the screening assessment for each site were included in Appendix C (SAC) and Appendix D (SPA) of the Screening Report.

Consideration was then given to whether the draft plan was likely to have significant adverse effects on the interest features of any Natura 2000 site, based on direct, indirect, temporary, permanent and harmful effects, or in combination.

This screening was undertaken at a very high level, in effect considering that where likely significant effects were possible then the site should be screened in for further assessment. In addition, where effects were considered possible but could not be stated for certain, then these sites were also "screened in" and taken forward to the Appropriate Assessment stage.

Therefore, in undertaking this assessment (and in accordance with case law), the test of likely significance was applied using the precautionary principle, which means that, unless it could be shown that there is no likely significant effect on a Natura 2000 site, such an effect must be assumed. Conversely, the European Court of Justice has ruled that if the effects of a plan or project would not undermine the conservation objectives of a European site then its effects cannot be regarded as significant.[9]

The OREDP was screened both in terms of the effects of its own component parts as far as they are known and also the effects of each of these parts in combination with other elements of the OREDP, as well as other approved plans and projects.

4.3 Results of Screening

From the starting point of 659 European sites in Ireland and Northern Ireland, screening concluded that of these, a total of 360 sites should be taken forward to the subsequent Appropriate Assessment stage because there was a likelihood of significant effect for these sites[10]. Table 4.2 provides a breakdown of the sites remaining and therefore deemed 'screened in' site.

Table 4.2 European Sites Screened In

Jurisdiction	SAC	SPA
Ireland	157	161
Northern Ireland	25	17

Detailed assessment tables for each site included in the Screening Assessment are presented in Appendix F.

With regard to the conclusions of screening, a subsequent consultation response on the draft OREDP and SEA Environmental Report was received from the Isle of Man Government. This requested that consideration of protection of European Protected Species and sites in Manx territory should be made with regard to assessment of the OREDP. These sites were screening against the criteria set out in Stage 2 above and it was concluded these sites were not covered by the criteria and have therefore been screened out.

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[9] European Court of Justice case C-127/02 dated 7 September 2004, often referred to as the Waddenzee ruling.

[10] Note however, one or two errors had crept into the screening process and two sites were screened in when they should actually have been screen out. This has been corrected in the subsequent stages discussed in the NIS.

5 Potential Effects of the OREDP

5.1 Introduction

This chapter sets out the potential effects of the plan. These will be used as the basis of the appropriate assessment in determining significant effect.

5.2 Plan Activities and Potential Effects

There are a number of generic activities that are likely to occur as a result of implementing the OREDP. These include:

- Marine survey and investigations;
- Installation and construction of wind, tidal or wave technology including cabling;
- Operation of wind, tidal and wave technology plus cable infrastructure;
- Maintenance and repair work to devices (including cabling); and
- Decommissioning and structure removal (or safe abandonment)

As a consequence of the above activities the following effects may result:

- Direct physical loss or damage to habitat;
- Direct physical loss or damage to non-mobile species;
- Direct physical damage to mobile species;
- Indirect disturbance or loss of habitats;
- Indirect disturbance or loss of species;
- Toxic effects;
- Non-toxic effects;
- Biological disturbance; and
- EMF and temperature.

Table 5.1 provides more explanation as to how the actives relate to the potential effects. Where activities at different stages of the development of marine renewable resources, from surveying through installation, operation to decommissioning and infrastructure removal may have similar effects on interest interests these have been grouped.

A detailed discussion of all of the potential environmental impacts associated with the plan is provided in the SEA Environmental Report. These cover all environmental topics although some of these may not be directly relevant to Appropriate Assessment. However, for information, the summary tables from the SEA Environmental Report, where they are relevant to this assessment, are reproduced in Appendix C of this NIS.

Table 5.1 Summary of Potential Effects of OREDP Activities.

Potential Effects	Activity
Direct effects on habitats or non-mobile species **Direct loss of/damage to habitats:** Physical damage to or removal/loss/reduction of habitats or removal/loss of non-mobile species due to direct intervention, which may be either permanent loss at the device position (i.e. at the foundation) or a substrate change, for example the use of gravel for gravity bases or trenching across tidal and sub-tidal areas for cabling. **Scouring:** There may also be direct effects resulting from scouring, erosion and other sedimentation changes caused by hydrodynamic changes.	Trawling surveys Foundation/device installation in particular piled foundations and gravity bases. Cable installation Installation of onshore infrastructure. Presence and positioning of devices causing hydrodynamic changes/ scouring/ erosion to substrate and habitats during operation Vessel movements causing coastal habitat erosion due to ship wash Repair and maintenance activities Decommissioning activities resulting in disturbance to established habitats and communities. Potential for reinstatement of former habitats.
Direct effects on mobile species **Collision Risk (below surface):** Physical damage to mobile species, e.g. injury to fish or marine mammals caused by direct contact (collision) with devices, collision with blades/devices, underwater pressure waves during survey or operation or vessel movements at all stages. **Collision Risk (above surface):** Collision with above waterline structures such as wind turbine towers or blades by bats and birds.	Seismic surveys Installation of foundations and devices Operation of devices Increased vessel activity Maintenance activities Decommissioning, removal of infrastructure
Indirect effects of habitats and non mobile species **Smothering:** effects of sediment disturbance, suspension and resettlement on species/habitats sensitive to smothering. **Changes in water flow** resulting from the extraction of energy from the tidal stream. **Changes in wave exposure** resulting from the extraction of energy from the existing wave regime. **Changes in suspended sediment levels and turbidity** and the effects of this on water quality and sensitive habitats and species.	Trawling surveys Foundation/device installation in particular piled foundations and gravity bases. Cable installation Installation of onshore infrastructure. Extraction of energy from tidal current/waves by operational devices. Increased vessel activity Maintenance activities Decommissioning, removal of infrastructure

Potential Effects	Activity
Indirect effects on mobile species **Habitat disturbance:** disturbance of mobile species, in particular seabirds and seals in haul out sites from noise and presence of installation vessels/other installation machinery. **Noise (installation):** effects of noise generated during the installation of devices, in particular piling activities, on marine mammals, reptiles, fish and seabirds in terms of disturbance and possible longer term displacement from habitats. **Noise (operation):** effects of noise generated by operational devices on marine mammals, reptiles, birds and fish. Habitat exclusion: physical presence of devices/arrays leading to long term exclusion from foraging, loafing (birds) and breeding habitats and also exclusion from migration routes. **Barrier effects:** restricted transit between feeding and breeding area and along migratory routes due to 'barriers' created by physical presence of offshore renewable energy developments and perceived risk of collision/effects on noise and general disturbance.	Seismic surveys Increased vessel activity Installation of foundations (percussive piling) Operation of underwater or surface devices (wave and tidal) Operation of wind turbines (flicker/air pressure waves) Lights on devices Maintenance activities Decommissioning, removal of infrastructure
Toxic effects Toxic effects on marine species caused by release of contaminants directly or from indirect disturbance of sediments due to underwater pressure waves, changes in hydrodynamics, scouring, etc.	Introduction of oil, hydraulic fluid, anti-fouling chemicals, or other substances from devices or vessels. Mobilisation of sediments resulting in release of toxins during construction, maintenance or decommissioning.
Non-toxic effects (see increased suspended sediment levels and turbidity) Non-toxic effects/disturbance caused by mobilisation of sediments, e.g. increases in turbidity causing disturbance or loss of feeding opportunities for marine pelagic species (fish and mammals) or birds. Also introduction of marine litter.	Trawler surveys Installation of devices and infrastructure (e.g. piling) Operation and maintenance of devices and infrastructure Decommissioning activities causing mobilisation of sediments
Biological disturbance Introduction of invasive, alien or non-native species carried by vessels, etc.	Increased vessel activity during all stages
EMF and temperature Electromagnetic fields around cables; temperature changes associated with operation of devices and cabling may cause physical conditions/habitats to be altered and behaviour of electro-sensitive species to change.	Operation of devices and cabling

5.3 Description of Potential Effects of OREDP Activities

5.3.1 Direct Physical Loss or Damage to Habitats or Non-Mobile Species

5.3.1.1 Direct Physical Loss or Damage

There is potential for **direct physical loss or damage** to the substratum and associated habitat/species located in the vicinity of offshore renewable energy developments resulting from the survey activities, installation of cables, piled foundations, gravity bases or clump weights, and deployment of anchors and jack-up rigs if used, vessel movements, maintenance activities and decommissioning. Although these effects are likely to be localised they will be permanent. The overall magnitude and significance of the effect will depend on the total area of habitat affected and the range/type of benthic communities/species present in main area of development.

5.3.1.2 Scouring

Scouring of sediments will occur around the base of any fixed structures or foundations on the seabed such as monopiles (mainly relevant to wind and tidal devices), and clump weights and gravity bases (wave and tidal). This scouring may have potential effects on the existing benthic environment in that immediate location. However, over time, sediment conditions will stabilise with finer sediments being lost and the larger sediment fraction remaining allowing recolonisation by species that may have been absent before.

Recolonisation may also lead to increased sediment consolidation and stability which would contribute to further recolonisation success. However, this in itself may increase friction levels with a resulting breakdown of consolidated sediment before equilibrium is reached and a new and changed benthic community becomes established. If scour protection is used the difference in faunal composition between before and after construction will be greater than without such protection.

5.3.2 Direct Physical Damage to Mobile Species:

In terms of direct physical effects on mobile species these include both below water surface and above water surface effects.

5.3.2.1 Collision Risk with structures above the surface of the water

The main direct effects above the surface of the water relate to potential collision risk between migratory birds and offshore wind turbine blades and towers. There may also be the risk of collision with other bird species using an area for foraging or breeding and bat species found offshore.

Bird collision risk with offshore wind turbines is predominately limited to the operational phase of a development and is influenced by a range of factors including species sensitivity, weather and visibility conditions, the location of bird populations adjacent to the wind farm, bird flight behaviour (height above sea level etc) and migration routes and flight routes to feeding areas that could potentially occur within the array. Collision risk is expected to be greater closer inshore as this will increase the proximity to flight paths by birds moving between feeding areas (e.g. scoters), feeding and roosting (e.g. waders and wildfowl) or breeding and feeding areas (e.g. seabird colonies), and larger-scale movements along the coast or migration landfall or departure. Further offshore, any large concentrations of birds are most likely to be present in response to food availability e.g. at tidal upwellings which concentrate plankton and shoals of fish, around fishing vessels, and when birds are rafting during feather moult.

A study at Nysted offshore wind farm (160 MW, 72 turbines) investigating whether long-lived geese and ducks can detect and avoid a large offshore wind farm demonstrated that the percentage of flocks entering the wind farm area decreased significantly (by a factor 4.5) from pre-construction to initial operation. At night, migrating flocks were more prone to enter the wind farm but counteracted the higher risk of collision in the dark by increasing their distance from individual turbines and flying in the corridors between turbines. Overall, less than 1% of the ducks and geese migrated close enough to the wind turbines to be considered to be at any risk of collision.

A combination of visual and radar studies in Germany (Hüppop *et al*. 2003, cited in Bird Life International, 2003) showed that considerable migration over the sea occurs at heights occupied by wind turbines, especially during low visibility (fog, rain, darkness) when birds fly at lower altitude.

Low-flying flocks of eiders were rarely seen to pass within 500m of the wind turbines during daytime, and avoidance behaviour was observed, with some birds altering direction 3-4kms before reaching the Utgrunden wind farm to fly around it (Pettersson 2002 cited in Birdlife International, 2003). No collisions were observed during this study, but it was difficult to judge whether this means collisions have not occurred on the basis of visual observations and limited radar tracking. Whilst the available evidence suggests that birds will in many cases change their behaviour to avoid collision with offshore windfarms, residual risks remain, particularly in areas with large numbers of migrating birds passing through, possible changes to route and altitude in response to the prevailing weather conditions. Avoidance behaviour also becomes more difficult in a scenario of multiple wind farms.

5.3.2.2 Collision risk with structures below the surface of the water.

Collision risk with submerged structures and moving parts of devices is considered to be a key potential effect in relation to offshore renewable energy developments, in particular wave and tidal technologies. The following section provides a description of the possible risk of collision between marine mammals and marine reptiles, fish and seabirds (in particular diving birds and pursuit feeders).

Marine Mammals and Reptiles

Given the wide range of devices that may be deployed, all species of marine mammals, finfish and marine reptiles are at some risk of collision effects. Whilst distinctions can be drawn between species that forage in the water column, or at the seabed, all species breathe at the surface and so regularly transit the water column.

A review of collision risk undertaken as part of the Scottish Marine Renewables SEA identified that certain parallels can be drawn between known collision risks and response of mammals encountering existing hazards (shipping, fishing gear interactions, killer whale tail swipes). However, there is considerable lack of empirical knowledge on this risk, and it is important to bear in mind that turbine blades, either of the horizontal or vertical axis type, present a threat quite unlike anything that marine mammals and reptiles have previously experienced. Therefore, whilst an overview of the factors likely to influence collision risks posed by marine renewable devices is summarised below, it is not possible to quantify this risk based on the current state of knowledge.

Mooring equipment such as anchor blocks and plinths are likely to function like other natural or artificial seabed structures and hence pose few novel risks for vertebrates in the water column. Cables, chains and power lines extending up through the water will have smaller cross-sectional area than vertical support structures and so produce reduced flow disruption and fewer sensory cues to approaching mammals. Instead of being swept around these structures, mammals are more likely to become wrapped around or entangled in them.

Being highly mobile underwater, marine mammals have the capacity to both avoid and evade marine renewable devices. This is as long as they have the ability to detect the objects, perceive them as a threat and then take appropriate action at long or short range. However, there are several factors that compromise this ideal scenario.

Detection failure: The broad acoustic, visual and hydrographic signatures of marine renewable devices are at present poorly understood. Other than the visual appearance of devices, the need for efficient energy conversion will encourage the development of devices that produce as little extraneous energy signatures as possible. This is in direct contrast to any warning stimuli required by the animals at risk. There is therefore a key conflict between the stimulus output from the devices and perceptual acuity of the animals at risk. The distances that animals perceive, and hence can take avoiding/evasive action will therefore depend on this ratio. Environmental circumstances such as darkness, turbid water, background noise from rough weather or ship noise may all effect perception distances and hence escape options.

Diving constraints: Marine mammals are accomplished divers and typically dive close to aerobic dive limitations. This means that animals do not have unlimited time and manoeuvrability underwater and may have few options other than upwards at the end of a dive. In addition to this, buoyancy varies among marine mammals from negative to neutral to positively buoyant. Irrepressible positive buoyancy is a particular problem for whales when surfacing from depth and therefore constrains manoeuvring options.

Group effects: whales and dolphins travelling or feeding together may be at greater risk than those with a solitary habit. A group could be regarded as a large "super organism" rather than behaving as individuals. Responses may lead to some individuals evading contact with turbine blades; whilst others could be directed into the path of a blade.

Attraction: It is quite possible that marine renewable devices will not be perceived as a threat but instead attract marine mammals as a result of devices acting as Fish Aggregating Devices (FADs) or artificial reefs. It is also possible that species such as seals and small delphinids will be attracted to renewable devices should they injure or disorientate their prey. Certain more "curious" species, such as common and grey seals may actually be attracted to devices, whilst other more timid species (such as harbour porpoise) may tend to be more wary of devices. The age of individuals may also be relevant, as juveniles may also be more likely to investigate novel features. It is therefore likely that the more timid species or individuals that have had previous negative interactions with devices will show the strongest avoidance reactions.

Confusion: We do not yet know how marine mammals will respond to perceiving a marine renewable device, especially one with moving parts. It is quite possible that they will simply swim around it but it is also possible that they will respond in an inappropriate way. This is particularly likely for devices with gaps that move relative to the animal's trajectory such as ducted / shrouded turbines. In arrays, an escape response from one device may put the animal into a collision path with another.

Distraction: Marine mammals undertake a variety of activities underwater from simple transits, social interactions to complex foraging tactics. It is likely that during some of these occasions the animals' awareness of objects in the water column will be compromised. A particular example is the range detection problem encountered by echolocating cetaceans. When acoustically locked onto prey they reduce the interpulse intervals of their echolocation clicks such that they become acoustically blind to objects at greater distance than their intended prey. Therefore cetaceans feeding around submerged devices run an enhanced risk of close encounters without active acoustic detection.

Illogical behaviour: It is commonly believed that marine mammals have a high capacity for intelligent behaviour and as such would act logically when faced with a threat. However, there are many examples where this is not the case. The reticence of dolphins to leap the head line of tuna nets is a prime and ecologically significant example.

Disease and life stage: It is likely that most collisions will involve young, old, diseased or disorientated individuals. As long as marine renewable devices do not significantly attract marine mammals for enhanced foraging opportunities, juveniles are likely to be more at risk than adults because of reduced sensory and mobility abilities and/or experience, whilst old, ill or disorientated individuals will have reduced abilities to detect the threat or escape from it once perceived.

Size: Smaller mammals (such as grey and common seals) are more likely to follow the flow streamlines around moving parts and thus avoid collision. The collision risk increases with increasing size.

Season: Collision risk will also vary with season, due to seasonal change in migrations and pupping periods. Some species, such as the baleen whales and warm water dolphins typically increase in abundance during the summer and autumn, whilst most other species are resident and show only local changes in distribution.

Collision risk is also expected to be influenced by the nature of the environment where the turbines are located:

Open water: Deployment of devices in the open sea will present the least risk unless the spacing between devices increases the risk of encounter. The effects of devices on marine mammal habitat exclusion are likely to be localized to the area of placement.

High flow environments**:** High flows can combine with swimming speeds to produce high approach velocities with consequently reduced avoidance or evasion response times. Many marine mammals (particularly harbour porpoises and bottlenose dolphins) are attracted to areas of high flow to forage.

