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Strategic Environmental Assessment (SEA) of the Offshore Renewable Energy Development Plan (OREDP) in the Republic of Ireland

Environmental Report Volume 4: Appendices

October 2010

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Appendix A
Seascape Assessment

Introduction

This Appendix considers the potential effects that off shore wind, wave and tidal devices could have on the seascape resource of the study area. It describes the key components, features and characteristics that make up the various strategic seascape types found within the study area. It refers to statutory designations relating to landscape value and considers the implications of wind, wave and tidal development in terms of potential effects on key seascape components and features. It considers at a strategic level which areas of the Irish seascape (within the study area), are likely to be least sensitive to the visual effects of wind, wave and tidal device characteristics and consequently most appropriate for locating this type of marine renewable energy.

A seascape can be described as a discreet area containing a seaward component, a coastline component and a landward component. It can be defined as '*the coastal landscape and adjoining areas of open water, including views from land to sea, from sea to land and along the coastline*[1]'.

Seascape character is made up of physical characteristics of hinterland, coast and sea as well as a range of perceptual responses to the seascape. Seascape effects are the changes in the character and quality of the seascape as a result of a development. Seascape assessment is, therefore, concerned with the direct and indirect effects upon specific seascape components and features, the more subtle effects on seascape character and the effects upon designated landscapes.

Seascape Methodology

Scope of the Assessment

This section provides an explanation of the approach taken to strategically assess the effect of wind, wave and tidal devices on the seascape resource of the study area. It should be noted that this section does not consider the potential effects associated with the ancillary land based components of wind, wave and tidal devices, such as transmission lines, sub stations, roads and tracks, as these are covered in Chapter 7 Technologies. The following description does not replace the SEA assessment method presented in Chapter 6 Assessment Method, but simply provides further description of the specific approach applied to the seascape assessment.

Due to the strategic nature of this study the seascape assessment has been undertaken by desk study only. However, additional survey work was carried out during the seascape familiarisation site visits (refer to Section 7 for further details). These helped to inform the threshold of visibility of the device characteristics considered and also to enable the assessment team to experience in the field the complex and varying nature of the Irish seascape by visiting different locations.

The study area looks at Irish waters. For the purposes of the seascape assessment a 10km landward extent has been considered as proposed in the SNH Commissioned Scott *et al* (2005) study.

Seascape Guidance / Good Practice

The seascape assessment has been prepared with reference to a number of guidance documents, primarily the DTI Guidance on Seascape and Visual Impact Assessment of Offshore Wind Farms[2] the Scottish Marine Renewables SEA, 2007[3], UK Offshore Energy SEA 2009[4], SEA of Offshore Wind and

[1] Guidance on the Assessment of the Impact of Offshore Wind Farms. Seascape and Visual Impact Report. (DTI, November 2005)
[2] Guidance on the Assessment of the Impact of Offshore Wind Farms. Seascape and Visual Impact Report. (DTI, November 2005)
[3] Scottish Marine Renewables Strategic Environmental Assessment 2007, Scottish Executive,
4 UK Offshore Energy Strategic Environmental Assessment 2009, DTI

Marine Renewable Energy in Northern Ireland [5], Welsh Seascapes and sensitivity to Offshore Development 2009[6], and the Scott *et al* Assessment of the Sensitivity and Capacity of the Scottish Seascape in relation to Offshore Wind Farms[7]. Reference has also been made to the Guide to Best Practice in Seascape Assessment (Hill *et* al., 2001)[8].

It should be noted that none of the seascape assessment guidance currently available relates to wave and tidal devices. The DTI Guidance does, however, seek to encourage consistency and good practice in seascape assessment and combined with the Scottish Marine Renewables SEA, 2007 and the Northern Ireland Offshore Renewables 2009, has provided a useful reference when refining the strategic approach adopted to seascape assessment in relation to wave and tidal devices.

Seascape Assessment Process

The flow diagram presented in Figure 2.1 provides an indication of the various stages followed in the seascape assessment process. This recognised approach has been adapted from the above DTI guidance and uses the good practice guidance for landscape assessment contained in the Guidelines for Landscape and Visual Impact Assessment (GLVIA), published by the Landscape Institute and the Institute of Environmental Management and Assessment in 2002.

Further details of the seascape assessment process are contained throughout this chapter as the results associated with the various stages of the assessment process are explained.

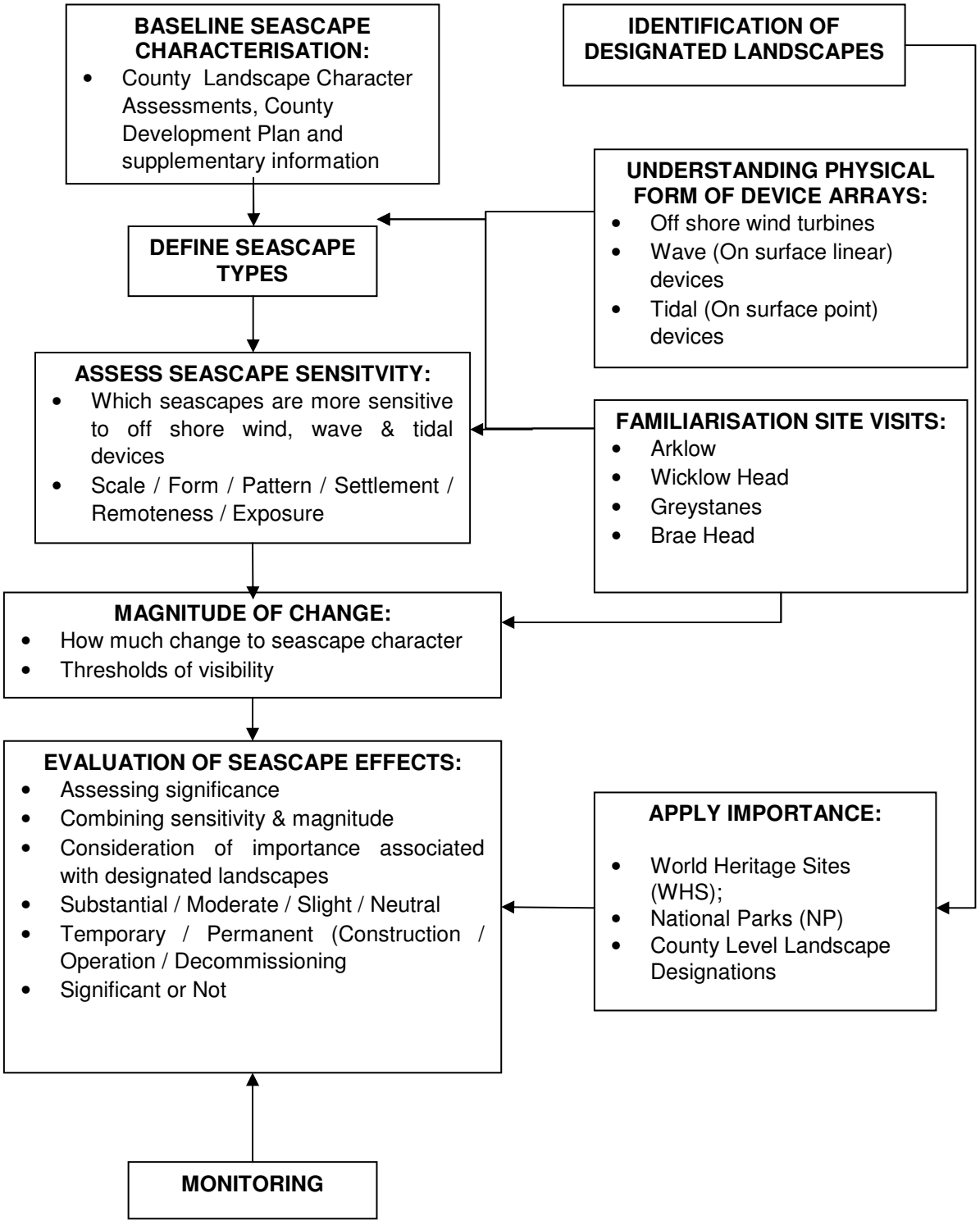
[5] SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009.

[6] Welsh Seascapes and sensitivity to Offshore Development, Countryside Council for Wales, 2009

7 Scott, K.E., Anderson, C. and Benson, J.F. (2005). An Assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms. Scottish Natural Heritage Commissioned Report No. 103 (ROAME No. F03AA06)

[8] Hill, M. *et al*. (2001) Guide to Best Practice in Seascape Assessment. Countryside Council for Wales

Figure A.1 Overview of key stages in seascape assessment process



Visual Impacts

Development can change people's direct experience and perception of the landscape/seascape depending on the existing context, the scale, form, colour and texture of the proposals, the nature of activity associated with the development and the distance and angle of view. However, for there to be a visual impact there is the need for a viewer, usually referred to as a receptor. Receptors can include residential properties, workplaces, recreational facilities, road users, pedestrians and other outdoor sites and viewpoints which would be likely to experience a change in existing view as a result of a development.

GLVIA acknowledges a relationship between the perception of landscape/seascape character and the experience of viewers or receptors. Although procedurally linked, they are separate and distinct assessments. Visual assessment differs from the assessment of potential changes to the landscape or seascape character in that it assess the change in relation to a specific development to a view from an identified viewpoint.

Given the strategic nature of this assessment it has been considered that it is not possible to effectively assess potential visual impacts associated with the device arrays as changes to visual amenity are a direct response to receptor locations. At a strategic level it is not possible to identify receptors (number or type) with any level of certainty therefore selected viewpoints are unlikely to be representative over a wider area. Furthermore the potential locations of developments in relation to a receptor will range widely from the nearest to the furthest point within each resource area. Visual assessment from selected viewpoints at a strategic level would therefore be likely to result in a range of effects (from substantial to neutral for each viewpoint) and would consequently not provide meaningful information for the SEA. Consequently visual impacts associated with the installation and operation of off-shore wind, wave and tidal devices within the study area have not been considered as part of this SEA.

Visual impact assessment is an important part of the EIA process and a full visual impact assessment should be undertaken when considering project specific off shore wind, wave and tidal developments. Visibility and key views of the sea from the landward, coastline and seaward components of the seascape should be identified and analysed as part of the visual impact assessment. Receptors are likely to be both land and marine based and could include the following:

Land Based

Residents;
Visitors/tourists;
Views from footpaths, cycleways and bridleways;
Other outdoor recreation e.g. fishing, bird watching, golf, swimming etc;
Coast road users;
Minor road users;
Arterial/trunk road users;
Rail passengers; and
Industrial and commercial activities.

Marine Based

Yachts and inshore recreational boating;
Water base recreation e.g. surfing, wind surfing, sea kayaking, and sea angling;
Competitive or high speed water sports e.g. jet skiing, speed boating;
Passenger ferries;
Commercial shipping and fishing vessels; and
Extractive oil or gas.

The above receptors have been broadly listed to reflect the decreasing sensitivity[9] for example views from residential properties are more sensitive than views from industrial or commercial activities. Equally views experienced from yachts and inshore recreational boating are more sensitive than views from commercial shipping and fishing vessels.

[9] Guidance on the Assessment of the Impact of Offshore Wind Farms. Seascape and Visual Impact Report. (DTI, November 2005)

Various ambient conditions will affect the visibility of a device from the receptor and will include factors such as distance, direction and angle of view to the device, time of day, season, light and prevailing weather.

Device Characteristics

Devices have been grouped by characteristics relevant to the assessment of seascape effects and these are described below. Reference should be made to Chapter 7 of this report for further information on offshore energy technology.

Wave (On Surface Linear) Devices

- Wave devices in open water;
- Between 2 and 14 m in height above the water surface; and

Commercial arrays comprising up to 6.5 km2.

Oscillating Wave Surge Devices

- Connected to an onshore generator comprising a fixed structure
- Oscillating submerged structure in water depths of 10 -15m
- The submerged structures will be intermittently visible as they break the surface,
- Visible components of the semi submerged structures are likely to be linear in appearance
- Commercial arrays comprising up to $2km_2$

Wave or Tidal (On Surface Point) Devices

- Wave or tidal devices in open water;
- The extent of protrusion above the sea surface would vary considerably, with the smallest visible element comprising marker buoys and lighting beacons, ranging to vertical structure up to 14 m in height;

Typical arrangements for wave devices are difficult to predict. For example a point absorber, which usually comprises buoys moored to the seabed, may have moorings that spread out over a significant distance thereby increasing the separation between devices in the array. For the purposes of this assessment the following arrangement has been considered: an array of approximately 50-100 tidal devices, generating 100-200 MW, in coastal water would be expected to occupy 1-2 km2.

Off Shore Wind Devices:

- Wind turbines in open water;
- Typically consisting of 3-5 MW turbines (height to blade tip approximately 80-120 m); and
- Typical arrangements would comprise approximately 300 MW array (60 turbines) of 30km2.

It is important to note that the device features could change as the technology develops and should therefore not be considered as being definitive. The exact geometry of the array will also vary from location to location and will be very site and device specific. Also as the technology develops the footprint of individual devices could extend, corresponding to the increase in energy output.

Baseline Environment

This section describes the key components, features and characteristics that make up the various strategic seascape types found within the study area. It refers to statutory designations relating to landscape value. A seascape can be described as a discreet area containing a seaward component, a coastline component and a landward component. It can be defined as 'the coastal landscape and adjoining areas of open water, including views from land to sea, from sea to land and along the coastline[10]'.

Seascape character is made up of physical characteristics of hinterland, coast and sea as well as a range of perceptual responses to the seascape. Seascape effects are the changes in the character and quality of the seascape as a result of a development. Seascape assessment is, therefore, concerned with the direct and indirect effects upon specific seascape components and features; the more subtle effects on seascape character and the effects upon designated landscapes.

Data Sources

The first stage in defining seascape character types at a national scale (to reflect the strategic nature of this study), involved reviewing the available Landscape Character Assessments (LCAs) commissioned and published by Irish County Councils. This review was informed by a document commissioned by the Heritage Council of Ireland: Landscape Character Assessment (LCA) in Ireland: Baseline Audit and Evaluation 2006 and the 2010 update to this report. The baseline audit set out a review and appraisal of Landscape Character Assessments in Ireland in relation to DoEHLG[11] Guidelines and European best practice. The audit looked at the quality, detail, relevance and availability of landscape character assessments in Ireland. The key findings of the report identified the considerable variation in content, length, presentation and methodology of available LCAs in Ireland. This has a significant bearing on the extent of usable baseline information to inform the seascape assessment for the SEA. Key sources are detailed in **Table A.15 Landscape Character Assessment Review** and section **6 References** at the end of this report.

Confidence Levels

Based on the criteria and assessments set out in the Baseline Audit and Evaluation report, confidence levels for the currently available Irish LCAs within the study area were established. This enabled a judgement to be made on where adequate baseline information existed. The Confidence Levels are set out below and presented in **Table A .1**.

Table A.1 Landscape Character Assessment Confidence Levels

Landscape Character Assessment Confidence Levels	Very Low	Minimal or no landscape information available; no assessment has taken place.
	Low	Some landscape information is available; a partial or poor quality landscape character assessment has taken place.
	Medium	Landscape character assessment is available but may be outdated or lack detail.
	High	Landscape character assessment is available that meets contemporary standards and best practice.

The amount of information describing the coastal or seascape character within the different LCAs also varies considerably. Therefore in order to aid the identification of data gaps an assessment of confidence levels in relation to coastal or seascape information was derived during the process of review. These confidence levels are outlined below in **Table A.2**.

[10] Guidance on the Assessment of the Impact of Offshore Wind Farms. Seascape and Visual Impact Report. (DTI, November 2005)

[11] Department of Environment, Heritage, and Local Government, Ireland

Table A.2 Seascape / Coastal Information Confidence Levels

Seascape / coastal information Confidence Levels	Very Low	No coastal landscape or seascape assessment has taken place; Minimal or no seascape or coastal landscape information available.
	Low	A partial or poor quality landscape assessment has taken place that includes some minimal coastal information.
	Medium	A coastal landscape or seascape character assessment is available but may be outdated or lack detail.
	High	Relevant coastal landscape and/ or seascape character assessment available that meet contemporary standards.

Information on baseline data **and confidence levels** used in this assessment can be found in Appendix A **Table A.15. Landscape Character Assessment Review**

Defining Seascape Types

The audit identified the existence of forty nine separate landscape character assessments split over nine counties within the SEA study area. These were all reviewed in order to extract information on the coastal character of the study area and confidence levels applied to ascertain the validity of the data (refer to **Tables A.1 and A. 2**). Where existing Seascape Assessments are available these were also reviewed and confidence levels applied. Whilst the majority of these LCAs defined coastal types or areas on the basis of the characteristics of the coastline, rather than the character of the marine element or relationship of land and sea, sufficient information on coastal character was generally available to form the basis of defining seascape character types across the study area.
Where either Landscape Character Assessments are not available or where the Confidence Levels were considered to be 'Very Low' alternative source material was reviewed to ascertain the characteristics of the coastal landscape to enable the data gaps to be filled and seascape character types to be defined. This is explained further in section 3.4 below.

The many defined coastal landscape character types from the LCA review were then grouped according to shared characteristics. The geographical spread of these dominant characteristics was evaluated in conjunction with aerial photographs and Ordinance Survey maps of the study area. These new groupings of amalgamated and slightly simplified coastal types were then reviewed in the context of their relationship with coastline and sea to formulate ten draft seascape types with shared dominant characteristics. These seascape types are presented on **Figure 9.7.1.**

In defining the seascape types it was important that the strategic scale of the assessment was considered. Ireland has a dramatic, varied and constantly changing coastline. Broad judgements have had to be made regarding the component parts of each seascape and a rationale developed in order to generalise and hence incorporate minor character areas set within a generic description of seascape type. Consequently, where a seascape has been deemed for example, to be Seascape Type 6 - Complex Indented Coast, Small Bays and Offshore Islands, there may be the occasional occurrence of a larger bay within the coastline. At a strategic level, this level of detail cannot be mapped without detracting from the clarity of baseline understanding of the study area.

Data Gaps

Where either no Landscape Character Assessments are available (Donegal, Sligo, Kerry and Waterford) or where the applied Confidence Levels were considered to be 'Very Low' alternative source material was reviewed to understand the characteristics of the coastal landscape to enable the data gaps to be filled and seascape character types to be defined.

In such instances a desk based assessment was undertaken drawing on development plan information, aerial photographs, OS maps and descriptions of nature conservation designations. The coastal characteristics of the four remaining counties were then determined based on this information and seascape types were subsequently defined. It is recognised that the confidence in these judgements is lower than where Landscape Character Assessment information is available as the LCAs are derived from detailed site based analysis. Due to the strategic nature of this appraisal it is not feasible or appropriate to undertake site survey of these areas. Further information on baseline

data used in this assessment can be found in Appendix A **Table A.15 Landscape Character Assessment Review.**

Baseline Description

Ireland has a long coastline that varies from deeply incised bays and loughs, high cliffs, and offshore islands (west coast), river estuaries, sweeping sandy bays (south) to rocky headlands and low lying linear beaches backed by dunes (east coast).
Much of the west coast is exposed and dramatic with mountainous hinterlands interspersed with the low plains and drumlin landscapes. Settlement is often sparse and scattered out with urban areas. The south and east coasts of Ireland consist mainly of low undulating or flat fertile agricultural land with a higher density of scattered development along with areas of dense urban character arround the coastal towns and cities. Along sections of the east coast the coastal edge is divided from the hinterland by road or rail infrastructure.

The following **Table A.3** seascape Types provides a description of the eight different seascape types contained within the study area as illustrated on **Figure 9.7.1 Irish Seascape Types**. Further information on these seascape types can be found in **Appendix A, Table A.3, Irish Seascape Types**.

Table A.3 Seascape Types

Seascape Type	Location	Physical Characteristics	Quality of Experience
1. Large Open or Partially Open Sea Lough with Raised Hinterland	Lough Foyle (Donegal), Lough Swilly (Donegal), Clew Bay (Mayo), Galway Bay (Galway and Clare) , Mouth of the Shannon (Clare and Kerry) and Carlingford Lough (Louth)	This seascape type comprises large scale sea loughs associated low-lying coastal plain, raised hinterland and headlands. Sea Loughs are typically contained within broad flat bottomed valleys enclosed by raised hinterland with a low lying coastal fringe. Tidal mudflats can be a common component of the seascape. Settlement can vary, the hinterland can comprise low lying agricultural land with scattered rural settlement, and elsewhere dense urban development is concentrated around the head of the sea loughs. Ports and harbours are sometimes located at the Lough heads with associated urban or industrial development.	Large scale open views along windswept low lying shorelines are contained by landmass. Long smaller scale contained views to the open sea framed by headlands are gained from Lough shores. Where there is an absence of urban development, truncated views along the Lough to the open sea give a wild open vista. There are often long views along the Loughs out to the open sea from the raised hinterland.

Seascape Type	Location	Physical Characteristics	Quality of Experience
2. Rugged Peninsulas with drowned valleys	Brandon Head (County Kerry) to Mizen Head (County Cork)	The steep exposed wild coastline with long peninsulas, sounds and islands provides a range of seascape scales and dramatic sea views ranging from small scale tranquil inner loughs and bays to rugged headlands with expansive open views. Long rugged hilly or mountainous ridges are separated by large 'V' shaped drowned valleys narrowing towards the valley head. The outer bay seascape is exposed with rocky promontories and islands. Inner bays are sheltered with numerous small islands and fertile and low lying land sloping down to the shore, scattered farmsteads and scenic coastal roads. There is a deep water harbour with some industrial infrastructure at Bantry Bay.	Outer bays and peninsulas are exposed and dramatic with large scale views framed by headlands and islands. Inner bays are more tranquil with small scale views within and along the lough framed by landmass.
3. Low Lying Plateau Landscape	Hook Head to Rosslare Harbour (Wexford), Courtown to Loughlinstown (Wexford), Arklow Head/ Clogga to Rathdown (Wicklow)	This seascape type provides slightly elevated sea views from flat or low rolling open plateau landscape consisting primarily of agricultural land dropping abruptly at the coastal edge with low cliffs and narrow curving sandy bays with rocky headlands. Widespread ribbon commercial and housing development follow coastal roads along the east coast.	Open and expansive slightly elevated sea views from the coastal edge with low intervisibility from the hinterland in many areas and smaller scale views from bays framed by headlands.

Seascape Type	Location	Physical Characteristics	Quality of Experience
4. Low Lying Coastal Plain and Coastal Estuarine Landscape, Low lying Islands and Peninsulas	Benwee Head to Blacksod Bay (Mayo), Kilkieran Bay (Galway), Toe Head to Cross Haven (Cork), hook Head to Loch Garman (Wexford), Loch Garman to Kilmicheal Point (Wexford), Portmarnock to Dunany Point (Fingal, Meath and Louth), Greencastle to Kilough (Down NI)	This type of seascape is diverse and changeable, ranging from large to medium scale.. The seascape is exceptionally flat and often exposed with generally wide, open views extending far out to sea, often with a high degree of intervisibility between sea and land. Low lying open landscape, with coastal edges comprised of long sandy beaches or strands, sweeping bays, curved sandy beaches or in some instances the foreshore can be rocky and part fragmented, sloping gently upwards to meet the coastal flats beyond. The mouths of low lying with river estuaries sand, gravel or mud flats, salt marsh and shallow inner bays, large bays and flats are sometimes backed by dune systems or may be open to the low mainly agricultural hinterland. These low lying coastal strips may rise to a hinterland of rolling foothills separated from the shore by moorland or agricultural land. Each forms an attractive soft coastal edge typical to this seascape type. The open landscape frequently has an exposed character. Patterns of settlement within this seascape type are generally rural and scattered particularly on the west coast, with areas of ribbon tourism development and isolated housing along coastal roads on the south and east coast. There are some urban settlements at the head of shallow bays or inlets. This seascape type also includes flat or very low lying rolling complex islands and peninsulas consisting of moorland, semi natural or natural grassland with sparse settlement and rocky or boggy moorland.	Typical of this seascape type are wide vistas with extensive sea views with a high degree of intervisibility between land and sea. Where landmass is visible in the far distance this serves to heighten further the sense of scale and openness. The horizontal emphasis adds to the very large sense of scale with uninterrupted sea views creating an interplay of light sea and sky that forms an important component of the local landscape character. Along some linear sandy areas of the east coast intervisibility between the low hinterland and sea varies, where there are extensive dune systems visibility is often limited to a short distance inland.

Seascape Type	Location	Physical Characteristics	Quality of Experience
5. Narrow coastal strip with raised hinterland	Maghera to Killybegs (Donegal), Lambay (Louth)	This seascape is typified by the occurrence of a narrow, often inaccessible, coastal strip backed by raised beach and headlands with expansive elevated sea views from the higher ground. Often the coastline can be indented with a low narrow coastal strip rising to steep hinterland, headlands and incised bays. The landscape is exposed and rugged with scattered rural settlement; small linear developments follow road corridors or clustered adjacent to sheltered bays. In places the coastal strip is divided from the rising hinterland by transportation corridors.	This seascape type is open and expansive with many elevated dramatic views to sea from both the raised hinterland and coastal shelf. There is a sense of exposure to the elements and wildness. The large scale of the seascape is in places heightened by this steeply rising hinterland and elevated viewpoints.
6. Complex Indented Coastline with Small Bays and Offshore Islands	Malin Head to Dunaff Head (Donegal), Fanad Head to Maghera (Donegal), Blacksod bay to Kilkieran Bay (Mayo and Galway), and Arran Islands (Galway).	Typically this seascape contains a varied, complex and incised coastline with steep, undulating hinterland, small bays and cliffs. Pockets of shelter along the exposed coastline by small semi enclosed bays and rugged offshore islands. In some locations the hinterland consists of a drumlin landscape which rolls down to meet a deeply indented shoreline. Traditional settlements and small towns are located at sheltered bays and inlets, with more rural settlement scattered over exposed uplands. The topography of this type of seascape is visually dramatic with ever changing views of the sea.	Due to the complexity of the landform associated with this distinct seascape type, the experience and views continually change. The raised headlands and hinterland are rugged and exposed with some sense of remoteness in localised areas. There are long expansive vistas from raised hinterland and headlands framed by complex shoreline and island landmass. Within the drumlins, small bays and drowned valleys, views can be enclosed with sea framed by an undulating landscape. Here the experience is sheltered and more intimate. From within indented inlets, contained views scaled by landmass give a sense of tranquillity and calm. The associated off shore islands create a rugged profile in a mass of sea when viewed from the shore.