Sounds**:** Sounds between land masses are often used by marine mammals as transit corridors, and because they present good opportunities for foraging, as fish also use them for transit. Deployment within sounds increases risk of encounter and subsequent collisions.

Loughs**:** Interactions between marine mammals and devices placed at the mouths of sea loughs are likely to be similar to those for sounds, but will only have an effect on local rather than transiting species.

Water quality: Collision risk can be expected to be greater for turbines deployed in regions of moderate to high turbidity, or if the turbines increase turbidity, because of the reduced visibility.

Some initial modelling was undertaken for the Scottish Marine Renewables SEA to assess the potential encounter rate with a hypothetical scenario involving 100 horizontal axis 8 m radius turbines operating off the Scottish coast and existing populations of harbour porpoise.

The model incorporated a number of assumptions about the vertical distribution of porpoises, their swimming speeds and distribution. As escape (avoidance and evasion) behaviours by porpoises to marine renewable devices are currently unknown it was also assumed that the animals were neither attracted to nor avoided the immediate area around the turbine. The model predicted that in a year of operation device encounters would occur for 3.6% of the harbour porpoise population between Cape Wrath, the Mull of Galloway.

Whilst collision risk therefore presents a potential effect of major significance on cetaceans, it should be borne in mind that this is a simplistic approach to quantifying collision risk, as marine mammals are likely to show behavioural responses to the presence of marine renewable devices. Whilst the ability of marine mammals to perceive their environment is well understood, their behavioural reactions to marine renewable devices are not. At long range they have the option to avoid the area of device placement (i.e. swim around) and at closer range they can evade the particular structures (i.e. dodge or swerve).

The balance between avoidance and evasion responses will depend on the distances that these animals will be able to perceive the devices, and their subsequent behavioural reactions. Their ability to detect devices will depend on the sensory capabilities of the species, and the visibility and level of noise emitted by the device. The potential for animals to escape collisions with marine renewable devices will also depend on their body size, social behaviour, foraging tactics, curiosity, habitat use, and underwater agility.

Ecological effects resulting from mammal interactions with devices can be expected to range from: no effects, to the potential removal or injury of individuals, and, if rates are sufficiently high, to the decline in population numbers.

Seabirds

Collision risk is also considered to be a key potential effect during wave and tidal device operation, and it is considered that, bearing in mind the wide range of devices that may be deployed, all species of birds using the study area are at some risk of collision with devices. However, there is considerable lack of empirical knowledge on this risk, and it is important to bear in mind that turbine blades (tidal energy devices), either of the horizontal or vertical axis type presents an underwater threat quite unlike anything that marine birds have previously experienced. Therefore, whilst an overview of the factors likely to influence collision risks posed by marine renewable devices is summarised in this section, it is not possible to quantify this risk based on the current state of knowledge. It is also worth noting that wave devices and venturi tidal devices that do not have rotating blades are considered to pose a lower collision risk than horizontal and vertical axis tidal turbines.

Mooring equipment such as anchor blocks and plinths are likely to function like other natural or artificial seabed structures and hence pose few novel risks for vertebrates in the water column. Cables, chains and power lines extending up through the water will have smaller cross-sectional area than vertical support structures and so produce reduced flow disruption and fewer sensory cues to approaching diving birds. Instead of being swept around these structures, mammals are more likely to become entangled in them.

Marine birds have means of escaping moving or stationary hazards. The response of marine birds to a wave or tidal scheme will depend on whether it is detected above or below the surface and how close the object is before the animal detects it, and whether it is interpreted as a hazard that needs to be avoided.

Fish

In terms of fish, the group of species at risk will vary depending on the type of device and its location within the water column. Demersal fish, spending all their time near the sea bed will not be affected by the moving parts of wave power generating devices that act at the surface. It is possible that they may benefit from the habitat structure provided by the foundations and or moorings for these devices. Some demersal species (Plaice or cod for example) may interact with turbines in mid water when they make excursions up the water column when using tidal stream transport during migration. Some devices, vertical axis turbines for example, may be placed in foundations on the sea bed in shallow water. Demersal species could be at particular risk from these devices.

In general pelagic species of fish (such as migratory salmon) will be at some risk of interaction with all types of device. Their diurnal vertical migration behaviour forces them to occupy all depths in the water column at some time during the day.

In addition there are a number of other parameters that can be expected to affect the degree of collision risk:

- Size: Very small fish and larval fish with very low inertia experiencing viscous flow regime are more likely to follow the flow streamlines around moving parts and thus avoid collision. The collision risk increases with increasing fish size, and the greatest collision risk, as far as fish size is concerned, is therefore expected to apply to basking shark.
- Schooling behaviour: Schooling species may be at greater risk than those with a solitary habit. A school could be regarded as a large “super organism” rather than behaving as individual. Schools of fish move together in polarised formations and their predator escape behaviour is coordinated. Responses may lead to some individuals evading contact with turbine blades; whilst others could be directed into the path of a blade.
- Life stage: Juveniles are likely to be more at risk than adults because of reduced sensory and mobility abilities and/or experience.
- Season: Species at most risk will also vary with season, due to seasonal change in geographic distribution, migrations and spawning periods.
- Fixed submerged structures (such as vertical or horizontal support piles, ducts & nacelles) are likely to attract marine life in the manner of artificial reefs or fish aggregating devices (FADs).
- Mooring equipment such as anchor blocks and plinths are likely to function like other natural or artificial seabed structures and hence pose few novel risks for vertebrates in the water column.
- Collision risk is expected to be influenced by the nature of the environment where the turbines are located:
- Open water: Deployment of devices in the open sea will present the least risk unless the spacing between devices increases the risk of encounter (see above). However, water depth at the point of deployment will be critical and turbines need to be raised far enough off the bottom to reduce interaction with benthic fish.
- High flow environments: High flows can combine with swimming speeds to produce high approach velocities and consequently reduced avoidance or evasion response times. In high flow environments, fish may hold station in front of a device until they reach exhaustion and then passively be swept downstream towards it. This assertion is based on research undertaken into fishing methods, and why fish become swept into trawling nets (Wardle 1986, Walsh, 2003, Breen M. 2004, Jamieson, et al. 2006).
- Sounds: Deployment within sounds increases risk of encounter and subsequent collisions.
- Loughs: Locating turbines in Lough entrances could prevent passage through the entrance into or out of a sea loch and therefore exclude fish from a loch or cause their retention within the loch. This effect would be of particular significance for migratory species such as salmonids. Although it is unlikely that complete exclusion or retention will result, a reduction in numbers passing through could have a significant effect on the diversity of sea loch communities.
- Turbidity: Collision risk can be expected to be greater for turbines deployed in regions of moderate to high turbidity, or if the turbines themselves increase turbidity. This is because of the turbines’ reduced visibility, and also because turbid waters are actively selected by many fish species, possibly as a refuge from predators.

Some initial modelling was undertaken as part of the Scottish Marine Renewables SEA to assess the potential encounter rate between a hypothetical array of 100 horizontal axis, 8 m radius turbines operating off the Scottish coast and existing populations of herring. The model incorporated a number of assumptions about the vertical distribution of herring, their swimming speeds and distribution. As escape (avoidance and evasion) behaviours by the fish to marine renewable devices are currently unknown it was also assumed that the fish were neither attracted to nor avoided the immediate area around the turbine. The model predicted that in a year of operation device encounters would occur for 2% of the Herring population between Cape Wrath and the Mull of Galloway.

However, this is a simplistic approach to quantifying collision risk, as marine fish are likely to show behavioural responses to the presence of marine renewable devices. Whilst the ability of fish to perceive their environment is well understood, their behavioural reactions to marine renewable devices are not. At long range they have the option to avoid the area of device placement (i.e. swim around) and at closer range they can evade the particular structures (i.e. dodge or swerve).

The balance between avoidance and evasion responses will depend on a product of the distances that these animals will be able to perceive the devices and their subsequent behavioural reactions. Fish sense their environment using sight, hearing, and chemoreception. Their ability to detect devices will depend on the sensory capabilities of the species and the visibility and level of noise emitted by the device. The potential for animals to escape collisions with marine renewable devices will also depend on their body size, social behaviour (especially schooling), foraging tactics, curiosity, habitat use, and underwater agility.

Ecological effects resulting from fish interactions with devices can be expected to range between: no effects to the potential removal or injury of individuals, and, if rates are sufficiently high, declines in populations. If avoidance responses occur then habitat exclusion is possible while if structures provide foraging opportunities then this could cause positive effects.

Based on discussions with developers, typical array sizes are likely to be typically 2 km^2 for wave arrays (20 – 50 devices), 0.5 km^2 (5 – 20 devices) for tidal arrays, 1-2 km^2 and 50 km^2 for wind (5-250 turbines). Depending on design devices are expected to each occupy a seabed area of between approximately 12m^2 (piles) and 40 m^2 (gravity bases).

5.3.3 Indirect Effects on Habitats and Non Mobile Species:

5.3.3.1 Increased Turbidity and Smothering

Indirect effects (increased turbidity and smothering) on the surrounding area would also result from the re-distribution of sediment into the water column. These effects will be localised and temporary and are likely to be most significant for installation of export cables, and devices which require structures to be piled into the seabed. Devices which use gravity bases, anchors and clump weights will have a much smaller effect resulting from disturbance of the seabed and sediment suspension. The effects on benthic fauna will be limited to localised mortality or displacement, where objects come into contact with the sediment and smothering by resettled sediment occurs. Recruitment from adjacent unaffected areas should ensure rapid recovery of benthic species.

5.3.3.2 Changes in Water Flow

There is potential that the extraction of tidal energy by tidal devices would affect the overall tidal regime in an area which could lead to reduction or changes in water flow. These changes in water flow could potentially affect habitats and species which are sensitive to changes to tidal flows regimes. The richness and variety of marine life in tidal rapids relies primarily on the strong water currents to carry food in, and waste materials and fine sediments away. Therefore, interruptions of tidal flows are likely to have implications for fauna and flora. Benthic habitats are also potentially affected by changes in sediment patterns as a result of reduction in tidal flows. Whether significant changes in community structure would occur and whether they would be considered deleterious would depend on the degree of change and the nature of the receiving environment. Based on limited existing projects and modelling studies, it is estimated that the extent of the potential effect on tidal energy can extend up to 0.5 km from tidal devices. Maerl beds, *Modiolus* beds, and some deep mud habitats may be highly sensitive to changes to tidal flows.

5.3.3.3 Changes in Wave Exposure

As with extracting energy from tidal flows, there is also potential that the extraction of energy from waves could lead to a decrease or changes in the levels of wave exposure in certain locations. Wave exposed habitats, and those consisting of mobile sediments, generally show reduced species diversity. These environments are likely to be resilient to the removal of wave energy. Based on limited existing projects and modelling studies, it is estimated that the extent of the potential effect on wave energy can extend up to 20 km from the wave device. Maerl beds and *Modiolus* beds are highly sensitive to decreases in wave energy.

5.3.3.4 Changes in Suspended Sediment Levels and Turbidity

Changes in suspended sediment levels and turbidity can occur during seabed disturbing installation activities, as fine particles travel further from the disturbed area, swept by tidal currents. Increased turbidity can have effects on foraging, and predator/prey interactions. The magnitude of this effect will depend on the high number of variables involved in determining both background and project caused suspended sediment levels and turbidity. However, given that the wave and tidal turbines will be placed in high energy environments, it is likely that the small amounts of sediment released into the water column during turbine and cable installation will be rapidly dispersed into the surrounding environment, and will have a negligible effect on background suspended sediment and turbidity levels.

Changes in suspended sediment levels and turbidity may also be caused by changes to sedimentation patterns resulting from extraction of tide and wave energy. Depending on the specific environmental parameters at a given location this may result in increases or decreases of both sediment suspension and deposition. High confidence estimates, based on expert knowledge can be given for the extent of potential effects on sediment processes of up to 50 m from devices (Bryden, 2006). Maerl beds are particularly sensitive to effects associated with changes to suspended sediment levels.

Whether changes to wave and tidal energy, and sedimentation patterns would cause significant changes in community structure, and whether they would be considered deleterious would depend on the degree of change and the nature of the receiving environment. Reduction of downstream water flow, if it occurs, is expected to be more significant in straits, tidal rapids and other constricted areas.

5.3.4 Indirect Effects on Mobile Species

5.3.4.1 Physical Disturbance

Marine Mammals

There is potential for seals hauled out on land to be physically disturbed during the installation of devices and cables, as a result of the presence of installation vessels and equipment, and the noise they produce in the vicinity of operations. Noise is a key factor in causing disturbance effects (as described below), but the physical presence of the installation vessels can also cause a disturbance effect. In general, ships more than 1,500m away from hauled out grey or harbour seals are unlikely to evoke any reactions from seals, between 900 and 1,500m seals could be expected to detect the presence of vessels and at closer than 900m a flight reaction could be expected (Brasseur & Reijnders, 1994).

The effects of physical disturbance would be most significant for breeding and moulting seals, hauled out on the coast and on intertidal banks. Breeding seals exhibiting flight reactions could temporarily abandon their young, causing a more significant disturbance effect during the breeding season. Moulting seals spend more time out of the water, and if they are scared into the water they may lose condition as a result of additional energetic costs. Physical disturbance of otters could also occur should disturbing works occur close to the coastal areas where they are present. As for seals, disturbance effects would be greatest during the primary breeding seasons for otters of spring and late autumn.

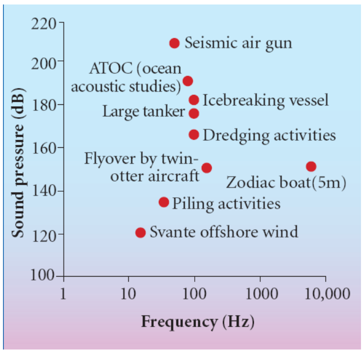
Seabirds

Physical disturbance to birds in the immediate vicinity of construction activities could potentially have a temporary effect during array and export cable construction. Noise is a key factor in causing the disturbance effect, but the physical presence of the installation vessels can also cause a disturbance effect due to physical and visual intrusion. Bird’s likely response to disturbance effects would be to avoid the immediate area during construction, which has implications of foraging and breeding success, stress on individuals and energy budgets. This has been looked at for shore birds, and it is recognised that disturbance may have long term effects if breeding is disrupted, or if birds feeding is disrupted with fitness affected. However, there is no quantified data from which to determine estimated magnitude of effect.

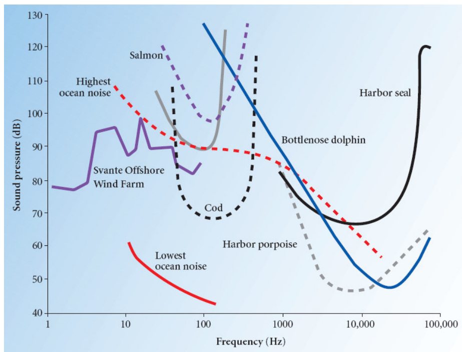
5.3.4.2 Marine Noise

In terms of offshore renewable energy developments marine noise can be generated during both the installation and decommissioning of devices/arrays and during the operation of offshore renewable energy developments. In general underwater noise is measured in terms of 'sound pressure levels'. Different marine activities also generate different sound pressure levels with different frequencies. Different marine species also have varying responses to the different sound pressure levels and frequencies. Figure 5.1 below gives some examples of noise pressure and pressure and frequency for certain types of underwater activities, and the parameters within which selected species could be expected to exhibit a behavioural response.

Figure 5.1: Anthropogenic noise sources and behavioural audiograms for selected species



A comparison of selected underwater anthropogenic noise sources (peak intensities: Vella, 2002 (adapted from Richardson et al., 1995 and Westerberg, 1999)



Underwater "behavioural audiograms" for selected marine wildlife species Vella, 2002 (adapted from Vella et al., 2001).

Installation Noise

Acoustic disturbance of seal and cetacean species both in the water, and seals using haulout sites, can occur during installation of wind, wave and tidal devices and cables. Should any piling or underwater blasting be required for device installation, the noise generated by these activities is likely to have a greater disturbance effect than for developments where piling is not required. Whilst piling and blasting noise would only be produced over a temporary period, for the duration of construction activities, the effects may continue for longer, as mammals may not immediately return to an area, particularly if they have been excluded for lengthy periods. This is particularly relevant in constrained areas (such as mouths of estuaries) where loud noise sources may prevent transit, effectively trapping individuals.

The key sources of device construction noise related to site preparation and device installation include: Shipping and machinery; dredging, and pile driving, blasting or drilling. In addition, cable burial requires the use of trenching or jetting machinery in soft sediments, rock cutting machinery in hard sea-beds, or rock or concrete mattress laying may be used to protect cables in areas where they cannot be buried. Noise emitted during pile driving is understood to have the greatest potential effects on marine wildlife (Thomsen et al, 2006).

It is believed that seals and cetaceans could both be generally expected to be able to hear piling noise up to a distance of 80km, and behavioural responses could be expected up to 20km (Thomsen et al, 2006 and Tougaard et al, 2009). In addition, physiological effects on both seals and cetaceans could include temporary or permanent hearing damage or discomfort. Permanent hearing damage in marine mammals is assumed to occur at an exposure of 40 dB above levels in which a temporary threshold shift in hearing occurs. For pinnipeds, this would be 144dB, while for cetaceans, onset of permanent hearing damage could be expected at sound exposure levels of 198dB (Southall et al 2007). Permanent hearing damage may be a concern at a distance of 400m from any pile driving activities for common seal, and 1.8km for harbour porpoise (Thomsen et al, 2006). However, these figures are likely to vary, depending on site characteristics (e.g. shielding affects of islands and affect of water depth). There is also a risk of injury of death associated with exposure to loud noise sources such as close proximity to piling operations. Some protections under the Habitats Directive and Habitats (NI) Regulations operate on the level of the individual marine mammal rather than at the population level, and pile driving activities without observing appropriate mitigation could be interpreted as "reckless or deliberate disturbance."