Seascape Type	Location	Physical Characteristics	Quality of Experience
7. Plateaus and High Cliffs	Inishowan Head to Malin Head (Donegal), Downpatrick Head to Benwee Head (Mayo), Loop Head Peninsula (Clare), Bray Head (Wicklow).	This is a wild, rugged and visually dramatic seascape. There is great vertical scale where often a high plateau landscape plunges abruptly to an incised coastal edge. Dramatic series of cliff faces present broken edge to the raised plateau landscapes. Below the cliffs the narrow coastal edge is typically low, flat and in places jagged, comprising a rocky mosaic, complete with rocky peninsulas and occasional small bays.	This seascape type is rugged and visually dramatic with open expansive and elevated views to the sea creating a sense of wildness. The interaction and interplay of weather and changing sea and sky form an integral part of the seascape character. The combination of exposure to the elements and vastness of scale contribute to a sense of drama within the seascape In some locations the plateau edge may be raised with limited views from the rural hinterland out to the open sea.
8. Large Bay	Donegal Bay (Donegal, Leitrim and Sligo), Ballyheigue, Tralee and Brandon Bay (Kerry), Cork Harbour to Loop Head (Cork and Waterford), Dublin bay (Dun Laoghaire) and Dundalk Bay (Louth).	Very large long sweeping bays often with sand dunes, expansive sands and tidal flats and rocky headlands. The scale of the seascape varies from medium to large with very long open views framed by landmass, both across the bay and out to the wide horizon of the open sea.	The effects of scale, light, and water in long uninterrupted vistas framed by landmass are important components of the seascape character within the bay area. The open and expansive long views from the inner shore are contained by views to headlands and distant shorelines creating a foreshortening effect looking across the bay, with long views out to the wide horizon of the open sea.
Type 9 Large River Estuary	Shannon Estuary (Clare, Limerick, Kerry)	Semi enclosed seascape bordered by low flat or rolling estuarine coastal fringe with mudflats and islands, the scale of the seascape varies from small to large with long open views across the estuary framed by landmass and out to the narrow horizon of the open sea. The broad slightly winding Shannon river estuary varies in width along its course widening out as it approaches the enclosing headlands of narrow river mouth. Low flat or rolling estuarine coastal fringe with mudflats and islands, rising to a rolling hinterland. Exposed	Large horizontal vistas enclosed by landmass. Islands and vertical elements such as built structures are visually prominent due to the low viewpoint and low profiles of distant shorelines. Commercial and industrial activities arround the Shannon estuary such as shipping, pylons and the power station at Money Point form dominant visual features.

		shorelines are interspersed with sheltered bays.	

Please refer to **Figure 9.7.1 Irish Seascape Types**

Protected Areas

For the purposes of the seascape assessment, importance has been addressed by reference to national, regional and local landscape designations. Absence of such a designation, however, does not infer a lack of quality or importance. Factors such as accessibility and local scarcity can render areas of nationally unremarkable quality, highly valuable as a local resource.

The following national landscape designations have been considered:

World Heritage Sites (WHS);and
National Parks

World Heritage Sites

The 1972 World Heritage Convention aims to protect the values of cultural or natural sites, which could deteriorate or, worse, disappear, often through lack of funding to preserve them. States Parties to the Convention contribute the necessary financial and intellectual resources to protect World Heritage sites.
There is one WHS within the study area identified in Chapter 9 Baseline **Fig 9.3.1 Protected Sites** and described below:

Skellig Micheal World Heritage Site

Location; Kerry

Skellig Michael was inscribed onto the World Heritage List by UNESCO in 1996 and is one of three World Heritage sites on the island of Ireland. The WHS designation was made in recognition of its outstanding cultural value as a very early monastic site and remote hermitage in an exceptional state of preservation. Skellig Michael is also internationally renowned as one of the most important sites for breeding seabirds in Ireland.

The Skelligs are steep rocky volcanic islands situated 12k south west of Inveragh Peninsula, County Kerry. The boundary of the WHS does not include the smaller, neighbouring island of Little Skellig or the surrounding sea area. The wild and dramatic setting of the ancient monuments is an integral part of the character and atmosphere of the WHS.

Potential World Heritage Sites

Nominations to the World Heritage List are based on a tentative list put forward by a national government. A tentative list is an inventory of those properties considered suitable on cultural and/or natural heritage criteria of outstanding universal value. Ireland's last official submission of a tentative list was in 1992. The following tentative list for Ireland was compiled by an internal Departmental committee in light of an advertised public consultation process:

Tentative List Ireland 2002

- Western Stone Forts
- Cashel
- Killarney National Park
- North West Mayo Boglands
- Clara Bog

- Burren
- Ceide Fields
- Clonmacnoise

The following locations are nominated for WHS designation
In 2009 the Department of the Environment, Heritage and Local Government published for consultation Ireland's draft Tentative List of potential nominees to the World Heritage List on the basis of the work of the Expert Advisory Group.

Draft Tentative List - Ireland 2009 (Alphabetical Order)

- The Burren
- Céide Fields and NW Mayo Boglands
- The Monastic City of Clonmacnoise and its Cultural Landscape
- Dublin - A Georgian City and its Literary Tradition
- Early Medieval Monastic Sites (Clonmacnoise, Durrow, Glendalough, Inis Cealtra, Kells and Monasterboice)
- The Royal Sites of Ireland (Cashel, Dún Ailinne, Hill of Uisneach, Rathcroghan Complex and Tara Complex)
- Western Stone Forts

National Parks

The term 'National Park' is reserved for areas that have not been materially altered by human exploitation and occupation and where species, geomorphological sites and habitats are of special scientific, educational and recreational interest or which contain a natural landscape of great beauty.

At the time of writing no definitive map information is available on the boundaries of Ireland's National Parks however, the following National Parks, noted in **Table A.4 National Parks**, may have coastal areas or significant sea views that contribute to the landscape character of the protected area:

Table A.4 National Parks

National Park	Location	Potential seascape or Coastal Elements
Glenvaeagh National Park	Donegal	There may be long views along the coast and out to sea from Derryveagh Mountains (Glenvaeagh National Park) situated inland from Donegal's west coast.
Ballycroy National Park	Mayo	Distant views of the coast may be possible from the Owenduff /Nephin Mountains (Ballycroy National Park).
Connemara National Park	Galway	Connemara National Park is situated at Diamond Hill and the Twelve Bens with views to the outer coast and islands including Ballynakil Harbour.
Burren Uplands National Park	Clare	The Burren Uplands National Park is located inland but may have long views to the coastline.
Killarney National Park	Kerry	Killarney National Park situated between Mangerton Mountain and the MacGillicuddy

		Reeks has distant views to the Kenmare River inner bay.
Wicklow Mountains National Park	Wicklow	There are potential long views to the coast and open sea from Wicklow Mountains National Park.

Designed Landscapes and Gardens

Due to the strategic scale of the assessment and the variation in detail and availability of information, the presence and value of designed landscapes have not been considered in this assessment but should be included as a consideration on a site specific basis.

Existing Developments and Proposals for Offshore Energy in Ireland

Existing developments and proposals for Offshore Energy in Ireland are discussed in detail in Chapter 9 along with **Figure 9.6.3**.

There is one existing offshore wind farm described below:

- Arklow Bank Wind Park located approximately 10 km off Arklow in County Wicklow consisting of 7 turbines.

There are several proposed wind farm developments listed below:

- Arklow Bank phase II (lease area granted) located approximately 10 km off Arklow in County Wicklow consisting of up to 200 turbines**;**
- Codling Wind Park (Phase II consent application submitted) located xxx km from the coast of Wicklow consisting of up to 200 turbines;
- Kish and Bray Banks (Dublin Array) (under application) located approximately 10km from Dun Laoghaire and Bray Head County Wicklow consisting of up to 145 turbines;
- Oriel Wind Farm (under application) located approximately 5-10 km off Ballagan Point County Louth consisting of up to 55 turbines; and
- Scerde Offshore Wind Farm (under application) located off the Galway coast consisting of up to 20 turbines.

There are is one wave energy test site and proposed test site for listed below

- Galway Bay Test Site located within Galway Bay, County Galway; and
- Bellmullet Test Site (proposed) located off the Bellmullet coast, County Mayo.

The following areas have been identified as Initial Development Zones (IDZ) for Offshore Energy Development[12]

- North Mayo (Wave Energy);
- West Clare (Wave Energy;
- North Kerry (Wave Energy); and
- East Wicklow (Tidal Energy).

Resource areas identified in this study are discussed in Chapter 8 of this report and illustrated on **Figure 11.4.**

[12] Initial Development Zones, To Focus On Realising Irelands Ocean Energy Potential, White paper MRIA 2010

County Level Landscape Designations

County Level landscape designations are very diverse in scale and format and therefore difficult to assess comparatively. These designations are identified below in **Table A.5 County Landscape Designations**. On shore landscape wind capacity studies available at a county level are have not been included in this baseline data as these studies are focused on the effects of land based wind development over wider geographic areas within which the coast and sea comprise a landscape component and therefore are not pertinent to the marine environment.

Table A. 5. County Landscape Designations.

County Level Designations	Designated Coastal Areas
Area Of Especially High Scenic Amenity – EHSA– (Donegal) The council apply the highest degree of protection to EHSA areas and seek to preserve views of special value and interest in particular between roads and the sea **Views and Prospects** – Protection of identified views and prospects	Identified views at the mouth of Lough Foyle and from high ground inland
	EHSA areas at Stroove, Inishowan Head and Culkeeny, identified views at Lough Foyle, Balbane Head and the coastal road north of Culdaff
	EHSA areas at headlands along the west coast with identified views at Malin Head, EHSA at Raghtin More mountain with identified coastal view.
	EHSA areas at the mouth of the Swilly Lough with identified views looking east along the coast
	EHSA area at Bloody Foreland, Cruet Island, Crohy Head and Dooey Point, multiple identified views from headlands
	EHSA areas including most coastal and mountain areas between Glengash Hill and Teelin, identified views from high points
	Identified **views** from headlands St John's Point, Doorin Point, and a sandy bay near Rossnowleagh
Areas of Outstanding Natural Beauty, - AONB- (Leitrim) These are the areas of highest quality landscape of natural beauty which the Council is committed to protecting. **Areas of High Visual Amenity- AHVA- (Leitrim)** These are highly scenic areas, although less sensitive than the highest level of local protection (Leitrim designation AONBs) **Outstanding Views and Prospects**	The Western Coastal area close to Tullaghan is protected as an **AONB** (Leitrim)**.**
	The Eastern Coastal Area is protected as an **AHVA** (Leitrim) ,
	Outstanding Views and Prospects are identified from the N15 looking north out to Donegal bay

County Level Designations	Designated Coastal Areas
Landscape Sensitivity (Sligo) **Normal Rural Landscape** with capacity to absorb a wide range of development **Sensitive Rural landscape** with an intrinsic scenic quality and low capacity to absorb development **Visually Vulnerable Landscape** with distinctive natural features and low capacity to absorb new development to which a high level of protection is applied **Scenic Routes** - identified routes with highly scenic views, the overall character of the scenic route has some protection	The hinterland and much of the coastal area is identified as **Normal Rural Landscape** with **Sensitive Rural Landscape** areas identified along the Donegal Bay coast along with Islands, some headlands and bays. The entire coastal edge is defined as **Visually Vulnerable Landscape**. The coastal roads N15, R292, N59 and R297 are identified as **scenic routes**
Landscape Sensitivity (Mayo) **Vulnerable:** defined as areas or principal features that create and sustain the character and distinctiveness of an area. **Sensitive** -Defined as landscape with a distinct homogenous character based on natural processes **Less sensitive -**Defined as: able to absorb development with limited views **Protected Views** of special amenity value or special interest **Highly Scenic routes** indicate public routes from which there are views of natural beauty and interest. Development between the road and foreshore, lakeside or riverside should be subject to strict visual criteria. **Scenic routes** indicate public routes from which there are views of natural beauty and interest. Development should not substantially alter the character of these views	The whole coastline of Mayo is defined as **Vulnerable** Landscape **Scenic Route** R314 Belderrig to Bunatrahir Bay There is a **Protected view** from the North coast of Mayo (near Behy). The area between western coastline and Beg Range the east is designated **Sensitive**. **Scenic Route**, R313 Bellmullet to Blacksod Point There are **Protected Views** - from southern coast of Mullet peninsula, and from Bellmullet peninsula The Mullet peninsula and Bellmullet peninsula are classed as **Sensitive** with rural lanes on the Bellmullet peninsula in view of the coast identified as **Scenic Routes**. **Scenic Route** N59 - Bangor to east of Rosturk The Achill Complex of Islands including Clare and Inishturk Islands are designated **Sensitive** East coast of Clew Bay is designated **Less Sensitive** **Scenic Route** R335 - Westport to Aasleagh There are **Protected views** - from south coast of Clew Bay which is designated as **Sensitive** There are rural lanes identified as **Scenic Routes** in South West Mayo which is designated as **Sensitive**

County Level Designations	Designated Coastal Areas
Landscape Sensitivity (Galway) **Class 5 Unique** -Defined as: Highly	The coastal zone from Galway Bay to Killary Harbour is recommended for further designations such as Area of Special Amenity or Landscape

Sensitive to all forms of development **Class 4 - Special Sensitivity** to visually intrusive forms of development **Class 3** - **High Sensitivity-** Identified important views and prospects to be retained Protection of identified **Protected Views** of special amenity value or special interest	Conservation Area for Scenic quality and is designated 'Outstanding' for Cultural and Environmental landscape values designated as **Class 5** -**Unique**
	There are a number of protected views from high ground within the Galway and Connemara Peninsula,
	The Connemara coast is designated 'Outstanding' for Cultural and Environmental landscape values and as **Class 4** - **Special Sensitivity**
	Designated as **Class 5** -**Unique Sensitivity** at Inishbofin and Inishark Islands and section of north west coast
	Slyne Head peninsula is designated as **Class 5** - **Unique Sensitivity**.
	North East coast Galway Bay is designated 'High' for Cultural and Environmental landscape values and designated **Class 3** - **High Sensitivity**-
	Lettermore and Gorumna Islands are designated 'High' for Cultural and Environmental landscape values
	Galway Bay is designated **Class 3** - **High Sensitivity** and designated **Class 4** - **Special Sensitivity**- in some coastal areas
	The coastal zone from Galway Bay to Killary Harbour is recommended for further designations Area of Special Amenity or Landscape Conservation Area for Scenic quality
	The north coast of Galway Bay is designated 'High' for Cultural and Environmental landscape values and designated **Class 3 - High Sensitivity** - along coastal edge

County Level Designations	**Designated Coastal Areas**
Vulnerable Landscapes (Clare) In areas identified as being vulnerable landscapes the Planning Authority will only normally permit proposals for development where the development will not adversely impact upon a significant extent upon the character, integrity or uniformity of the landscape. **Scenic Routes (Clare**) are identified where development which would interfere with views from designated roads will not normally be permitted. **Areas of High Amenity** are defined as landscapes of special value or sensitivity within the county, in which inappropriate development would contribute to a	Muckinish Point is classified as a visually **Vulnerable** and visually sensitive area in the Clare County Development Plan.
	The Coastline from Aughinish Bay to Loop Head to Clonderalaw Bay is classified as an **Area of High Amenity** in the County Development Plan.
	Scenic route R479, rural lanes and coastal section of N67
	Fanmore is a Blue Flag beach and also classified as a visually **Vulnerable** and visually sensitive area in the county development plan.
	The seascape of the Cliffs of Moher is considered valuable due to its high visual amenity, ornithology, ecology and geology.
	Lahinch is classified as a visually **Vulnerable**

significant diminution of the landscape setting of the county. These are designated under a Special Amenity Area Order **(SAAO)**	and visually sensitive area.
	Scenic Route N67, R478, R479 and coastal section of N67
	The tidal flats to the east of Whitestrand and Whitestrand itself are designated as visually sensitive and **Vulnerable** under the county development plan.
	Spanish Point and Mutton Island are highly **Sensitive** to change due to its visible headland. Sightlines between promontory forts are a significant factor in their visual amenity.
	Scenic Route N67
	White Strand is a visually **Vulnerable** and visually sensitive area.
	The natural grassland at Loop Head is classified as visually sensitive and **Vulnerable** under the county development plan.
	Scenic Route R487 and rural lanes at Loop Head Peninsula
	Scenic Routes at coast roads between Carraigaholt to Doona and south east of Caoagh to Crrowdotin South along the north coast of the Shannon
	The north coast of the Shannon (excluding Money Point) is classed as a **Vulnerable Landscape** under the county development plan.
	The wooded coast arround Clonderdaw Bay is classed as a Visually Vulnerable and Sensitive Area , the coastline of Clonderdaw Bay is classed as an **Area of High Amenity**

County Level Designations	**Designated Coastal Areas**
Scenic Views and Prospects, (Limerick) identified views are protected under a wider set of policies for the landscape character area	**Protected views and prospects** of the Shannon Estuary along the southern coastline from Foynes to Glin
	N69 is identified as a **Scenic Route** along the south coast of the Shannon Estuary
Landscape Zones (Kerry) **Rural Prime Special Amenity Areas** are those landscapes which are very sensitive and have little or no capacity to accommodate development.	Along the south coast of the Shannon Estuary an area from Ballfford Bay to Glencloosagh Bay is zoned for the development of **Industry**
	Coastal area west to Glencloosagh Bay is zoned as **Secondary Special Amenity**
Rural Secondary Special Amenity - The landscape of areas in this designation is generally sensitive to development. Accordingly, development in these areas must be designed so as to minimise the effect on the landscape	**Rural Secondary Special Amenity** area at Kerry Head and the Mouth of the Shannon headlands
	Protected views at Kerry Head and the Mouth of the Shannon headlands and Inshaboy point
Identified views and prospects are	Small areas of **Rural Prime Special Amenity Areas** along east and south coasts of

protected and development, where permitted, should not seriously hinder or obstruct these views The outer coastal zone is defined as being of intrinsic **Natural and Special Amenity Value.** The part of the south coast of the Shannon Estuary is zoned for the development of **Industry**	Balleyheigue, Tralee Bay and Brandon Bay with most of the bay coastlands and headlands identified as **Rural Secondary Special Amenity** areas. There are **Protected views** within the Bay areas
	Small areas of **Rural Prime Special Amenity Areas** are identified at headlands and islands such as Sybyll Head, Blasket Island, Slea Head Bray Head, Bolus Head and Abbey Island
	Rural Secondary Special Amenity area along most of the coast of Dingle and Inveragh Peninsulas with extensive sections of the coast and high ground are identified as **protected views**

County Level Designations	**Designated Coastal Areas**
Landscape Value and Sensitivity (Cork) **Very High Landscape Value** is defined as scenic landscapes with highest natural and cultural quality, areas with conservation interest and of national importance Landscapes defined as being of **Very High Sensitivity** are extra vulnerable landscapes (for example an area of national importance) likely to be fragile and susceptible to change The County Cork Development Plan also includes the identification of **Scenic Areas and Scenic Routes**.	**Scenic Coastal Routes** S118, S117, S116, S113, S110, S109
	Dursey Island, Bear Island, Whiddy Island, Shirkin Island and most small Islands to the south, the western ends of the three peninsulas, and significant sections of the inlet coasts are designated as **Scenic Areas** in the Cork County Development Plan.
	The West Coast area is classified in Cork County Development Plan as **Very High Landscape Value, Very High Landscape sensitivity,** and of **National Landscape Importance**
	Coastal Scenic Routes S85S78, S76.S75, S74, S72, S70, S67, S66, S59
	Many of the inlets and promontories along this coast are designated as **Scenic Areas** in the Cork County Development Plan.
	The South east coastal area is classified **Very High Landscape Value, Very High Landscape sensitivity,** and **National Landscape Importance**
	The eastern coastal area is classified as **Very High Landscape Value, Very High Landscape sensitivity,** and **County Landscape Importance**
Landscape Sensitivity (Waterford) **Vulnerable** - defined as shores of the main water bodies - lakes, large rivers, coasts, estuaries, promontories and headlands as conspicuous features of the natural landscape visible over a wide area. **Sensitive**: These land-use categories include open and exposed areas which are sensitive due to their natural character therefore any loss to their	All beaches and strands, including headlands and promontories, from Waterford Harbour to East Point are designated as **Vulnerable.**

structure would have a visual impact over a wide area. **Normal:** This landuse category includes the main areas of farming and rural residences. **Robust:** These landuse categories include towns and built up areas, suburban and other developed areas. **Scenic Routes** are protected from obstruction or degradation of the views towards visually vulnerable features or significant alterations to the appearance or character of sensitive areas.	

County Level Designations	**Designated Coastal Areas**
Landscape Sensitivity (Wexford) **Vulnerable Landscape** is defined as having very distinctive features with a very low capacity to absorb new development without significant alterations of existing character over an extended area. **Sensitive Landscapes** are defined as landscapes where due to their natural character and open and exposed nature any development will be widely visible	Linear Coasts are classed as **'Vulnerable landscapes'** as they are prominent landscape features - development may affect the visual integrity of the surrounding area. Dunes, beaches ,sands, and coastal lagoons are defined as **'Sensitive Landscapes'** in the Wexford Development Plan- due to their natural character open and exposed nature in which any development will be widely visible
Areas of Outstanding Natural Beauty, - AONB- (Wicklow designation) Landscape areas which are most vulnerable and sensitive, and which are considered to be of greatest scenic value. **Special Amenity Zones –(Wicklow)** Those landscape areas which, whilst not as vulnerable or as sensitive as those areas in the AONB. zone, are still subject to pressure for development which could result in a serious deterioration in the landscape. Designation is by Special Amenity Area Order **(SAAO)** Protection of identified **Views And Prospects** of special amenity value or special interest	The whole Wicklow coastal area is designated as an **AONB** (Wicklow) in the Wicklow development plan Identified **Views And Prospects** include the coastal railway between Greystones and Wicklow, Cliff road Windgates, R761, C32, C108, C160, Bray- Greystones cliff Walk, C35, R750. Bray Head is proposed for designation under Special Amenity Area Order **(SAAO)**
Protected Views and Prospects (Dun Loachaire)	The draft 2010-2016 County Development Plan identifies protected **Views And Prospects** along north coast of Dun Loachaire and arround Dalkey
Landscape Amenity (Fingal) **Areas Of High Landscape Amenity** are defined as landscapes of special value or sensitivity within the county, in which inappropriate development would contribute to a significant diminution of	In Fingal Development Plan 2005 -2011 the coastal zone is identified as a sensitive and vulnerable landscape of **High Landscape and Amenity Value.** The South Eastern half of the Howth Peninsula is

the landscape setting of the county. These are designated under a Special Amenity Area Order **(SAAO)** It is Fingal Council policy to protect **Views And Prospects** of special amenity value or special interest	designated under the 1999 **SAAO,** the Eastern and South west coastal edges including offshore water are identified as Areas of Special Interest within the Howth **SAAO**

County Level Designations	Designated Coastal Areas
Landscape Value and Sensitivity (Meath) **Sensitive** and **Exceptional Landscape Value** areas. Sensitive landscapes are defined as demesne villages and LCAs identified as being sensitive. Protection of **Views And Vistas** that contribute to the appreciation of landscape character.	The Coastal Plain Landscape is described as of **Medium Landscape Value**, **Regional Importance** and **High Sensitivity**.
	Nanny Valley is defined as of **Very High Landscape Value, Regional Importance** and **High Sensitivity**.
Landscape Value and Sensitivity (Louth) The **Sensitivity** of a landscape is defined as the measure of its ability to accommodate intervention without suffering an unacceptable or detrimental loss or alteration of landscape character type. **Landscape Value** judgments include environmental and cultural benefits including services and functions. **Scenic Quality** describes the landscape elements which appeal prominently to the visual senses.	**Landscape Value** of Dunany, Boyne Estuary Coast is classed as of **Regional Importance** in the development plan LCA 2002
	Clogher Head is identified in the development plan LCA 2002 as being of **High Landscape Value** , and is proposed as an **Area of Special Amenity (SAAO)** for its outstanding natural beauty and special recreational value
	Clogher Head is listed in the development plan as an **AONB** (Louth) and Ganderstown lands are listed as being of **High Scenic Quality**
	Landscape Value of Dundark Bay Coast is classed as of **Regional Importance** in the development plan LCA 2002

Transboundary Areas

Transboundary Seascape areas outwith Irish waters which may potentially be within visual range of the study area have been identified within the jurisdiction of Northern Ireland and Scotland.

The areas identified where potential transboundary effects should be considered are listed below (See **Figure 9.7.1 Irish Seascape Types)**

- Lough Foyle (Northern Ireland),
- The Atrim Coast from Magiligan Point to Benbanehead ((Northern Ireland),
- The south west coast of Islay (Scotland),
- Dudrum Bay and Kilkeel (Northern Ireland),
- Carlingford Lough (Northern Ireland).

Transboundary Seascape Types

Baseline information and identification of Seascape types is set below and is drawn from the Scottish Marine Renewables SEA, Scottish Executive, 2007 and the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, DETI 2009.

Table A.6 Transboundary Seascape Types

Transboundary Seascape Types	Location	Physical Characteristics	Quality of Experience
T1. Large Open or Partially Open Sea Lough with Raised Hinterland[13]	Lough Foyle (Londonderry), Carlingford Lough (Down)	This seascape type comprises large scale sea loughs associated low-lying coastal plain, raised hinterland and headlands. Sea Lough contained within broad flat bottomed valleys enclosed by raised hinterland with a low lying coastal fringe. Tidal mudflats can be a common component of the seascape. Settlement can vary, the hinterland can comprise low lying agricultural land with scattered rural settlement, elsewhere dense urban development is concentrated around the head and mouth of the sea loughs, with visually prominent industrial infrastructure and linear development in some locations. Large ports and harbours are located at the lough heads with associated urban or industrial development. Ferry terminals and busy shipping lanes are located at Lough Foyle.	Large scale open views along windswept low lying shorelines are contained by landmass. Long smaller scale contained views to the open sea framed by headlands are gained from Lough shores. Where there is an absence of urban development, truncated views along the Lough to the open sea give a wild open vista.

[13] Seascape type 1, as defined in the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009.

Transboundary Seascape Type	Location	Physical Characteristics	Quality of Experience
T2. Low Lying Coastal Plain[14]	Kilkeel, Dundrum Bay (Down)	This type of seascape is diverse and changeable, ranging from large to medium scale, depending on geographical arrangement. The seascape is exceptionally flat and often exposed with generally wide, open views extending far out to sea. The coastal edge either comprises long sandy beaches or strands, or may contain sweeping rounded bays or curved sandy beaches. Each forms an attractive soft coastal edge typical to this seascape type. In some instances the foreshore can be rocky and in part fragmented sloping gently upwards to meet the coastal flats beyond. Often these low lying coastal strips rise to a hinterland of rolling foothills, separated from the shore by land best suited for agriculture.	Open expansive views to sea are afforded from the flat coastal plains. Here the sense of scale is enormous with uninterrupted sea views creating vast interplay of light sea and sky. Where landmass is visible in the far distance this serves to heighten further the sense of scale and openness of this seascape type.
T3. Plateaus and High Cliffs[15]	Antrim Coast (Londonderry)	This is a wild, rugged and visually dramatic seascape. There is great vertical scale where often a high plateau landscape with basalt cliffs plunges abruptly to an incised coastal edge. A dramatic series of cliff faces present a broken edge to raised plateau. The narrow coastal edge is low, flat and in places jagged, comprising a rocky mosaic, complete with rocky peninsulas and occasional small bays. Typically the plateau edge is raised with limited views from the rural hinterland out to the open sea. This seascape contains the unique geological features at Giant's Causeway designated a World Heritage Site.	The open expansive and elevated views to sea add to a sense of wildness within this seascape type. The exhilarating experience can be heightened by the interaction and interplay of weather and changing sea and sky. The combination of exposure to the elements and vastness of scale contribute to a breathtaking sense of drama within the seascape. Long open elevated views along the coast and out to the open sea including long views to Donegal and along the north coast.

[14] Seascape type 4 as defined in the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009

[15] Seascape type 7, as defined in the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009.

Transboundary Seascape Type	Location	Physical Characteristics	Quality of Experience
T4. Rugged Coastal Shelf and Headlands with Open Views to Sea[16]	South West Coast of Islay (Isle of Islay, Argyle and Bute)	The seascape comprises raised beaches backed by old cliff lines and level coastal terraces. The land usually rises steeply from the coast, into craggy bluffs the presence of which heightens the rugged open and exposed character of the coastline. Headlands give access to wide open sea views. A common feature of this seascape is the barren and wild nature of the associated landscape.	Views seaboard can be across sounds dotted with small islands, larger islands then beyond to wide open sea or simply of an uninterrupted expanse of sea. Where headlands are visible on opposing shores, the linearity of seascape reduces the perceived scale.

Transboundary Protected areas

The following national level designations were taken into consideration:

- Area of Outstanding Natural Beauty – ANOB
- World Heritage Site – WHS

Proposed candidate sites for Northern Ireland's first national park have not been considered as this designation is currently subject to consultation..It is recommended, however, that any further assessment of devices in relation to the seascape resource should consider this national level designation as one of the key designations which may be reflective of high seascape quality.

World Heritage Sites (WHS)

One WHS falls within the area identified where potential transboundary effects should be considered identified in Chapter 9 **Figure 9.3.1** Designated Areas and described below.

Giant's Causeway World Heritage Site
Location: Antrim Coast

The stones at the Giant's Causeway and surrounding cliffs were designated by UNESCO as a World Heritage Site (WHS) in 1986. It is the one of 3 natural World Heritage Sites in the UK. The WHS designation was made in recognition of its geological, geomorphical values, its history of scientific study and its exceptional landscape values. The site occupies about 70ha of land and 160ha of sea along the north Antrim Coast consisting of dramatic cliffs, unique geological formations and small sheltered bays. There are extensive and dramatic vistas both from the causeway and the cliff tops looking out to the open sea and along the coast to the Donegal Mountains. The Giant's Causeway is Ireland's premier visitor attraction attracting thousands of visitors every year.

Area of Outstanding Natural Beauty (AONB)

Four AONBs fall within the areas identified where potential transboundary effects should be considered. There are two levels of AONB protection based on the date of designation.

[16] Seascape type 8, as defined in the Scottish Marine Renewables SEA, Scottish Executive, 2007

The following AONB's were designated under the Nature Conservation and Amenity Lands Order (Northern Ireland) 1985. The AONB areas are judged to fall within Category V – Protected Landscape of the International Union for the Conservation of Nature (IUCN) which is roughly equivalent to the protection levels of a National Park.

The Causeway Coast AONB (1989)
Location: Antrim Coast

The Antrim Coast and Glens (1988)
Location: Antrim Coast

Mourne (1986)
Location: south shore of Dundrum Bay, Kilkeel hinterland, and north shore of Carlingford Lough

The following area falls under earlier AONB designation created through Amenity Lands Act 1965 which offers a lower level of protected status.

Lecale Coast (1967)
Location: North shore of Dundrum Bay

Effects on Seascape

Potential Key Effects

Renewable energy technology is a rapidly evolving field, appearance and scale of potential future development is accordingly difficult to predict with accuracy. When considering the potential effects of device characteristics on the existing seascape we have taken a precautionary view, basing assessment of the sensitivity to change, magnitude and on effects prior to mitigation.

There are a number of ways in which the device arrays may affect the seascape resource, as detailed below.

- The scale and form of the array could prove inappropriate and intrusive in the context of the existing seascape;
- The arrays could introduce activity, features and forms out of keeping with the seascape;
- The arrays could involve the loss or fragmentation of important and distinctive seascape components, features and characteristics; and
- The introduction of an array in a nationally designated seascape could affect the integrity of a national resource.

The extent to which the device array would affect the seascape varies depending on the various stages of the development and the capacity of the existing seascape to absorb these components. The construction and decommissioning phases of the development would involve temporary and relatively short periods of change and as a result the effects on the seascape are not considered to be greater than the permanent operational effects and are consequently not considered below. The operational phases of the development when the devices are installed in the water would, however, result in more permanent and potentially significant effects and it is these operational effects on the seascape, which are described below. It should be noted that whilst submerged devices are not considered to result in potential significant effects the buoys and lighting associated with these device arrays have been assessed as there is the potential for them to affect the seascape.

Seascape Sensitivity to Change

The determination of the sensitivity to change of the seascape resource to the device arrays has been based upon an assessment of key elements and characteristics, which have been developed into broadly physical and perceptual criteria for determining seascape sensitivity. **Table A.7** below identifies the criteria used and summarises the main points considered when assessing the seascape

types for their sensitivity to the device arrays. It should be noted that this table has been included to help aid transparency to the approach taken and does not represent a complete account of the various judgements and considerations that were undertaken when determining sensitivity.

Table A .7 Criteria for Seascape Sensitivity

Criteria	Increase Sensitivity	Decrease Sensitivity
Scale	Small scale, enclosed views extend across sea to horizon Elevated views from coastal edge Absence of scaling elements	Large scale, open
Coastal Topography / form /pattern	Intricate, complex, rugged Important focal points – mountains, headlands, offshore islands	Flat, horizontal, simple, lack of natural focal points
Settlement/infrastructure	Traditional coastal and rural, scattered settlements Lack of visually prominent infrastructure.	Larger scale, urban mass and linear settlements Larger scale infrastructure and busy navigational routes
Scenic quality	Seascape of high scenic quality with distinctive visual qualities, and inherent natural characteristics or traditional landscape patterns intact, or in good state of repair, or well looked after.	Denuded set of landscape features contributing to create a less intact visual quality within the landscape. Visually prominent industrialisation of landscape present.
Exposure	Sheltered, calm coastal areas	Exposed, dramatic seascapes
Protected Areas	Areas protected by specific designations that include protection of landscape character or scenic quality such as WHS, NP and County designations	No designations relating to the area that include protection of landscape character or scenic quality

Scale: the scale of the seascape takes into consideration whether the emphasis is horizontal or vertical, linear, open, large or small. Where for example there are low coastal sand and flats with uninterrupted seaboard views, the seascape is deemed to be large scale. The interplay of sky/sea/horizon all contribute to a large sense of scale. Sensitivity to devices will generally increase with small scale enclosed seascapes and decrease with large open scale areas. Large scale seascapes may still be sensitive to exceptionally large devices, such as off shore wind turbines.

Coastal topography / form / pattern: Where seascape forms is relatively, flat and simple such as low lying agricultural coastal land, low lying wave (linear) devices could relate to this characteristic. However, the introduction of large tidal (point) devices or turbines could intrude into the broadly horizontal plane of the same seascape. In the case of off shore wind turbines, the scale of the vertical element to be introduced into the seascape is potentially large and will impact on the horizon to a far greater extent than the smaller tidal (point) devices. Where the seascape form is more complex and intricate, the straight linear lines of arrays may conflict with the inherent pattern, forms and focal points. Topography of associated land form, even when distant, will also inform the sensitivity of seascape to change, especially, when in the case of off shore wind, the landmass is prominent within the setting. Where the accessible coastal edge or immediate hinterland provides elevated views the distance at which effects would be considered low or negligible, would increase proportionally creating a higher level of sensitivity. The zone of intervisibility increases proportionally in relation to the elevation of the view point. For example the theoretical maximum viewable distance of a wind turbine from Seascape Type 4 – Low Lying Coastal Plain (such as Toe Head to Cross Haven, County

Cork) will be 49-50 km but from Seascape Type 7– Plateaus and High Cliffs (such as Slieve League , Donnegal) the maximum viewable distance might be 52-62 km.17

Conversely characteristics of coastal devices may be less noticeable where the elevation of the viewpoint allows uninterrupted views over the device to the open sea horizon.

Settlement/infrastructure: Device arrays are more likely to relate to linear developments, urban forms and areas where larger scale infrastructure exists than to small clustered, nucleated villages or scattered settlement where scale and character contrasts are greater. It should be noted that settlement and infrastructure is only considered in relation to the seascape and not the importance of visibility and views from them. Often where there is little settlement there will be little in the way of associated infrastructure. For off shore wind, only settlement of a prominent industrial scale and/or associated with high density urban environments will relate to the turbines.

Scenic Quality: The scenic quality of a landscape relates to its inherent distinctive visual qualities, and to the condition and completeness of inherent natural characteristics or traditional landscape patterns. In the context of seascape this can often be related to the drama, sense of wildness or tranquillity that is associated with the area. For example where the hinterland of a coastline has a defined geometric geography, evolved over time due to intense farming, a coloured patchwork of field patterns may be highlighted against the backdrop of a wide open sea. Often designations highlight the landscape quality, recognising the visual, functional and ecological perspectives. Absence of a designation will not render a seascape void of scenic quality. However, where the scenic quality of a seascape is deemed to be evident, it has been deemed sensitive to device characteristics. To what extent an area is sensitive is in part related to the intactness and state of repair of individual features which contribute to the quality of any one place. It should be noted that when making a judgement on the scenic quality of a particular seascape type the desk-based study has not identified individual developments such as oil rigs, fish farms or land based wind farms.

Exposure: Exposure to the elements is linked to the scale of the seascape but is also affected by topography. The mouths of open sea loughs can feel as exposed as a seascape dominated by cliffs and basalt escarpments. As waves crashing against rocks can seem dramatic and heighten the sense of wildness of the sea, so a distinction has been made on whether an area is calm, sheltered (higher sensitivity) or exposed, wild (lower sensitivity) and what effect the elements could have on each of the device characteristics. Devices will respond to exposure in different ways. For the purposes of this study an assumption has been made that seascapes which are exposed will be more sensitive to Tidal (On Surface Point) Devices than Wave (On Surface Linear Structure) devices. The latter share a motion with the movement of waves that lessens the effect of the sensitivity as there is a sense of the natural in its movement. The former, standing vertical above the waves will become a (series of) fixed points of contrast for the waves to crash against, accentuating the force of nature. In the case of off shore wind turbines the support column of the devices will remain prominent above the horizon and in addition the rotating blades will from a perpetual focal point within the seascape.

Protected Areas: For the purposes of the seascape assessment, landscape value has been addressed by reference to national, or county level landscape designations. Absence of such a designation, however, does not infer a lack of quality or importance. Factors such as accessibility and local scarcity can render areas of nationally unremarkable quality, highly valuable as a local resource. The presence of a national, or county level designation does not automatically preclude potential development but there may be potential for some device characteristics to conflict with the landscape objectives of a designation. The World Heritage Site at Skellig Michael is an area of special sensitivity that has a very low capacity to accommodate change.

The assessment of the seascape sensitivity to change remains specifically related to the three different device characteristics. The extent to which the seascape components would accommodate and tolerate the type of change, which could be caused by the three device characteristics, is assessed by consideration of the following factors:

- The form and nature of the change proposed; and

[17] Welsh Seascapes and sensitivity to Offshore Development, Countryside Council for Wales, CCW/White Consultants, 2009

- The ability of the seascape components which are physically affected to accommodate the change proposed.

The seascape sensitivity has been evaluated on a relative basis within the study area and is described using the following 3 point scale as follows:

- **High Sensitivity**- A seascape of unique character and particularly high scenic quality, where the key characteristics are fragile and susceptible to small changes of the type proposed;
- **Medium Sensitivity** – A seascape where the key characteristics are vulnerable but with some capacity to tolerate change of the type proposed; and
- **Low Sensitivity** – A seascape where the key characteristics are robust and potentially tolerant of substantial change of the type proposed.

Sensitivity of Seascape Types

Table A.8 below summarises the sensitivity to change of each of the eight seascape types and 4 transboundary seascape types in relation to each of the three different device characteristics. Section 2 provides further detailed information of the various criteria considered when determining the sensitivity of the seascape types to the potential changes discussed. Sensitivity has been determined for Seascape types only where the wind, wave or tidal resources are likely to be available.

Table A.8 Sensitivity to Change of Wave, Tidal and Off Shore Wind Device Characteristics

Seascape Type	Sensitivity to Change			
	Wave (On Surface Linear) Devices	Wave (Oscillating Surge) Devices	Tidal (On Surface Point) Devices	Off Shore Wind Turbines
1 – Large Open or Partially Open Sea Lough with Raised Hinterland	Medium	Medium/High	Medium/High	High
2. Rugged Peninsulas with drowned valleys	High	High	N/A	High
3. Low Lying Plateau Landscape	N/A	N/A	Low/Medium	Low/Medium
4. Low Lying Coastal Plain and Estuarine Landscape, Low lying Islands and Peninsulas	Low/Medium	Medium	Medium	Low/Medium
5 - Narrow Coastal Strip with Raised Hinterland	Medium/ High	Medium/High	Medium/High	High
6 – Complex Indented Coast, Small Bays and Off Shore Islands	Medium/ High	Medium	Medium/High	High
7 – Plateaus and High Cliffs	High	Medium/High	High	High
8 – Large Bay	Low/Medium	Medium	Medium	Low/Medium
9 – Large River Estuary	N/A	Medium/High	Medium	N/A

Transboundary Seascape Types	Sensitivity to Change			
	Wave (On Surface Linear) Devices	Wave (Oscillating Surge) Devices	Tidal (On Surface Point) Devices	Off Shore Wind Turbines

T.1. Large Open or Partially Open Sea Lough with Raised Hinterland[18]	Medium/High	N/A	Medium/High	High
T.2. Low Lying Coastal Plain[19]	N/A	N/A	N/A	Low/Medium
T.3. Plateaus and High Cliffs[20]	High	N/A	High	High
T.4 Rugged Coastal Shelf and Headlands with Open Views to Sea[21]	Medium/ High	N/A	High	High

Wave (On Surface Linear Structure) Devices

Generally, seascapes which are least sensitive to the wave (on surface linear) device characteristics are those with a large scale character combined with open, expansive views of the sea. The wave (on surface linear) device could mimic to a certain extent the natural movement of the sea, and be camouflaged by wave motion.

The sensitivity to the wave (on surface linear) device has been described as Low/Medium in seascape type 4: Low Lying Coastal Plain and type 8 Large Bay as the large scale and low viewpoint would reduce sensitivity.

In Seascapes type 1 Large Open or Partially Open Sea Lough, type 6: Complex Indented Coastline with Small Bays and Offshore Islands, transboundary types T.1. Large Open or Partially Open Sea Lough and T.4 Rugged Coastal Shelf and Headlands with Open Views to Sea, topography and scale could potentially curtail views and limit perception of a wave (surface linear) device although there is a possibility that the linear form of array may conflict with the character of a complex coastal edge. From the elevated viewpoints of Type 5: Narrow Coastal Strip with Raised Hinterland, and from the hinterland of type 1 Large Open or Partially Open Sea Lough, transboundary types T.1. Large Open or Partially Open Sea Lough and T.4 Rugged Coastal Shelf and Headlands, offshore wave (on surface) devices may be evident from further afield with greater potential visibility. Sensitivity to Wave (On Surface Linear) devices is therefore medium to medium high for all these seascapes.

Seascape types 2 Rugged Peninsulas, Type 7 Plateaus and High Cliffs, and Transboundary type T3 Plateaus and High Cliffs combine extensive and elevated panoramic views with vulnerable and unique seascape qualities resulting in a high sensitivity to wave (on surface linear) device characteristics..

Wave (Oscillating Surge) Devices

Sensitivity to coastal devices is largely dependent on the scale form and pattern of the coastal edge. There is also the effect that a coastal device may have on a sense of remoteness or wildness. Coastal Devices may potentially be less noticeable where the raised viewpoint allows views over the devices to the open horizon. The partially submerged portion of the device may be intermittently visible depending on tides and weather conditions. The offshore elements of these devices are located at depths of 10-15m and therefore will be principally located close to the shoreline.

In Seascape type 4 Low Lying Coastal Plain due to the low viewpoint and predominantly submerged structure of the offshore elements visibility would rapidly diminish in over distance however the

[18] Seascape type 1, as defined in the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009.

[19] Seascape type 4 as defined in the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009

[20] Seascape type 7, as defined in the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009.

[21] Seascape type 8, as defined in the Scottish Marine Renewables SEA, Scottish Executive, 2007

onshore fixed structure may potentially form a prominent feature in an open flat coastal landscape which may be in conflict with the character of remote or exposed natural areas.

Seascapes type 1 Large Open Sea Lough, 6 – Complex Indented Coast, Small Bays and Off Shore Islands and type 8. Large Bay would be of Medium sensitivity to these devices as the scale of the seascape is reduced and arrays of offshore structures may conflict with complex coastal edges while the fixed on shore structures may introduce visually a prominent new element in conflict with the local landscape / seascape character although conversely there may be scope for structures to be concealed by topography. Consequently Sensitivity to Wave (Oscillating Surge) Devices for these seascape types is Medium.

Seascapes type, 5. Narrow Coastal strip with Raised Hinterland 7. Plateaus and High Cliffs has a Medium High sensitivity as the extensive and elevated panoramic views would render offshore elements more visible over an extended area with potential for onshore fixed structures to conflict with wild rugged seascapes /coastal landscape, however it may be possible in some instances to use topography to conceal or have views out over fixed structures .

The most sensitive seascape to this type of development is 2. Rugged Peninsulas with Drowned Valleys as it would be likely that inshore devices of this type would be in conflict with vulnerable and unique seascape qualities highly visible due to the combination of narrow inlets, complex coastline and rugged exposed headlands with extensive elevated views .

Tidal (On Surface Point) Devices

Horizontal and large-scale seascapes with open views across the sea have a greater potential capacity to accommodate tidal (on surface point) devices. However, depending on the scale and placement of these devices within the seascape, the introduction of new vertical elements within the sweeping vista could potentially affect the existing seascape character.

Seascape type 3 Low Plateau Landscape and type 8 Large Bay are large scale seascapes with low/ medium sensitivity to tidal (on surface point) devices.

Seascapes type 4 Low Lying Coastal Plain and Type 9. Large River Estuary are of medium sensitivity to tidal (point) devices as the low viewpoint will increase the prominence of a vertical element introduced into the broad horizontal vista.

Types:1 Large Open or Partially Open Sea Lough,, types 5 Narrow Coastal Strip with Raised Hinterland, 6 Complex Indented Coast, Small Bays and Off Shore Islands, and transboundary types T1 Large Open or Partially Open Sea Lough, are of medium high sensitivity to tidal (on surface point) devices. This is due to enclosing the topography, elevated viewpoints from the hinterland and reduced scale although there may be some potential for topography to curtail views and limit perceptions.

The introduction of tidal (on surface point) device characteristics to the extensive and elevated panoramic views of Seascape type 7 Plateaus and High Cliffs, transboundary types T3 Plateaus and High Cliffs, and T4 Rugged Coastal Shelf and Headlands could potentially create a noticeable focal point in the open sea, where none previously existed, therefore this seascape is of high sensitivity.

Offshore Wind Turbines

The seascape types least sensitive to offshore wind turbines are large scale robust and open. The broad horizontal sea horizon of, Seascape Type 4: Low Lying Coastal Plain, type 3 Low lying Plateau Landscape and transboundary type T2 Low Lying Coastal Plain has some capacity to absorb change although there is potential for the low angle of vision to be sensitive to the introduction of large scale vertical element; hence it is judged to be of Low/ Medium Sensitivity to the device described.

Sensitivity of Type 8 – Large Bay is High/medium as the large scale vistas are framed by landmass with potential for wind turbines within the bay to create a noticeable focal point.

Within Seascape type 1 Large Open or Partially open Sea Lough 6: Complex Indented Coast with Small Bays and Off Shore Islands and transboundary type T1 Large Open or Partially open Sea Lough the reduced scale of the sea horizon and enclosed views are potentially less accommodating of the device characteristics. The elevated viewpoints of Seascape Type 6 Narrow Coastal Strip with Raised Hinterland, Type 7: Plateau and High Cliffs, and T8 Rugged Coastal Shelf and Headlands, provide extensive elevated panoramic vistas which may increase the potential prominence and visibility of device characteristics. The sensitivity to offshore wind turbines for these Seascape Types is high

Magnitude of Change

The issues which influence magnitude of change are complex, and comprise a number of quantifiable and less quantifiable parameters. More quantifiable parameters include, the distance from the development and the number and proportion of devices visible in the array. Less quantifiable parameters include the scale of change with respect to the loss or addition of key components, features and characteristics of the seascape; the nature of the effect – whether adverse, beneficial or neutral; and the effects of aspect, lighting and weather on the changing perception of the seascape character.

Visibility and Atmospheric Conditions

Visibility is influenced by atmospheric conditions such as visual clarity and light quality. Visual clarity is influenced by humidity, temperature and the presence or absence of air pollution. The Scott, K.E (2005)[22] publication noted that levels of visibility are higher in Scotland (or at certain places in Scotland) and the potential visual range significantly higher than in England and Wales. The report 'Welsh Seascapes and Sensitivity to Offshore Development' 2009[23] states that the prevailing moist westerly winds along the Welsh coastline result in a lower level of visual clarity in comparison to the colder, unpolluted atmosphere of western Scotland which has a higher level of visual clarity. There is no information currently available on levels of visibility for Irish seascape.

Thirty year mean values documented by the Irish Meteorological Office (see **Table A.9** below) indicate a higher level of haze along the south and east coast with an associated lower level of visual clarity (conditions may be similar to the Welsh coast). The lower level of haze and higher rainfall along the west and north coast along with low levels of air pollution suggest a higher level of visual clarity. These effects were verified by observations in the field[24]. For the purposes of this assessment conditions of optimum visibility are assumed.

Table A.9 Information on the Irish climate drawn from the Irish Meteorological Office

1961 -1990 Annual mean values over 30 years

Location	Relative Humidity %		Overcast days without sun	Days with more than 5mm Rain	Days of Fog
	9am	3pm			
Dublin (East Coast)	82	72	61	48	50.5
Rosslaire (South East Coast)	84	78	61	59	38.5
Roche's Point (South Coast)	85	79	63	63	46.5

[22] xxx

[23] Welsh Seascapes and sensitivity to Offshore Development, Countryside Council for Wales, CCW/White Consultants, 2009 2009

[24] Please refer to Appendix A of this report 'Familiarisation Study' for further details.

Valentia (South West Coast)	83	78	75	95	8.9
Belmullet (West Coast)	83	78	66	80	16.6
Malin Head (North Coast)	82	78	67	76	11.8

Visibility Thresholds

It is often, however, the distance from the receptor/seascape components, which tends to most strongly influence judgements on the magnitude of change to a seascape. The DTI guidance[25] suggests that distance is a key parameter and one, which might offer some form of standardisation in the way that magnitude of change is considered. Whilst the guidance ultimately advises that a range of criteria should be considered when determining magnitude of change, the high level nature of this SEA and the lack of information on the location of the devices within the study area, has meant that visibility thresholds have been used as the determining factor when considering the magnitude of change.

The magnitude of change arising from wind device characteristics has been based on a review of the visibility thresholds documented in:

- The SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland 2009,
- The UK Offshore Energy SEA 2009,
- Welsh Seascapes and sensitivity to Offshore Development 2009,
- Visual Assessment of Windfarms: Best Practice SNH, 2002,
- Wind Energy Development Guidelines DoEHLG 2004,
- Seascape and Visual Impact Assessment: Guidance for Offshore Wind Farm Developers, DTI, 2005, and
- Kish and Bray Banks Offshore Windfarm EIS 2005.

Visibility over distance is affected by the curvature of the Earth therefore an observer at sea level may be able to discern the hub of a turbine 150m in height at a distance of 25 - 30km while an observer at 100m above sea level would be able to see a similar view (reduced in scale) at 45-50km. Theoretically the blades of a turbine would be visible at sea level at a distance 43-53km although this would be difficult to perceive by the human eye.26

The Wind Energy Development Guidelines (DoEHLG 2004) which is principally focused on land based windfarm development, recommends a 20km limit for Zones of Visual Influence (ZVI) and 25km limit for ZVI's in relation to landscapes of national importance. A ZVI or ZTV (Zone of Theoretical Visibility) is defined as the area in which a specific development is visible or theoretically visible. The Environmental Statement prepared for the Kish and Bray Offshore Windfarm Proposal uses a ZTV of 30km from the centre of the proposed development based on DoEHLG guidance of distance in relation to turbine height27. The potential distance at which offshore wind development will be visible is greater than land based wind development, due to the larger scale of devices and lack of intervening topography.

For the purpose of assessing effects of offshore wind development a 35km seaward limit is recommended as the limit of visual components for seascape assessment by the DTI Visual Impact

[25] Guidance on the Assessment of the Impact of Offshore Wind Farms. Seascape and Visual Impact Report. (DTI, November 2005)

[26] Based on 'The Visual representation of Windfarms SNH Technical Appendix F, 2006, The UK Offshore Energy SEA 2009 and Scott, K.E., Anderson, C and Benson, J.F. (2005) An Assessment of the Sensitivity and Capacity of the Scottish Seascape in relation to Offshore Windfarms, Scottish Natural Heritage

[27] Wind Energy Development Guidelines DoEHLG 2004,

Assessment: Guidance for Offshore Wind Farm Developers 2005.28 Based on the most recent guidance on visual significance of wind device characteristics[29] effects at a distance greater than 35km will be assumed to be negligible in most cases for the purposes of this assessment, as changes to the seascape will very minor or imperceptible to the human eye. Visibility may extend over longer distances for seascapes associated with high cliffs or steep hinterland although the scale of visible components will reduce proportionally resulting in slight to very minor changes in the seascape components.

Magnitude of Change Criteria

The magnitude of change arising from the wave and tidal device characteristics has been based on the visibility thresholds established during fieldwork documented in the Scottish Marine Renewables SEA, 2007 and verified by fieldwork documented in the SEA of Offshore Wind and Marine renewables Northern Ireland. These differ from thresholds developed for offshore windfarms in previous documented studies due to the very different scale and physical characteristics associated with wave and tidal devices.

The following visual thresholds for wind turbines have been applied based on the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland 2009, Scottish Marine Renewables SEA, 2007 and the UK Offshore Energy SEA 2009 These thresholds were tested and verified during the site visits within Ireland and fieldwork carried out as part of Wind and Marine Renewable Energy in Northern Ireland 200930

These visual thresholds are the basis for assessing magnitude of change using the following 4- point scale.

For Wave (On Surface Linear) Arrays and Tidal (On Surface Point) Arrays

Large: 0 - 5km from the coast. Notable change in seascape characteristics over an extensive area ranging to a very intensive change over a more limited area;
Medium: 5 - 10km from the coast. Moderate change in localised areas;
Small: 10 - 15km from the coast. Small or imperceptible change in seascape components; and
Negligible. 15km + from the coast. No discernible change in any seascape component.