Recent research work also suggests that the detection of sound or pressure changes may play an important role in assisting seals to sense their environment and to hunt efficiently. Initial research reported in the Strangford Lough MCT ES (Royal Haskoning, 2005), suggests that seals may rely upon a form of passive sonar through which they sense the environment and form sound “maps” of their seabed surroundings, whilst relying on vision and vibrissae for “close work” associated with hunting.

Acoustic disturbance in the marine environment is an important cause of behavioural disturbance in cetaceans because they use acoustics to navigate, locate prey and maintain social contact. Noise produced during marine construction could potentially interfere with these signals through masking of communication calls, or disruption of foraging clues. This effect should be considered in the context of the many other sources of both natural and anthropogenic noise in the marine environment which could also cause masking effects.

The effects of piling installation noise on harbour porpoise was assessed for the Strangford Lough MCT Seagen project (COWRIE, 2008). Comparison of the measured background noise data with the hearing sensitivity of the harbour porpoise has indicated that this region is a noisy environment for marine animals that are sensitive to high frequency noise. The data for the drilling noise indicated that these species are unlikely to be able to hear noise from the piling operation over the high levels of perceived background noise, highlighting the importance of considering the spectral perception of underwater noise by marine animals when estimating its effect.

The data indicated that the noise does not exceed the 90dBht level, at which strong and sustained avoidance is expected, at any measured range. The 50dBht level, at which a mild and brief reaction is expected in a minority of individuals, extends to a maximum range of 115 m. The MCT data indicated that, when taking into account the existing background noise, marine mammals considered are unlikely to be disturbed by the drilling noise unless they are in the close vicinity of the piling activities.

It has also been identified that migratory salmon might detect pile-driving pulses also at considerable distances from the source. Behavioural effects, like avoidance and flight reactions, alarm response, and changes of shoaling behaviour are possible due to piling noise. There may also be physical effects, such as internal or external injuries or deafness up to cases of mortality, in the close vicinity to pile-driving and underwater blasting.

Operational Noise

As for construction noise, noise produced during operation of offshore wind, wave and tidal developments could also potentially disrupt prey location, navigation and social interaction behaviour in marine mammals, or result in temporary or permanent hearing damage. Whilst the noise levels likely to be generated during wave and tidal device operation are currently not known, operation noise is considered to be considerably less in magnitude than construction noise. The potential noise sources during device operation include: rotating machinery, flexing joints, structural noise, moving air, moving water, moorings, electrical noise, and instrumentation noise.

Operational noise of wind turbine of 1.5MW should have only minor influence as the detection radii for harbour porpoises and seals is rather small. However, since operational noise of larger turbines cannot be assessed reliably yet, these results are preliminary. It is very likely that larger turbines are noisier resulting in much larger areas of noise influence. At 100 m distance turbine noise would be audible to both harbour porpoises and common seals. At 1,000m the signal to noise ratio is too low for detection in harbour porpoises. In common seals, detection might be possible at distances greater than 1,000m in the 125 – 160 Hz range.

A specialist study undertaken for the Scottish Renewable SEA modelled the potential for permanent and temporary hearing damage to result from operating devices. This study was based on the likely noise generated from a single type of tidal and wave device and therefore may not be applicable across all wave and tidal devices, or wind devices. It does, however, provide an indicative estimate of the levels of noise involved. The study concluded that, for the tidal device, if the most sensitive receptor were to spend 30 minutes within 16 m of tidal device it might suffer permanent hearing damage. The assessment also indicated that 8 hours within 934 m could result in temporary hearing damage. These findings were based on generic threshold curves that were used to determine potential effects on a range of species and sensitivities. However, evidence suggests that it is unlikely that an animal would choose to stay in close proximity to the source of a loud noise (Tougaard, *et al.* 2003).

Based on the available information, the underwater noise produced during operation of wave and wind devices is considered to be less than for tidal, and the risk of permanent hearing damage is considered unlikely – however it should be noted that the current information on wave devices relates to measurement of a single device on a single day. For temporary hearing damage the maximum predicted range for an exposure of 8 hours is only 6 metres, so the risk of an animal experiencing Temporary Threshold Shifts (TTS) from a single 1 MW wave device of this type is insignificant. It should be noted, however, that this analysis did not include structural noise from the wave device, which is unknown.

Marine life may exhibit avoidance reactions to underwater noise at levels much lower than the permanent and temporary hearing damage thresholds described above. It should therefore be noted that arrays of devices may appear as impenetrable barriers to an animal, perhaps separating them from feeding grounds, even though there may be plenty of room between devices for the animal to pass without experiencing damaging noise levels. In addition noise produced during operating devices has the potential for “masking effects” disrupting prey location, navigation and social interaction.

5.3.4.3 Habitat Exclusion

The physical presence of offshore wind, wave and tidal arrays will cause loss of habitat during device operation. This may including foraging habitat (birds, marine mammals and fish) and loafing areas (seabird). Developments may also lead to the exclusion of seals and seabirds from coastal terrestrial breeding habitats by providing a physical or perceive barrier to these areas or producing noise that results in avoidance behaviour. Cetaceans may also be excluded from areas used as nursery or breeding areas, migration/travelling routes and socialising areas. Exclusion may limit other device interactions, such as collisions, but will also limit the available habitat.

Evidence from wind farm projects indicates that many species, most notably diver and sea-duck have been displaced as much as between 2 to 4km from offshore wind farm areas, and this wider displacement effect is thought to be due to the bird’s perceptual reaction to turbines or maintenance vessels.

Whilst it is considered that alternative foraging areas may be available to these species, the array will create a net loss of foraging area and removal of food resource, depending on the means of securing the device to the seabed. There may also be a knock-on effect on adjacent bird populations arising from increased competition for prey species in adjacent areas.

However, the installation of marine turbines may also create new habitat that could potentially be colonised by benthic species and affect the availability of prey species in the vicinity of turbines.

5.3.4.4 Barriers to Movement

There is the potential that device arrays may form a barrier to the usual migration and transit patterns of marine mammals, either because of collision risk, aversive reactions to operation noise or perceptions of devices and associated infrastructure. This is particularly relevant in constrained areas (such as mouths of sea loughs) where loud noise sources may prevent transit, effectively trapping individuals.

5.3.5 Toxic Effects

There is potential that the leaching of toxic compounds from sacrificial anodes, antifouling paints or leakage of hydraulic fluids (if present) from devices during installation and operation could have an effect on water quality, habitats and both non mobile and mobile species. A small number of wave and tidal devices are expected to use antifouling coatings, and whilst organotins are now banned, the use of copper is still permitted. Seals and cetaceans in the study area generally have a low sensitivity to contamination, although the sensitivity rises to medium around seal breeding sites. However, as top predators seals and cetaceans are more susceptible to various substances building up to higher levels in their bodies.

The quantities and toxicities associated with sacrificial anodes and antifouling coatings are generally expected to be extremely small, and it is therefore considered that this potential effect will be of negligible significance. It is not possible to make any realistic estimate of the geographical extent of this effect due to the large numbers of variables involved (quantities leaked, metocean conditions, etc).

Accidental leakage of hydraulic fluids may be more significant, should they occur through storm damage, device malfunction or collision with navigating vessels. Devices which use hydraulic systems will normally be designed such that at least two seal or containment failures are required before a leaking fluid reaches the sea. It is not possible to be definitive for every device listed in this document as a number of them are still at concept stage and this aspect is a matter for detailed design. However, the industry's design guidelines (Carbon Trust, 2005), if followed, would lead a developer to minimise risks of hydraulic fluid leakage. Potentially more significant still are the potential effects from leakage of cargoes or fuel carried by a vessel involved in a collision with renewable device arrays. This impact is impossible to quantify due the number of variables such as vessel cargo, risk of vessel collision, etc.

5.3.6 *Electro-Magnetic Fields (EMF)*

In general it is acknowledged that elasmobranchs are most sensitive to EMF effects, although other fish and marine mammal species may also be sensitive (Gill *et al*., 2005). Magnetic fields are produced from AC or DC current passing through the conductor. Magnetic field strength generated during electricity cable operation is variable, and dependent on a number of factors including cable alignment and configuration. Electric fields can be produced in water passing through the magnetic field surrounding a cable. Electric fields can be almost completely blocked from emanating externally by the shielding effect of a cable's structure. The magnetic field from the Nysted wind park cable to shore was approximately 5 microtesla (μT), at 1 m above the cable; the natural magnetic field in Denmark is 45 μT (Tougaard *et al.,* 2006).The strength of both magnetic and electric fields decreases with distance from the source, and field strength at the seabed surface would therefore be dependent on the depth to which cables are buried.

Electric and magnetic fields are produced as a result of power transmission in the inter array cables and the export cable to shore. The devices themselves will also have an electrical signature, however this will be specific to the individual devices e.g. whether the power generator is in the water or on a platform and if there is a riser cable from a device on the seabed. These have the potential to affect migration and prey detection in certain electro-sensitive fish species such as elasmobranchs (sharks and rays). A number of research reports have been undertaken by COWRIE into the likely field strengths and potential effects on marine species (CMACS 2003; CMAS 2005; CMACS 2006). A literature review of research into this area, undertaken for the Scottish Marine Renewables SEA (Scottish Executive, 2006) concluded the following:

- Electrical and magnetic fields generated by the operation of offshore wind, wave and tidal devices are likely to be small and within the variation range of naturally occurring fields in the study area, but detectable to electro/magnetosensitve species. Burial of the cables will offer a protective barrier to electro/magnetosensitive species from the strongest magnetic and induced electric fields generated next to the cable.
- Marine teleost (bony) fishes do not react to electric field strengths of less than 6 V/m (several orders of magnitude greater than the estimated field strength from the inter array and export cables). No effects are expected.
- Current research indicates that certain species of elasmobranchs are likely to be able to detect the level of electric field that will be generated by a typical export cable but the field would not cause an avoidance reaction. Furthermore, there is no evidence to indicate that existing cables have caused any significant effect on elasmobranch migration patterns.
- Atlantic salmon, eels and Sea Trout are believed to be sensitive to magnetic fields. There is currently no evidence from existing cables to suggest that navigation and migration in these species is unlikely to be affected by the magnetic field produced by the operation of wave and tidal devices.

The underlying assumption that cetaceans have ferromagnetic organelles capable of determining small differences in relative magnetic field strength remains a complicated, understudied and unproven field of science (Basslink, 2001), with only circumstantial evidence. Cetaceans cross cables constantly, for example, migration of the harbour porpoise in and out of the Baltic Sea necessitates several crossings over operating subsea HVDC cables in the Skagerrak and western Baltic Sea without any apparent effect on its migration pattern (Basslink, 2001). There is no apparent evidence that existing electricity cables have influenced migration of cetaceans, but further study is thought warranted (Gill *et al*., 2005). There is also no evidence that seals are sensitive to electromagnetic fields.

6 Assessment of LSEs WITHOUT MITIGATION

6.1 Introduction

This chapter identifies whether the interest features of those sites screened in are at risk from a significant effect as a consequence of implementing the OREDP.

The chapter is structured by six categories of interest feature:

- Habitats (grouped by similar habitat types)
- Marine Mammals;
- Fish and Freshwater Pearl Mussel;
- Otters;
- Bats; and
- Birds (differentiating between seabirds and other birds).

Each interest feature has been assessed against the potential effect of the OREDP as discussed in Chapter 5 and Table 5.1 the results of which are set out below.

6.1.1 Interest Features

It should be noted that interest features for any particular site can be divided into 'primary features' (also referred to as qualifying features). These include features (European habitats or species) for which the site is primarily designated, and 'non-primary features' which are additional features of European importance listed on the citation for the site. However, in terms of undertaking an Appropriate Assessment all interest features of European importance for which a site is designated (whether they are primary or non-primary) have to be considered on an equal basis.

All of the sites assessed at this stage and all of their interest features are shown in the tables in Appendix B. In addition, detailed maps were produced showing the locations of all of these sites in relation to the OREDP resources areas and these figures are included at the end of this report (Figures 5.1 and 5.2).

In order to simplify the assessment, the interest features were grouped into the categories listed in section 6.1 above and considered collectively.

6.2 Risk of LSE of the OREDP

Using the information developed in the preceding stage, potential LSE on the interest features and overall integrity of the sites containing those interest features were assessed against the potential activities of the OREDP and associated effects as set out Chapter 5. This assessment was based on current scientific understanding and takes into account options for implementing the OREDP. However, the assessment at this point **DOES NOT include any mitigation measures**. Potential LSEs taking into account mitigation are discussed in Chapter 8. The results of this assessment have been presented by associating a level of risk to each of the interest features associated with the potential effect of the plan. Four levels of risk have been identified, these described below:

- High Risk
- Medium Risk
- Medium / Low Risk
- Low Risk

The risk to the interest features are presented under the five categories listed in Section 6.1 in Tables 6.1 to 6.5 below.

6.3 Habitats

6.3.1 Introduction

This category includes SAC where marine or coastal habitats (and/or non-mobile species) are interest features, and for convenience SPA where the habitat supports the interest bird interest, even though that habitat is not defined as an interest feature. Such sites may be within the boundaries of the proposed Resource Areas or within the OREDP area generally, or may lie outwith the geographical boundary but may yet be affected by it, for example, European sites located within Northern Ireland territory.

In determining the likely significant effects on this category the following criteria were used:

- Where the site lies directly within identified OREDP Resource Area(s), or is within influencing distance of such an area (e.g. via sediment transportation, release of toxic substances or changes in hydrodynamics), then it could not be concluded at the screening stage that there will be no likely significant effects on interest features and therefore such sites were screened in and taken forward to the Appropriate Assessment stage.
- Where birds that are interest features of SPA are dependent on certain habitats for feeding, loafing, breeding, etc., within SPA boundaries and these habitats lie directly within identified OREDP Resource Area(s), or within influencing distance of such an area, then it could not be concluded at the screening stage that there will be no likely significant effects on interest features and therefore such sites were screened in and taken forward to the Appropriate Assessment stage.

Details of the sites where sensitive habitats are interest features are included in Appendix C.

6.3.2 Risk of Likely Significant Effect on Habitats (without Mitigation)

Table 6.1 below identifies the potential risks to the interest features associated with the SACs and SPAs in Ireland that were screened in during the previous stage of the assessment. This assessment is based on the description of potential effects discussed in Chapter 5. This part of the assessment does not include any mitigation.

Table 6.1 Potential Adverse Effects on Habitats

Code	Sensitive Annex 1 Habitat	Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats and non mobile species	Indirect disturbance or loss of mobile species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
Subtidal Habitats										
1110	**Sandbanks which are slightly covered by sea water all the time**	High	Low Med	n/a	Med	n/a	Med	Low	Low	Low
1170	**Reefs**	High	High	n/a	High	n/a	High	High	Low	Med
1150	**Coastal lagoons**	Med	Low	n/a	Low Med	n/a	Med	Low Med	Low	Low
1160	**Large shallow inlets and bays**	Med	Low Med	n/a	Low Med	n/a	Med	Low Med	Low	Med
1130	**Estuaries**	High	Low Med	n/a	Med	n/a	High	Med	Low	Med
Intertidal Habitats										
8330	**Submerged or partly submerged sea caves**	Med	Low	n/a	Low	n/a	Low	Low	Low	Low
1330	**Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
1410	**Mediterranean salt meadows (*Juncetalia maritimi*)**	Low	Low	n/a	Low	n/a	Low	Low	Low	Low
1210	**Annual vegetation of drift lines**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low

Code	Sensitive Annex 1 Habitat	Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats and non mobile species	Indirect disturbance or loss of mobile species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
1310	**Salicornia and other annuals colonizing mud and sand**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
1320	**Spartina swards (*Spartinion maritimae*)**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
1230	**Vegetated sea cliffs of the Atlantic and Baltic coasts**	Low	Low	n/a	Low	n/a	Low	Low	Low	Low
1140	**Mudflats and sandflats not covered by seawater at low tide**	Med	Med	n/a	Low Med	n/a	Med	Low	Low	Low
Supratidal Habitats										
1420	**Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
2110	**Embryonic shifting dunes**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
2120	**Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
2130	**Fixed coastal dunes with herbaceous vegetation (grey dunes)**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
2140	**Decalcified fixed dunes with *Empetrum nigrum***	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
2150	**Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
2160	**Dunes with *Hippophae rhamnoides***	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
2170	**Dunes with *Salix repens* ssp.*argentea* (*Salix arenariae*)**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
2190	**Humid dune slacks**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
21A0	**Machairs (* in Ireland)**	Low Med	Low	n/a	Low	n/a	Low	Low	Low	Low
	Likelihood (risk) of significant effect: Low		**Low/Medium**			**Medium**			**High**	

6.3.3 Summary of the Risks to Habitats

This initial assessment concludes that, without mitigation there is a risk that the OREDP would have Likely Significant Effects on a number of habitats and non mobile species, in particular direct effects sub-tidal habitats such as reefs, submerged sand banks, large shallow inlets and bays and estuaries. The most significant effects are likely to occur as a result of direct damage of loss or habitats or non mobile species resulting from the physical installation of devices in certain locations. There is also a risk of LSE associated with accidental contamination from the leaching of hazardous substances from devices during installation and operation or from accidental spillage from cargo vessels as a result of collision between vessels and devices or other vessels.

There is also a medium risk of LSE on some intertidal habitats, in particular partially submerged mudflats and sandflats which could potentially be directly affected during the installation of export cables. Other coastal habitats e.g. dunes could also be affected by export cables and the installation of associated onshore infrastructure e.g. substations.

There are a number of measures that could be implemented to reduce or avoid the potential for LSE on habitats. These include plan level mitigation measures (strategic mitigation measures to be integrated into the OREDP) and project level mitigation measures based on recognised industry standards and good practice. The proposed options for mitigation are discussed in detail in Chapter 7.