For Offshore Wind Turbines 5-7MW

Large: 0-15km from the coast. Notable change in seascape characteristics over an extensive area ranging to a very intensive change over a more limited area;
Medium: 15-24km from the coast. Moderate change in localised areas;
Small: 24 - 35km from the coast. Minor change in localised areas
Negligible 35km + from the coast. No discernible change in any seascape component

Wave (Oscillating Surge) devices require water depths of 10 -15 m along with fixed coastal structures, therefore all devices are within 0-5km of the coast and effects are site specific.

Significance of Effects

Assessment Criteria

[28] Based on 5MW turbine heights using the equation put forward in the Visual Assessment of Windfarm: Best Practice, Scottish Natural Heritage, 2002

[29] Please see Chapter XX Devise Characteristics and Chapter Xx of this report XX

[30] Please refer to Appendix A of this report 'Familiarisation Study' for further details.

The two principal criteria determining the potential significance of effect are the sensitivity of the seascape and the magnitude of change and it is the evaluation of these factors against clearly defined criteria, which enables a reasoned judgement to be made on significance of effect.

Account has not been taken of the effect that any mitigation measures could have on minimising potentially detrimental effects or improving the seascape composition of the area as at the time of the assessment there were no industry standard mitigation commitments available.

The findings are represented using a descriptive scale ranging from substantial, moderate and slight adverse effects, neutral effect, to an ascending scale of slight, moderate and substantial beneficial effect. Explanation of the effect ratings is provided in **Table A.10** below.

Table A.10 Seascape Effects Significance Criteria

Type of Effect	Rationale for Assessment of Significance
Substantial adverse (negative) effect:	The proposals are at considerable variance with the scale, form and pattern of the seascape; They are likely to degrade, diminish or even destroy the integrity of a range of characteristic features and elements or their setting; They would be substantially damaging to a high quality or highly vulnerable seascape; and They are in serious conflict with the landscape objectives of a designation.
Moderate adverse (negative) effect	The proposals are out of scale with the seascape, or at odds with the local pattern and form; They are likely to strongly contrast with or cause loss of characteristic features and elements or their setting; and They would compromise the landscape objectives of a designation.
Slight adverse (negative) effect	The proposals do not quite fit the form and scale of the seascape; They are likely to result in only small changes to characteristic features and seascape elements; and They would not compromise the landscape objectives of a designation.
Neutral effect	The proposals are well designed to complement the scale, form and pattern of the seascape; They would integrate into the existing seascape through siting and design; They would not cause loss or change to characteristic features and seascape elements; and They would avoid conflict with landscape objectives of a designation.
Slight Beneficial Effect	The proposals fit well with the scale, form and pattern of the seascape; and They would maintain or enhance existing seascape characteristics.
Moderate Beneficial Effect	The proposals considerably enhance the form and pattern of the seascape; and They would enable some sense of quality to be restored or enhanced to a seascape which is not of any formally recognised quality.
Substantial Beneficial Effect	The proposals constitute a major restructuring of a degraded seascape or one in poor condition.

Potential Effect on Seascape

The following section provides an assessment of the potential effects that the different device types could have on the seascape resource of the study area during operation, these potential effects are summarised in **Table A.11** below and illustrated by **Figures 12.15, 12.16 and 12.17**. It should be noted that all potential effects identified in the table below are considered during the operational phase of the development and the confidence level for all effects is low.

Table A.11 Potential effects of Wave (On Surface Linear) Arrays on Seascape Character

Seascape Types	Magnitude of change				
	Sensitivity to Change	Large 0-5km	Medium 5-10km	Small 10-15km	Negligible 15 Km+
1 – Large Open or Partially Open Sea Lough with Raised Hinterland	Medium	Moderate Substantial	Moderate	Slight	Neutral
2. Rugged Peninsulas with drowned valleys	High	Substantial	Mod - Substantial	Moderate	Slight
3. Low Lying Plateau Landscape	N/A	N/A	N/A	N/A	N/A
4. Low Lying Coastal Plain and Estuarine Landscape, Low lying Islands and Peninsulas	Low/Medium	Moderate	Slight	Slight - Neutral	Neutral
5 - Narrow Coastal Strip with Raised Hinterland	Medium/ High	Substantial	Moderate	Slight - Moderate	Slight- Neutral
6 – Complex Indented Coast, Small Bays and Off Shore Islands	Medium/ High	Substantial	Moderate	Slight - Moderate	Slight- Neutral
7 – Plateaus and High Cliffs	High	Substantial	Mod - Substantial	Moderate	Slight- Neutral
8 – Large Bay	Low/Medium	Moderate	Slight	Slight - Neutral	Neutral
Transboundary Seascape Types					
T.1- Large Open or Partially Open Sea Lough with Raised Hinterland	Medium/High	Mod – Substantial	Moderate	Slight - Moderate	Slight- Neutral
T.2-Low Lying Coastal Plain		N/A	N/A	N/A	N/A
T.3 Plateaus and High Cliffs	High	Substantial	Mod - Substantial	Moderate	Slight- Neutral

T.4- Rugged Coastal Shelf and Headlands with Open Views to Sea	Medium/ High	Substantial	Mod - Substantial	Slight - Moderate	Neutral

Table A.12 **Potential effects of Wave (Oscillating Surge) Arrays on Seascape Character**

Seascape Types	Sensitivity to Change	Magnitude of change			
		Large 0-5km	Medium 5-10km	Small 10-15km	Negligible 15 Km+
1 – Large Open or Partially Open Sea Lough with Raised Hinterland	Medium/High	Moderate Substantial	N/A*	N/A*	N/A*
2. Rugged Peninsulas with drowned valleys	High	Substantial	N/A*	N/A*	N/A*
3. Low Lying Plateau Landscape	N/A	N/A	N/A	N/A	N/A
4. Low Lying Coastal Plain and Estuarine Landscape, Low lying Islands and Peninsulas	Medium	Moderate	N/A*	N/A*	N/A*
5 - Narrow Coastal Strip with Raised Hinterland	Medium/High	Moderate Substantial	N/A*	N/A*	N/A*
6 – Complex Indented Coast, Small Bays and Off Shore Islands	Medium	Moderate	N/A*	N/A*	N/A*
7 – Plateaus and High Cliffs	Medium/High	Moderate Substantial	N/A*	N/A*	N/A*
8 – Large Bay	Medium	Moderate	N/A*	N/A*	N/A*
Transboundary Seascape Types					
T.1- Large Open or Partially Open Sea Lough with Raised Hinterland	N/A	N/A	N/A	N/A	N/A
T.2-Low Lying Coastal Plain	N/A	N/A	N/A	N/A	N/A
T.3 Plateaus and High Cliffs	N/A	N/A	N/A	N/A	N/A
T.4- Rugged Coastal Shelf and Headlands with Open Views to Sea	N/A	N/A	N/A	N/A	N/A

*Not Applicable due to the requirement to site devices at depths no greater than 10-15m

Table A.13 Potential effects of Tidal (On Surface Point) Arrays on Seascape Character

Seascape Types	Sensitivity to Change	Magnitude of change			
		Large 0-5km	Medium 5-10km	Small 10-15km	Negligible 15 Km+
1 – Large Open or Partially Open Sea Lough with Raised Hinterland	Medium /High	Mod – Substantial	Moderate	Slight - Moderate	Slight-Neutral
2. Rugged Peninsulas with drowned valleys	High	N/A	N/A	N/A	N/A
3. Low Lying Plateau Landscape	Low/Medium	Moderate	Slight	Slight - Neutral	Neutral
4. Low Lying Coastal Plain and Estuarine Landscape, Low lying Islands and Peninsulas	Medium	Moderate	Moderate	Slight	Neutral
5 - Narrow Coastal Strip with Raised Hinterland	Medium/ High	Substantial	Moderate	Slight - Moderate	Slight-Neutral
6 – Complex Indented Coast, Small Bays and Off Shore Islands	Medium/High	Substantial	Moderate	Slight - Moderate	Slight-Neutral
7 – Plateaus and High Cliffs	High	Substantial	Mod - Substantial	Moderate	Slight-Neutral
8 – Large Bay	Low/Medium	Moderate	Slight	Slight - Neutral	Neutral
9. Large River Estuary	Medium	Moderate	Moderate	N/A*	N/A*
Transboundary Seascape Types					
T.1- Large Open or Partially Open Sea Lough with Raised Hinterland	Medium/High	Mod – Substantial	Moderate	Slight - Moderate	Slight-Neutral
T.2-Low Lying Coastal Plain		N/A	N/A	N/A	N/A
T.3 Plateaus and High Cliffs	High	Substantial	Mod - Substantial	Moderate	Slight-Neutral
T.4- Rugged Coastal Shelf and Headlands with Open Views to Sea	High	Substantial	Mod - Substantial	Moderate	Slight-Neutral

Table A.14 Potential effects of Wind Turbines on Seascape Character

		Magnitude of change			
Seascape Types	**Sensitivity to Change**	Large <15km	Medium 15-24km	Small 24-35km	Negligible 35Km+
1 – Large Open or Partially Open Sea Lough with Raised Hinterland	High	Substantial	Substantial	Moderate	Slight Neutral
2. Rugged Peninsulas with drowned valleys	High	Substantial	Substantial	Moderate	Slight Neutral
3. Low Lying Plateau Landscape	Low/Medium	Moderate	Slight - Moderate	Slight Neutral	Neutral
4. Low Lying Coastal Plain and Estuarine Landscape, Low lying Islands and Peninsulas	Low/Medium	Moderate	Slight - Moderate	Slight Neutral	Neutral
5 - Narrow Coastal Strip with Raised Hinterland	High	Substantial	Substantial	Moderate	Slight Neutral
6 – Complex Indented Coast, Small Bays and Off Shore Islands	High	Substantial	Substantial	Moderate	Slight Neutral
7 – Plateaus and High Cliffs	High	Substantial	Substantial	Moderate	Slight Neutral
8 – Large Bay	High/ Medium	Substantial	Moderate	Slight	Slight Neutral
Transboundary Seascape Types					
T.1- Large Open or Partially Open Sea Lough with Raised Hinterland	High	Substantial	Substantial	Moderate	Slight Neutral
T.2-Low Lying Coastal Plain	Low/Medium	Moderate	Slight - Moderate	Slight Neutral	Neutral
T.3 Plateaus and High Cliffs	High	Substantial	Substantial	Moderate	Slight Neutral
T.4- Rugged Coastal Shelf and Headlands with Open Views to Sea	High	Substantial	Substantial	Moderate	Slight Neutral

* Not Applicable due to the enclosed nature and reduced scale of the seascape

Potential Effects of Wave (Surface Linear) Arrays

Within 5km of the coastal edge all seascapes with wave resources would be subject to Substantial - to Moderate effects as a result of such devices (dependant on sensitivity) however this would drop to Moderate to Slight /Neutral effects after 10km.

The large horizontal scale and low viewpoint of Seascapes type 4 Low Lying Coastal Plain, and 8 Large Bay would be most able to accommodate characteristics of Wave (On Surface Linear) devices with moderate effects within 5km of the coast dropping to slight neutral effects after 10 km.

Wave (On Surface linear) devices would have moderate substantial effects within 0-5 km of seascape types 1 Large Open Sea Lough, and transboundary type T1 Large Open Sea Lough. The enclosing topography and raised viewpoints from the elevated hinterland, dropping to slight to slight moderate after 10km. The Seascapes type 2 Rugged Peninsulas, 5 Narrow Coastal Strip with Raised Hinterland, 6 Complex Indented Coast, 7 Plateaus and High Cliffs and transboundary types, T3 Plateaus and High Cliffs and T4 Rugged Coastal Shelf with Headlands, have the lowest capacity for Wave (On Surface Linear Structure) Structures with significance of effects ranging from Substantial within 5km dropping to Moderate to Moderate Substantial after 10 km. This is due to the greater potential visibility of wave (Surface Linear) devices from elevated viewpoints along the coastal edge and the more intimate scale of seascape framed by headlands and islands.

Potential Effects of Wave (Oscillating Surge) Devices

Offshore elements of Wave Oscillating Surge devices are likely to be located in inshore waters 0-5km from the coast due to the requirement to site equipment at depths of 10-15m. Due to the lower profile and intermittent visibility of offshore elements effects of offshore elements are likely to be less than the effects of linear wave devices. However as the effects of fixed onshore elements of the device will remain constant and may be the most noticeable element of the device, effects of the fixed coastal structure are therefore equivalent to effects at 0-5 km.. All the following effects are therefore assumed to be within 0-5km of the coastal edge.

This type of device would have moderate effects on seascape types 4 Low Lying Coastal Plain, 6. Complex Indented Coastline and 8 Large Bay, as offshore arrays may conflict with the complex coastal edges or bays while the fixed on shore structures may introduce visually prominent new element in conflict with the local landscape / seascape character.

Seascape types 1 Large open Sea Lough, 5, Narrow Coastal Strip with Raised Hinterland and 7. Plateaus and High Cliffs have potential for moderate substantial effects b due to elevated panoramic views over an extended area with potential for onshore fixed structures to be in conflict with local seascape and landscape character.

Type 2 Rugged Peninsulas has the lowest capacity for Wave (Oscillating Surge) devices due to the combination of extensive and elevated panoramic views from headlands and hinterland with the complex coastal edge and reduced seascape scale of drowned valleys. The topography would potentially render devices in inshore waters visually prominent over an extended area with potential for onshore fixed structures to conflict with vulnerable and unique seascape qualities.

Potential Effects of Tidal (On Surface Point) Arrays

Within 5km of the coastal edge all seascapes with tidal resources would be subject to Substantial - to Moderate effects as a result of such devices (dependant on sensitivity) however this would drop to Moderate to Slight Neutral effects after 10km.

The Seascape types most able to accommodate these device characteristics are type 3 Low Plateau Landscape, and type 8 Large Bay due to the large horizontal scale. Effects of Tidal (On Surface Point) Devices within 5km would be moderate dropping to slight -neutral after 10km.

In Seascape Type 4 Low Lying Coastal Plain, and Type 9 Large River Estuary, the low lying coastline could potentially increase the prominence of Tidal (On Surface Point) Devices as a new vertical element against the horizon or distant shoreline. Consequently effects would be moderate dropping to slight after 10km. For devices located within Type 9 Large River Estuary the reduced scale and enclosing topography make it unlikely that devices could be sited more than 10 km from the shore.

Due to the long elevated views from the hinterland and reduced scale Seascape types 1 Large Open Sea Lough, 5 Narrow Coastal Strip with raised Hinterland, 6 Complex indented coast with Islands, and transboundary type T1 Large Open Sea Lough would be subject to moderate substantial to substantial effects within 5km of the coast dropping to slight moderate effects after 10km.

Seascape types 7 Plateaus and High Cliffs and transboundary types, T3 Plateaus and High Cliffs and T4 Rugged Coastal shelf with Headlands, have the lowest capacity for Tidal (On Surface Point Devices) with effects ranging from Substantial within 5km dropping to Moderate after 10 km, as Tidal (On Surface Point Devices) could potentially create a noticeable focal point in the extensive elevated panoramic views of the open sea, where none previously existed.

Potential Effects of Off Shore Wind Turbines

Due to the scale and form of Offshore Wind Turbines the significance of effect within 15 km offshore for most seascape types with wind resources would be substantial.

The low lying coastline and large horizontal vistas of Seascape types type 3 Low Plateau Landscape, 4 Low Lying Coastal Plain and transboundary seascape T2 Low Lying Coastal Plain are the least sensitive to this type of development and the significance of effect within 15 km would be Moderate reducing to slight neutral after 24km from the shore..

Seascape types 1 – Open Sea Lough, 2 Rugged Peninsulas, type 5 – Narrow Coastal Strip with raised Hinterland, type 7 – Plateaus and Cliffs, type 8 Large Bay and transboundary types 1 Open Sea Lough, T3 Plateaus and High Cliffs and T4 Rugged Coastal shelf have the lowest capacity for characteristics of Off Shore Wind Turbines with Substantial effects within 24km dropping to moderate effects after 24 km.

Mitigation

Possible mitigation measures associated with the reduction of potential adverse effects on the seascape resource would include two key objectives; sensitive siting of the device arrays and consideration of the visual appearance of both the devices themselves and the array; both in terms of layout and use of colour.

Siting of Device Arrays and fixed coastal structures

The location of the device array within the seascape is an important consideration which could substantially diminish the level of effect that might otherwise result on the seascape. Seascape therefore needs to be considered at the outset of the layout, siting and design process in order to limit effects.

The potential effect of a proposed development and the scope for effective mitigation is very specific to individual developments. It is dependent on the type of device, the scale of the proposed array and the characteristics of the affected seascape type. Factors to consider when determining the layout and siting of arrays include the following:

- Arrays should not be sited where they appear to block or close the entrance to bays/loughs/narrows/sounds or where they separate a bay from the open sea;
- Tidal and Wave device arrays should reflect the shape of the coastline and align with the dominant coastal edge;

- Arrays should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate;
- Device arrays should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement;
- Avoid siting arrays where they conflict with the scale and subtleties of complex, indented coastal forms;
- Consideration should be given to locating devices in already industrialised and developed seascapes;
- Where seascapes are considered to be less sensitive to the type of device proposed, devices could be clustered; thereby condensing the effects of the device in one area, leaving more sensitive seascapes intact;
- Generally the further the device array is located from the coastline the lesser the effect, due to there being both fewer seascape components and features to be affected by the development as well as an increased distance between visual receptor and device; and
- Avoid siting fixed coastal structures where they will conflict with the landscape character of the coastal edge or form dominant features visible over an extensive area.

Siting of Device Arrays

Visual Appearance of device arrays and fixed coastal structures

Consideration should be given to the following factors.

- Minimising the height and size of the structure above the water surface. Completely submerged devices would be preferable;
- Where there is no navigational requirement for the devices to be highly visible using contrasting bright colours, consideration should be given to the use of more dark, muted colours which would be less obtrusive and blend with the seascape more subtly;
- Materials wherever possible should be chosen which do not have a highly reflective surface;
- Wind turbine towers should be a non-reflective light hue of natural colour; and
- When lighting is required consideration should be given to minimising glare and reducing the extent of light emission; and
- Where possible fixed coastal structures should comply with the appearance of local vernacular structures.

Likelihood of Occurrence

There is a high probability of the effects identified below resulting, although there are a number of factors that will influence this, of which one of the key ones is visibility and how changes in weather, light and aspect can affect this. A range of factors can influence visibility and these can vary across the study area. The Scott *et al.*, study[31] identified the following key findings:

- The seasonal and diurnal patterns of visibility for coastal environments are significantly different to landward areas and generally visibility is higher compared with landward sites;
- Highest values of coastal visibility tend to occur in the afternoon whilst poor visibility builds up during the night. This means that views of devices at sunset are more likely than views at sunrise making seascapes with westerly aspects slightly more sensitive in this respect;
- Coastal areas near centres of population may experience lower levels of visibility due to reduced air quality;

[31] Scott, K.E., Anderson, C and Benson, Jf (2005) An Assessment of the Sensitivity and Capacity of the Scottish Seascape in relation to Offshore Windfarms, Scottish Natural Heritage Commissioned Report no 103 (ROAME no F03AA06)

- Less fog occurs on the west coast of Ireland, where temperature differentials between sea and air are reduced by the Gulf Stream;
- Windows of exceptional visibility exist just after rain and before evaporation occurs; and
- Excellent visibility is associated with unstable polar airstreams, particularly if these came directly from more northern latitudes and across sea tracks rather than urban areas.

Other factors such as the angle at which the sun illustrates a vista or seascape feature is an important factor in visibility and therefore the extent to which devices may appear in the seascape.

The actual physical form of the device array and its geometry will also affect the level of effect and the siting, layout and design are all factors which will influence the likelihood of the effects resulting.

Confidence and Data Gaps

The seascape assessment is a strategic, desk based study and as such the level of assessment reflects the high level nature of the SEA and does not replace the need for more detailed seascape assessment on a project level basis.

The available baseline information on coastal landscape character at the time of this study varies widely in detail, quality and scope resulting in areas of low confidence. Where either Landscape Character Assessments are not available or where the Confidence Levels were considered to be 'Very Low' alternative source material was reviewed to ascertain the characteristics of the coastal landscape to enable the data gaps to be filled and seascape character types to be defined. . Baseline data gaps are discussed in more detail below.

The technology surrounding the development of wind, wave and tidal devices is rapidly changing and evolving with a range of potential devices being tested with limited information available regarding the recognised effects of these devices. As a result no single wind, wave or energy development scenario could be used for this assessment. Consequently common characteristics associated with the device arrays have been considered in order to provide a consistent approach to the strategic assessment on seascape. Different device scenarios will result in different types and scale of effect on the seascape resource and will consequently need to be assessed on a case by case basis.

The significance of effect of the device types on each of the nine seascape types was identified on plan, verified and mapped using GIS then assessed by means of buffering each of the seascape types according to the significance of effect at each of the visual threshold distances. Due to the complex nature of much of the study area the buffers have sometimes resulted in overlap between seascape types, which is particularly apparent where one seascape type abuts another of a lesser significance. This has sometimes resulted in sections of seascape, which should only be of moderate significance to the device in question appearing to be of major significance due to the buffer overlap from an adjacent seascape type which is more sensitive to change. Whilst such anomalies should be borne in mind when reviewing the figures it does, to a certain extent, reflect the transitional nature between one seascape and another.

In determining the significance of effect of the seascape types to the various device characteristics, it is important to note that judgements have not been made about whether the effect is acceptable or unacceptable, this is a judgement which should be made by decision makers at both strategic and project levels.

Residual Effects

The mitigation measures identified in Section 4.6 could reduce the potential effects identified above, thereby resulting in lower levels of residual effect. However, it is not possible with any level of certainty, to determine the exact level of residual effect on the seascape types as a result of the device arrays, as the extent of mitigation achievable will be heavily dependent on many project specific factors. However, to provide consistency with other topic areas in this SEA, potential residual effects have been estimated and summarised in Tables 11.1 -11.6 Summary of Potential Effects.

Summary

The study area comprises a number of diverse and complex seascape types, which vary considerably in terms of their components, features and characteristics as well as their sensitivity to change.

The significance of effect on the seascape resource of the study area varies according to a number of factors; the type of device, the seascape type and distance from the shore. Each of the nine seascape types considered are likely to be subject to differing levels of effect significance depending on the type of device array considered. For example, the introduction of a tidal (surface point) array into Seascape Type 7 Plateau and High Cliff is likely to result in a more significant effect on the seascape than in Seascape Type 4 Low Lying Coastal Plain. Equally, the introduction of a wave (surface linear) array within Seascape Type 4 is likely to be less significant than tidal (surface point) array. Due to the size and scale of offshore wind turbines in comparison to wave or tidal arrays, levels of effect are proportionally higher and devices are likely to be seen over a larger area. Effects of wave (oscillating surge) devices are likely to be more dependent on site specific conditions such as local topography.

In general, arrays which comprise tidal (surface point) devices and offshore wind turbines are likely to be less easily accommodated within the seascape of the study area than wave (surface linear or Oscillating Surge) devices. However, the large horizontal scale of seascape types 3 and 4 are likely to be least sensitive to surface point devices and offshore wind turbines in comparison to other seascape types.

A further consideration is the positioning of the array within the seascape, in terms of distance from the shore. Generally the further the device array is situated from the heart of the seascape core (i.e. within several kilometres of the coastal edge) the less likely the key features and components that make up the seascape character will be affected.

Whilst it is recognised that there are various technical and other constraints affecting the design and siting of wind, wave and tidal devices, it is considered that careful attention to the visual appearance of the design and its relationship to specific seascape characteristics and components will play a significant role in the acceptability or otherwise of wind, wave and tidal developments in the Irish seascape.

Recommended Baseline Survey and Monitoring

Monitoring of seascape and visual effects associated with wind, on surface wave and tidal devices; through periodic, repeat data collection is recommended so that the actual and predicted effects on seascape and visual amenity can be compared. This would strengthen and improve future seascape and visual effect assessments of similar developments and would also provide a mechanism to check whether mitigation measures have been put in place successfully and whether improvements to the mitigation could be made.

Monitoring could also provide information about whether the perceived value of seascapes effected by wave and tidal development changes for different visual receptors.

As technology develops and the characteristics of the devices evolve and the scale of the device arrays change, ongoing monitoring will be essential to ensure that the geometry of the array layout responds to the site specific locations. Refinement of the sensitivity to change of the broader seascape types as well as more localised seascape units in relation to the different device arrays will be critical if the most sensitive seascapes are to be avoided.

Availability of a comprehensive series of Landscape Character Assessments for Ireland in line with recent recommendations would provide a necessary and valuable baseline to inform specific proposals and further studies.
Detailed seascape and visual effect assessments for specific device arrays in site specific locations should be undertaken to both refine the judgements made by landscape professionals in future appraisals but also to inform the design and location of future wind, wave and tidal developments. In order to achieve this, further research is recommended to establish the key parameters affecting wave and tidal array layouts in particular and to a lesser extent wind turbine arrays from a seascape and visual amenity perspective.

Table A.15 landscape Character Assessment Review

Table 1: Landscape Character Assessment Review

County	Landscape Character Assessment Confidence Levels*	Source Material	Coastal Landscape Character Areas identified in LCAs	Seascape/Coastal Information Confidence Levels**	Coastal Landscape Character information in LCAs	Alternative Source / analysis for landscape information	Coastal LCA information based on alternative source material
Donegal	very low	County Donnegal Development Plan 2006 - 2012	No LCA available, The development plan identifies area of scenic value but no descriptions are provided.	Very low	N/A	Local Plan, Google Map/ OS / aerial Photo, http://www.npws	**Londonderry to Inishowen Head (Lough Foyle)** - large scale sea lough associated low-lying coastal plain, raised hinterland and headlands. **Inishowen Head to Malin Head** - High cliffs edge a raised plateau landscapes. Below the cliffs the narrow coastal edge is typically low, flat and in places jagged, complete with rocky peninsulas and occasional small bays. **Malin Head to Dunaff Head** -varied, complex and incised coastline with steep, undulating hinterland, drumlin landscapes, small bays and cliffs. **Lough Swilly** - large scale sea lough associated low-lying coastal plain, raised hinterland and headlands. **Maghera to Drumanoo** - a narrow, coastal strip or small bay backed by steeply sloping raised hinterland, raised beach and headlands with expansive elevated sea views from the higher ground. **Slieve League -** High cliffs edge a raised landscape. Below the cliffs the narrow coastal edge is typically low, flat and in places jagged, complete with rocky peninsulas and occasional small bays. **Drumanoo Head to Bundoran** (Donegal Bay) - very long open views framed by landmass both across the bay and out to the wide horizon of the open sea often with extensive sands or tidal flat
Leitrim	High	Landscape Assessment of County Leitrim, Nov 2002, ERM	**Tullaghan Coast Character Area**	High	Land slopes gradually down to low rocky cliffs with pebble and boulder intertidal flats	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
Sligo	very low	Sligo Development Plan 2005-2011, County Sligo Heritage Plan 2007-2011	No LCA available	Very low	N/A	Local Plan, Google Map/ OS / aerial Photo, http://www.npws	**Tullaghan Coast to Castle Connor (Donegal Bay, Sligo Bay and Killala Bay)** - large bays with very long open views framed by landmass both across the bay and out to the wide horizon of the open sea often with extensive sands or tidal flats.
Mayo	Medium	Landscape Appraisal of County Mayo, Mayo County Council	**North Coast Plateau**	Medium	Steeply sloping terrain with cliffs and steep inlets	Local Plan, Google Map/ OS / aerial Photo, http://www.npws	Latragh Island to Broadhaven
			North West Coastal Bog	Medium	Low lying moorland coastal strip	Local Plan, Google Map/ OS / aerial Photo, http://www.npws	Broad Haven

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Mayo continued			**North West Coastal Moorland**	Medium	Low lying complex islands and peninsulas, Dunes and sandy beaches to the north west	Local Plan, Google Map/ OS / aerial Photo, http://www.npws	Duveel Point to Hruhill Lough
			Archill Clare, Inishturk and related Coastal Complex	Medium	Complex coastline of Islands and peninsulas, Steep topography, with cliffs and elevated and extensive coastal views	Local Plan, Google Map/ OS / aerial Photo, http://www.npws	LCA description verified
			Clew Bay Glacial Drumlins	Medium	Complex seascape of numerous small drumlin islands. long open views out to sea framed by land mass	Local Plan, Google Map/ OS / aerial Photo, http://www.npws	LCA description verified
			Croagh Patrick Association	Medium	Narrow low lying coastal strip with steeply rising hinterland	Local Plan, Google Map/ OS / aerial Photo, http://www.npws	Kilsallagh to Roonagh Quay- Rocky coastline and long sandy bays
			South West Coastal Basin	Low	Low lying coastal moorland and pasture	Local Plan, Google Map/ OS / aerial Photo, http://www.npws	Bays with sandy beaches and rocky headlands
			South West Mountain Moorlands	Low	*(no coastal information)*	Local Plan, Google Map/ OS / aerial Photo, http://www.npws	Roonagh Quay to Barnabaum Point - Bays with sandy beaches and rocky headlands
Galway	Medium	County Development Plan, landscape and Landscape Character for Galway 2003-2009	**Killlary Harbour**	Low	Highly Scenic coastline	Google Map/ OS / Aerial Photo, http://www.npws	Killlary Harbour- Sea Lough with steeply sloping hinterland , Headlands and sandy bays
			West Coast Clifden to Killlary	Low	Expansive sea views	Google Map/ OS / Aerial Photo, http://www.npws	West Coast Clifden to Killlary- Complex indented coastline with small islands and steeply rising hinterland
			West Coast Gorteen bay to Clifden	Low	*(little or no coastal information)*	Google Map/ OS / Aerial Photo, http://www.npws	West Coast Gorteen bay to Clifden - Low lying rocky / rocky mosaic coast with white sand bays
			Bertraghboy Bay and eastern banks	Low	*(little or no coastal information)*	Google Map/ OS / Aerial Photo, http://www.npws	Bertraghboy Bay and eastern banks- complex indented coastline with inlets and small islands
			Lettermore and Gorumna Islands	Low	Low lying open island landscape	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
			Carraroe (Cashla Bay to Glencoh	very Low	*(little or no coastal information)*	Google Map/ OS / Aerial Photo, http://www.npws	Carraroe Peninsula - expansive sea views, low rolling exposed landscape
			Inveran to Galway City Coastline	Low	Flat open coastline with rocks and sand merging with grassland, expansive sea views	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified

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Galway (continued)			**East Galway Bay (Oramore to Kinvarra Bay**	Low	sinuous coast	Google Map/ OS / Aerial Photo, http://www.npws	East Galway Bay (Oramore to Kinvarra Bay- low lying agricultural land
			Arran Islands	Low	Flat open island landscape sloping gently to north east shore, expansive sea views	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
Clare	High	Landscape Character assessment of County Clare, 2004, ERM	**Burren Uplands**	High	Narrow low lying coastal strip with steeply rising hinterland. Within Blackhead bay estuarine mudflats, with coastal limestone farmland and valleys, islands, Long expansive views from higher slopes out to Galway bay and Arran Islands. On the west coast of the Burran the coast includes Flat limestone pavements, limestone farmlands and low limestone cliffs along with dune systems.	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
			Cliffs of Mohair and Lahinch	High	Distinctive and spectacular cliff formation extending for 7km and reaching 203m in height exposed landscape of coastal plateau and farmland sloping gently to coast. Open bay with long views out over the Atlantic Ocean, with low shelving cliffs containing bay beyond beach, estuarine landscape with salt marsh and dunes	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
			Malbay Coastal Farmlands	High	Low lying indented coastline, with rocky headlands , wide sandy bays and dune systems. Open and windswept character, with extensive views to offshore islands and coastline.	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
			Loop Head Peninsula	High	Flat exposed peninsular farmland – very distinctive ladder fields, estuaries, salt marsh and mudflats, sand and boulder coves, dune systems, shelving coastal rocks, vertical cliffs. Dramatic coastal formations along the north west coast t with high cliffs, arches, stacks and rocky inlets. More sheltered salt marsh and estuarine bays are typically on the southern side of the peninsula. Extensive open views to sea and along north and south coasts. Remote and isolated character.	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
			Lower Shannon	High	Wide expanse of water, with a more maritime than estuarine character. Low estuarine fringe and farmland, there is a Marina at Kilrush. Pylons and Money Power Station are visually prominent features. There are long views to islands and the south shore, the seascape is in moderate to poor condition with degraded views.	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified

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Clare continued			**Shannon Estuary Farmland**	High	Flat coastal fringe slopes to sea rising to hinterland of ridged hills. Scattered housing and small villages with some estate houses, forestry plantations and broad leaf woodlands. Scattery Island and monastery form an important local feature. There are views of industrial activity on the Shannon and long views to Limerick and across estuary from the shoreline and elevated points in the hinterland.	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
			Seascape River Shannon	High	Low lying muddy linear coastline, with intertidal mudflats at Clonderlaw Bay. Low coastal fringe sloping to sea comprised an agricultural landscape of large straight sided fields with scattered farmhouse settlements. Ruined 16C tower houses dot the shore on promontories, there are several light houses and a Car Ferry to Tarbet. Views of the Shannon are dominated by Shipping, industrial and commercial activity.	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
Limerick	Medium	Limerick County Development Plan 2005	**Shannon Integrated Coastal Management Zone**	Medium	Low ground rising to south, farmland enclosed by hedgerow, irregular field patterns, low estuarine landscape	Google Map/ OS / Aerial Photo, http://www.npws	South coast of the inner Shannon estuary, Estuarine Landscape with Rolling hinterland
Kerry	very low	Kerry County Development Plan 2009 -2015	No LCA available, The development plan identifies areas of amenity or scenic value but no descriptions are provided.	very low	N/A	Google Map/ OS / Aerial Photo, http://www.npws	**The Shannon Estuary (south coast from Carrig Island to Tarbet bay**) Low rolling coastal edge and estuarine Landscape with Rolling hinterland
				very low	N/A	Google Map/ OS / Aerial Photo, http://www.npws	Mouth of The Shannon (south coast west to Carig Island)- large scale sea lough with associated low-lying coastal plain, raised hinterland and headlands.
				very low	N/A	Google Map/ OS / Aerial Photo, http://www.npws	**Tralee Bay and Brandon Bay** - very long open views framed by landmass both across the bay and out to the wide horizon of the open sea often with extensive sands or tidal flats.
				very low	N/A	Google Map/ OS / Aerial Photo, http://www.npws	**Dingle and Inveragh Peninsula**s -The steep exposed wild coastline with long peninsulas, sounds and islands provides a range of seascape scales and dramatic sea views ranging from small scale tranquil inner lochs and bays to rugged headlands with expansive open views.

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Cork	Medium	Cork County Council Draft Landscape Strategy 2007	**Ardgroom, Ballycrovane Harbour, Dursey- Bear Haven, Reenmore Point, Allhies, Adrigole-Glengariffle, Roaring Water Bay and Islands, Sheeps Head - Mizen Head**	High	Part of a group of rugged hilly or mountainous ridges with drowned valleys between them . The landscape is exposed and dramatic with rocky promontories and islands. Bays are sheltered with numerous small islands, land is fertile and low lying, sloping down to the shore from the hinterland.	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
			Toe Head /Lough Hyne, Glandore, Gallet Head, Ilnchydoney, Seven Heads, Courirmacsherry, Garrettstown Strand, Old Head of Kinsale, Kinsale Harbour, Roberts Head, Cross Haven	High	Exposed and windswept gently undulating topography with shallow river estuaries, mudflats or marsh areas.	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
			Cork City and Harbour, Power Head, Ballycotton Bay, Younghall Bay	High	Large sweeping sandy bays with low rocky promontories low cliffs and low rocky coastline.	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
Waterford	Very Low	The Waterford City Environs Local Area Plan 200 46 8-2014 Appendix 4 Scenic Landscape Evaluation,	No LCA available	Very low	N/A	Google Map/ OS / Aerial Photo, http://www.npws	**Waterford Coast** - large bays, with very long open views framed by landmass both across the bay and out to the wide horizon of the open sea often with extensive sands or tidal flats.
Wexford	Low	Wexford Development Plan 2007 -2013, Appendix V Landscape Character Assessment	**South Coast**	Low	Low lying, flat topography with views from hinterland out to sea low lying, flat agricultural land, with areas of enclosure at Bannow Bay, Ballyteige, Tacumshin and Lady Island	Google Map/ OS / Aerial Photo, http://www.npws	South Coast of Wexford -low lying, flat agricultural land, incised by large sandy bays with cliffs and rocky headlands
			East Cost	Low	Low lying, flat topography with long relatively straight coasts of sand or shingle backed by low cliffs and limited coastal views from hinterland.	Google Map/ OS / Aerial Photo, http://www.npws	East Coast of Wexford - Linear coastline with Large bay/ coastal Lagoon at Wexford along with urban settlement.
Wicklow	Low	Development Plan 2010-2016, Appendix F, Landscape Assessment Study and Landscape	**Arklow Head /Clogga**	Low	Sandy beaches with dunes, largely rural area	Google Map/ OS / Aerial Photo, http://www.npws	Arklow Head /Clogga- Flat linear coast , low cliffs, dunes and sand or shingle beaches, mainly rural
			Arklow Town	Low	Dunes, urban settlement at Arklow, Commercial port	Google Map/ OS / Aerial Photo, http://www.npws	Arklow Town- Flat linear coast , dunes and sand or shingle beaches, urban port , existing offshore wind farm development at Arklow Bank.
			Sallymount/Johnstown	Low	Sandy beaches with dunes ,	Google Map/ OS / Aerial Photo, http://www.npws	Sallymount/Johnstown - Flat linear coast , low cliffs, dunes and sand or shingle beaches, mainly rural hinterland
			Brittas Bay	Low	Sandy beaches with dunes, rural hinterland	Google Map/ OS / Aerial Photo, http://www.npws	Brittas Bay- Low rolling rural hinterland and long shallow curving sandy bay with dunes, rising to low cliffs with small shallow bays to the north .
			Wicklow Head /Kilpoole	Very Low	*(no relevant coastal information available from the LCA)*	Google Map/ OS / Aerial Photo, http://www.npws	Wicklow Head /Kilpoole Low rolling rural hinterland and long shallow curving sandy bay with low cliffs with small shallow bays .
			Wicklow Town	Low	Harbour	Google Map/ OS / Aerial Photo, http://www.npws	Wicklow Town, Urban and developed coastline of low cliffs and small shallow bays

Table 1: Landscape Character Assessment Review **DRAFT**

County	Landscape Character Assessment Confidence Levels*	Source Material	Coastal Landscape Character Areas identified in LCAs	Seascape/Coastal Information Confidence Levels**	Coastal Landscape Character information in LCAs	Alternative Source / analysis for landscape information	Coastal LCA information based on alternative source material
Wicklow continued			**The Murrough**	Low	Long sandy beaches north of Wicklow with rural hinterland, and areas of saltmarsh	Google Map/ OS / Aerial Photo, http://www.npws	The Murrough - Flat rural hinterland with low linear coastline of long sandy beaches with areas of saltmarsh and shingle, u
			Ballynerrin	Low	Rural landscape	Google Map/ OS / Aerial Photo, http://www.npws	Ballynerrin - Flat rural hinterland with low linear coastline of long sandy beaches with areas of saltmarsh and shingle, urban and developed coastline to the north.
			Greystones	Low		Google Map/ OS / Aerial Photo, http://www.npws	Greystones - Flat rural hinterland with low linear coastline of long sandy beaches with areas of saltmarsh and shingle, urban and developed coastline
Wicklow continued			**Rathdown**	Low	Rural sandy beaches with Yacht club.	Google Map/ OS / Aerial Photo, http://www.npws	Rathdown - Low linear coastline of long sand and shingle beaches backed by cliffs rising in height to the north
			Bray Head	Low	Cliffs	Google Map/ OS / Aerial Photo, http://www.npws	Bray Head- Rocky headland and high cliffs with elevated open sea views ,
Dun Laoghaire	High	Plan, Section 3 Existing Environment and Appendix F Landscape Character Areas.	**Shanagagh**	Very Low	Low density housing,	Google Map/ OS / Aerial Photo, http://www.npws	Shanagagh -Linear coast line with shallow sandy beach, and ribbon development
			Dalkey and South Dublin Bay	Very Low	long seascape and coastal views,	Google Map/ OS / Aerial Photo, http://www.npws Draft Development Plan	Headland and south shore of large bay, rocky shoreline, predominantly urban, low density housing , long seascape and coastal views,
Fingal	Medium	Fingal County Development Plan, Appendix F Landscape Character Areas, Appendix B Landscape Character Assessment	**Howth**	Medium	There is a harbour at Howth and areas of dense housing along west and north coast of the peninsula, with large areas of heathland to the east and areas of fields woodland and heath along southern coast.	Google Map/ OS / Aerial Photo, http://www.npws	Howth peninsula has cliffs and rocky shore lines to the east with sloping hinterland rising to the Ben of Howth and low lying sandy beaches to the west. Irelands Eye is an uninhabited plateau island of open heathland with cliffs rocky foreshore and sandy bays
			Portmarnock	Medium	Estuarine landscape and inner bay enclosed by Portmarnock peninsula with low coastal edge with sandy beaches backed by Golf and ribbon development	Google Map/ OS / Aerial Photo, http://www.npws	Portmarnock- Sandy beaches backed by golf and ribbon development
			Malahide Hinterland	Low	the villages of Malahide and Portmarnock are separated by agricultural fields	Google Map/ OS / Aerial Photo, http://www.npws	Malahide coast - A low flat coastal strip with a broad sandy beach to the north becoming rocky coastal edge,
			Malahide (Broadmeadow) Estuary	Very Low	*(no relevant coastal information available from the LCA)*	Google Map/ OS / Aerial Photo, http://www.npws	Malahide (Broadmeadow) Estuary -Low coastal strip with long linear beaches , large inner bay and estuarine landscape. Marina and urban development at Malahide on south coast of estuary with ribbon development and golf course to the north.

			Lambay	Medium	The island has a wild open character	Google Map/ OS / Aerial Photo, http://www.npws	Lambay -A rocky shoreline and steeply rising hinterland forms a prominent landscape widely visible along the coast.

Table 1: Landscape Character Assessment Review

County	Landscape Character Assessment Confidence Levels*	Source Material	Coastal Landscape Character Areas identified in LCAs	Seascape/Coastal Information Confidence Levels**	Coastal Landscape Character information in LCAs	Alternative Source / analysis for landscape information	Coastal LCA information based on alternative source material
Fingal continued			**Donabate**	Low	*(no relevant coastal information available from the LCA)*	Google Map/ OS / Aerial Photo, http://www.npws	Donabite - Rocky headland with low cliffs, sandy beaches and small bays
			Rogerstown estuary	Medium	Tranquil low lying estuarine landscape with salt marsh, sand spits and mudflats within inner bay.	Google Map/ OS / Aerial Photo, http://www.npws	Rogerstown estuary - Large outer bay with long sandy beaches and expansive sea views framed by headlands;
			Rush	Medium	Flat and low lying coast backed by horticulture and small holdings. Seaside resort and harbour at Rush.	Google Map/ OS / Aerial Photo, http://www.npws	Rush - long beaches with headlands
			Skerries Hinterland	Medium	Flat low lying coastal edge with areas of mature woodland, sloping back to raised hinterland. Sandy beaches and peninsula with small Islands. Harbour and urban settlement at Skerries	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
			Northern Coastal strip	Medium	Low-lying flat open agricultural land with rocky headlands and sandy bays. Long and expansive views out to sea and along coast	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified
Meath	Medium	Meath Landscape Character Assessment, Cultural Heritage and Landscape Protection, Meath County Development Plan , 2007-2013,	**Coastal Plain**	Medium	low rolling coastal hinterland between Boyne Estuary to the north and Nanny valley estuary to the south.	Google Map/ OS / Aerial Photo, http://www.npws	Low lying linear coastline with long sandy beaches and dunes
			Nanny Valley	Medium	Flat bottomed river valley with wooded slopes	Google Map/ OS / Aerial Photo, http://www.npws	Estuarine landscape with sandy flats at river mouth
Louth	Medium	Landscape Character Assessment, Louth County Council, 2002 Louth County Development Plan 2009-2015 Chapter 2 Conservation and Heritage	**Dunany, Boyne Estuary Coast**	Medium	Long sandy beaches, and dune systems with low undulating hinterland.	Google Map/ OS / Aerial Photo, http://www.npws	Part of wider linear coastline with elevated rocky headlands,
			Dundark Bay Coast	Medium	low lying expansive marshy and sandy intertidal flats and rolling agricultural hinterland.	Google Map/ OS / Aerial Photo, http://www.npws	Large shallow bay with elevated rocky headlands, estuarine landscape
			Lower Faughart, Castletown and Flurry River Basins	Medium	Estuary with low flat hinterland and extensive marsh areas. Extensive views north to Slieve Gullion, Feede and Carlingford Mountains	Google Map/ OS / Aerial Photo, http://www.npws	Large estuary, part of wider estuarine landscape
			Cooly Lowlands and Coastal Areas	Medium	Predominantly low flat rocky shoreline with small sandy beaches and agricultural hinterland, sloping down from gently the base of Slieve na Gloch and Carlingford Mountains. Raised headlands and cliffs at Cooley point. Extensive views to Cooley and Mourne Mountains and across Dundalk Bay	Google Map/ OS / Aerial Photo, http://www.npws	LCA description verified

* Landscape Character Assessment Confidence Levels

Very low	Minimal or no landscape information available; no assessment has taken place
Low	Some landscape information is available; A partial or poor quality assessment has taken place
Medium	Landscape character assessment is available but may be outdated or lack detail
High	Landscape Character assessment available that meets contemporary standards

** Seascape/Coastal Information Confidence Levels

Very low	Minimal or no seascape or coastal landscape information available; no coastal landscape
Low	Some costal landscape information is available; A partial or poor quality landscape
Medium	Coastal landscape or seascape character assessment is available but may be outdated or
High	Relevant coastal landscape and/or seascape character assessment available that meets

Seascape Familiarisation Visits

The brief for this additional seascape work was to carry out seascape familiarisation visits to support the seascape assessment which forms part of the Irish Offshore Strategic Environmental Assessment (SEA) of Wave, Tidal and Offshore Wind Development in Irish Waters undertaken by AECOM and Metoc. This document has informed the seascape assessment of the SEA and should be read in conjunction with it.

As part of the SEA, the potential impact that wind, wave and tidal devices could have on the seascape environment was considered.

The study area comprises some very complex and diverse coastlines, which vary considerably both in terms of their character and sensitivity to change. The type of device and its arrangement in the water will influence the extent and magnitude of impact that could result. Equally the specific sensitivity of a seascape in relation to the marine renewable device will vary due to the complex and diverse character of the Irish coastline and the associated differences in terms of the actual and perceived remoteness and naturalness of the area.

In order to understand the sensitivity of these different seascape character areas to wind, wave and tidal devices, it is important to experience coastal environments in order to inform the criteria for sensitivity analysis. Whilst reviewing baseline data and good practice guidance on seascape assessment (along with previous studies[32]), it became apparent that there were gaps in the baseline data available for assessing the sensitivity of Irish seascape to wind, wave and tidal devices. In order to fill some of these gaps alternative sources of information where used to supplement available Landscape Character Assessments. Further survey based seascape analysis was considered to be necessary at selected locations to verify the desk based study.

In defining the seascape types it was important that the strategic scale of the assessment was considered. Ireland has a dramatic, varied and constantly changing coastline. Broad judgements have had to be made regarding the component parts of each seascape and a rationale developed in order to generalise and hence incorporate minor character areas set within a generic description of seascape type. Consequently, where a seascape has been deemed for example, to be Seascape Type 6 - Complex Indented Coast, Small Bays and Offshore Islands, there may be the occasional occurrence of a larger bay within the coastline. At a strategic level, this level of detail cannot be mapped without detracting from the clarity of baseline understanding of the study area.
The purpose of this additional site specific seascape work is to inform the SEA and specifically the strategic seascape assessment which is being undertaken by AECOM. The assessment of the sensitivity of a seascape in relation to a development is a relative and comparative exercise where consistency in approach is critical.

The purpose of this study is two fold. Firstly it aims to inform an understanding of the different elements of seascape character such as contrasts in scale, form and pattern, which could have an implication on how wind, wave and tidal devices are experienced in differing seascape character types. This will help inform the sensitivity of seascape types to wind, wave and tidal devices. Secondly it will help inform the professional judgement used to establish the potential visual significance of marine devices, for example, at the distance at which the visibility of off shore turbines and tidal devices become insignificant.

A site visit to Arklow (County Wicklow) to view the existing offshore Array at Arklow Bank was undertaken in order to inform the methodology and sensitivity criteria used. Additional site observations were carried out along the coast of County Wicklow to provide inform of the judgements made during the desk based seascape SEA.
This study also draws on previous site studies undertaken as part of the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland[33], and Scottish Marine Renewables SEA, 2007[34], looking at device characteristics and transboundary areas.

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[32] Please see references listed in Seascape at the end of this Appendix

[33] SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009.

[34] Scottish Marine Renewables Strategic Environmental Assessment 2007, Scottish Executive,

Methods and Approach

The SEA study area comprises the coastline of Ireland and those areas of the Northern Ireland and Scottish coast which may be vulnerable to transboundary effects.

Familiarisation visits were made in May 2010, in order to understand the marked differences in seascape character which exist across the study area. Visits were made to the following locations:

- Arklow and Mizen Head (County Wicklow)
- Wicklow Coast, (County Wicklow)
- Bray Head, (County Wicklow)
- Culdaff Bay, (County Donegal)

Information is included for the following transboundary areas as extracts from the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland

- The Causeway Coast
- Dundrum Bay
- Lough Foyle and Magilligan Flats

The following information from previous comparative studies[35] was used to inform the familiarisation study.

- Robins Rigg Offshore Wind Farm, Solway Firth
- Prototype Tidal Device, Strangford Lough

The complexity of islands and indented coastline seascapes, sounds and sea loughs or simplicity of open estuarine or linear coastal seascapes provide a contrast in scale, form and pattern which can influence people's experience and perception of them. The seascapes selected to visit further enabled clarification of the consistency of approach taken in assessing sensitivity. Observations recorded have been used to substantiate the assessment of sensitivity which is a relative and comparative exercise.

The familiarisation visits were also used to inform an understanding of the potential visual significance of marine devices. For example, to determine at what distance the visibility of wind turbines become insignificant. Guidance on visual significance of marine devices can be found in a number of publications. These however relate either to the Scottish or Welsh coastlines or to offshore wind farms. The Scott, K.E (2005) publication noted that levels of visibility are higher in Scotland (or at certain places in Scotland) and the potential visual range significantly higher than in England and Wales. There was no information available on levels of visibility found for Ireland. Visual significance is influenced by atmospheric conditions such as visual clarity and light quality. Visual clarity is influenced by humidity, temperature and the presence of air pollution. The report 'Welsh Seascapes and sensitivity to Offshore Development' 200936 states that the prevailing moist westerly winds along the Welsh coastline result in a lower level of visual clarity in comparison to the colder, unpolluted atmosphere of western Scotland which has a higher level of visual clarity.

[35] SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009.
[36] Welsh Seascapes and sensitivity to Offshore Development, Countryside Council for Wales, 2009

Information on the Irish climate was drawn from the Irish Meteorological Office

1961 -1990 Annual mean values over 30 years

Location	Relative Humidity %		Overcast days without sun	Days with more than 5mm Rain	Days of Fog
	9am	3pm			
Dublin	82	72	61	48	50.5
Rosslaire	84	78	61	59	38.5
Roche's Point	85	79	63	63	46.5
Valentia	83	78	75	95	8.9
Belmullet	83	78	66	80	16.6
Malin Head	82	78	67	76	11.8

In order to help inform the likely visibility of the sea from the land, maps and a hand held GPS was used to determine distances from locations on the coast to from turbines at Arklow Bank and distances to visible landmarks on the Irish coastline. This was helpful in verifying the limits of visual significance identified during the desk based study and to inform the seascape assessment of the SEA. It should be noted that the recorded distances for guidelines purpose only and only as accurate as the GPS unit registered.

Descriptions of the vista and observation of what was visible to the naked eye at varying distances along the coast were noted. This helped inform how different seascape types and coastlines alter how devices are likely to be perceived.

A number of factors affecting the sensitivity of each individual seascape were considered. Principal amongst these was scale; form; pattern; settlement; scenic quality and exposure.
The study is also informed by similar visits to offshore wind development at the Solway Firth and pilot tidal device at Strangford Lough carried out as part of the Offshore Wind and Marine Renewable Energy in Northern Ireland SEA[37].

Wind, Wave and Tidal Devices Considered

Given the evolutionary nature of wave and tidal technology, no single device scenario has been assessed in the Seascape SEA. Consequently, it was considered that device characteristics would be used as a basis to assess the affect of wind, wave and tidal device arrays on the seascape resource of the study areas. The following device characteristics have been used in the seascape assessment and were considered when in the field during both site visits.

- On surface linear structures – these are typically wave devices in open water, 2-3m (height) of the device visible above the sea surface with a typical array arrangement 1km by 4km, oblong shape;
- On surface point structures – these are typically tidal devices although they can also be wave and protrude above the water surface up to 10m. A typical arrangement for a 30 unit tidal array would be expected to occupy 0.5km2;
- Wind Structures - Typically consisting of 5MW turbines (height to blade tip approximately 80-120m) in a 100-500 MW array of 10km2 – 50km2

Visibility and Distance

The following considerations were also noted during the observations and have been used to inform the Seascape SEA.

[37] SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009.