6.4 Marine Mammals

6.4.1 Introduction

The screening process determined that for all SAC where marine mammals constituted interest features, it was not possible to conclude that there would be no likely significant effect on marine mammals. Of these SAC, all sites where cetaceans are an interest feature are in Irish waters, i.e. within the ORDEP Resource Areas. In addition, sites where seals comprise the interest features are located within SAC both in Irish and Northern Irish waters (see Appendix B).

6.4.2 Risk of Likely Significant Effects on Marine Mammal (Without Mitigation)

Table 6.2 below identifies the potential risks to the interest features associated with the SACs for marine mammals in Ireland that were screened in during the previous stage of the assessment. This assessment is based on the description of potential effects discussed in Chapter 5. This part of the assessment does not include any mitigation.

Table 6.2 Potential Adverse Effects on Marine Mammals

Code	Sensitive Annex 1 Species	Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats	Indirect disturbance or loss of species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
1364	**Grey seal (*Halichoerus grypus*)**	Low	n/a	High	Low	Med	Low	Low	Low	Low
1365	**Harbour (Common) seal (*Phoca vitulina*)**	Low	n/a	High	Low	Med	Low	Low	Low	Low
1351	**Harbour porpoise (*Phocoena phocoena*)**	Low	n/a	High	Low	Med	Low	Low	Low	Low Med
1349	**Bottlenose dolphin (*Tursiops truncatus*)**	Low	n/a	High	Low	Med	Low	Low	Low	Low Med
	Likelihood (risk) of significant effect: Low [ ] Low/Medium [ ] Medium [ ] High [ ]									

6.4.3 Summary of Risks to Marine Mammals (without Mitigation)

There is still relative uncertainty surrounding the potential effects of offshore renewable energy development on marine mammals due to limits in our knowledge as to how seals and cetaceans interact with devices in the water, in particular with tidal devices with submerged turbines. There are also limitations on our understanding of which sites (SACs) specific marine mammals are associated with, if any, and therefore whether the interest feature of a certain site would actually be affected. At this stage it is not possible to ascertain which site specific individual species are attributed too without carrying out surveys and tagging exercises. For the purpose of this assessment it is therefore assumed that marine mammals present in Irish waters are likely to be part of the population of marine mammals for which a site in Irish or Northern Ireland waters has been designated.

Taking these limitations and areas of uncertainty into account, the initial assessment concludes that, in the absence of mitigation, there is a high risk that the OREDP could have a direct LSE on marine mammals resulting from possible collision with operational devices. There is also potential for an indirect LSE on all marine mammal species identified as interest features. These indirect effects could occur for a number of reasons such as noise generated during the installation of piled foundations and blasting activities and from the operation of devices in particular tidal devices, physical disturbance from the presence of installation and maintenance vessels, habitat exclusion due to the physical presence of arrays in foraging and breeding areas and along migration corridors and creation of barriers to movements between foraging and breeding areas and on migration routes due to the physical presence of devices, the generation of high levels of noise and the perceived risk of collision.

6.5 Fish and Freshwater Pearl Mussels

6.5.1 Introduction

The screening process determined that there were a number of SAC in Ireland where it was not possible to conclude that there would be no likely significant effect on migratory fish or freshwater pearl mussels (refer to Appendix B).

In addition to European sites located in estuaries where these species may comprise interest features, there are some entirely freshwater SAC where these species are listed. Where such species would have to pass through Resource Areas then such sites were included in the assessment, which in practice means that all rivers where such species are listed as interest features were included.

For sites where such migratory fish are interest features and the site or fish movements pass directly within identified OREDP Resource Area(s), where devices may be located, or are within influencing distance of such an area (e.g. via sediment transportation, release of toxic substances or changes in hydrodynamics), it could not be concluded that there would be no likely significant effects on interest features and therefore such sites were screened in.

6.5.2 *Risks of Likely Significant Effects on Fish and Freshwater Pearl Mussel (Without Mitigation)*

Table 6.3 below identifies the potential risks to fish and Freshwater Pearl Mussel associated with SAC sites in Ireland that were screened in during the previous stage of the assessment. This assessment is based on the description of potential effects discussed in Chapter 5. This part of the assessment does not include any mitigation.

Table 6.3 Potential Adverse effects on Fish and Fresh Water Pearl Mussels

Code	Sensitive Annex 1 Species	Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile	Direct physical damage to mobile species	Indirect disturbance or loss of habitats	Indirect disturbance or loss of species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
1102	**Allis shad (*Alosa alosa*)**	Low	Low	Low Med	Low	Low Med	Low	Low	Low	Low
1103	**Twaite shad (*Alosa fallax*)**	Low	Low	Low Med	Low	Low Med	Low	Low	Low	Low
1099	**River lamprey (*Lampetra fluviatilis*)**	Low	Low	Low Med	Low	Low Med	Low	Low	Low	Low
1096	**Brook lamprey (*Lampetra planeri*)**	Low	Low	Low Med	Low	Low Med	Low	Low	Low	Low
1095	**Sea lamprey (*Petromyzon marinus*)**	Low	Low	Low Med	Low	Low Med	Low	Low	Low	Low
1106	**Atlantic salmon (*Salmo salar*)**	Low	Low	Low Med	Low	Med	Low	Low	Low	Low
1029	**Freshwater pearl mussel (*Margaritifera margaritifera*)**	Low	Low	Low	Low	Med	Low	Low	Low	Low
1990	**Nore freshwater pearl mussel (*Margaritifera durrovensis*)**	Low	Low	Low	Low	Med	Low	Low	Low	Low
	Likelihood (risk) of significant effect: Low		**Low/Medium**			**Medium**			**High**	

6.5.3 Summary of Risks to Fish and Freshwater Pearl Mussel (without Mitigation)

A number of migratory fish associated with SACs are sensitive to indirect effects such as turbidity, noise and vibration, habitat exclusion and changes in hydrodynamics in areas that they are required to pass from or to the sites with which they are associated. Barrier effects may also prevent them from reaching the rivers where they breed. Whilst these effects could potentially have a LSE on the integrity of an SAC for which these features are qualifying features, the likely risk of these effects occurring is medium. Direct physical effects may occur where fish cannot avoid coming into direct contact with devices (such as tidal turbines). However, the likely risk of this occurring has also been assessed to be of medium risk. There could also be a medium risk of LSEs on Freshwater Pearl Mussels associated with increased levels of suspended sediment/turbidity in certain locations.

6.6 Otters

6.6.1 Introduction

The screening process concluded that there were a number of SAC in Ireland where it was not possible to conclude that there would be no likely significant effect on otters (*Lutra lutra*) (refer to Appendix B). Sites designated for otters where there was a coastal or marine habitat element were therefore screened in to the assessment.

6.6.2 Risks of Likely Significant Effect on Otters (Without Mitigation)

Table 6.4 below identifies the potential risks to the interest features associated with the SACs for otters in Ireland that were screened in during the previous stage of the assessment. This assessment is based on the description of potential effects discussed in Chapter 5. This part of the assessment does not include any mitigation.

Table 6.4 Potential Adverse Effects on Otters

Code	Sensitive Annex 1 Species	Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats	Indirect disturbance or loss of species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
1355	Otter (*Lutra lutra*)	Low Med	Low	Low Med	Low Med	Low Med	Low Med	Low	Low	Low
	Likelihood (risk) of significant effect: Low / Low/Medium / Medium / High									

6.6.3 Summary of Likely Significant Effect on Otters (Without Mitigation)

Otters generally occupy nearshore areas out to about 1km from the coast. Whilst they are potentially highly sensitive to disturbance and other effects associated with offshore renewable energy developments such as noise, barrier effects, habitat exclusion and loss, most developments are likely to occur at a distance of more than 1km from the coast due to both technological/operating reasons (availability of resource) and environmental factors. However, there is potential for otters to be disturbed/affected during the installation of export cables and other supporting coastal infrastructure such as substations etc. Taking this into account, the potential risk of LSE on otters, without mitigation, has been assessed as being of low to medium risk.

6.7 Bats

6.7.1 Introduction

There is evidence that bats can fly some distance over the sea and could risk collision with wind turbine blades, or be affected by associated air pressure wave effects.

Therefore SACs within 30km of the coast where bats are an interest feature were included in the assessment as it was not possible to conclude that there would be no likely significant effect on bats. However, although there are a number of different bat species, all of which are protected under the Habitats Directive, only one species is listed as an interest feature of a European site. This is the lesser horseshoe bat (*Rhinolophus hipposideros*). There are a number of SACs in Ireland, within 30km of the coast, are designated for lesser horseshoe bat.

6.7.2 Risks of Likely Significant Effects on Bats (Without Mitigation)

Table 6.5 below identifies the potential risks to the interest features associated with the SACs for bats in Ireland that were screened in during the previous stage of the assessment. This assessment is based on the description of potential effects discussed in Chapter 5. This part of the assessment does not include any mitigation.

Table 6.5 Potential Adverse Effects on Bats

Code	Sensitive Annex 1 Species	Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats	Indirect disturbance or loss of species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
1303	**Lesser horseshoe bat (*Rhinolophus hipposideros*)**	Low	Low	Low Med	Low	Low Med	Low	Low	Low	Low
	Likelihood (risk) of significant effect: **Low** **Low/Medium** **Medium** **High**									

6.7.3 Summary of Likely Significant Effect on Bats (Without Mitigation)

It has been identified that there is potential for bats to be present in offshore locations either following migratory routes or foraging. However, these tend to be more nearshore areas or locations such as harbours where there are recognised features that can be used to aid sonar navigation. There is increasing research into the potential effects of renewable energy developments, in particular, wind turbines on bats. The main effects indentified include collision risk, physical damage and mortality from changes in air pressures around turbines and lights causing barrier effects and habitat exclusion. There is potential for these effects to also occur in offshore locations such as offshore wind farms. However, the occurrence of bats in offshore locations is generally more limited than onshore/terrestrial environments. Therefore the potential risk of the OREDP having LSE on bats and the integrity of the sites they are interest features of (without mitigation) has been assessed at low to medium.

6.8 Birds

6.8.1 Introduction

This section considers the likely significant effects of the OREDP on bird species that are listed as interest features of SPAs in Ireland and Northern Ireland.

Citations for all Irish and Northern Irish SPAs have been reviewed as part of this assessment. All birds listed as breeding or forming part of internationally important wintering or staging assemblages at each site, and which forage or migrate over sea areas, were considered for sensitivity with regard to the OREDP.

Bird species that were considered not to be at risk from the plan comprised those species that are entirely resident within Ireland and do not migrate or forage over the sea. However, screening determined that some or all of the interest bird species of all SPAs within Ireland and Northern Ireland either forage at sea or migrate over it and therefore all Irish SPAs were screened in and brought forward to the assessment stage.

Table 6.6 below identifies all of the Article 4.1 birds that are interest features of SPA in Ireland and Northern Ireland and Table 6.7 lists all of the Article 4.2 birds,[11] and groups these into categories based on whether their breeding, over-wintering or staging populations comprise interest features of SPA. The tables indicate which broad habitat types are most important for these species, as well as their foraging mode and also where they nest.

Foraging mode is a particularly important consideration because certain species, for example those that are pursuit divers or those that spend most of their life cycle at sea, are likely to be more vulnerable to the effects of the OREDP, such as to collision with devices, as well as other direct and indirect effects, than shore-line waders, for example.

A distinction is therefore made between those species that are dependent on the sea and marine or coastal habitats, for breeding, foraging, loafing, etc., and those species that are mainly terrestrial but may over-fly sea areas, for example whilst migrating.

Table 6.6 Breeding and foraging parameters of Article 4.1 Birds

Article 4.1 Birds	Habitat	Foraging Mode	Nesting Location
Red-throated Diver	Coastal / Marine	Pursuit-diver	Ground
Black-throated Diver	Coastal / Marine	Pursuit-diver	Ground
Great Northern Diver	Coastal / Marine	Pursuit-diver	Ground
Mediterranean Gull	Coastal / Marine	Surface feeder	Ground
Slavonian Grebe	Freshwater	Surface feeder	Ground
Storm Petrel	Marine	Surface feeder	Burrow/crevice
Leach's Storm-petrel	Marine	Surface feeder	Burrow/crevice
Little Egret	Coastal	Wader	Ground
Sandwich Tern	Coastal	Surface feeder	Ground
Roseate Tern	Coastal	Surface feeder	Ground
Common Tern	Coastal	Surface feeder	Ground
Arctic Tern	Coastal	Surface feeder	Ground
Little Tern	Coastal	Surface feeder	Ground
Ruff	Terrestrial / Coastal	Wader	Ground
Bar-tailed Godwit	Coastal	Wader	Ground
Wood Sandpiper	Terrestrial / Coastal	Wader	Ground
Bewick's swan	Freshwater	Terrestrial feeder	Ground
Whooper Swan	Freshwater	Terrestrial feeder	Ground
White-fronted Goose	Terrestrial	Terrestrial feeder	Ground
Barnacle goose	Terrestrial	Terrestrial feeder	Ground
Marsh Harrier	Terrestrial	Hunter	Ground
Hen Harrier	Terrestrial	Hunter	Ground
Merlin	Terrestrial	Hunter	Ground
Peregrine Falcon	Terrestrial	Hunter	Cliffs
Corn Crake	Terrestrial	Terrestrial feeder	Ground

[11] Under the terms of the Birds Directive, Member States are required to classify the most suitable areas for the conservation of Article 4.1 birds as SPA for the conservation of these species, (Article 4.1). Member States also have to take similar measures for regularly occurring migratory species not listed in Annex I of the Directive, bearing in mind their breeding, moulting and wintering areas and staging posts along their migration routes (Article 4.2 birds).

Article 4.1 Birds	Habitat	Foraging Mode	Nesting Location
Golden Plover	Terrestrial	Terrestrial feeder	Ground
Short-eared Owl	Terrestrial	Hunter	Ground
Kingfisher	Freshwater	Surface feeder	Burrow/crevice
Chough	Coastal	Terrestrial feeder	Cliffs

Table 6.7 Breeding and foraging parameters of Article 4.2 Birds

Article 4.2 Birds	Habitat	Foraging Mode	Nesting Location
Wintering Birds			
Wintering Scaup	Coastal	Surface feeder	N/A
Wintering Black tailed godwit	Terrestrial / Coastal	Wader	N/A
Wintering Common redshank	Terrestrial / Coastal	Wader	N/A
Wintering Great crested grebe	Terrestrial / Coastal	Surface feeder	N/A
Wintering Pale bellied Brent goose	Terrestrial / Coastal	Terrestrial feeder	N/A
Wintering Long-tailed duck	Coastal	Surface feeder	N/A
Wintering Tufted duck	Freshwater	Surface feeder	N/A
Wintering Goldeneye	Freshwater / Coastal	Surface feeder	N/A
Wintering Common pochard	Freshwater	Surface feeder	N/A
Wintering Ruddy turnstone	Coastal	Wader	N/A
Wintering Ringed plover	Terrestrial / Coastal	Wader	N/A
Wintering Red knot	Terrestrial / Coastal	Wader	N/A
Staging Birds			
Staging spotted redshank	Terrestrial / Coastal	Wader	N/A
Staging greenshank	Terrestrial / Coastal	Wader	N/A
Staging Curlew	Terrestrial / Coastal	Wader	N/A
Staging Sandpiper	Terrestrial / Coastal	Wader	N/A
Staging Ringed plover	Coastal	Wader	N/A
Staging Black tailed godwhit	Coastal	Wader	N/A
Staging Lesser black-backed Gull	Terrestrial / Coastal	Surface feeder	N/A
Breeding Birds			
Breeding Cormorant	Coastal / Marine	Pursuit-diver	Cliffs
Breeding Shag	Coastal / Marine	Pursuit-diver	Cliffs
Breeding Common scoter	Coastal / Marine	Diver/pursuit diver	Ground
Breeding Puffin	Coastal / Marine	Pursuit-diver	Burrow/crevice
Breeding Razorbill	Coastal / Marine	Pursuit-diver	Cliff
Breeding Black Guillemot	Coastal / Marine	Pursuit-diver	Cliff
Breeding Guillemot	Coastal / Marine	Pursuit-diver	Cliff
Breeding Manx Shearwater	Coastal / Marine	Surface/pursuit diver	Burrow/crevice

Article 4.2 Birds	Habitat	Foraging Mode	Nesting Location
Breeding Common Gull	Coastal / Marine	Surface feeder	Ground
Breeding Black-headed Gull	Coastal / Marine	Surface feeder	Ground
Breeding Lesser black-backed gull	Coastal / Marine	Surface feeder	Ground
Breeding Herring Gull	Coastal / Marine	Surface feeder	Ground
Breeding Great black-backed gull	Coastal / Marine	Surface feeder	Ground
Breeding Gannet	Coastal/Marine	Diver	Cliff
Breeding Fulmar	Coastal / Marine	Surface feeder	Cliff
Breeding Kittiwake	Coastal / Marine	Surface feeder	Cliff
Breeding Little Tern	Coastal / Marine	Surface feeder	Ground
Breeding Curlew	Terrestrial / Coastal	Wader	Ground
Breeding Dunlin	Coastal	Wader	Ground
Breeding Greylag geese	Terrestrial / Freshwater	Terrestrial feeder	Ground
Breeding Great crested grebe	Freshwater	Terrestrial feeder	Freshwater/Terrestrial
Breeding reed warbler	Terrestrial	Terrestrial feeder	Reeds/Terrestrial
Breeding Lapwing	Terrestrial	Terrestrial feeder	Ground
Breeding Tufted duck	Freshwater	Surface feeder	Ground
Breeding Coot	Freshwater	Surface feeder	Ground
Breeding Raven	Terrestrial	Terrestrial feeder	Trees/Cliffs
Breeding Snipe	Terrestrial	Wader	Ground
Resident			
Resident Gadwall	Freshwater	Surface feeder	Ground

6.8.2 Risk of Likely Significant Effect on Birds (Without Mitigation)

The sensitivities for birds are presented below in tabular form, which has been expressed as the likelihood (or risk) of significant adverse effects on interest features from the implementation of the OREDP.