- Devices which are seen in a backlit situation will appear to be more visible. An object is barely visible when the contrast between the brightness of the sky and the brightness of the object is at a minimum.
- Backdrop to the device will be important when considering its visibility. For instance a device which is seen against a backdrop of landform will potentially be less visible than a device which is seen against the skyline, breaking the horizon.
- Colour of the devices will be an important consideration to minimise their visibility.

The visibility thresholds for the three device characteristics have been developed based on information documented in the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland[38], the UK Offshore Energy SEA 2009, Welsh Seascapes and sensitivity to Offshore Development 2009[39] in relation to wind devices and considerations for Wave and Tidal devices documented in the Scottish Marine Renewables SEA, 2007

It is considered that the following thresholds of visibility would be appropriate to use when considering wind devices in the Irish study area.

For Wave (On Surface Linear) Arrays and Tidal (On Surface Point) Arrays

- Large: 0 - 5km from the coast. Notable change in seascape characteristics over an extensive area ranging to a very intensive change over a more limited area;
- Medium: 5 - 10km from the coast. Moderate change in localised areas;
- Small: 10 - 15km from the coast. Small or imperceptible change in seascape components; and
- Negligible. 15km + from the coast. No discernible change in any seascape component.

For Offshore Wind Turbines 5MW

- Large: 0-15km from the coast. Notable change in seascape characteristics over an extensive area ranging to a very intensive change over a more limited area;
- Medium: 15-24km from the coast. Moderate change in localised areas;
- Small: 24 - 35km from the coast. Minor change in localised areas
- Negligible 35km+ from the coast. No discernible change in any seascape component

Wave (Oscillating Surge) devices require water depths of 10 -15 m along with fixed coastal structures, therefore all devices are within 0-5km of the coast and effects are site specific.

Sensitivity

The following key elements and characteristics of seascapes are considered to be important criteria to be used in the determination of sensitivity of change of different seascapes to the device arrays considered in the SEA.

- Scale of the seascape (small scale, enclosed or large scale and open);
- Coastal topography / form / pattern (intricate, complex, rugged, focal points or flat, horizontal, simple, lack of natural focus);
- Presence of settlement / infrastructure (small scale, scattered development, limited road network, lack of infrastructure or larger scale, urban mass and larger scale infrastructure);
- Scenic Value (undeveloped, isolated or developed);
- Exposure (sheltered, calm or exposed and dramatic).

Irish Seascape Familiarisation Study

[38] SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009.
[39] Welsh Seascapes and sensitivity to Offshore Development, Countryside Council for Wales, 2009

Seascape Character and Sensitivity

The seascape assessment identified 9 different seascape types across the Irish seascape and the following were visited and verified:

- Type 3 Low lying plateau landscape
- Type 4 Low Lying Coastal Plain and Estuarine Landscape, Low lying Islands and Peninsulas
- Type 7 Plateaus and High Cliffs
- Type 8 Large Bay

Seascape Types 1, 2, 5, 6, and 9 were not visited as part of this study.

Criteria to define sensitivity were considered and the various seascape types found on the within the site study areas were used to test the criteria and rationalise the approach to defining seascape types at a strategic level.

Arklow to Wicklow Head

The Arklow Bank off shore wind farm was viewed at different distances along the coastline and observations made on visibility and how it sat within the seascape. The 25MW development consists of 7 x 3.6 MW turbines (height to blade 124m) located 10 km off the coast of Arklow. Weather conditions were generally fair and overcast throughout the site visit with poor to fair visibility. With improved visibility it is considered that greater detail would have been apparent at the 10 and 15km ranges. This is further supported by the observations made in the Scott *et al.* (2005)[40] study and field observations of Robin's Rigg Offshore Wind park in the Solway Firth in previous studies.[41]

Seascape Character and Sensitivity

Seascape character is made up of physical characteristics of hinterland, coast and sea as well as perceptual responses to the seascape. The following characteristics of the seascape from Arklow to Wicklow Head were noted based on observations made during the site visit (May 2010). .

- Low undulating plateau topography with low flat ground at Arklow around the Avoca River estuary
- Urban seafront at Arklow with piers, docklands and industrial estates.
- Long low sandy beaches or small bays backed by dunes or low grassy plateau edge rising to low cliffs at Wicklow Head and Mizen Head.
- Agricultural hinterland with scattered housing development along the coast road, little intervisibility with the coast from the hinterland.

[40] Scott, K.E., Anderson, C. and Benson, J.F. (2005) An Assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms. Scottish Natural Heritage Commissioned Report No. 103 (ROAME No. F03AA06)

[41] SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009

Arklow Pier – looking due east towards Arklow Bank Wind Farm (10Km)

Arklow Seafront looking due east towards Arklow Bank Wind Farm (10 Km)

Site Observation: Arklow Town Seafront

Views from the Arklow town shoreline to Arklow Offshore Wind Park (at a distance of approximately 10km and 7 m above sea level) looking out to the open sea.

The weather conditions were dry bright and overcast with a slight haze along the coast and a bank of dense fog offshore resulting in generally poor visibility, The time was t 11.45. The following observations were made:

- Shallow bay with wide sea horizon framed by distant headlands.
- The Arklow Bank turbines at 10 km distance were completely obscured by offshore fog it is likely these would be visible in better weather conditions.
- The Arklow Offshore Wind Park Information board at Arklow Town shoreline states : *"The wind park is normally only visible on a clear day"*[42],
- Looking along the coast there were hazy views along the coast to the raised headlands of Arklow Head 5 km to the south and Mizen Head 10 km to the north.

Site Observation: Seabank (R750)

Views from the roadside (R750) north of Seabank to Arklow Offshore Wind Park (at a distance of approximately 10 km and 8 m height above sea level) looking out to the open sea.

The weather conditions were dry, overcast with a distinct bank of dense fog offshore resulting in poor visibility; The time was 13.05. The following observations were made:

- Low rolling rural plateau landscape dropping abruptly to narrow linear sandy coastal edge, wide open sea horizons; and
- The tops of the turbines hubs 10 km offshore were visible above a distinct offshore bank of dense fog. The height and position of the visible sections of turbine suggested that the Wind Park would be a prominent feature on the sea horizon in clear weather.

[42] Quoted from the information board provided by GE Energy and Airtricity erected at Arklow seafront, County Wicklow.

Mizen Head looking north over Brittas Bay to Wicklow Head (10 Km)

Mizen Head looking south and east towards Arklow Bank Wind Park (12km)

Site Observation: Mizen Head

Views from the roadside (R750)at Mizen Head along the coast, to Arklow Offshore Wind Park (at a distance of approximately 12 km and 16 m height above sea level) looking out to the open sea.

Weather conditions were dry, overcast with sea haze and offshore fog banks, visibility was poor, the time was 13:30.

- Low rolling grassy plateau rising to grassy headland;
- Small sandy bays backed by low grassy plateau edge;
- Sea vistas framed by headlands;
- Agricultural hinterland;
- Visibility limited by sea haze along the coast and offshore fog;
- Despite poor visibility Wicklow Head is clearly visible at 10 km distance; and
- Due to haze and offshore fog it is not possible to discern Arklow Bank turbines at 12 km distance although it is likely these would be visible on a clear day.

Wicklow Head to Bray Head

Seascape Character and Sensitivity

The following characteristics of the seascape from Wicklow Head to Bray Head were noted based on observations made during the site visit (May 2010).

- Low undulating plateau topography with low coastal flats between Wicklow and Greystokes rising to rocky headlands at Bray Head and Wicklow Head;
- Urban seafront at Wicklow and Greystokes;
- Elevated railway line along the coastal edge separating the hinterland from the sea between Wicklow and Bray Head;
- Long low linear sandy beaches with dunes backed by agricultural coastal flats or small bays backed by low grassy plateau edge rising to low cliffs at Wicklow Head and more substantial cliffs at Bray Head; and
- Agricultural hinterland with scattered housing development along the coast road and larger settlements at Wicklow and Greystokes, little intervisibility between the hinterland and the coast in many areas.

Wicklow Head looking north, Bray Head (20K) is visible as a shadow in the sea haze

Wicklow Head, private golf course on headland, rolling plateau landscape forming low cliff edge

Site Observation: North of Wicklow Head

Views from the cliff edge north of Wicklow Head (at a height of 15 m above sea level) looking out to the north and east to the open sea.

The weather conditions were dry and bright, overcast with patches of clear sky and hazy sea mist along the coast resulting in poor visibility, the time was 14:10. The following observations were made:

- Low rolling rural plateau landscape with low cliffs dropping abruptly to small shallow sandy bays, wide open sea horizons with distant headlands;
- Natural coastal edge backed by housing and scattered development, the headland at Wicklow Head is occupied by a commercial golf course;
- Low grassy flats of Newcastle and Kilcoole visible in the distance (10 Km); and
- Bray Head visible as a distant shadow in the mist (20Km).

Greystokes looking north to Bray Head (5km), low flat linear beach with urban coastal character

Greystokes looking south, with railway infrastructure, low flat linear beach with urban coastal character

Site Observation: Greystokes

Views from the seafront at Greystokes (at a height of 6m above sea level) looking along the coast and out to the open sea horizon.

The weather conditions were dry and overcast with patches of clear sky, hazy sea mist along the coast and offshore fog banks resulting in poor visibility, the time was 15:00. The following observations were made:

- Low lying flat coastal plane with a narrow sandy linear coastal edge;
- Urban character with an elevated railway line to the rear of the beach separating the hinterland from the shore. No intervisibility between the shore and urban hinterland;
- Very expansive wide open sea horizons; and
- Bray head is visible to the north (5 Km)

Bray Head looking South to Graystokes (5km) and coastal flats beyond, the distinction between low plateau coastal edge and coastal flats is clearly visible. Wicklow Head (20km) is just discernable as a shadow in the coastal haze.

Site Observation: Bray Head

Views from Cliff Road at Bray Head (at a height of 120 m) looking out to the sea horizon and along the coast to the south.

The weather conditions were dry, bright and overcast with patches of clear sky, hazy sea mist along the coast and offshore fog banks resulting in poor visibility, the time was about 15:30 pm. The following observations were made:

- Low plateau landscape visible between Greystokes (5km) and Brayhead rising to form the rocky headland of Bray Head;
- Lush wooded agricultural landscape on lower slopes giving way to open moorland and scrub at the top of Bray Head;
- Ribbon development of modern bungalows and houses, the open hilltop has been enclosed for development. Suburban character;
- Long elevated views to the open sea horizon limited by tree cover and offshore fog banks, it is likely that views will be more extensive in clear conditions; and
- Long elevated views along the coast to the south limited by tree cover.

Culduff Bay, Donnegal

A site visit was carried out in April 2010 to verify and supplement the desk based seascape character study.

Culdaff Bay looking north west to Glengad Head

Culdaff Bay looking east

Seascape Character and Sensitivity

The following characteristics of the seascape at Culduff Bay were noted based on observations made during the site visit (April 2010).

- Settlement is largely rural and scattered.
- The rolling plateau and cliffs present large scale expansive views to the open sea with long views of the coastline. The cliff landscape is exposed, rugged and of high scenic quality
- Sandy bay framed by rocky headlands.

Transboundary Areas

There are four transboundary seascapes with potential to be affected by development of resource areas within Irish waters of which three were considered previously in the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland43.

- T: Large Open or Partially Open Sea Lough With Raised Hinterland
- T2: Low Lying Coastal Plain
- T3: Plateaus and High Cliffs

Approach

The following summaries are based on detailed site observations documented in The SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland Observations and site survey information were recorded in writing, use of GPS, and photographs.

Site Observations: Dundrum Bay

Weather conditions were generally bright but overcast with fair to good visibility and squally showers; the time was approximately 12 noon to 4:30 pm. The seascape of the bay is distinct in comprising of a very large long sweeping bay with sand dunes backed by flat agricultural land. The following observations were made:

Views from A2, north east Dumdrum Bay east of Minerstown

[43] From the SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009

- There are large scale long extensive views across the bay (aprox 15 km) and out to the open sea horizon.

Views from Tyrella Beach, Dundrum Bay

- There are large scale and long extensive out to the expansive open sea horizon framed by headlands and long views along the bay.
- The shore is undeveloped, low lying, open and exposed with high scenic quality

Figure E2.12 Dumdrum Bay, Tyrella Beach, looking east to the open sea

Site Observations: Giant's Causeway Coast

Weather conditions were generally poor and overcast with poor to fair visibility, low cloud and squally showers the time was approximately 10:30 – 3:30. Mist and low cloud created poor light conditions at the Giant's Causeway.

Seascape Character and Sensitivity

There is great vertical scale where often a high plateau landscape with basalt cliffs plunges abruptly to an incised coastal edge. This seascape contains the unique geological features at Giant's Causeway designated a World Heritage Site.

- Settlement is largely rural and scattered. The steep cliffs (aprox 80 - 90m above sea level) present large scale expansive views to the open sea with long dramatic views of the coastline. The cliff landscape is exposed, rugged and of very high scenic quality
- Long open elevated views along the coast and out to the open sea including long views along the north coast to Donegal. The land mass of Donegal was clearly visible from the world heritage site (approximately 28km at 2m above sea level) despite poor weather conditions.

Figure E2.17 Giant's Causeway Coast, long expansive views along the Antrim coast to Donegal (aprox 26km +)

Site Observations: Magilligan Flats, Derry Coast and Lough Foyle

3 different seascape types[44] were identified in the study area:

- Type 1: Large Open or Partially Open Sea Lough With Raised Hinterland
- Type 4: Low Lying Coastal Plain
- Type 7: Plateaus and High Cliffs

The following considerations were also noted

Weather conditions were generally good with good visibility, clear skies and some distant sea haze.

Seascape Character and Sensitivity

The low flat or elevated cliff topography allows long views along the coast with expansive seascape vistas including views to the Donegal coastline.

Figure E2.23 Derry Coast, long views along the coast to the west

Figure E2.25 Magilligan Flats , views to Donegal Coast to the west across the mouth of Lough Foyle

[44] SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland, Department of Enterprise, Trade and Investment (DETI), 2009

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Appendix B: Sediment and Water Quality and Contamination

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Current Irish guidelines for assessing the potential risks from disposal of dredging spoils (IMI 2006) include data on the background concentration of naturally occurring and anthropogenic contaminants in Irish coastal sediments, their concentrations in harbour sediments and concentrations expected to produce environmental effects. The background and harbour sediment concentrations given are for the 95%ile (i.e. the concentration exceeded by 5% of samples). The effects range-median (ERM) and effects range-low (ERL) values are sediment quality guidelines based on a biological effects empirical approach. The values represent chemical concentration ranges that are rarely (i.e. below the ERL), sometimes (i.e. between ERL and ERM), and usually (i.e. above the ERM) associated with toxicity for marine and estuarine sediments (Table 1). Data in this table confirms that even harbour sediments are unlikely to exceed the ERM and that generally sediment contaminant concentrations are likely to be below the ERL.

Table 1: Concentrations of contaminants in Irish coastal sediments.

Contaminant	**Units**	**Ireland Background** 95%ile	**Harbour Sediments** 95%ile	**North Atlantic Coastal**	**ERL**	**ERM**
Copper	$mgkg^{-1}$	33.8	89.45	20[(a)]	34	270
Zinc	$mgkg^{-1}$	154.8	562.6	90[(a)]	150	410
Cadmium	$mgkg^{-1}$	0.71	3.47	0.2[(a)]	1.2	9.6
Mercury	$mgkg^{-1}$	0.12	0.65	0.05[(a)]	0.15	0.71
Lead	$mgkg^{-1}$	53.8	248.8	25[(a)]	46.7	218
Arsenic	$mgkg^{-1}$	nd	37.9	5[(b)]	8.2	70
Chromium	$mgkg^{-1}$	117.5	88	60[(a)]	81	370
Manganese	$mgkg^{-1}$	nd	808.58	850[(b)]	-	-
Nickel	$mgkg^{-1}$	nd	49	30[(a)]	20.9	51.6
Dibutyltin	$mgkg^{-1}$	nd	0.24	nns	-	-
Tributyltin	$mgkg^{-1}$	nd	2.39	nns	-	-
γ-HCH	μgkg^{-1}	0.14	3.61	nns	-	-
DDDpp	μgkg^{-1}	0.45	20.95	nns	2.2	27
DDEop	μgkg^{-1}	0.17		nns	1.6	27
DDE(pp')	μgkg^{-1}	0.47	8.71	nns	2.2	27
DDT(pp')	μgkg^{-1}	0.83	0.53	nns	1.6	27
ΣDDT	μgkg^{-1}	1.31		nns	1.6	46.1
Hexachlorobenzene	μgkg^{-1}	0.18	0.05	nns		
Anthracene	μgkg^{-1}	nd	78.78	3[(a)]	85.3	1100
Fluoranthene	μgkg^{-1}	nd	373.85	20[(a)]	600	5100
Phenanthrene	μgkg^{-1}	nd	296.4	17[(a)]	240	1500
Pyrene	μgkg^{-1}	nd	308.55	13[(a)]	665	2600

Benz-[A]-anthracene	μgkg^{-1}	nd	198.75	9[(a)]	261	1600
Benzo-[A]-pyrene	μgkg^{-1}	nd	182.55	nd	430	1600
Benzo-[ghi]-perylene	μgkg^{-1}	nd	150.05	nd	72017	260017
Acenaphthene	μgkg^{-1}	nd	16.02	nd	16	500
Chrysene	μgkg^{-1}	nd	236.6	11[(a)]	384	2800
Dibenzo(ah)anthracene	μgkg^{-1}	nd	53.35	nd		
Benzo(k)fluoranthene	μgkg^{-1}	nd	183.6	nd	280	1620
Benzo(b)fluoranthene	μgkg^{-1}	nd	138.65	nd	320	1880
Naphthalene	μgkg^{-1}	nd	284.3	5[(a)]	160	2100
Fluorene	μgkg^{-1}	nd	22.55	nd	19	540
Indeno-[1,2,3-cd]-pyrene	μgkg^{-1}	145.85	138.2	50[(a)]	26003	
PCB 28	μgkg^{-1}	0.51	16.5	nns	22.7	180
PCB 52	μgkg^{-1}	0.32	30.47	nns	22.7	180
PCB 101	μgkg^{-1}	0.43	33.5	nns	22.7	180
PCB 138	μgkg^{-1}	0.5	45.17	nns	22.7	180
PCB 153	μgkg^{-1}	0.46	44.35	nns	22.7	180
PCB 180	μgkg^{-1}	0.31	20.59	nns	22.7	180
PCB 118	μgkg^{-1}	0.54	32.22	nns	22.7	180

Data Sources: IMI 2006;
(a) OSPAR maritime area background (OSPAR 2006)
(b) Near shore mud values (Chester 1990)

nns – no natural source
nd – no data

Appendix C: Summary of Protected Sites in the Study Area

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Appendix C: Summary of Protected Sites in the Study Area

Site Name	Designation							
	International			European		National		
	WHS	Biosphere Reserve	Ramsar	SAC	SPA	MNR	NHA	pNHA
The Archaeological Ensemble of the Bend of the Boyne	X							
Achill Head				X				
Akeragh, Banna And Barrow Harbour				X	X			X
Aran Island (Donegal) Cliffs				X				X
Ardamine Wood								X
Ardboline Island and Horse Island					X			
Ardmore Head				X				
Ardmore Point Grassland								X
Arklow Rock-Askintinny								X
Arklow Sand Dunes								X
Aughris Head					X			X
Aughrusbeg Machair And Lake				X				X
Baldoyle Bay			X	X	X			X
Ballinskelligs Bay and Inny Estuary				X				X
Ballyallia Lough			X					
Ballybeg Island								X
Ballyconneely Bay					X			X
Ballycotton Bay			X		X			
Ballycotton Islands								X
Ballycotton, Ballynamona and Shanagarry								X
Ballyeelinan Wood								X
Ballyhoorisky Point To Fanad Head				X				X
Ballymacoda			X	X				X
Ballymacoda Bay					X			
Ballymastocker Dunes								X
Ballymoney Strand								X
Ballynakill Bay and Lamb's Island								X
Ballyness Bay				X				X
Ballysadare Bay				X	X			X
Ballyteige Burrow				X	X			X
Ballyteige Marsh								X
Ballyvergan Marsh								X

Site Name	Designation							
	International			European		National		
	WHS	Biosphere Reserve	Ramsar	SAC	SPA	MNR	NHA	pNHA
Ballyvoyle Head to Tramore								X
Bannow Bay			X	X	X			X
Barley Cove To Ballyrisode Point				X				X
Beara Peninsula					X			
Bellacragher Saltmarsh				X				X
Benaderreen Cliffs								X
Bertraghboy Bay								X
Bills Rocks					X			X
Black Head-Poulsallagh Complex				X				X
Blacksod Bay/Broadhaven			X		X			
Blackwater River and Estuary			X	X	X			X
Blasket Islands				X	X			
Boyne Coast and Estuary				X	X			X
Bray Head				X				X
Broadhaven Bay				X				X
Broadmeadow/Swords Estuary					X			
Buckroney-Brittas Dunes and Fen				X				X
Bull and Cow Rocks								X
Bunduff Lough and Machair/Trawalua/Mullaghmore				X				X
Burnham Inlet								X
Caher Island								X
Cahore Point North Sandhills								X
Cahore Polders and Dunes				X				X
Capel Island and Knockadoon Head								X
Carlingford Lough					X			X
Carlingford Shore				X				
Carna Heath and Bog							X	
Carnsore Point				X				
Carrowmore Dunes				X				
Carrowmore Point to Spanish Point and Islands				X				X
Cashen River Estuary								X
Castlemaine Harbour			X	X	X			X
Castletownshend								X
Clara Bog			X					
Clare Island Cliffs				X				
Clare Island					X			X
Cleanderry Wood				X				X
Clew Bay Complex				X				X

Site Name	Designation							
	International			European		National		
	WHS	Biosphere Reserve	Ramsar	SAC	SPA	MNR	NHA	pNHA
Cliffs of Moher					X			X
Clogher Head				X				X
Cloghmoyle Dunes								X
Clonakilty Bay				X				X
Cloonee and Inchiquin Loughs, Uragh Wood				X				
Connemara Bog Complex				X				X
Coole Lough & Garryland Wood			X					
Cork Harbour			X		X			
Corraun Plateau				X				X
Corraun Point Machair/Dooreel Creek								X
Courtmacsherry Estuary				X				X
Courtown Dunes and Glen								X
Creevagh Head								X
Cregduff Lough				X				X
Cregganna Marsh							X	
Croaghaun/Slievemore				X				X
Cross Lough				X	X			X
Cruagh Island					X			X
Crump Island Complex								X
Cummeen Strand/Drumcliff Bay (Sligo Bay)			X	X	X			
Cuskinny Marsh								X
Cusroe, Whiddy Island								X
Dalkey Coastal Zone and Killiney Hill								X
Darrynane Bay Islands and Marsh, Lamb's Head								X
Deenish Island and Scariff Island					X			X
Dingle Peninsula					X			
Dirk Bay								X
Dog's Bay				X				X
Donaghmore Sandhills								X
Donegal Bay				X	X			X
Doogort East Bog							X	
Doogort Machair/Lough Doo				X				X
Doulus Head to Cooncrome Harbour								X
Downpatrick Head								X
Drongawn Lough				X				
Drumcliff Bay					X			
Duck Island								X

Site Name	Designation							
	International			European		National		
	WHS	Biosphere Reserve	Ramsar	SAC	SPA	MNR	NHA	pNHA
Dunany Point								X
Dunbeacon Shingle				X				
Duncannon Sandhills								X
Dundalk Bay			X	X	X			X
Dungarvan Harbour			X		X			X
Dunmore East Cliffs								X
Durnesh Lough				X				X
Dursey Island								X
Duvillaun Islands				X	X			X
Eagle Island								X
Eagle Rock								X
Easky Bog			X					
Eeshal Island								X
Emlagh East Salt Marshes								X
Erne Estuary/Finner Dunes								X
Erris Head				X				X
Eyeries Island								X
Farranamanagh Lough				X				
Farrihy Lough								X
Finish Island Machair								X
Fountainstown Swamp								X
Frehill Island								X
Friar Island								X
Furbogh Wood								X
Galley Head to Duneen Point					X			
Galway Bay Complex				X				X
Garinish Point								X
Garrettstown Marsh								X
Garrylucas Marsh								X
Glanmore Bog								X
Glashedy Island								X
Glenamoy Bog Complex				X				X
Glenanna Wood								X
Glengarriff Harbour and Woodland				X				X
Great Skellig								X
Gurrig Island (Magharees)								X
Gweedore Bay and Islands				X				X
Helvick Head				X	X			X
Hen Island								X

Site Name	Designation							
	International			European		National		
	WHS	Biosphere Reserve	Ramsar	SAC	SPA	MNR	NHA	pNHA
High Island					X			X
Hook Head				X				X
Horn Head and Rinclevan				X				X
Horn Head to Fanad Head					X			
Horse Island Complex								X
Howth Head				X	X			X
Illancrone								X
Illancrone and Inishkeeragh					X			
Illanmaster					X			
Illaunnabarnagh Island								X
Illaunonearaun					X		X	
Illauntannig (Magharees)								X
Inagh River Estuary				X				X
Inch Lough and Levels					X			
Inishbarnog								X
Inishbeg								X
Inishbofin (Donegal)								X
Inishbofin and Inishshark				X				X
Inishbofin, Inishdooey and Inishbeg					X			
Inishdalla								X
Inishdegil Islands								X
Inishduff					X		X	
Inisheer Island				X				X
Inishgalloon								X
Inishglora and Inishkeeragh					X			X
Inishkea Islands				X	X			X
Inishkeel					X			
Inishkeeragh								X
Inishmaan Island				X				X
Inishmore Island				X				X
Inishmurray					X			X
Inishmuskerry								X
Inishsirrer and Inishmeane					X			
Inishtooskert and Illaunimmil (Magharees)								X
Inishtrahull				X	X			X
Inishturk								X
Inner Galway Bay			X		X			
Ireland's Eye				X			X	
Iveragh Peninsula					X			

Site Name	Designation							
	International			European		National		
	WHS	Biosphere Reserve	Ramsar	SAC	SPA	MNR	NHA	pNHA
James Fort								X
Keel Machair/Menaun Cliffs				X				X
Keeragh Islands					X		X	
Kenmare River				X				
Kenmare River Islands								X
Kerry Head				X	X			
Kilcatherine Heath								X
Kilgorman River Marsh								X
Kilkee Reefs				X				
Kilkeran Lake And Castlefreke Dunes				X				X
Kilkieran Bay and Islands				X				
Killala Bay/Moy Estuary			X	X	X			X
Killarney National Park		X		X				X
Kilmuckridge-Tinnaberna Sandhills				X				X
Kilpatrick Sandhills				X				X
Kingstown Bay				X				
Kinvarra Saltmarsh								X
Knockmoyle/Sheskin			X					
Lackan Saltmarsh and Kilcummin Head				X				X
Lady's Island Lake				X	X			X
Lambay Island				X	X			X
Laytown Dunes/Nanny Estuary								X
Leagaun Machair								X
Leahill Bog							X	
Lehid Harbour								X
Little Skellig								X
Loop Head					X			X
Lough Barra Bog			X					
Lough Beg (Cork)								X
Lough Cahasy, Lough Baun and Roonah Lough				X				X
Lough Corrib			X					
Lough Derravaragh			X					
Lough Ennell			X					
Lough Foyle					X			
Lough Gall Bog				X				X
Lough Gara			X					
Lough Gill					X			
Lough Glen			X					

Site Name	Designation							
	International			European		National		
	WHS	Biosphere Reserve	Ramsar	SAC	SPA	MNR	NHA	pNHA
Lough Greney Bog							X	
Lough Hyne Nature Reserve and Environs				X		X		X
Lough Iron			X					
Lough Melvin				X				X
Lough Nagreany Dunes								X
Lough Oughter			X					
Lough Owel			X					
Lough Swilly				X				X
Loughshinny Coast								X
Lower River Shannon				X				
Mace Head Islands								X
Magharee Islands				X	X			
Magherabeg Dunes				X				X
Malahide Estuary				X				X
Mason Island Machair								X
Meenachullion Bog			X					
Mid-Clare Coast					X			
Mid-Waterford Coast					X			
Mongan Bog			X					
Monkstown Creek								X
Mount Brandon				X				X
Moycullen Bogs							X	
Moylaun Island								X
Mucklaghmore Island								X
Mucksna Wood				X				X
Mullet/Blacksod Bay Complex				X				X
Mulroy Bay				X				
Murvey Machair				X				
Mweelaun Island								X
Mweelrea/Sheeffry/Erriff Complex				X				X
Mweenish Island Machair								X
North Bull Island		X	X		X			
North Dublin Bay				X				X
North Inishowen Coast				X				X
Oilean Na Ngeabhrog (Illaungurraig)								X
Old Domestic Building, Askive Wood								X
Old Domestic Building, Dromore Wood				X				X
Old Head of Kinsale					X			X

Site Name	Designation							
	International			European		National		
	WHS	Biosphere Reserve	Ramsar	SAC	SPA	MNR	NHA	pNHA
Omey Island Machair				X				X
Orthon's Island, Adrigole Harbour								X
Owenboy			X					
Owenduff catchment			X					
Owenduff/Nephin Complex				X				
Owen's Island								X
Parkmore Point								X
Pettigo Plateau								
Pollardstown Fen								
Portraine Shore								X
Puffin Island					X			
Puffin Sound-Horse Island Cliffs								X
Pulleen Harbour Bog							X	
Raheenmore Bog			X					
Rathlin O'Birne Island				X				X
Raven Point Nature Reserve				X				
Reen Point Shingle				X				
River Barrow and River Nore				X				
River Nanny Estuary and Shore					X			
Roancarrigbeg and Roancarrigmore								X
Roaninish					X		X	
Roaringwater Bay and Islands				X				X
Rockabill Island								X
Rogerstown Estuary			X	X	X			X
Rosroe Bog				X				X
Rosscarbery Estuary								X
Rossdohan Island								X
Rostellan Lough, Aghada Shore and Poulnabibe Inlet								X
Roughty River Estuary								X
Rusheenduff Lough				X				X
Rutland Island and Sound				X				
Saltee Islands				X	X			X
Sandymount Strand/Tolka Estuar			X					
Seven Heads and Dunworly Bay								X
Seven Heads					X			
Sheelane Island								X
Sheephaven				X				X
Sheep's Head				X	X			X
Sheskinmore Lough					X			

Site Name	Designation							
	International			European		National		
	WHS	Biosphere Reserve	Ramsar	SAC	SPA	MNR	NHA	pNHA
Skellig Michael	X							
Skelligs					X			
Skerries Islands					X		X	
Slaney River Valley				X				
Slea Head								X
Slieve Bloom Mountains			X					
Slieve League				X				X
Slieve Tooey/Tormore Island/Loughros Beg Bay				X				X
Slieveward Bog							X	
Slyne Head Islands				X	X			X
Slyne Head Peninsula				X				X
Smerwick Harbour Sandhills and Marshes								X
South Dublin Bay				X	X			X
Sovereign Islands					X		X	
Spanish Island								X
St. Helen's Burrow								X
St. John's Point				X				X
St. Macdara's Island								X
Stags of Broadhaven					X			X
Streedagh Point Dunes				X				X
Sybil Point/Carrigbrean								X
Tacumshin Lake				X	X			X
Termon Strand				X				X
Termoncarragh Lake and Annagh Machair					X			
The Broadmeadow Estuary								
The Bull and The Cow Rocks					X			
The Gearagh			X					
The Murrough				X	X			X
The Raven			X		X			
The Twelve Bens/Garraun Complex				X				X
Three Castle Head To Mizen Head				X				X
Tory Island				X	X			X
Trafrask Bog							X	
Tralee Bay and Magharees Peninsula			X	X	X			X
Tramore Back Strand			X		X			
Tramore Dunes and Backstrand				X				X
Tranarossan and Melmore Lough				X				X

Site Name	Designation							
	International			European		National		
	WHS	Biosphere Reserve	Ramsar	SAC	SPA	MNR	NHA	pNHA
Trawbreaga Bay			X		X			
Tullaghan Bay and Bog							X	
Tully Mountain				X				X
Valencia Harbour/Portmagee Channel				X				
Valencia Island Cliffs								X
Valencia River Estuary								X
Ventry Dunes and Marshes								X
Waterford Harbour								X
West Donegal Coast					X			
West Of Ardara/Maas Road				X				X
Wexford Harbour and Slob					X			X
Wexford Wildfowl Reserve			X					
White Strand/Carrowmore Marsh								X
Whitegate Bay								X
Wicklow Head					X			X
Wicklow Reef				X				
Wicklow Town Sites								X

Appendix D: Birds Technical Report

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Appendix D: Birds Technical Report

The coastal sea cliffs, estuaries and offshore islands of Ireland are host to a number of nationally and internationally important bird species, with many areas designated as Special Protection Areas (SPAs). Coastal habitats provide important breeding sites for many species of seabirds, a number of which are protected under national and European legislation. This section summarises the populations and distribution of coastal and marine birds found from the high tide line out to 200 m water depth, around Ireland.

Data Sources

BirdWatch Ireland (BWI) have recently revised their lists of species of high, medium and low conservation priority in Ireland. There are currently 19 breeding species currently included on the Red List, which signifies species of high conservation concern, with a further six wintering or passage species listed (Lynas *et al* 2007). Rare and vulnerable bird species are also listed on Annex I of the E.U. Birds Directive (79/409/EEC).

Seabird 2000 attempted to census all breeding seabirds in Britain and Ireland, between 1998 and 2002, covering both coastal and inland breeding colonies. Results and comparisons with the two previous major censuses were published as *Seabird populations of Britain and Ireland* (Mitchell *et al* 2004).

There have been two major studies of seabirds and marine mammals at sea in Irish waters. Survey work for the first of these was conducted between August 1994 and January 1997, and results were published as a JNCC report *The distribution of seabirds and cetaceans in the waters around Ireland* (Pollock *et al* 1997). The report also presented previously collected European Seabirds at Sea (ESAS) data in conjunction with the project data.

The second major study was conducted by the Coastal and Marine Resources Centre (CMRC) of the University College Cork (UCC), and covered the period July 1999 to September 2001. Results from this period of fieldwork were published as a report, *Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume 1 – Seabird distribution, density and abundance* (Mackey *et al* 2004).

A review of gaps in ESAS survey coverage in Irish waters was recently conducted for National Parks and Wildlife Service, to highlight gaps in survey effort, as well as discussing the age of existing data, seasonal and temporal gaps and summarising other sources of seabird data for Irish waters. The review *A Gap Analysis of Irish Waters using the European Seabirds at Sea (ESAS) database* (Pollock & Barton in press) will be published as an Irish Wildlife Manual shortly.

The Irish Wetland Bird Survey scheme monitors non-breeding waterbirds in Ireland, using monthly land-based "core counts" undertaken by volunteers to annually identify population sizes, determine trends in numbers and to identify important sites for waterbirds. A review of wintering waterbirds and their wetlands in Ireland was recently published as *Ireland's Wetlands and their Waterbirds: Status and Distribution* (Crowe 2005). Relevant information on coastal wetlands and the species present is summarised here.

Information on qualifying interests for individual Special Protection Areas (SPAs) is available online from the NPWS website (NPWS 2010).

At least 45 species of seabird have been recorded during at-sea surveys in Irish waters, of which 23 species regularly breed around Ireland (Pollock *et al* 2007, Mackey *et al* 2004).

In addition, a further 59 species of waterbird regularly occur at coastal sites such as estuaries around Ireland, including 5 grebe species, 2 heron species, 26 species of wildfowl and 26 wader species (Crowe 2005). Some of these species are migratory, and are present only during migration periods in spring and autumn, others come to Ireland to breed or to spend the winter, while some are resident all year round.

Coastal or marine species of conservation concern

BirdWatch Ireland (BWI) have categorised species of high, medium and low conservation priority in Ireland, based on a suite of criteria including international conservation status, historical breeding declines, recent population declines (numbers and range in breeding and non-breeding seasons), European conservation status, breeding rarity, localised distribution and the international importance of populations (Lynas *et al* 2007). Coastal or marine species of high and medium conservation status are outlined below.

There are currently 19 breeding species on the Red List, (which signifies species of high conservation concern) including Common Scoter, four species of upland breeding wader (Golden Plover, Lapwing, Curlew, Redshank), Black-headed Gull and Herring Gull. Golden Plover is also listed on Annex I of the EU Birds Directive (79/409/EEC).

Six wintering or passage species are also Red-listed, including Sooty Shearwater and Balearic Shearwater, which is also an Annex I species. Both are listed because of their global conservation status (Lynas *et al* 2007).

A further 25 species of seabirds, 6 species of wildfowl and 9 species of waders are Amber-listed, which signifies species of moderate conservation concern (Table 1). Thirteen of these species are Annex I listed species.

Table 1: Species of moderate conservation concern in Ireland (Amber-listed), that occur regularly in coastal or offshore marine habitats

Seabirds	Black-legged Kittiwake	Eurasian Wigeon
Red-throated Diver [1]	Sandwich Tern [1]	European Teal
Great Crested Grebe	Roseate Tern [1]	Common Goldeneye
Cory's Shearwater [1]	Common Tern [1]	Northern Eider
Manx Shearwater	Arctic Tern [1]	
European Storm-petrel [1]	Little Tern [1]	**Waders**
Leach's Storm-petrel [1]	Common Guillemot	Oystercatcher
Northern Gannet	Razorbill	Ringed Plover
Great Cormorant	Black Guillemot	Grey Plover
European Shag	Atlantic Puffin	Dunlin [2]
Great Skua		Common Snipe
Mediterranean Gull [1]	**Wildfowl**	Black-tailed Godwit
Common Gull	Barnacle Goose [1]	Bar-tailed Godwit [1]
Lesser Black-backed Gull	Brent Goose	Greenshank
Great Black-backed Gull	Common Shelduck	Common Sandpiper

1 listed on Annex I of the EU Birds Directive (79/409/EEC)
2 Race *Schinzii* is listed on Annex I of the EU Birds Directive (79/409/EEC)
Source: Lynas *et al* 2007

In addition, 15 seabird species, 2 heron species, 5 wildfowl species and 11 species of wader are listed on the Green list (Lynas *et al* 2007). Of these, five species (Black-throated Diver, Great Northern Diver, Little Egret, Ruff and Wood Sandpiper are also Annex I listed.

Breeding seabirds

Of Ireland's 23 regularly breeding seabird species, ten species breed in internationally important numbers (Table 2). The locations of the main seabird colonies are shown in Figure 9.2.4.

Table 2: **Breeding populations of seabirds in Ireland**

Species	Breeding population[1]
Northern Fulmar	38,910
Manx Shearwater	37,178
European Storm-petrel	99,065
Leach's Storm-petrel	310
Northern Gannet	36,111
Great Cormorant	4,736
European Shag	3,727
Mediterranean Gull	5
Black-headed Gull	13,983
Common Gull	1,617
Lesser Black-backed Gull	4,849
Herring Gull	6,235
Great Black-backed Gull	2,319
Black-legged Kittiwake	49,160
Sandwich Tern	3,716
Roseate Tern	738
Common Tern	4,189
Arctic Tern	3,502
Little Tern	206
Common Guillemot	236,654
Razorbill	51,530
Black Guillemot	3,367
Atlantic Puffin	21,251

1 Totals given as pairs, except for Common Guillemot, Razorbill, Black Guillemot and Atlantic Puffin, which are individual birds attending colonies. Species that breed in internationally important numbers are shown in **bold**. Totals include inland populations. Source: Mitchell *et al* 2004

Table 3 lists the most important seabird colonies around Ireland i.e. colonies which regularly hold nationally important breeding numbers for at least one species. See also Figure 9.2.4

Table 3: Summary of important coastal seabird colonies in Ireland

Sites	County	Key Species [1]
Rockabill	Dublin	Roseate Tern, Common Tern , Arctic Tern, Black Guillemot
Lambay Island	Dublin	**European Shag, Common Guillemot, Razorbill,** Northern Fulmar, Great Cormorant, Lesser Black-backed Gull, Herring Gull, Great Black-backed Gull, Black-legged Kittiwake
Howth Head	Dublin	Black-legged Kittiwake, Razorbill and Black Guillemot
Ireland's Eye	Dublin	Northern Gannet, Great Cormorant, Herring Gull, Great Black-backed Gull, Black-legged Kittiwake, Guillemot, Razorbill
Skerries	Dublin	Great Cormorant, European Shag, Herring Gull, Great Black-backed Gull
Wicklow Head	Wicklow	Black-legged Kittiwake, Black Guillemot
Lady's Island Lake	Wexford	**Sandwich Tern,** Roseate Tern, Common Tern, Arctic Tern, Mediterranean Gull, Black-headed Gull
Saltee Islands	Wexford	Northern Fulmar, Northern Gannet, Great Cormorant, European Shag, Lesser Black-backed Gull, Great Black-backed Gull, Herring Gull, Black-legged Kittiwake, Common Guillemot, Razorbill, Atlantic Puffin
Old Head of Kinsale	Cork	Black-legged Kittiwake, Common Guillemot, Razorbill
The Bull & Cow Rocks	Cork	European Storm-petrel, Northern Gannet, Great Black-backed Gull, Atlantic Puffin
Sovereign Islands	Cork	Great Cormorant
Skelligs	Kerry	**European Storm-petrel, Northern Gannet,** Northern Fulmar, Manx Shearwater, Black-legged Kittiwake, Common Guillemot, Razorbill, Atlantic Puffin
Puffin Island	Kerry	**European Storm-petrel, Manx Shearwater,** Northern Fulmar, Lesser Black-backed Gull, Great Black-backed Gull, Razorbill, Atlantic Puffin
Blasket Islands	Kerry	**European Storm-petrel, Manx Shearwater,** Northern Fulmar, European Shag, Lesser Black-backed Gull, Herring Gull, Great Black-backed Gull, Black-legged Kittiwake, Razorbill, Black Guillemot, Atlantic Puffin
Magharee Islands	Kerry	European Shag, Common Gull, Arctic Tern, Little Tern
Deenish & Scariff Islands	Kerry	European Storm-petrel, Manx Shearwater, Northern Fulmar, Lesser Black-backed Gull, Arctic Tern
Kerry Head	Kerry	Northern Fulmar
Loop Head	Clare	Black-legged Kittiwake, Common Guillemot
Cliffs of Moher	Clare	**Razorbill**, Northern Fulmar, Black-legged Kittiwake, Common Guillemot, Atlantic Puffin
Slyne Head Islands	Galway	Arctic Tern, Black Guillemot
Cruagh Island	Galway	**Manx Shearwater,** Great Black-backed Gull
Inishkea Islands	Mayo	European Shag, Common Gull, Lesser Black-backed Gull, Herring Gull, Great Black-backed Gull
Stags of Broadhaven	Mayo	European Storm-petrel, Leach's Storm-petrel, Atlantic Puffin
Illanmaster	Mayo	**European Storm-petrel,** Atlantic puffin
Inishglora & Inishkeeragh	Mayo	European Storm-petrel, Great Cormorant, European Shag, Lesser Black-backed Gull, Herring Gull, Arctic Tern
Duvillaun Islands	Mayo	Northern Fulmar, European Storm-petrel, Herring Gull, Great Black-backed Gull
Clare Island	Mayo	Northern Fulmar, European Shag, Common Gull, Great Black-backed Gull, Black-legged Kittiwake, Common Guillemot, Razorbill, Black Guillemot
Bills Rocks	Mayo	Atlantic Puffin
Aughris Head	Sligo	Black-legged Kittiwake

Table 3: Summary of important coastal seabird colonies in Ireland (continued)

Sites	County	Key Species [1]
Ardboline & Horse Islands	Sligo	Great Cormorant
Horn Head	Donegal	**Razorbill,** Northern Fulmar, Black-legged Kittiwake, Common Guillemot
Horn Head to Fanad Head	Donegal	Northern Fulmar, Great Cormorant, European Shag, Black-legged Kittiwake, Razorbill, Black Guillemot
Tory Island	Donegal	Northern Fulmar, Black-headed Gull, Common Gull, Black-legged Kittiwake, Little Tern, Razorbill, Black Guillemot, Atlantic Puffin
Greers Isle	Donegal	Black-headed Gull, Common Gull, Sandwich Tern
Inishbofin, Inishdooey, & Inishbeg	Donegal	European Shag, Arctic Tern
Inishtrahull	Donegal	European Shag, Common Gull, Great Black-backed Gull
Inishduff	Donegal	European Shag, Great Black-backed Gull
Roaninish	Donegal	Herring Gull
Illancrone & Inishkeeragh	Donegal	Arctic Tern, Little Tern
West Donegal Coast	Donegal	Northern Fulmar, Great Cormorant, European Shag, Herring Gull, Black-legged Kittiwake, Razorbill, Black Guillemot

1 Species that breed in internationally important numbers are shown in **bold**. All sites listed have been designated as SPAs on the basis of the suite of breeding species present.
Sources: Mitchell *et al* 2004, SPA Site Synopses (NPWS 2010)

International importance of Ireland's breeding seabirds

The populations of 20 of Ireland's breeding seabirds are presented within an international context to highlight their significance (Table 4) (after Mitchell *et al* 2004).

For fifteen species, more than 1% of the bio-geographical population breeds in Ireland. For two species, European Storm-petrel and Roseate Tern, more than 10% of the biogeographical populations are found breeding in Ireland, while significant numbers of Great Cormorant and Manx Shearwater also breed here.

On the global level, more than 1% (the threshold that indicates international importance) of the global breeding populations of nine species of seabird breeds in Ireland, with European Storm-petrel and Northern Gannet the most important species.

Table 4: Biogeographical importance of breeding seabird populations in Ireland

Species	Biogeographic importance		Global importance	
	Minimum	Maximum	Minimum	Maximum
Northern Fulmar	1.0%	1.4%	0.5%	0.7%
Manx Shearwater	6.6%	17.9%	6.6%	17.9%
European Storm-petrel	10.7%	42.7%	10.6%	41.3%
Northern Gannet	8.5%	8.5%	8.5%	8.5%
Great Cormorant	9.8%	10.0%	0.9%	0.9%
European Shag	5.1%	5.6%	4.5%	5.1%
Black-headed Gull	0.5%	0.7%	0.5%	0.7%
Common Gull	0.2%	0.4%	0.2%	0.4%
Lesser Black-backed Gull	2.7%	2.7%	1.5%	1.8%
Herring Gull	0.8%	0.9%	0.5%	0.6%
Great Black-backed Gull	2.2%	2.2%	1.2%	1.3%
Black-legged Kittiwake	1.6%	2.0%	0.9%	1.1%
Sandwich Tern	4.7%	5.4%	2.2%	2.3%
Roseate Tern	30.8%	38.8%	0.6%	0.6%
Common Tern	1.2%	1.9%	0.7%	0.9%
Arctic Tern	0.2%	0.7%	0.1%	0.4%
Little Tern	1.0%	1.2%	0.2%	0.5%
Common Guillemot	5.5%	5.7%	2.1%	2.2%
Razorbill	6.6%	6.6%	5.4%	5.6%
Atlantic Puffin	0.3%	0.4%	0.3%	0.4%

Source: Mitchell *et al* 2004. Figures indicate the minimum and maximum percentages of the relevant biogeographical population that the Irish population represents. The relevant biogeographical populations are defined in Stroud *et al* (2001). Species highlighted in **bold** breed in Ireland in globally important numbers.

Seabirds at sea

At least 45 species of seabird have been recorded during at-sea surveys (Pollock *et al* 2007, Mackey *et al* 2004). The following accounts summarise the at-sea distribution of the most regularly occurring species.

Divers and grebes

Three species of divers occur regularly around the coast of Ireland; Red-throated Diver, Black-throated Diver and Great Northern Diver. All three prefer inshore waters, with sandy or rocky bottoms. Two species of grebe; Great Crested Grebe and Red-necked Grebe have been recorded on ESAS surveys around Ireland. Numbers of both divers and grebes recorded on ESAS surveys must be treated as under-estimates of their presence, as there is little survey coverage very close inshore, where both groups tend to be found.

Petrels

Two species of petrel; Northern Fulmar and European Storm-petrel are regularly recorded in Irish waters, while Leach's Storm-petrel and Wilson's Storm-petrel are seen less often. Northern Fulmar is the only resident petrel species, and is widely distributed in low to moderate density over shelf waters (out to 200m). European Storm-petrels winter off southern Africa, returning to Irish waters to breed, and so are most abundant in summer months in shelf waters off the south-west of Ireland, closest to the main breeding colonies.

Leach's Storm-petrels are predominantly found over deeper water, only returning to breeding colonies at night. Wilson's Storm-petrel is a rare but regular visitor to Irish waters, with the majority of sightings occurring over the shelf edge between June and August.

Shearwaters

Five species of shearwater are regularly recorded in Irish waters in the summer months, but only Manx Shearwater actually breeds, with several internationally important colonies. Highest density of Manx Shearwaters on ESAS surveys was recorded between July and August in the Irish Sea, where birds associate with the Irish Sea front, as well as off the Welsh colonies of Skomer and Skokholm (Pollock *et al* 2007). Manx Shearwaters were also found in moderate to high densities off the south west coast, and in offshore areas such as the Rockall Bank (Mackey *et al* 2004).

Sooty Shearwater, Cory's Shearwater and Great Shearwater are all non-breeding visitors to Irish waters, mostly in late summer and early autumn. Numbers can vary between years, with large influxes to the south west occurring sporadically. In autumn, numbers off headlands in the south west and west coasts can sometimes reach the thousands, e.g. 2,020 Cory's Shearwaters seen off Cape Clear on 16th August 2000, or 5,388 Great Shearwaters seen off Cape Clear on 11th September 2000 (Cronin *et al* 2006).

Small numbers of Balearic Shearwaters are also recorded in late summer and autumn, particularly off the south-west coast. Balearic Shearwaters have a tiny breeding range and a small rapidly declining population due to predation at breeding colonies by introduced cats, and by-catch of foraging birds by long-line fisheries. The species is listed as Critically Endangered on the 2007 IUCN (World Conservation Union) Red List (Birdlife International 2007). The species is also listed on Annex I of the EU Birds Directive (79/409/EEC), and on BWI's Red List, due to their global conservation status (Lynas *et al* 2007).

Northern Gannet

ESAS surveys show that Northern Gannets are generally found in low to moderate density over Irish shelf waters throughout the year, with high densities in inshore areas recorded close to the main breeding colonies in the south-west in the summer months.

Great Cormorant and Shag

Both Great Cormorant and Shag show a preference for inshore coastal waters, and so are generally under-recorded on ESAS surveys. Highest densities of Great Cormorants were recorded on surveys in Galway Bay, Dingle Bay and Tralee Bay, while moderate to high densities of European Shags were recorded along the north-west and south-west coasts (Pollock *et al* 1997).

Seaduck

Five species of seaduck have been recorded in low numbers on ESAS surveys in Irish waters; Common Eider, Common Scoter, Velvet Scoter, Common Goldeneye and Red-breasted Merganser (Pollock *et al* 1997). However, as all five species show a preference for inshore coastal waters, ESAS data for these species is likely to be an under-estimate.

Grey Phalarope

Sightings of Grey Phalaropes on ESAS surveys occurred mainly off the west coast over shelf waters, between July and October (Pollock *et al* 1997). Small numbers are regularly recorded from south-west and west coast seawatching locations such as the Bridges of Ross in autumn.

Skuas

Four species of skua are regularly recorded in Irish waters. Great Skua and Arctic Skua are the most commonly seen, while Pomarine Skua and Long-tailed Skua occur in smaller numbers. All four species occur as passage migrants in shelf waters in both spring and autumn, although up to 3 pairs of Great Skua bred on an island in Connaught in 2006 (Hillis 2007). Numbers of Great Skuas recorded on ESAS surveys were highest in November and December in the southern Celtic Sea (Pollock *et al* 1997).

Gulls

Seven species of gull are regularly recorded on ESAS surveys in Irish waters; Little Gull, Black-headed Gull, Common Gull, Lesser Black-backed Gull, Herring Gull, Great Black-backed Gull and Black-legged Kittiwake.

Little Gulls are present in varying numbers off the Irish east coast in winter months. Seabird surveys over the Arklow Bank have recorded large numbers in winter e.g. 4,032 birds in January 2005, which greatly exceeds the internationally important threshold for this species (840 birds - Crowe 2005) (Barton *et al* 2008).On ESAS surveys, inshore species such as Black-headed Gulls and Common Gulls are generally under-recorded. ESAS surveys recorded the majority of Lesser Black-backed Gulls to the south of Ireland between February and April, with birds less widespread during the breeding season, when coastal waters were important. Birds moved south again out of Irish waters from September onwards (Pollock *et al* 1997).

Herring Gull at-sea distribution showed a north-easterly distribution, with highest concentrations in the eastern Irish Sea and North Channel throughout the year. Elsewhere, birds were present in low density in the coastal waters off the south-west of Ireland, with fewer recorded away from the coast compared to the more pelagic Lesser Black-backed Gull (Pollock *et al* 1997).

ESAS surveys recorded Great Black-backed Gull distribution as patchy in coastal waters, with low to moderate densities recorded off the west coast in winter, and around the north coast in summer (Pollock *et al* 1997, Mackey *et al* 2000).

In summer, ESAS surveys recorded Black-legged Kittiwakes in moderate to high concentrations all round the Irish coast. In winter, highest densities were recorded to the south-west in coastal waters and over the shelf edge (Pollock *et al* 1997). In addition, counts of over 10,000 Black-legged Kittiwakes have also been recorded in winter over the Arklow Bank (Barton *et al* 2008).

Terns

Four species of terns are regularly recorded in Irish waters in the summer months; Sandwich Tern, Roseate Tern, Common Tern and Arctic Tern. Numbers of all terns recorded on ESAS surveys were low, due to a lack of inshore coverage. Highest recorded densities were concentrated mainly around the breeding colonies (Pollock *et al* 1997).