Sensitivities have taken into account the behaviour of different bird species in the marine environment (as summarised in Tables 6.6 and 6.7 above), differentiating between:

- Whether they are mainly marine or terrestrial/freshwater species;
- Whether they forage by diving or feed at the surface;
- The time of day (or night) that they forage;
- Where they generally nest; and
- Breeding, over-wintering or staging populations.

Table 6.8 identifies the potential risks to the interest features associated with the potential effects of the OREDP as set out in Table 5.1 and therefore SPAs in Ireland that were screened in during the previous stage of the assessment.

Table 6.8 Potential Adverse Effects on Birds

Code	Birds	Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats	Indirect disturbance or loss of species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
	Annex 1 Birds									
A001	Red-throated Diver	Low	Low	High	Low	Med	Low	Low	Low	Low
A002	Black-throated Diver	Low	Low	High	Low	Med	Low	Low	Low	Low
A003	Great Northern Diver	Low	Low	High	Low	Med	Low	Low	Low	Low
A176	Mediterranean Gull	Low	Low	High	Low	Med	Low	Low	Low	Low
A007	Slavonian Grebe	Low	Low	High	Low	Med	Low	Low	Low	Low
A014	Storm Petrel	Low	Low	High	Low	Med	Low	Low	Low	Low
A015	Leach's Storm-petrel	Low	Low	High	Low	Med	Low	Low	Low	Low
A026	Little Egret	Low	Low	Low	Low	Low	Low	Low	Low	Low
A191	Sandwich Tern	Low	Low	Med	Low	Low	Low	Low	Low	Low
A192	Roseate Tern	Low	Low	Med	Low	Low	Low	Low	Low	Low
A193	Common Tern	Low	Low	Med	Low	Low	Low	Low	Low	Low
A194	Arctic Tern	Low	Low	Med	Low	Low	Low	Low	Low	Low
A195	Little Tern	Low	Low	Med	Low	Low	Low	Low	Low	Low
A151	Ruff	Low	Low	Low	Low	Low	Low	Low	Low	Low
A157	Bar-tailed Godwit	Low	Low	Low	Low	Low	Low	Low	Low	Low
A166	Wood Sandpiper	Low	Low	Low	Low	Low	Low	Low	Low	Low
A037	Bewick's swan	Low	Low	Low	Low	Low	Low	Low	Low	Low
A038	Whooper Swan	Low	Low	Low	Low	Low	Low	Low	Low	Low
A395	White-fronted Goose	Low	Low	Low	Low	Low	Low	Low	Low	Low
A045	Barnacle goose	Low	Low	Low	Low	Low	Low	Low	Low	Low
A081	Marsh Harrier	Low	Low	Low	Low	Low	Low	Low	Low	Low
A082	Hen Harrier	Low	Low	Low	Low	Low	Low	Low	Low	Low
A098	Merlin	Low	Low	Low	Low	Low	Low	Low	Low	Low
A103	Peregrine Falcon	Low	Low	Low	Low	Low	Low	Low	Low	Low
A122	Corn Crake	Low	Low	Low	Low	Low	Low	Low	Low	Low
A140	Golden Plover	Low	Low	Low	Low	Low	Low	Low	Low	Low
A222	Short-eared Owl	Low	Low	Low	Low	Low	Low	Low	Low	Low
A229	Kingfisher	Low	Low	Low	Low	Low	Low	Low	Low	Low
A346	Chough	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Article 4.2 Birds									

Code	Birds	Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats	Indirect disturbance or loss of species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
	Wintering Birds									
	Wintering Scaup	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Wintering Black tailed godwit	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Wintering Common Redshank	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Wintering Great crested grebe	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Wintering Pale bellied Brent goose	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Wintering Long-tailed duck	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Wintering Tufted duck	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Wintering Goldeneye	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Wintering Common Pochard	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Wintering Ruddy turnstone	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Wintering Ringed plover	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Wintering Red knot	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Staging Birds									
	Staging Spotted redshank	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Staging Greenshank	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Staging Curlew	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Staging Sandpiper	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Staging Ringed plover	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Staging Black tailed godwhit	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Staging Lesser black-backed Gull	Low	Low	Med	Low	Low	Low	Low	Low	Low
	Breeding Seabirds									
	Breeding Cormorant	Low	Low	High	Low	Med	Low	Low	Low	Low
	Breeding Shag	Low	Low	High	Low	Med	Low	Low	Low	Low
	Breeding Common scoter	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Breeding Puffin	Low	Low	High	Low	Med	Low	Low	Low	Low
	Breeding Razorbill	Low	Low	High	Low	Med	Low	Low	Low	Low
	Breeding Black Guillemot	Low	Low	High	Low	Med	Low	Low	Low	Low
	Breeding Guillemot	Low	Low	High	Low	Med	Low	Low	Low	Low
	Breeding Manx Shearwater	Low	Low	High	Low	Med	Low	Low	Low	Low
	Breeding Common Gull	Low	Low	Med	Low	Low	Low	Low	Low	Low
	Breeding Black-headed Gull	Low	Low	Med	Low	Low	Low	Low	Low	Low
	Breeding Lesser black-backed gull	Low	Low	Med	Low	Low	Low	Low	Low	Low

Code	Birds	Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats	Indirect disturbance or loss of species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
	Breeding Herring Gull	Low	Low	Med	Low	Low	Low	Low	Low	Low
	Breeding Great black-backed gull	Low	Low	Med	Low	Low	Low	Low	Low	Low
	Breeding Gannet	Low	Low	High	Low	Low	Low	Low	Low	Low
	Breeding Fulmar	Low	Low	Med	Low	Low	Low	Low	Low	Low
	Breeding Kittiwake	Low	Low	Med	Low	Low	Low	Low	Low	Low
	Breeding Little Tern	Low	Low	Med	Low	Low	Low	Low	Low	Low
	Other Breeding Birds									
	Breeding Curlew	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Breeding Dunlin	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Breeding Greylag geese	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Breeding Great crested grebe	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Breeding Reed warbler	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Breeding Lapwing	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Breeding Tufted duck	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Breeding Coot	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Breeding Raven	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Breeding Snipe	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Resident									
	Gadwall	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Likelihood (risk) of significant effect: Low			**Low/Medium**			**Medium**		**High**	

6.8.3 *Summary of Potential Effects on Birds*

As can be seen from Table 6.8 the species most likely to be subject to significant effects are those species which feed at sea and which are mainly pursuit divers. It is not known for certain how such diving birds may be affected by submerged structures, particularly where these have moving components. The assessment is therefore cautious as to the likely significant effects that could occur. In addition, some of these effects may be indirect, such as disorientation caused by underwater noise and vibration, flicker, or lights on structures.

Surface feeders, such as gulls, are less likely to be directly affected as they will not generally interact with submerged devices and should be able to see surface structures, although there is still the risk of collision with structures and wind turbine blades, for example.

For species that do not feed below the tidal zone, such as waders, the potential effects are likely to be indirect and of low likelihood. Feeding areas for these birds are often dynamic and can change from season to season and it is likely that the devices proposed within the OREDP will not modify coastal process to the extent that coastal habitats for waders are lost entirely.

For birds that do not feed in the marine or coastal environment, but which are listed because they are migratory and may overfly devices, there is a risk of collision, for example with offshore wind turbine blades. In addition, there may be indirect effects from the presence of structure arrays that may be lit at night that therefore may cause disorientation or barrier effects.

Toxic effects from bioaccumulation of substances associated with structures (e.g. antifouling coatings) may also occur although this is not likely to be significant.

6.8.3.1 Effects Related to Habitat Change or Loss

Changes or loss of habitat that the interest bird interest relies on (for example, for feeding, roosting, breeding or loafing) can affect the conservation status of the birds and therefore could represent a likely significant effect, depending on species. This habitat may not necessarily be located within the SPA boundary. Such impacts on habitats would be associated with the construction, operation and decommissioning phases of the development and may be indirect in that they reduce or change prey species upon which the interest bird species rely.

In addition, actual habitat loss may be associated with changes to hydrodynamic regimes from the presence and/or operation of tidal or wave devices causing changes to sediment deposition at and/or erosion of habitats which may cause indirect effects that occur outwith the immediate Assessment Areas.

The level of significance of any effect depends on whether the habitat will be affected by the activity compared to the overall size and stability of the whole site. If the area of habitat lost or changed is negligible then there is unlikely to be a significant effect on interest bird interest. In addition, the timescales of any changes will be important as temporary disturbance may not pose a significant impact whilst progressive or longer term or ‘permanent’ installation of devices may have a likely significant effect.

In addition, certain interest species may be more sensitive to disturbance at particular times of the year, for example disruption during the breeding season for interest bird species that breed at a site and/or are required to forage to feed young may not affect bird assemblages that overwinter at the same site and vice versa.

Where it has been determined that the activities associated with the OREDP are not likely to affect interest features either through virtue of scale of change, permanence or timing, then significant effects will not be likely. However, where the magnitude, location or duration of the effect cannot be determined then a likely significant effect has to be assumed.

6.8.3.2 Operational Effects of Proposed Devices

Birds are vulnerable to collision with device elements or disturbance during all development stages by noise, lights, barrier effects, flicker/movement and vessel activities. Such disturbance may occur during migration, foraging, loafing or breeding activities. Depending on foraging strategy, different species may be vulnerable to collision with differing device types, for example pursuit divers may be more vulnerable to submerged devices such as tidal turbines.

Birds may be attracted to devices as roosting or feeding stations thus increasing the chances of collision or disturbance. In addition, the physical presence of devices may change foraging opportunities through attracting or discouraging prey species to or from foraging areas.

As details of exactly where devices will be positioned is unknown and there is little empirical evidence with regard to their effects on birds, a likely significant effect on sensitive interest bird features has to be assumed with regard to the OREDP.

7 Mitigation

7.1 Introduction

This chapter sets out proposed mitigation that should be implemented to ensure that the OREDP does not result in a significant adverse effect on a Natura site.

As the OREDP is in effect a high level plan then plan level mitigation is required. However, because the plan is so high level, and therefore the details of its implementation cannot be known at this time, it is necessary for the plan to make some commitments to project level mitigation so that significant adverse effects on interest features of Natura sites can be avoided.

This chapter has been divided into two types of mitigation. Firstly plan level mitigation which focuses on how the actions in the draft OREDP could be strengthened and secondly project level mitigation that can be implemented.

7.2 Plan Level Mitigation

Plan level mitigation comprises statements incorporated into the plan (OREDP) as actions which aim to avoid/reduce or offset significant adverse effects. These relate to strategic level measures that have been identified as being necessary for the scenarios for the development of offshore renewable energy, as set out in the OREDP, to be achieved in a way that avoids or minimises any significant adverse effects on the environment.

Plan level mitigation measures, include for example, measures for filling strategic data and information gaps or implementing the deploy and monitor approach to development which aims to control the scaling up of commercial developments so that necessary data (evidence) in relation to potential effects on the environment can be obtained before development is extended to its full commercial scale.

The following recommended actions were included in the draft OREDP on the basis of the SEA Environmental Report to minimise or reduce the potential for significant adverse effects to occur from offshore wind and marine renewable energy developments in Irish waters:

7.3 Extract from Section 10.6 of the Draft OREDP

7.3.1 Recommended Actions

<u>Collaboration and Coordination:</u>

- **Action 1**: Development of a mechanism for greater coordination between all state bodies concerned to improve the effectiveness of the delivery of the OREDP as policy develops. This could include an enhanced role for the existing multi-body Ocean Energy Steering Committee.
- **Action 2:** Collaborative working with the existing Ocean Energy Advisory Group to assist/advise SEAI and DCENR with taking forward the OREDP.

<u>SEA Monitoring Requirements:</u>

- **Action 3:** In accordance with Article 17 of the SEA Regulations 2004, the group identified in the mechanism for enhanced co-ordination in Action 1 shall ensure the significant environmental effects of the implementation of the plan are monitored. This will ensure that unforeseen adverse effects are identified at an early stage and that appropriate remedial action is taken as required.

Addressing Data, Information and Knowledge Gaps:

- **Action 4:** DCENR and SEAI, in the context of the offshore renewable energy sector, should collaborate with the lead authorities on the MSFD and other statutory requirements that are taking forward requirements relating to collation, management and dissemination of data and information collected for the marine environment so that data is made publicly available so that it may be taken into account by those developers and bodies involved in the siting, design, consenting and permitting of individual projects.

Consenting and Permitting:

- **Action 5:** Future foreshore consenting processes should take into account the broad findings and assessment of this SEA and AA in terms of location and constraints.
- **Action 6:** The foreshore consent process should require developers to put in place appropriate monitoring programmes to assess the effects of their development.
- **Action 7:** The foreshore consenting process should consider the application of an incremental (the 'deploy and monitor') approach as part of the scaling up of offshore renewable energy developments.

Guidance and Advice:

- **Action 8:** The project level mitigation measures/EIA Guidance prepared as part of the SEA Environmental Report could be incorporated into National EIA Guidance for offshore renewable energy developments.
- **Action 9:** Development and maintenance of a GIS database tool to inform the Foreshore Consenting process, led by the Marine Institute.

7.4 Review of Recommended Actions

The inclusion of the recommended actions into the draft OREDP was positive. However, with a view to strengthening the commitments to environmental concerns and in light of our assessment, we would recommend that they be turned from 'recommended' actions to 'actions.' We would propose the following highlighted changes (in bold) to the 'actions:' It is noted in the context of compliance with Article 6.3 of the Habitats Directive, 'mitigation' means measures that prevent a plan or project from having a significant impact on the integrity of a European site.

7.4.1 Reviewed Actions

Collaboration and Coordination:

- **Action 1:** Development of a mechanism for greater coordination between all state bodies concerned to improve the effectiveness of the delivery of the OREDP as policy develops. This could include an enhanced role for the existing multi-body Ocean Energy Steering Committee.
- **Action 2:** Collaborative working with the existing Ocean Energy Advisory Group to assist/advise SEAI and DCENR with taking forward the OREDP. **The composition of the Ocean Energy Advisory Group should be expanded to include other interests in the marine sector including fisheries and environmental bodies.**

SEA Monitoring Requirements:

- **Action 3:** In accordance with Article 17 of the SEA Regulations 2004, the group identified in the mechanism for enhanced co-ordination in Action 1 shall ensure the significant environmental effects of the implementation of the plan are monitored. This will ensure that unforeseen adverse effects are identified at an early stage and that appropriate remedial action is taken as required.

Addressing Data, Information and Knowledge Gaps:

- **Action 4:** DCENR and SEAI, in the context of the offshore renewable energy sector, **will** collaborate with the lead authorities on the **Marine Strategy Framework Directive** and other statutory requirements that are taking forward requirements relating to research, collation, management and dissemination of data and information collected for the marine environment **(including research work on the marine environment being undertaken by the Marine Institute and National Parks and Wildlife) to ensure** that data is made publicly available so that it may be taken into account by those developers and bodies involved in the siting, design, consenting and permitting of individual projects.
- **Action 5: A combination of filling data gaps at a strategic level (as set out in Action 4), filling data and knowledge gaps at individual project level and filling data gaps through use of the deploy and monitor approach will be pursued. DCENR and SEAI, in the context of their collaboration with lead authorities on the Marine Strategy Framework Directive, should endeavour to ensure as much data collection and research as possible on Resource Assessment Areas 5 and 6 which are considered more high risk than other resource assessment areas.**

Consenting and Permitting:

- **Action 6:** Future foreshore consenting processes **will** take into account the broad findings and assessment of the SEA and this Natura Impact Statement (NIS) in terms of location and constraints.
- **Action 7:** The foreshore consent process **will** require developers to put in place appropriate monitoring programmes to assess the effects of their development.
- **Action 8:** The foreshore consenting authority **will** consider the application of an incremental (the 'deploy and monitor') approach as part of the scaling up of **larger** offshore renewable energy developments.
- **Action 9: All individual projects subject to foreshore consent for development are will be required to comprehensively demonstrate that the development would not have a Likely Significant Effect (LSE) on the integrity of a Natura 2000 site. Where it is not possible to conclude that there would be no LSE, the applicant must clearly demonstrate as part of the Foreshore Consent Application process the mitigation measures that will be implemented as part of the project to avoid LSE, detailing how these measures will be implemented. Where there are no options for avoiding LSE the applicant must demonstrate that there are Imperative Reasons of Overriding Public Interest (IROPI) for the project.**

Guidance and Advice:

- **Action 10:** The project level mitigation measures/EIA Guidance prepared as part of the SEA Environmental Report **will be integrated into the final OREDP (rather than being an Appendix) and will be** incorporated into National EIA Guidance for offshore renewable energy developments **by the relevant authority**. **Project level mitigation measures in the OREDP (and in the National EIA Guidance for offshore renewable energy) will incorporate Table 7.1 of this Natura Impact Statement "Suggested Mitigation Measures where there is Potential for LSE."**
- **Action 11:** Development and maintenance of a GIS database tool to inform the Foreshore Consenting process, led by the Marine Institute.
- **Action 12: As policy develops and evolves, and as the OREDP is implemented, any decisions around levels of development to be pursued and around future foreshore consenting policy , particularly if it is decided to instigate a foreshore leasing round, will take into account in-combination effects. At a project level, the assessment of in combination effects will be an obligatory part of the award of a foreshore lease. The state bodies identified in Action 1 undertake to consider in-combination effects in their decision making as policy evolves. Consultation and liaison between relevant Government Departments nationally and with state bodies in Northern Ireland, Isle of Man and mainland UK will be undertaken and maintained as policy develops, including through such structures as the British Irish Council. In-combination effects will be considered as part of the initial review in 2015 of the OREDP and the full review in 2020 in light of policy development in the interim.**

7.5 Project Level Mitigation

Project level mitigation measures developed as part of the SEA process are referred to throughout the OREDP and are included in Appendix 2 of the OREDP. These measures should be moved to the main body of the OREDP, rather than being carried as an Appendix, given their importance.

As one of the OREDP actions is that the project level mitigation measures will be turned into National EIA Guidance for offshore renewable energy developers, and as another of the OREDP actions is that the foreshore consent process will require developers to put in place appropriate monitoring programmes to assess the effects of their development, it is considered reasonable to assume that these measures will be implemented appropriately and that commitment to and implementation of such mitigation will be necessary in order to achieve development consent/Foreshore Leases at the project level.

At this point, Section 1.3 of the Natura Impact Statement on the Limitations of the Assessment is recalled as is the recently developed guidance by SNH/David Tyldesley and Associates (August 2010) "Habitats Regulations Appraisal of Plans: Guidance for Plan Making Bodies in Scotland." That guidance noted that in certain circumstances it may be acceptable for a Plan level Appropriate Assessment to rely on a later Project level Assessment to ensure no adverse effect on the integrity of a European site. The OREDP as noted, is a very high level document, and notes that policy is evolving and levels and location of development in coming years will significantly depend on policy evolution and decisions that have yet to be taken on whether or not to pursue certain strategies.

In light of this, project level mitigation and the national EIA guidance that it is to be turned into, takes on particular relevance in the context of the OREDP implementation. The potential for impacts on the integrity of Natura 2000 sites will be addressed by considering, at project level, the extent to which such impacts can be avoided by careful positioning of infrastructure and the implementation of mitigation measures set out in the OREDP, and proceeding only with those projects that do not potentially impact the integrity of the sites.

However, it is necessary for the purposes of this NIS to identify in more detail the mitigation that should be incorporated into the plan in order to avoid likely significant effects on interest features of European sites. Such mitigation ranges from basic 'best practice' through to site-specific and complex activities that are designed to mitigate effects at defined locations and in relation to specific receptors in relation to individual project plans.

These measures are generally related to construction techniques, timing and programming, and are based on project level mitigation already employed on renewable energy projects, particularly off-shore wind-farms, reflecting conditions commonly placed on developers by the relevant statutory authorities but without putting an unacceptable burdened on the developer such that development becomes untenable.

For the purposes of this NIS it has been assumed that there is a commitment for such measures to be incorporated into and future developments that are a consequence of the OREDP.

Table 7.1 below identifies mitigation measures for each group of inters features where the potential effect of the plan could result in a low/ medium or higher risk on the interest features. Mitigation has not been presented for those effects which were classified as having a low risk on interest features at this stage. The list of mitigation provided in Table 7.1 is not exhaustive and should only be used as a guide for future developments. Project level mitigation should also be built upon the outcomes of further research and monitoring.

Table 7.1 Suggested Mitigation Measures where there is Potential for LSE

Interest Features	Potential Effect	Suggested Project Level Mitigation Measures
Habitats	Direct physical loss / damage to habitats	- Careful site selection avoiding sensitivities features for devises and export cables in particular estuaries - Habitat surveys to characterise the seabed and indentify sensitive habitat and species - Avoid installation during sensitive seasons
	Indirect disturbance or loss of habitats	- Avoid device / infrastructure placement within 500m of areas of known sediment contamination - Habitat surveys to characterise the seabed and indentify sensitive habitat and species
	Toxic effects	- Design devises to minimise risk of leakage of pollutants - Risk assessment and contingency planning - Implementation of SOPEP (Shipboard Oil and Pollution Energy Plan)
	Biological disturbance	- Careful site selection avoiding sensitivities features for devices and export cables in particular estuaries - Habitat surveys to characterise the seabed and indentify sensitive habitat and species
Marine Mammals	Direct physical damage to mobile species	- Detailed survey would be required to examine the marine mammal distribution around the coast in order to fully understand and mitigate for this risk - Avoid sites for sensitive species - Avoid installation during the sensitive seasons - Design device for minimal impact - Avoid siting devices in sensitive areas such as migration routes, feeding and breeding areas - Increase device visibility, or use of acoustic deterrent devices - Enforce speed limits for vessels used in construction and establish a code of conduct to avoid disturbance to marine mammals both during construction activities and in transit to construction area if entering areas of high abundance - Use of protective netting or grids - Seasonal restrictions on the operation of devices to avoid impacting on marine mammals at vulnerable times of the year - The use of acoustic deterrents such as pingers or acoustic harassment devices. - Soften collision by adding smooth edges or padding - Protect against entrapment by incorporating escape hatches into device design.
	Indirect disturbance or loss of species	- Minimise the use of high noise emission activities such as impact pilling and blasting - Avoid installation during sensitive periods - Soft starting pilling activities / passive acoustic deterrents – gradually increasing noise produce do allow mammals to move away from activities - Underwater noise during the operation may be beneficial in alerting species to the presence of the device, reducing the risk of collisions. However, this requires further research. - Noise from operating turbines can be reduced by using isolators. However this has not been tested in the long term and to account for cumulative effects - Use of sound installation on equipment - Use of bubble curtains (this may only be effective in shallow water) - Use of acoustic deterrent or disturbance devices to scare sensitive species away - Use of mammal observers and passive acoustic monitoring to facilitate implementation of exclusion area during noisy activities - Use of IWDG recommendations for multibeam survey and cetacean impacts
	EMF	- Cable configuration and orientation can reduce field strength - Cable burial, where possible to minimise field effect at the seabed
Fish and Freshwater	Direct physical damage to	- Design device for minimal impact - Do not site devices in particularly sensitive sites e.g. migratory routes feeding

Interest Features	Potential Effect	Suggested Project Level Mitigation Measures
Pearl Mussels	mobile species	and breeding areas - Maximise device visibility - Use of acoustic deterrents devices - Use of protective netting or grids - Use of protective screens to prevent fish from entering the device - Avoid constrained waterways
	Indirect disturbance or loss of species	- Adherence to IDWC recommendations to minimise impacts on fish - Undertake surveys to determine site specific noise effects - Minimise the use of high noise emission activities such as piling - Avoid installation during sensitive periods - Consider using alternatives (clump weights, gravity bases, cable protection rather than burial)
Otters	Direct physical loss / damage to habitats	- Detailed otter surveys would be required in order to fully understand and mitigate for this risk - Avoid sensitive habitat areas - Design device for minimal impact on habitat
	Direct physical damage to mobile species	- Detailed otter surveys would be required in order to fully understand and mitigate for this risk - Underwater noise during the operation may be beneficial in alerting species to the presence of the device, reducing the risk of collisions. However, this requires further research. - Avoid installation during the sensitive seasons - Increase device visibility, or use of acoustic deterrent devices - Use of protective netting or grids - Protect against entrapment by incorporating escape hatches into device design. - Seasonal restrictions on the operation of devices to avoid impacting on otters at vulnerable times of the year - Soften collision by adding smooth edges or padding
	Indirect disturbance or loss of habitats	- Avoid siting devices in sensitive areas such as feeding and breeding areas
	Indirect disturbance or loss of species	- Minimise the use of high noise emission activities such as impact pilling and blasting - Enforce speed limits for vessels used in construction and establish a code of conduct to avoid disturbance to otters both during construction activities and in transit to construction area if entering areas of high abundance - Avoid installation during sensitive periods - Use of sound installation on equipment - Soft starting pilling activities / passive acoustic deterrents – gradually increasing noise produce do allow otters to move away from activities - Use of bubble curtains (this may only be effective in shallow water) - The use of acoustic deterrents such as pingers or acoustic harassment devices. - Noise from operating turbines can be reduced by using isolators. However this has not been tested in the long term and to account for cumulative effects
	Toxic effects	- Design devises to minimise risk of leakage of pollutants - Risk assessment and contingency planning - Implementation of SOPEP (Shipboard Oil and Pollution Energy Plan)
Bats	Direct physical damage to mobile species	- Avoid siting the devices within sensitive sites - Site specific surveys at project level to identify the presence of key commuting/foraging flightlines to aid site selection - Appropriate siting of developments e.g. away from roost sites and commuting/foraging flightlines - Alignment of turbines in rows parallel to flightline direction - Several kilometre wide free flightline corridors between wind farms - Avoiding large-scale continuous illuminations and only use appropriate

Interest Features	Potential Effect	Suggested Project Level Mitigation Measures
		sensitive lighting suitable for bats
	Indirect disturbance or loss of species	- Avoid installation during sensitive periods
Birds	Direct physical damage to mobile species	- Avoid siting the devices within sensitive sites - Avoid installation during sensitive seasons (i.e. breeding and moulting) - Site specific surveys at project level to identify the presence of key foraging hotspots and / or resting areas and to aid site selection - Appropriate siting of developments e.g away from breeding colonies, important feeding and roosting areas, nearshore areas and migration corridors - Alignment of turbines in rows parallel to the main migratory direction - Several kilometre wide free migration corridors between wind farms - No construction of wind farms between resting and foraging areas - Shut down of turbines at night with bad weather / visibility and high migration intensity - Avoiding large-scale continuous illuminations - Measures to make wind turbines more recognisable to birds
	Indirect disturbance or loss of species	- Minimise the use of high noise emission activities such as impact piling or blasting - Avoid installation during sensitive periods - Review and consideration of noise reduction techniques (e.g. bubble curtains around the pile) - Use of sound installation on plant equipment and device deign.

7.6 Project Level Appropriate Assessment

As identified above, recently developed guidance[12] describes the circumstances where it may be acceptable for a Plan Level Appropriate Assessment to rely on a later Project Level Appropriate Assessment to ensure no adverse effect on the integrity of a European site.

This is considered to be permissible because important information about the effects of the plan may only become evident once specific proposals and projects are brought forward, i.e. these details could not be known when the plan level Appropriate Assessment was undertaken. The guidance indicates that reliance on the lower tier Project Appropriate Assessment may be more appropriate, provided that such lower tier assessments can influence the details of how individual projects are implemented. This requirement is reflected in Action 8 above.

[12] SNH/David Tyldesley and Associates (August 2010) Habitats Regulations Appraisal of Plans: Guidance for Plan-Making Bodies in Scotland

8 Assessment of LSEs WITH MITIGATION

8.1 Introduction

The following section sets out the results from the assessment of LSE on the interest features that have been identified as potentially being affected by the activities associated with the OREDP. This section focuses on the interest features that were identified in Chapter 6 as being of medium to high risk of LSE from the OREDP and includes a summary of the assessment of LSE before mitigation (without mitigation) and following the implementation of mitigation (with mitigation) discussed in Chapter 7.

8.2 Assessment of LSE on Habitats and Non Mobile Species

This section presents the results from the assessment of the potential risk of LSE on interest features (habitats and non mobile species) associated with the SACs and SPAs in Ireland that were screened in during the previous stage of the assessment.

8.2.1 Risk of Likely Significant Effect (LSE) on Habitats and Non Mobile Species

Table 8.1 below presents the results of the assessment of LSE on the main interest features (habitats and non mobile species) that were identified in Chapter 6 as being of medium to high risk of LSE from the OREDP (without mitigation). The following assessment identifies the potential risk of LSE with and without mitigation. The assessment of LSE with mitigation is based on the mitigation measures presented in Chapter 7.

Table 8.1: Assessment of LSE on Habitats and Non-Mobile Species (with and without mitigation)

Code	Sensitive Annex 1 Habitat		Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats and non mobile species	Indirect disturbance or loss of mobile species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
Sub-tidal Habitats											
1110	Sandbanks which are slightly covered by sea water all the time	Without Mitigation	High	Med	n/a	Med	n/a	Med	Low	Low	Low
		With Mitigation (see Chapter 7)	Med	Low Med	n/a	Low Med	n/a	Low	Low	Low	Low
1170	Reefs	Without Mitigation	High	High	n/a	High	n/a	High	High	Low	Med
		With Mitigation (see Chapter 7)	Med	Low Med	n/a	Med	n/a	Low	Low Med	Low	Low
1150	Coastal lagoons	Without Mitigation	Med	Low	n/a	Low Med	n/a	Med	Low Med	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	n/a	Low	n/a	Low	Low	Low	Low
1160	Large shallow inlets and bays	Without Mitigation	Med	Low Med	n/a	Low Med	n/a	Med	Low Med	Low	Med
		With Mitigation (see Chapter 7)	Low	Low	n/a	Low Med	n/a	Low	Low Med	Low	Low
1130	Estuaries	Without Mitigation	High	Low Med	n/a	Med	n/a	Med	Med	Low	Med
		With Mitigation (see Chapter 7)	Low Med	Low Med	n/a	Low Med	n/a	Low	Low Med	Low	Low

Code	Sensitive Annex 1 Habitat		Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats and non mobile species	Indirect disturbance or loss of mobile species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
Intertidal Habitats											
8330	**Submerged or partly submerged sea caves**	**Without Mitigation**	Med	Low	n/a	Low	n/a	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low Med	Low		Low		Low	Low	Low	Low
1140	**Mudflats and sandflats not covered by seawater at low tide**	**Without Mitigation**	Med	Med	n/a	Low Med	n/a	Med	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low		Low		Low	Low	Low	Low
	Likelihood (risk) of significant effect:	Low		Low/Medium		Medium		High			

8.2.2 Summary of Results from Assessment of Likely Significant Effect (LSE) on Habitats and Non Mobile Species

The assessment has identified that for sandbanks which are slightly covered by seawater all the time and reefs, even with the implementation of appropriate mitigation there is still a medium risk of LSE occurring as a result of direct damage to or loss of habitats from the installation of offshore renewable energy developments in areas where sensitive habitats are present. There is also a low risk of LSE on coastal lagoons, large shallow inlets and bays and a low to medium risk of LSE on estuaries. However, it is likely that potential effects on these interest features will be minimal as most development is expected to occur in areas further offshore where these habitats are less likely to be present, in particular estuaries which, with the exception of the Shannon Estuary, are excluded from the study area.

There is also a low to medium risk of LSE from indirect effect associated with the installation of devices e.g. from increased turbidity and suspended sediment and changes in tidal flow or wave energy regime. There may also be some direct effects on intertidal and coastal habitats from the installation of export cables and other associated infrastructure. However, with the implementation of appropriate mitigation e.g. route selection studies and surveys etc to identify the location of sensitive habitats in relation to cable routes, LSE on these habitats will be avoided.

The conclusions relating to sand banks and reefs reflect the high level nature of this assessment and the high level of uncertainty surrounding the type of development that may occur in a certain area and the precise location of any future development. The assessment has identified that the most significant effects on habitats and mobile species associated with SACs and some SPAs are likely to occur as a result of direct damage or harm. Any potential LSE on these interest features could therefore be avoided by preventing development in the sites containing these features.

However, it is very important to note that the interest features for which a certain site is designated e.g. reefs, may not be present throughout an entire site. There is potential that the interest feature for which a site is designated is present outside the main area that may be of interest for a developer, or that the interest features located within a site are less sensitive to different types of offshore renewable energy development that could occur in that area (as identified in Chapter 6). Consequently, it is not possible to conclude that development within a protected site (SAC or SPA) would definitely have an LSE on the actual interest feature(s) for which the site has been designated and therefore may not affect the integrity or conservation objectives of that site, although the likelihood of an LSE occurring is much higher.

These limitations in terms of the lack of knowledge on where development would occur, what that development would comprise, and therefore the likely effect on protected sites was recognised in the SEA and has also been acknowledged in the OREDP. Although results from the Strategic Environmental Assessment (SEA) identified that it is possible for the development scenarios set out in the OREDP to be achieved without developing within Natura sites (SACs and SPAs), it is acknowledged that there is significant potential resource located within a number of protected sites which individual developers may, at some point, seek permission to exploit.

The SEA and the OREDP therefore does not conclude that development would not be permitted within these protected sites. However, both documents do clearly state that '**development should not take place within Natura 2000 sites unless it can be comprehensively demonstrated at the project level that there would be no LSE on the integrity and conservation objectives of the site'.**

These findings are reflected in the plan level actions (Action 8) and project level mitigation presented in Chapter 7 of this NIS which identify that further assessment work (e.g. surveys, monitoring and research) would be required as part of any individual development taken forward following implementation of the OREDP in order to ascertain whether there would be a LSE on the interest features for which the SACs in Irish and Northern Ireland waters have been designated.

8.3 Assessment of LSE on Marine Mammals

This section presents the results from the assessment of the potential risk of LSE on interest features (marine mammals) associated with the SACs in Ireland that were screened in during the previous stage of the assessment.

8.3.1 Risk of Likely Significant Effect (LSE) on Marine Mammals

Table 8.2 below presents the results of the assessment of LSE on the main marine mammals species associated with the SACs that were identified in Chapter 6 as being of medium to high risk of LSE from the OREDP (without mitigation). The following assessment identifies the potential risk of LSE with and without mitigation. The assessment of LSE with mitigation is based on the mitigation measures presented in Chapter 7.

Table 8.2: Assessment of LSE on Marine Mammals (with and without mitigation)

Code	Sensitive Annex 1 Species		Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats	Indirect disturbance or loss of species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
1364	**Grey seal (*Halichoerus grypus*)**	**Without Mitigation**	Low	n/a	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	n/a	Med	Low	Med	Low	Low	Low	Low
1365	**Harbour (Common) seal (*Phoca vitulina*)**	**Without Mitigation**	Low	n/a	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	n/a	Med	Low	Med	Low	Low	Low	Low
1351	**Harbour porpoise (*Phocoena phocoena*)**	**Without Mitigation**	Low	n/a	High	Low	Med	Low	Low	Low	Low Med
		With Mitigation (see Chapter 7)	Low	n/a	Med	Low	Med	Low	Low	Low	Low
1349	**Bottlenose dolphin (*Tursiops truncatus*)**	**Without Mitigation**	Low	n/a	High	Low	Med	Low	Low	Low	Low Med
		With Mitigation (see Chapter 7)	Low	n/a	Med	Low	Med	Low	Low	Low	Low

Likelihood (risk) of significant effect: Low ▢ **Low/Medium** ▢ **Medium** ▢ **High** ▢

8.3.2 Summary of Results from Assessment of Likely Significant Effect (LSE) on Marine Mammals

The results presented above reflect the levels of uncertainty associated with limited knowledge and understanding on how marine mammals interact with operational offshore renewable energy development, in particular wave and tidal devices, and how they affected by noise from piling and other physical disturbance during the installation, maintenance and decommissioning of devices.

Collision risk is still one of the main factors that could affect marine mammals, especially as developments are scaled up from current demonstration and testing phases through to larger commercial scale developments. Similarly, further work is required to fully understand the potential for noise, habitat exclusion and perceived risk of collision, associated with a number of commercial scale developments to create barriers to the movement of mammals along migration routes and transit between foraging areas, breeding grounds and haul out sites (seals).

The findings from this assessment presented in Table 8.2 above, and the mitigation measures presented in Chapter 7, reflect these limitations in current levels of understanding of the interactions between offshore renewable energy developments and marine mammals. Due to the nature and behaviour of mobile species there are also limitations in the certainty with which individual species belong to populations for which certain SAC sites have been designated. In order to identify whether certain individual mammals belong to a particular resident population it would be necessary to carry out detailed tagging and monitoring exercises throughout Irish and Northern Ireland waters (and possibly UK waters).

In conclusion, at this stage in the assessment, due to the limitations discussed above, it is not possible to conclude at a strategic level that there would be no LSE on marine mammals or the integrity and conservation objectives of the sites where marine mammals are interest features. Taking this into account it is necessary for the OREDP to include specific measures as identified in Chapter 7 requiring developers to **comprehensively demonstrate at the project level that there would be no LSE on the integrity and conversation of objectives of a Natura site**.

Depending on the location and type of individual developments, this is likely to involve detailed surveys, tagging and monitoring exercises and further research, as well the implementing a number of project level mitigation measures listed in Chapter 7. If at the project level it is not possible to ascertain that there would be no LSE on the integrity and conversation objectives of Natura site where marine mammals are an interest feature, or developers are unable to clearly demonstrate how specific mitigation measures would be implemented to avoid LSE on marine mammals, then individual projects would not be permitted to be taken forward unless it was demonstrated that there were Imperative Reasons of Overriding Public Interest (IROPI). This is reflected in the actions included in the OREDP.

8.4 Assessment of LSE on Fish and Freshwater Pearl Mussels

This section presents the results from the assessment of the potential risk of LSE on interest features (fish and freshwater pearl mussels) associated with the SACs that were screened in during the previous stage of the assessment.

8.4.1 Risk of Likely Significant Effect (LSE) on Fish and Freshwater Pearl Mussels

Table 8.3 below presents the results of the assessment of LSE on fish and freshwater pearl mussels associated with the SACs that were identified in Chapter 6 as being of medium to high risk of LSE from the OREDP (without mitigation). The following assessment identifies the potential risk of LSE with and without mitigation. The assessment of LSE with mitigation is based on the mitigation measures presented in Chapter 7.

Table 8.3: Assessment of LSE on Marine Mammals (with and without mitigation)

Code	Sensitive Annex 1 Species		Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile	Direct physical damage to mobile species	Indirect disturbance or loss of habitats	Indirect disturbance or loss of species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
1106	Atlantic salmon (*Salmo salar*)	Without Mitigation	Low	Low	Low Med	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low Med	Low	Low	Low	Low
1029	Freshwater pearl mussel (*Margaritifera margaritifera*)	Without Mitigation	Low	Low	Low	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low	Low	Low Med	Low	Low	Low	Low
1990	Nore freshwater pearl mussel (*Margaritifera durrovensis)*	Without Mitigation	Low	Low	Low	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low	Low	Low Med	Low	Low	Low	Lo w
	Likelihood (risk) of significant effect:		Low		Low/Medium			Medium		High	

8.4.2 Summary of Results from Assessment of Likely Significant Effect (LSE) on Fish and Freshwater Pearl Mussels

The results from the assessment conclude that following the implementation of mitigation there is a low to medium risk of LSE on Atlantic salmon. This is mainly related to the potential for commercial scale offshore renewable energy developments creating barriers to the movement of Atlantic salmon along key migratory routes and gaining access to freshwater habitats (rivers). Again, at this stage it is not possible to conclude that there would be no LSE on Atlantic salmon due to the level of uncertainty surrounding the precise location and type of development that is likely to occur.

However, with the implementation of appropriate project level mitigation measures such as carrying out siting studies to establish whether an area is located on/intercepts a salmon migration route, or to avoid siting developments in locations that would block or partially restrict entrances to rivers and estuaries, it would be possible at the project stage for LSE on Atlantic salmon to be avoided. These requirements are reflected in the OREDP through the actions (see Chapter 7) requiring developers to **comprehensively demonstrate at the project level that there would be no LSE on the integrity and conversation of objectives of a Natura site.** Where developers are unable to demonstrate that there would be no LSE developments would not be permitted unless IROPI was demonstrated. This is reflected in the actions included in the OREDP.

As with the Atlantic salmon, the assessment also identifies that there is a low to medium risk of LSE on the Freshwater Pearl Mussel. This risk relates specifically to habitat loss/exclusion and potential for smothering/effects associated with increased suspended sediment and turbidity. As part of any individual project, surveys and studies would be required in order to demonstrate that development would not have a LSE effect on Freshwater Pearl Mussels in the area. This would be achieved though siting studies to avoid areas where Freshwater Pearl Mussels are known to be present or implementing design/construction measures to reduce the potential for a development to generate increased levels of suspended sediment/turbidity. Modelling may also be required to ascertain whether a development would affect the existing tidal or wave energy regime in a certain area and the effects of this on the Freshwater Pearl Mussels and the integrity of the site they are an interest feature of.

8.5 Assessment of LSE on Bats and Otters

The assessment in Chapter 6 identified that the potential risk of activities associated with the OREDP having an LSE on bats or otters is considered to be low. Otters in general occupy nearshore habitats which extent out to 1km offshore. It is likely that most of offshore renewable energy developments would be located in areas further offshore limiting the potential for direct interaction with otters and their habitat. There is potential for interactions between otters and cabling activities and the installation of other supporting coastal infrastructure. However, any LSE would be avoided through the implementation of appropriate mitigation measures at the project level such as routeing studies to avoid otters and their habitat. The requirement for these project level mitigation measures to be implemented appropriately is reflected in the actions included in the OREDP and listed in Chapter 7.

In terms of bats, it is acknowledged that bat species are potentially affected by changes in air pressure created by the movement of wind turbines. Although these potential effects have been studied for a number of onshore wind farms, there is still limited evidence relating to the effects of offshore wind farms, mainly attributed to the limited activities of bats in offshore locations. The SEA identified that the areas of greatest potential for offshore wind developments were off the east coast or north coast of Ireland where shallower water depths meant developments could be located further offshore to reduce potential effects on seascape character and coastal/nearshore protected sites and species. It may be necessary at the project stage to survey bat activities along the coast in these areas to determine whether bats are likely to be present in offshore areas. However, for the purpose of this assessment, it is assumed that bat activities are generally restricted to coastal movements or around harbours or possible migration routes across short distances of open water, rather than offshore activity.

8.6 Assessment of LSE on Birds

This section presents the results from the assessment of the potential risk of LSE on interest features (birds) associated with the SPAs that were screened in during the previous stage of the assessment.

8.6.1 *Risk of Likely Significant Effect (LSE) on Birds*

Table 8.4 below presents the results of the assessment of LSE on birds associated with the SPAs that were identified in Chapter 6 as being of medium to high risk of LSE from the OREDP (without mitigation). The following assessment identifies the potential risk of LSE with and without mitigation. The assessment of LSE with mitigation is based on the mitigation measures presented in Chapter 7.

Table 8.3: Assessment of LSE on Birds (with and without mitigation)

Code	Birds		Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats	Indirect disturbance or loss of species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
Annex 1 Birds											
A001	Red-throated Diver	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
A002	Black-throated Diver	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
A003	Great Northern Diver	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
A176	Mediterranean Gull	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
A007	Slavonian Grebe	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
A014	Storm Petrel	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
A015	Leach's Storm-petrel	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
A191	Sandwich Tern	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
A192	Roseate Tern	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
A193	Common Tern	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
A194	Arctic Tern	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
A195	Little Tern	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
	Staging Lesser black-backed Gull	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low

Code	Birds		Direct physical loss / damage to habitats	Direct physical loss / damage to non-mobile species	Direct physical damage to mobile species	Indirect disturbance or loss of habitats	Indirect disturbance or loss of species	Toxic effects	Non-toxic effects	Biological disturbance	EMF and/or temperature
	Breeding Cormorant	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
	Breeding Shag	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
	Breeding Puffin	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
	Breeding Razorbill	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
	Breeding Black Guillemot	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
	Breeding Guillemot	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
	Breeding Manx Shearwater	**Without Mitigation**	Low	Low	High	Low	Med	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low Med	Low	Low	Low	Low
	Breeding Common Gull	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
	Breeding Black-headed Gull	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
	Breeding Lesser black-backed gull	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
	Breeding Herring Gull	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
	Breeding Great black-backed gull	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
	Breeding Gannet	**Without Mitigation**	Low	Low	High	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Med	Low	Low	Low	Low	Low	Low
	Breeding Fulmar	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
	Breeding Kittiwake	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low
	Breeding Little Tern	**Without Mitigation**	Low	Low	Med	Low	Low	Low	Low	Low	Low
		With Mitigation (see Chapter 7)	Low	Low	Low Med	Low	Low	Low	Low	Low	Low

8.6.2 Summary of Results from Assessment of Likely Significant Effect (LSE) on Birds

As with marine mammals, there is still limited information and understanding on how certain bird species, in particular pursuit feeders and diving birds interact with offshore renewable energy developments, especially devices with moving parts such as turbines that are submerged below the surface. There are also a number of limitations relating to gaps in data and information on the location of certain habitats such as offshore foraging and loafing areas.

Taking these limitations into account the assessment concludes that, taking into account mitigation, there is a medium risk of LSE on birds from direct effects (collision risk) and a low to medium risk of LSE in with respect to indirect effects e.g. disturbance, noise and habitat exclusion. These results reflect the strategic nature of this assessment and the lack of information on the precise type and location of development that is likely to occur as the OREDP is taken forward.

As with marine mammals, the issue with marine birds is that they often occupy habitats outside the boundaries of the SPA site for which they are designated as an interest feature. Consequently, it is not possible to avoid potential LSE by avoiding a site, although this would help to reduce potential effects on breeding populations in some areas. Avoidance of the areas adjacent to sites would also help to reduce the potential for LSE on some species, particularly ones known to forage in nearshore areas. However, the effects on species that occupy habitats further offshore are still unknown.

As identified in Chapters 6 and Table 8.4 above, not all bird species are sensitive to offshore renewable energy developments. Therefore whilst the SEA identified that the development scenarios set out in the OREDP could be achieved by developing the areas of resource located outside protected SPA sites, if the SPA sites do not contain bird species that are sensitive to offshore renewable energy developments then these sites may not need to be avoided.

As identified in the OREDP, given the current levels of uncertainty relating to the interactions between birds and offshore renewable energy developments and limitations in information and data on the location of offshore habitats (used by interest features) it will be necessary for further work to be carried out at the project level to determine whether there would be any LSE on birds. This additional work is likely to include surveys, monitoring and further research as set out in the mitigation measures included in Chapter 7. Where potential LSE on birds are identified at the project level it will be the responsibility of the developer to clearly demonstrate how these potential effects will be avoided (through the implementation of appropriate mitigation measures and project design) before a development can be permitted. Where it is not possible to demonstrate that there would be no LSE, developments would not be permitted unless the project was considered to be IROPI.

9 Sites at Risk

9.1 Introduction

The following chapter identifies the main sites (SACs and SPAs) where the interest features for which the site has been designated have been identified as being at medium to high risk of LSE from the previous assessment (Chapter 8).

9.1.1 Results from the Assessment of Sites

The results from the assessment of the interest features identified whether the key qualifying features are potentially at low, low to medium, medium or high risk of LSE from the activities associated with the OREDP. The conclusions from the assessment identified that, taking into account the mitigation measures listed in Chapter 8, none of the interest features are at high risk of LSE, although some interest features are at medium risk of LSE. The interest features that were identified at being at medium risk of LSE include:

Habitats (SAC and SPA sites):

- Sandbanks which are slightly covered by sea water all the time
- Reefs

Marine Mammals (SAC sites):

- Grey seal (Halichoerus grypus)
- Harbour (Common) seal (Phoca vitulina)
- Harbour porpoise (Phocoena phocoena)
- Bottlenose dolphin (Tursiops truncatus)

Birds (SPA sites)

- Red-throated Diver
- Black-throated Diver
- Great Northern Diver
- Mediterranean Gull
- Slavonian Grebe
- Storm Petrel
- Leach's Storm-petrel
- Breeding Cormorant
- Breeding Shag
- Breeding Puffin
- Breeding Razorbill
- Breeding Black Guillemot
- Breeding Guillemot
- Breeding Manx Shearwater
- Breeding Gannet

The sites where these interest features are present and the OREDP Assessment Area that the sites are linked to or are associated with are summarised in Table 9.1 below.

Table 9.1 Medium High Risk Sites and Qualifying Features present with SACs

Name of SAC	Qualifying Feature at Medium Risk	Location with respect to OREDP Assessment Area
Lambay Island	▪ Grey Seal	**Area 1**
Long Bank	▪ Sandbanks which are slightly covered by sea water all the time	**Area 2**
Lady's Island Lake	▪ Reefs	**Area 2**
Wicklow Reef	▪ Reefs	**Area 2**
Carnsore Point	▪ Reefs	**Area 2 and Adjacent to Area 3**
Saltee Islands	▪ Reefs ▪ Grey Seal	**Adjacent to Area 2 and within Area 3**
Hook Head	▪ Reefs	**Area 3**
Donegal Bay (Murvagh)	▪ Common Seals	**Within 30km from Areas 6**
Roaringwater Bay and Islands	▪ Cetaceans ▪ Reefs ▪ Grey Seal	**Area 4**
Valencia Harbour/Portmagee Channel	▪ Reefs	**Area 4**
Kenmare River	▪ Reefs ▪ Common Seal	**Area 4**
Lough Hyne Nature Reserve and Environs	Reefs	**Area 4**
Glengarriff Harbour and Woodland	▪ Common Seals	**Adjacent to Area 4**
Blasket Islands	▪ Reefs ▪ Grey Seal	**Area 4 and Adjacent to Area 5**
Tralee Bay and Magharees Peninsula, West to Cloghane	▪ Reefs	**Area 5**
Duvillaun Islands	▪ Reefs ▪ Grey Seal	**Area 5**
Mullet/Blacksod Bay Complex	▪ Reefs	**Area 5**
Black Head-Poulsallagh Complex	▪ Reefs	**Area 5**
Inishmaan Island	▪ Reefs	**Area 5**
Inishmore Island	▪ Reefs	**Area 5**
Slyne Head Islands	▪ Reefs ▪ Grey Seals	**Area 5**
Lower River Shannon	▪ Estuaries ▪ Cetaceans ▪ Sandbanks which are slightly covered by sea water all the time ▪ Reefs	**Area 5**

Name of SAC	Qualifying Feature at Medium Risk	Location with respect to OREDP Assessment Area
Magharee Islands	▪ Reefs	**Area 5**
Kerry Head Shoal	▪ Reefs	**Area 5**
Kilkieran Bay and Islands	▪ Reefs ▪ Common Seal	**Area 5**
Carrowmore Point to Spanish Point and Islands	▪ Reefs	**Area 5**
Inishkea Islands	▪ Grey Seals	**Area 5**
Clew Bay Complex	▪ Common Seal	**Area 5**
Inishbofin and Inishshark	▪ Grey Seals	**Area 5**
Achill Head	▪ Reefs	**Area 5**
Kilkee Reefs	▪ Reefs	**Area 5**
Carrowmore Dunes	▪ Reefs	**Area 5**
Galway Bay Complex	▪ Reefs ▪ Common Seal	**Adjacent to Area 5**
Connemara Bog Complex	▪ Reefs	**Within 30km of Area 5**
Broadhaven Bay	▪ Reefs	**Area 6, Adjacent to Area 5**
West of Ardara/Maas Road	▪ Common Seal	**Area 6**
Rathlin O'Birne Island	▪ Reefs	**Area 6**
Slieve League	▪ Reefs	**Area 6**
Horn Head and Rinclevan	▪ Grey Seal	**Area 6**
Slieve Tooey/Tormore Island/Loughros Beg Bay	▪ Grey Seal	**Area 6**
Rutland Island and Sound	▪ Reefs ▪ Common Seal	**Area 6**
Tory Island Coast	▪ Reefs	**Area 6**
Mulroy Bay	▪ Reefs	**Area 6**
Gweedore Bay and Islands	▪ Reefs	**Area 6**
Cummeen Strand/Drumcliff Bay (Sligo Bay)	▪ Common Seals	**Adjacent to Area 6**
Killala Bay/Moy Estuary	▪ Common Seals	**Adjacent to Area 6**
Ballysadare Bay	▪ Common Seals	**Adjacent to Area 6**
Strangford Lough	▪ Grey Seal	**Greater than 30km from all Areas**
Rathlin Island	▪ Grey Seal	**Greater than 30km from all Areas**
Belgica Mound Province	▪ Reefs	**Marine**
Hovland Mound Province	▪ Reefs	**Marine**
South-West Porcupine Bank	▪ Reefs	**Marine**
North-West Porcupine Bank	▪ **Reefs**	**Marine**

Table 9.2 Medium High Risk Sites and Qualifying Features present in SPAs

Name of SPA	Qualifying Feature at Medium Risk	Location with respect to OREDP Assessment Area
Dundalk Bay	▪ Red-throated Diver ▪ Great Northern Diver	**Area 1**
Skerries Islands	▪ Breeding Cormorant	**Area 1**
Sandymount Strand/Tolka Estuary	▪ Mediterranean Gull	**Adjacent to Area 1**
Lough Cutra	▪ Breeding Cormorant	**Adjacent to Area 1**
Lough Scannive	▪ Breeding Cormorant	**Adjacent to Area 1**
The Raven	▪ Red-throated Diver ▪ Great Northern Diver ▪ Slavonian Grebe	**Area 2**
The Murrough	▪ Red-throated Diver	**Area 2**
Lady's Island Lake	▪ Mediterranean Gull	**Area 2 & Adjacent to Area 3**
Inish and Sgarbheen	▪ Mediterranean Gull	**Within 30km of Areas 2 & 3**
Helvick Head Coast	▪ Breeding Black Guillemot	**Area 3**
Keeragh Islands	▪ Breeding Cormorant	**Area 3**
Seven Heads	▪ Breeding Cormorant	**Area 3**
Mid-Waterford Coast	▪ Breeding Cormorant	**Area 3**
Beara Peninsula	▪ Breeding Shag	**Area 4**
Sheep's Head to Toe Head	▪ Breeding Shag	**Area 4**
Puffin Island	▪ Storm Petrel	**Area 4**
Skelligs	▪ Storm Petrel	**Area 4**
Basket Islands	▪ Storm Petrel ▪ Leach's Storm-petrel	**Area 4**
The Bull and The Cow Rocks	▪ Storm Petrel	**Area 4**
Deenish Island and Scariff Island	▪ Storm Petrel ▪ Breeding Manx Shearwater	**Area 4**
Castlemaine Harbour	▪ Red-throated Diver ▪ Great Northern Diver	**Adjacent to Area 4**
Mid-Clare Coast SPA	▪ Great Northern Diver	**Area 5**
Inishkea Islands	▪ Storm Petrel	**Area 5**
High Island (Galway)	▪ Storm Petrel ▪ Breeding Manx Shearwater	**Area 5**
Inishglora and Inishkeeragh	▪ Storm Petrel	**Area 5**
Duvillaun Islands	▪ Storm Petrel ▪ Breeding Cormorant	**Area 5**
Slyne Head Islands	▪ Storm Petrel ▪ Breeding Manx Shearwater	**Area 5**
Magharee Islands	▪ Breeding Cormorant	**Area 5**
Bills Rocks	▪ Storm Petrel	**Area 5**
Illaunonearaun	▪ Breeding Cormorant ▪ Breeding Shag ▪ Breeding Puffin	**Area 5**

Name of SPA	Qualifying Feature at Medium Risk	Location with respect to OREDP Assessment Area
Cliffs of Moher	▪ Breeding Razorbill ▪ Breeding Black Guillemot	**Area 5**
Inner Galway Bay	▪ Red-throated Diver ▪ Black-throated Diver ▪ Great Northern Diver ▪ Breeding Cormorant	**Adjacent to Area 5**
Inishmurray	▪ Storm Petrel	**Area 6**
Stags of Broad Haven	▪ Storm Petrel ▪ Leach's Storm-petrel ▪ Breeding Puffin	**Area 6**
Tory Island	▪ Storm Petrel	**Area 6**
Illanmaster	▪ Storm Petrel ▪ Breeding Puffin	**Area 6**
Inishduff	▪ Storm Petrel	**Area 6**
Rathlin O'Birne Island	▪ Storm Petrel	**Area 6**
Roaninish	▪ Storm Petrel ▪ Breeding Cormorant	**Area 6**
Aughris Head	▪ Breeding Razorbill ▪ Breeding Guillemot	**Area 6**
Ardboline Island and Horse Island	▪ Breeding Cormorant	**Adjacent to Area 6**
Killala Bay/Moy Estuary	▪ Red-throated Diver	**Adjacent to Area 6**
Blacksod Bay/Broadhaven	▪ Red-throated Diver ▪ Great Northern Diver	**Adjacent to Area 6**
Donegal Bay	▪ Red-throated Diver ▪ Black-throated Diver ▪ Great Northern Diver	**Adjacent to Area 6**
Glenveagh National Park	▪ Red-throated Diver	**Within 30km of Area 6**
Sheep Island	▪ Breeding Cormorant	**Greater than 30km from all Areas**
Outer Ards	▪ Breeding Manx Shearwater	**Greater than 30km from all Areas**
Copeland Islands	▪ Breeding Manx Shearwater	**Greater than 30km from all Areas**

9.1.2 Summary of Results from the Assessment of Sites

Based on the results above there are a number of sites located within Ireland and Northern Ireland where further work including surveys, assessments, monitoring and research would be required at a project level in order to determine the potential for LSE on the features of interest listed above and the overall integrity and conservation objectives of the site. In terms of the Assessment Areas identified in the SEA and the OREDP the following provides a summary of the relative number of sites (SACs and SPAs) where further assessment would be required at a project level.

Table 9.3 Number of Medium Risk Sites within Assessment Zones

Assessment Zones	Number of Medium Risk SAC (including sites within 30km)	Number of Medium Risk SPA (including sites within 30km)
1	1	**5**
2	4	**3**
3	2	**6**
4	6	**8**
5	20	**11**
6	14	**13**
Outwith Assessment Zones (30km from all zones)	**6**	**3**

The information presented within Table 9.3 above is based on sites that have been identified as being of medium risk (or above) of LSE from the activities associated with the OREDP. There are also a number of sites containing interest features that have been identified as being of low to medium risk of LSE from activities associated with the OREDP. Most of these sites are similar to those listed above. However, it will still be necessary at a project stage for all possible sites and interest features to be reviewed as part of more detailed assessments to ensure no sites have been omitted. This will be of particular importance where there is ongoing designation of new sites, some of which may not have been included in this assessment, but may be proposed or designated as individual offshore renewable energy projects are brought forward during the timescale of the plan (by 2030 with reviews at 2015 and 2020).

10 In-Combination Effects

10.1 Introduction

Due to the strategic nature of the plan the assessment of in-combination effects should be aimed at the same level. Attempting to identify potential in-combination affects with all plans and projects at this stage without spatial information would be inappropriate. Therefore the assessment has considered in-combination effects with other plans that are of a similar spatial nature. For this reason the plans that have been considered at this stage are as follows:

- Northern Ireland Offshore Renewable Energy Strategic Action Plan (ORESAP)
- The Crown Estate Scottish Offshore Wind Licensing Round.
- The Crown Estates Offshore Wind Licensing Rounds 1, 2 and 3 including extensions to Rounds 1 and 2.
- Department of Energy and Climate Change UK Offshore Energy SEA 2 (OESEA2)
- Potential developments in Isle of Man Waters
- Petroleum Affairs Division - Ireland Offshore Strategic Environmental Assessments (IOSEAs) 1-4

There is the potential for in-combination effects with other plans and projects such as the County and Local Development Plans and infrastructure projects. In this instance in-combination effects could result as a consequence of the terrestrial sections of the associated infrastructure for offshore devices on the coastal protected sites. A list of these development plans has been listed in Appendix E and should be referred to, and updated, as part of the project level Appropriate Assessment.

Given the high level nature of the OREDP and the fact that policy is still evolving and that decisions around whether or not to pursue many actions is open with no definitive decision one way or the other, an action on in-combination effects has been built in to the mitigation measures. The action is that:

"As policy develops and evolves, as the OREDP is implemented, any decisions around levels of development to be pursued and around future foreshore consenting policy, particularly if it is decided to instigate a foreshore leasing round, will take into account in-combination effects. At a project level, the assessment of in combination effects will be an obligatory part of the award of a foreshore lease. The state bodies identified in Action 1 undertake to consider in-combination effects in their decision making as policy evolves. Consultation and liaison between relevant Government Departments nationally and with state bodies in Northern Ireland, Isle of Man and mainland UK will be undertaken and maintained as policy develops, including through such structures as the British Irish Council marine energy sub-group. In-combination effects will be considered as part of the initial review in 2015 of the OREDP and the full review in 2020 in light of policy development in the interim".

10.1.1 Northern Ireland Offshore Renewable Energy Strategic Action Plan (ORESAP)

The greatest potential for in-combination effects with this plan is associated with future development within Assessment Areas one and six which boarder Northern Ireland territorial waters. Table 10.1 below identifies the main sites within these Assessment Areas containing interest features that, based on the results from the assessment in Chapter 8, are at medium risk of LSE from activities associated with the OREDP.

Table 10.1: Sites in Assessment Areas 1 and 6 where there could be in combination effects with developments taken forward under the Northern Ireland ORESAP.

Designation	Area 1	Area 6
SAC	▪ Rogerstown Estuary SAC ▪ Strangford Lough SAC ▪ Dundalk Bay SAC ▪ Boyne Coast and Estuary SAC ▪ Lambay Island	▪ West of Ardara/Maas Road SAC ▪ Dundalk Bay SAC ▪ Ballysadare Bay SAC ▪ Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC ▪ Ballyness Bay SAC ▪ Lough Swilly SAC ▪ Broadhaven Bay ▪ West of Ardara/Maas Road ▪ Rathlin O'Birne Island ▪ Slieve League ▪ Horn Head and Rinclevan ▪ Slieve Tooey/Tormore Island/Loughros Beg Bay ▪ Rutland Island and Sound ▪ Tory Island Coast ▪ Mulroy Bay ▪ Gweedore Bay and Islands ▪ Cummeen Strand/Drumcliff Bay (Sligo Bay) ▪ Killala Bay/Moy Estuary ▪ Ballysadare Bay
SPA	▪ Dundalk Bay SPA ▪ Sandymount Strand/Tolka Estuary SPA ▪ Lough Cutra SPA ▪ Lough Scannive SPA ▪ Skerries Islands SPA	▪ Killala Bay/Moy Estuary SPA ▪ Blacksod Bay/Broadhaven SPA ▪ Glenveagh National Park SPA ▪ Stags of Broad Haven SPA ▪ Tory Island SPA ▪ Illanmaster SPA ▪ Inishduff SPA ▪ Rathlin O'Birne Island SPA ▪ Roaninish SPA ▪ Aughris Head SPA

This table is not exhaustive and should only be used as guide to those sites where there is the greatest potential for an in-combination effect with this plan when looking to develop in these assessment areas. Likewise when determining in-combination affects all sites where there is a risk of an effect whether that is high or low needs to be considered. Whilst the OREDP alone may not result in a significant effect when in-combination a significant effect may result.

10.1.2 The Crown Estate Scottish Offshore Wind Licensing Round.

This plan has the greatest for an in-combination effect with developments in assessment areas one and six and therefore the sites that are listed in Table 10.1 above. Whilst developments as a consequence of these plans will not be directly adjacent, siting will need to be considered in-combination in relation to the migratory routes of the interest features.

10.1.3 The Crown Estates Offshore Wind Licensing Rounds 1, 2 and 3 including extensions to Rounds 1 and 2 and the UK Offshore Energy SEA 2 (OESEA2)

These plans have the greatest potential for an in-combination effect with offshore renewable energy developments located off the east coast within Assessment Areas one, two and three. The sites within these Assessment Areas that contain interest features identified as being at risk of LSE from activities associated with the OREDP as identified in Chapter 8 of this report are listed in Table 10.2 below.

Table 10.2: Sites with potential for in-combination effects with the OESEA2

Designation	Area 1	Area 2	Area 3
SAC	▪ Rogerstown Estuary SAC ▪ Strangford Lough SAC ▪ Dundalk Bay SAC ▪ Boyne Coast and Estuary SAC ▪ Lambay Island	▪ The Raven ▪ The Murrough ▪ Long Bank ▪ Lady's Island Lake ▪ Wicklow Reef ▪ Carnsore Point	▪ Ballymacoda (Clonpriest and Pillmore) ▪ Ballyteige Burrow ▪ Bannow Bay ▪ Great Island Channel ▪ Courtmacsherry Estuary ▪ River Barrow and River Nore ▪ Blackwater River (Cork/Waterford) ▪ Saltee Islands ▪ Hook Head
SPA	▪ Dundalk Bay SPA ▪ Sandymount Strand/Tolka Estuary SPA ▪ Lough Cutra SPA ▪ Lough Scannive SPA ▪ Skerries Islands SPA	▪ The Raven ▪ Lady's Island Lake ▪ Inish and Sgarbheen ▪ The Murrough	▪ Inish and Sgarbheen ▪ Ballymacoda (Clonpriest and Pillmore) ▪ Ballyteige Burrow ▪ Bannow Bay ▪ Great Island Channel ▪ Courtmacsherry Estuary ▪ River Barrow and River Nore ▪ Blackwater River (Cork/Waterford)

As with developments associated with The Crown Estates Scottish Offshore Wind Licensing Round, the main potential in-combination effects relate to potential effects of offshore renewable energy developments on habitat exclusion and direct effects such as increase collision risk as well as the creation of barriers to movement along migratory routes and between feeding and breeding areas. This is of particular importance for developments along the east coast which acts as a corridor north south between the Irish Sea and waters around Northern Ireland, Scotland and South West England. Potential effects on migration routes will need to be assessed in more detail as individual projects are taken forward.

10.1.4 Potential Developments in Isle of Man Waters

Siting of offshore renewable energy arrays may lead to impacts with the Isle of Man territorial waters. Project level assessments will need to take into account any site specific proposals which might border Isle of Man territorial waters. Impacts on habitats and species (including basking sharks and cetaceans) particularly those within Isle of Man waters which may be affected by devices bordering Isle of Man territorial waters will need to be considered by any projects seeking to develop in that area. Fisheries and shipping are also relevant considerations. In combination effects relating to developments taking place in or near Isle of Man waters will need to be part of project developers' assessments.

10.1.5 Petroleum Affairs Division -- Ireland Offshore Strategic Environmental Assessments (IOSEAs) 1-4

Table E.2 in Appendix E details which of the IOSEAs has the greatest potential for in-combination effects with each of the assessment areas. Whilst all of the assessment areas have potential for in-combination effects with at least one of the IOSEAs assessment area five has been identified as having the greatest potential for in-combination effects with three out of the four IOSEAs. Therefore whilst all future offshore developments will need to be considered in-combination with development in the IOSEA areas in particular with regards to migratory routes significant assessment will need to be undertaken when considering future development within assessment area five.

11 Conclusion

11.1 Limitations to the Assessment

There are a number of limitations that influence the overall conclusions discussed below. These include:

- Lack of information or detail on the precise location of future developments
- Lack of information or detail on the type of development that is likely to occur in certain locations e.g. type of devices deployed, scale of development, configuration, distance from shore, water depth, method of attachment to the seabed, proportion of development located below the water surface and above the water surface.
- Limited knowledge/understanding on the interactions between marine mammals and seabirds (in particular diving birds and pursuit feeders) and offshore renewable energy developments.
- Gaps in data and knowledge on migration routes for certain species of marine mammal and fish and the location of offshore foraging and loafing areas (birds).

11.2 Summary of Results from the Assessment

Taking into account the limitations identified above, the results from the assessment presented in Chapter 8 identified the following features of interest to be at medium risk of LSE from the activities associated with the OREDP:

Habitats (SAC and SPA sites):

- Sandbanks which are slightly covered by sea water all the time
- Reefs

Marine Mammals (SAC sites):

- Grey seal (Halichoerus grypus)
- Harbour (Common) seal (Phoca vitulina)
- Harbour porpoise (Phocoena phocoena)
- Bottlenose dolphin (Tursiops truncatus)

Birds (SPA sites)

- Red-throated Diver
- Black-throated Diver
- Great Northern Diver
- Mediterranean Gull
- Slavonian Grebe
- Storm Petrel
- Leach's Storm-petrel
- Breeding Cormorant
- Breeding Shag
- Breeding Puffin
- Breeding Razorbill

- Breeding Black Guillemot
- Breeding Guillemot
- Breeding Manx Shearwater
- Breeding Gannets

These features of interest were identified as being present in a number of sites located within the main Assessment Areas, or adjacent to, in Irish waters and adjacent Northern Ireland waters. The total number of sites containing interest features that were identified as being at risk from LSE are summarised in Table 11.1 below.

Table 11.1: Number of Medium Risk Sites within Assessment Zones

Assessment Zones	Number of Medium Risk SAC (including sites within 30km)	Number of Medium Risk SPA (including sites within 30km)
1	1	**5**
2	4	**3**
3	2	**6**
4	6	**8**
5	20	**11**
6	14	**13**
Outwith Assessment Zones (30km from all zones)	**6**	**3**

11.3 Conclusion

In conclusion, at this stage in the assessment, due to the limitations discussed above, it is not possible to conclude at a strategic level that there would be no LSE on the features of interest listed above or the integrity and conservation objectives of the sites containing these interest features. Taking this into account it is necessary for the OREDP to include specific measures as identified in Chapter 7 requiring developers to **comprehensively demonstrate at the project level that there would be no LSE on the integrity and conversation of objectives of a Natura site**.

Depending on the location and type of individual developments, this is likely to involve detailed surveys, tagging and monitoring exercises, more detailed assessments and further research, as well the implementing a number of project level mitigation measures listed in Chapter 7. If at the project level it is not possible to ascertain that there would be no LSE on the integrity and conversation objectives of Natura site where the interest features listed above are present, or developers are unable to clearly demonstrate how specific mitigation measures would be implemented to avoid LSE on marine mammals, then individual projects would not be permitted to be taken forward unless it was demonstrated that there were Imperative Reasons of Overriding Public Interest (IROPI). This is reflected in the actions included in the OREDP.