Auks

Common Guillemot and Razorbill were the commonest two auk species recorded on ESAS surveys in Irish waters, and Common Guillemot was the most numerous species recorded in the Irish Sea. Highest densities of both species were recorded around the main breeding colonies in summer, but large concentrations were also recorded in the western Irish Sea over the east coast sand banks and over the Irish Sea front. Inshore waters were important for moulting auks in August, with highest densities recorded in the bays of south-west Ireland at this time (Pollock *et al* 1997). Both species were widely distributed at low densities over winter

months, with moderate to high concentrations of Common Guillemots off the south coast at this time.

ESAS surveys recorded Black Guillemots as being patchily distributed in inshore waters throughout the year, but the species was probably under-estimated on surveys. Atlantic Puffins were recorded at low to moderate density on ESAS surveys in the Irish Sea throughout the summer months, but showed a more pelagic distribution in winter (Pollock *et al* 1997).

Gaps in ESAS survey coverage

A recent study for National Parks and Wildlife Service (NPWS) aimed to review ESAS survey data that has been collected to date in Irish waters and to highlight areas which have not yet been covered or are in need of further surveys (Pollock & Barton in press). Several criteria were used to define gaps, including age of data, number of years of survey required, number of months and overall amount of data required. A brief summary of seasonal data less than 20 years old is presented here.

All data were summarised into two seasons - summer (April to September) and winter (October to March) to look at seasonal differences in coverage. Seasonal survey coverage was considered adequate if surveys had been conducted in a minimum of 4 months per season. This was defined as coverage of 120 km^2 per ¼ ICES rectangle (offshore areas) and 40 km^2 per 15'N x 10' W rectangles (inshore areas).

Although there was survey coverage over the majority of inshore waters out to 200m in summer, much of this was below the target of 40 km^2 per 15'N x 10' W rectangles, apart from small areas off Cork Harbour, Galway Bay, off the north-west coast and west of Ireland out to the shelf edge (Figure a). Further offshore, there were major gaps in survey effort in oceanic waters to the north-west of Ireland, as well as along the shelf break south-west of Ireland.

In winter months, survey coverage was almost entirely restricted to the shelf waters (within 200 m depth). Again, survey coverage was generally below the desired target, and was totally lacking in some inshore areas of the south-west such as Kenmare River, Dingle Bay and Tralee Bay. Inshore areas of the north-west also had no coverage, including the Clifden coast, around the Aran Islands, Clew Bay, the north coast of Mayo and Sligo, inner Donegal Bay, Gweebarra Bay and Sheep Haven on the North Donegal coast (Figure b). These large gaps in survey coverage in winter were mainly because of lower vessel availability and harsher weather conditions.

Figure a **ESAS survey effort in Irish waters during summer (April to September), data less than 20 years old**

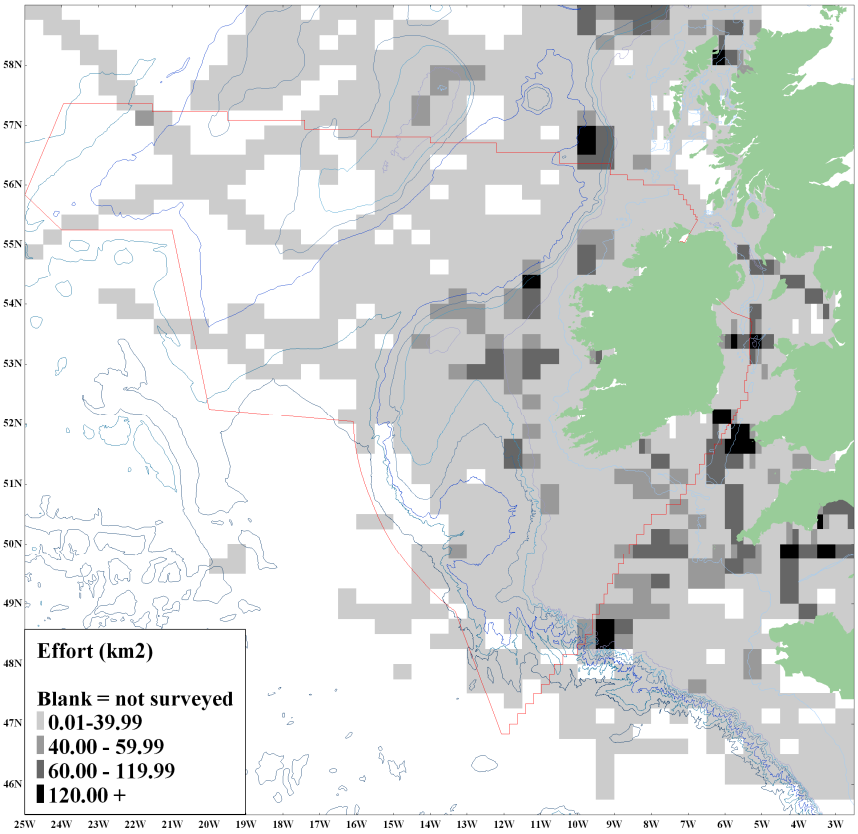
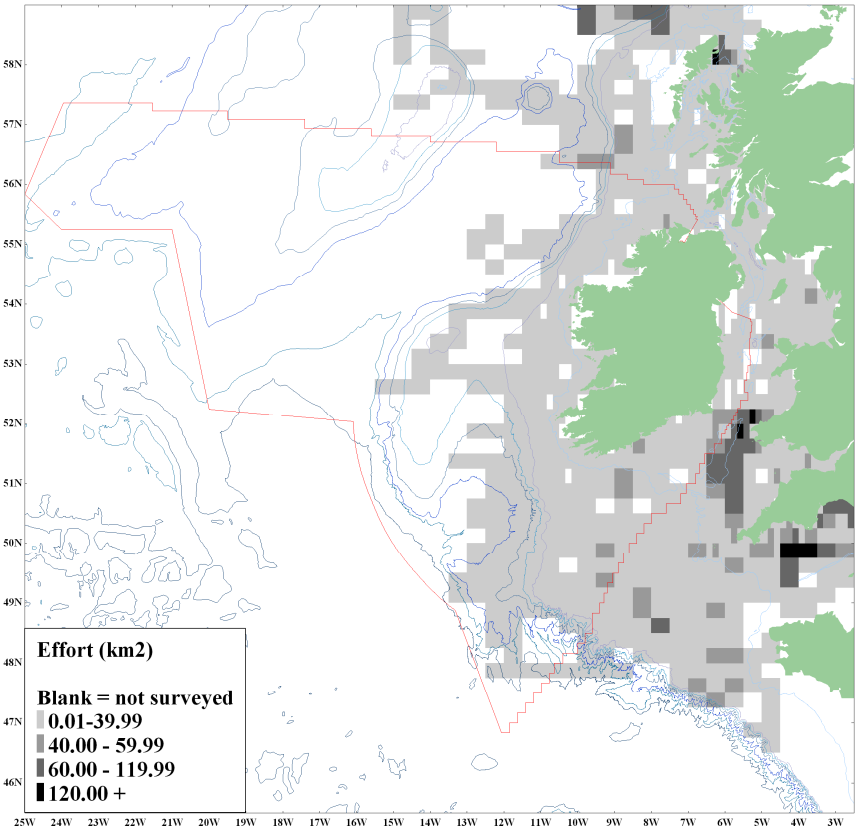


Figure b **ESAS survey effort in Irish waters during winter (October to March), data less than 20 years old**



Source: Pollock & Barton in press, reproduced with permission from NPWS

Wildfowl and waders

There are a total of 28 coastal sites in Ireland listed as being of international importance for at least one species, based on Irish Wetland Bird Survey (I-WeBS) data (Table 5)(Crowe 2005).

Table 5: **Coastal wetland sites of international importance between 1996/97 and 2000/01**

Site	County	Number of species of international/national importance		Mean of summed annual peak 1996 - 2000
		Int	Nat	
Dundalk Bay	Louth	5	14	53,722
Shannon & Fergus Estuary	Clare	3	19	52,654
Wexford Harbour & Slobs	Wexford	5	24	40,843
Cork Harbour	Cork	2	18	35,836
Dublin Bay	Dublin	4	15	29,448
Tralee Bay, Lough Gill & Akeragh Lough	Kerry	1	23	28,652
Tacumshin Lake	Wexford	3	11	20,913
Dungarvan Harbour	Waterford	2	13	19,483
Boyne Estuary	Louth	1	8	17,434
The Cull & Killag	Wexford	2	8	17,346
Castlemaine Harbour & Rossbehy	Kerry	1	15	16,687
Inner Galway Bay	Galway	2	15	15,968
Rogerstown Estuary	Dublin	1	16	15,234
Bannow Bay	Wexford	2	11	13,809
Courtmacsherry, Broadstrand & Dunworley	Cork	1	9	13,510
Blackwater Estuary	Waterford	1	7	11,581
Broadmeadow Estuary	Dublin	2	12	10,918
Tramore Backstrand & Bay	Waterford	1	8	10,578
The Mullet, Broadhaven & Blacksod Bays	Mayo	2	9	8,437
Clonakilty Bay	Cork	1	3	7,645
Baldoyle Bay	Dublin	1	5	6,699
North Wicklow Coastal Marshes	Wicklow	1	4	6,537
Ballysadare Bay	Sligo	1	4	6,295
Sligo Harbour	Sligo	1	3	4,417
Donegal Bay	Donegal	2	2	4,131
Drumcliff Bay Estuary	Sligo	1	2	2,779
Skerries Islands	Dublin	1	3	2,660
Trawbega Bay	Donegal	2	0	2,554

Source: Crowe 2005

Key species for each of the sites listed above are detailed in Table 6. A total of 10 species regularly occur in internationally important numbers (**bold text**), while species that occur in nationally important numbers are shown in normal text.

Table 6: **Summary of important coastal sites for wildfowl, waders (& gulls) in Ireland**

Site	County
Dundalk Bay	**Light-bellied Brent Goose, Knot, Black-tailed Godwit, Bar-tailed Godwit, Redshank,** Great Crested Grebe, Greylag Goose, Shelduck, Teal, Mallard, Pintail, Red-breasted Merganser, Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Dunlin, Curlew, Black-headed Gull, Common Gull, Herring Gull
Shannon & Fergus Estuary	**Light-bellied Brent Goose, Black-tailed Godwit, Redshank,** Great Cormorant, Whooper Swan, Shelduck, Wigeon, Gadwall, Teal, Pintail, Shoveler, Scaup, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Knot, Dunlin, Bar-tailed Godwit, Curlew, Greenshank, Black-headed Gull, Common Gull
Wexford Harbour & Slobs	**Mute Swan, Greenland White-fronted Goose, Light-bellied Brent Goose, Black-tailed Godwit, Bar-tailed Godwit,** Great Northern Diver, Little Grebe, Great Crested Grebe, Great Cormorant, Bewick's Swan, Shelduck, Wigeon, Gadwall, Teal, Mallard, Pintail, Scaup, Goldeneye, Red-breasted Merganser, Moorhen, Oystercatcher, Golden Plover, Grey Plover, Lapwing, Knot, Sanderling, Dunlin, Curlew, Greenshank, Black-headed Gull,
Cork Harbour	**Black-tailed Godwit, Redshank,** Little Grebe, Great Crested Grebe, Great Cormorant, Shelduck, Wigeon, Teal, Pintail, Shoveler, Red-breasted Merganser, Oystercatcher, Golden Plover, Grey Plover, Lapwing, Dunlin, Bar-tailed Godwit, Curlew, Greenshank, Black-headed Gull, Common Gull, Lesser Black-backed Gull
Dublin Bay	**Light-bellied Brent Goose, Black-tailed Godwit, Bar-tailed Godwit, Redshank,** Shelduck, Wigeon, Teal, Pintail, Shoveler, Red-breasted Merganser, Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Knot, Sanderling, Dunlin, Curlew, Turnstone Black-headed Gull, Common Gull, Herring Gull
Tralee Bay, Lough Gill & Akeragh Lough	**Light-bellied Brent Goose,** Great Northern Diver, Barnacle Goose, Shelduck, Wigeon, Gadwall, Teal, Pintail, Shoveler, Scaup, Common Scoter, Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Greenshank, Turnstone, Black-headed Gull, Common Gull
Tacumshin Lake	**Mute Swan, Whooper Swan, Black-tailed Godwit,** Little Grebe, Bewick's Swan, Wigeon, Gadwall, Teal, Pintail, Shoveler, Coot, Golden Plover, Grey Plover, Lapwing
Dungarvan Harbour	**Light-bellied Brent Goose, Black-tailed Godwit,** Shelduck, Red-breasted Merganser, Oystercatcher, Golden Plover, Grey Plover, Lapwing, Knot, Dunlin, Bar-tailed Godwit, Curlew, Redshank, Turnstone
Boyne Estuary	**Black-tailed Godwit,** Shelduck, Oystercatcher, Golden Plover, Grey Plover, Lapwing, Knot, Redshank, Turnstone
The Cull & Killag	**Light-bellied Brent Goose, Black-tailed Godwit,** Bewick's Swan, Shelduck, Pintail, Ringed Plover, Golden Plover, Lapwing, Bar-tailed Godwit, Curlew
Castlemaine Harbour & Rossbehy	**Light-bellied Brent Goose,** Great Northern Diver, Great Cormorant, Wigeon, Pintail, Scaup, Common Scoter, Oystercatcher, Ringed Plover, Grey Plover, Sanderling, Bar-tailed Godwit, Redshank, Greenshank, Turnstone

Table 6: **Summary of important coastal sites for wildfowl, waders (& gulls) in Ireland (continued)**

Site	County
Inner Galway Bay	**Great Northern Diver, Light-bellied Brent Goose,** Great Cormorant, Shelduck, Wigeon, Teal, Shoveler, Red-breasted Merganser, Ringed Plover, Golden Plover, Lapwing, Dunlin, Bar-tailed Godwit, Curlew, Redshank, Greenshank, Turnstone, Black-headed Gull, Common Gull
Rogerstown Estuary	**Light-bellied Brent Goose,** Greylag Goose, Shelduck, Pintail, Shoveler, Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Knot, Sanderling, Dunlin, Black-tailed Godwit, Redshank, Greenshank, Turnstone, Black-headed Gull, Herring Gull
Bannow Bay	**Light-bellied Brent Goose, Black-tailed Godwit,** Shelduck, Pintail, Oystercatcher, Golden Plover, Grey Plover, Lapwing, Knot, Dunlin, Bar-tailed Godwit, Curlew, Redshank
Courtmacsherry, Broadstrand & Dunworley	**Black-tailed Godwit,** Great Northern Diver, Shelduck, Wigeon, Red-breasted Merganser, Golden Plover, Lapwing, Bar-tailed Godwit, Curlew, Greenshank, Black-headed Gull, Common Gull
Blackwater Estuary	**Black-tailed Godwit,** Great Northern Diver, Wigeon, Golden Plover, Lapwing, Dunlin, Curlew, Redshank, Greenshank
Broadmeadow Estuary	**Light-bellied Brent Goose, Black-tailed Godwit,** Shelduck, Pintail, Goldeneye, Red-breasted Merganser, Oystercatcher, Golden Plover, Grey Plover, Knot, Dunlin, Bar-tailed Godwit, Redshank, Greenshank
Tramore Backstrand & Bay	**Light-bellied Brent Goose,** Red-throated Diver, Golden Plover, Grey Plover, Lapwing, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew
The Mullet, Broadhaven & Blacksod Bays	**Great Northern Diver, Barnacle Goose,** Red-throated Diver, Common Scoter, Red-breasted Merganser, Ringed Plover, Sanderling, Purple Sandpiper, Dunlin, Bar-tailed Godwit, Turnstone
Clonakilty Bay	**Black-tailed Godwit,** Shelduck, Curlew, Greenshank
Baldoyle Bay	**Light-bellied Brent Goose,** Pintail, Goldeneye, Ringed Plover, Golden Plover, Grey Plover, Bar-tailed Godwit
North Wicklow Coastal Marshes	**Light-bellied Brent Goose,** Red-throated Diver, Greylag Goose, Wigeon, Teal, Black-headed Gull, Herring Gull
Ballysadare Bay	**Light-bellied Brent Goose,** Dunlin, Bar-tailed Godwit, Redshank, Greenshank
Sligo Harbour	**Light-bellied Brent Goose,** Oystercatcher, Redshank, Greenshank
Donegal Bay	**Great Northern Diver, Light-bellied Brent Goose,** Whooper Swan, Common Scoter, Red-breasted Merganser
Drumcliff Bay Estuary	**Barnacle Goose,** Sanderling, Bar-tailed Godwit
Skerries Islands	**Light-bellied Brent Goose,** Great Cormorant, Purple Sandpiper Turnstone, Herring Gull
Trawbega Bay	**Barnacle Goose, Light-bellied Brent Goose**

Source: Crowe 2005

Conservation designations

The study area contains nationally and internationally important populations of a large number of seabird, wildfowl and wader species, which are protected under the EC Birds Directive, through the establishment of SPAs, for the conservation of breeding, migrating and wintering birds. Details of designated and proposed SPA's in Ireland are given in Section 9.2.4

Currently there are no entirely marine SPAs protecting offshore aggregations of seabirds or important feeding locations for particular species in Irish waters.

Quality of baseline data

Breeding seabirds

Overall, the quality of survey coverage for seabird 2000 was very good, however, some of the more remote island colonies for hard to census species were not covered. Thus for Manx Shearwater, while the major colonies were covered, some smaller colonies or potential sites were not visited, however. For European Storm-petrel, one of the largest colonies in Ireland, Illaunmaster, was not surveyed, and was highlighted as a priority for future work by Mitchell *et al* (2004).

Seabirds at sea

In both summer and winter seasons, ESAS survey coverage was generally below the desired level of coverage, with some inshore areas of the south-west and north-west coasts unsurveyed in winter months. In addition, temporal gaps in coverage are an important issue as many species are migratory and risk being under-recorded if there is no coverage at appropriate times of year.

The need to devise a survey strategy to address existing gaps in terms of geographical and seasonal coverage, and to cover areas used by species that are presently under-represented were highlighted as priorities for future work by Pollock and Barton (in press).

Wildfowl and waders

Land-based counts such as I-WeBS tend to underestimate numbers of divers, grebes and seaduck as counts are conducted on preset dates, which frequently do not coincide with the good weather and calm sea conditions required to obtain accurate counts of these species (Evans 2000). Conducting counts in less than ideal conditions affects count accuracy as distant flocks will be much harder to count in heavy rain and/or strong winds.

There may also be problems covering large sites, resulting in incomplete counts, incomplete geographical coverage in remote areas and reduced coverage of non-estuarine habitat types e.g. rocky shores. In addition, some species are included as 'optional' species to count, and so are not always recorded e.g. gulls and terns.

Key Issues and Future Trends

Vulnerability to surface pollution and disturbance: Many shallow inshore areas contain important aggregations of diving waterbirds such as divers, ducks and grebes. These areas provide key feeding grounds for large numbers of birds during winter, and also during summer for coastal breeding species. As such, these inshore areas are particularly vulnerable to surface pollution and disturbance.

Legislation: Currently there are no entirely marine SPAs protecting offshore aggregations of seabirds or important feeding locations for particular species in Irish waters. The SPA designation process is ongoing and seaward extensions of existing designated coastal seabird colonies are expected to give protection to feeding or resting birds in the vicinity of coastal colonies. It is also envisaged that Natural Heritage Areas in the marine environment will be considered in the future.

Climate change: An increase in sea temperatures caused by global warming could have many effects on marine and coastal birds. A rise in sea temperatures may lead to changes in prey availability, affecting the distribution, abundance, and breeding cycles of whole populations of many different species. Rising sea levels may also decrease available feeding areas for migratory wading birds.

Appendix E: Marine Mammals Technical Report

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Appendix E: Marine Mammals

Data sources

Cetaceans

Most historical information on large cetacean distribution has come from records of the whaling industry and stranding data. The early 20th century whaling era resulted in at least 894 whales being taken by Irish–based whalers off the northwest coast between 1908 and 1922 (Fairley 1981), while 521 records of cetacean strandings on the Irish coast between 1901 and 1995 were reviewed by Berrow & Rogan (1997).

More recent research has concentrated on the at-sea distribution of cetaceans, and is summarised below.

Pollock *et al.* (1997) reported on the seasonal distribution and abundance of cetacean populations in the waters around Ireland.

The SCANS (Small Cetaceans in the European Atlantic and North Sea) study run by St. Andrews University, Scotland aimed to determine the absolute abundance of small cetacean populations and develop a framework for management of bycatch. SCANS-I was carried out in July 1994, covering the North Sea, Kattegat, Skagerrak, western Baltic, English Channel and Celtic Sea (Hammond *et al*. 2002). The SCANS-II survey covered a wider area, also including continental shelf waters to the west of Britain, Ireland, France, Spain and Portugal. These surveys were conducted in July 2005 and included aerial surveys of coastal Ireland and the Irish sea (SCANS-II 2008). The Cetacean Offshore Distribution and Abundance in the European Atlantic (CODA) project was planned as a follow-up to SCANS-II, with the aim of estimating the abundance of cetacean species in waters beyond the continental shelf. Surveys were conducted in July 2007 (CODA 2009).

The UK Mammal Society Cetacean Group, subsequently forming the Seawatch Foundation, has been recording cetacean sightings since 1973. Until the 1980's these were largely opportunistic, but data from subsequent effort-related surveys from land and offshore are available (Reid *et al*. 2003).

Data collected by European institutions involved in offshore seabird and cetacean research during standard ship-based and aerial surveys contribute to the European Seabirds at Sea (ESAS) database, maintained by the Joint Nature Conservation Committee (JNCC) in Aberdeen, Scotland. Surveys of cetaceans in Irelands Atlantic Margin were conducted between 1999-2001 using platforms of opportunity on naval and research vessels (Ó Cadhla *et al*. 2004), and have also been incorporated into the ESAS database. From this database, Mackey *et al* (2004) produced seasonal distribution maps for all cetacean species encountered in Irish waters.. The JNCC have also compiled an atlas of cetacean distribution in European Atlantic offshore waters using SCANS I, ESAS, and Seawatch data (Reid *et al*. 2003).

The Irish Whale and Dolphin Group (IWDG), carries out ship based surveys, covering both inshore and offshore areas, and has compiled an all-Ireland database of casual cetacean sightings and strandings occurring since 1991. Regular monthly effort-related surveys from commercial ferries and land-based stations have also been conducted since 2001, with increased survey effort from offshore platforms under the Irish Scheme for Cetacean Observation and Public Education (ISCOPE II) programme. Offshore survey effort focuses on seasons and locations with a previously low record of cetacean survey effort. A review of all cetacean sightings by the IWDG was carried out by Berrow *et al* (2002), and a review of recent research on cetaceans in Irish waters was conducted by O'Brien *et al* (2009).

Pinnipeds

The National Parks and Wildlife Service (NPWS) have been conducting counts of both harbourseals (*Phoca vitulina vitulina*) and grey seals (*Halichoerus grypus*) since the 1970s, with annual land-based counts of common seals in the southwest of Ireland since the late 1980s. Survey effort in general varies widely geographically. Lyons (2004) reviewed NPWS survey data for both harbour and grey seals.

Harrington (1990) reported on harbour seal populations at 24 sites in 8 counties following the outbreak of Phocine Distemper Virus (PDV) in 1988-89. Additional information on harbour seal population distribution and abundance are available for 1978-84 (Summers *et al*. 1980, Warner 1983, 1984). A national minimum population estimate for harbour seals was obtained in 2003 using aerial survey and thermal imaging techniques (Cronin *et al*. 2007).

From the mid 1990s, small-scale surveys of grey seals have been conducted by the CMRC and NPWS to establish and update information on population size at the main breeding colonies (e.g. Ó Cadhla & Strong 2003). A nationwide grey seal census took place in the 2005 breeding season (Ó Cadhla *et al*. 2005), moult population surveys took place in 2006 and breeding colonies on the east coast of Ireland were surveyed aerially in 2009.

The at-sea distribution of harbour seals in southwest Ireland has been investigated by the CMRC (Cronin *et al*. 2008, Cronin *et al*. 2009), and the at-sea distribution of grey seals in southwest Ireland is the focus of current studies conducted by the CMRC.

Few records exist for walrus in Irish waters. Records are reviewed by Cotton (2007). Walrus are not considered to be a native species, but a vagrant.

Otters

Whilst generally regarded as a freshwater/terrestrial species, populations in coastal areas utilise shallow, inshore marine areas for feeding. The first baseline study of the distribution of otters in Ireland, was undertaken in 1980-81 (Chapman & Chapman 1982), and was followed by a more limited survey in the early 1990s (Lunnon & Reynolds 1991). The most recent national survey was conducted in 2004-05 (Bailey & Rochford 2006).

Background

Below is a summary of the known distribution and abundance of marine mammals off the coast of Ireland. 28 species of marine mammal are known to occur in these waters (24 cetacean, 2 seal, walrus, and otter).

Ireland is obliged to implement the EC Habitats Directive on the Conservation of Natural Habitats and of Fauna and Flora. The Habitats Directive states that species listed in Annex IV require strict protection; prohibiting deliberate capture, killing, disturbance (particularly during breeding, rearing, and migration), and deterioration or destruction of breeding sites or resting places. All cetacean species occurring in European waters are listed as Annex IV species. Five species are further listed as Annex II species of community importance (bottlenose dolphin, harbour porpoise, grey seal, harbour seal, otter) and require the designation of Special Areas of Conservation (SACs) for their protection.

The Wildlife Act 1976 and Wildlife (Amendment) Act 2000 are Ireland's primary national legislation for the protection of wildlife. It provides strict protection from injury and disturbance/damage to breeding or resting places, and covers all dolphin, porpoise, seal and whale species.

Table 1. List of marine mammal species occurring in Irish waters and current conservation status

Species	Conservation Status	Special Areas of Conservation
Minke whale	Good	N/A
Sei whale	Unknown	N/A
Blue whale	Unknown	N/A
Fin whale	Good	N/A
Beluga/White whale	Unknown	N/A
Common dolphin	Good	N/A
Northern right whale	Unknown	N/A
Long-finned pilot whale	Unknown	N/A
Pygmy sperm whale	Unknown	N/A
Risso's dolphin	Unknown	N/A
Northern bottlenose whale	Unknown	N/A
Atlantic white-sided dolphin	Good	N/A
White-beaked dolphin	Unknown	N/A
Humpback whale	Unknown	N/A
Sowerby's beaked whale	Unknown	N/A
Gervais' beaked whale	Unknown	N/A
True's beaked whale	Unknown	N/A
Killer whale	Unknown	N/A
Harbour porpoise*	Good	Roaringwater Bay, Blasket Islands
Sperm whale	Unknown	N/A
False killer whale	Unknown	N/A
Striped dolphin	Unknown	N/A
Common bottlenose dolphin*	Good	Lower River Shannon
Cuvier's beaked whale	Unknown	N/A
Harbour seal/Common seal*	Good	Glengarriff Harbour and Woodland, Donegal Bay (Murvagh), West of Ardara/Maas Road, Galway Bay Complex, Killala Bay/Moy Estuary, Ballysadare Bay, Cummeen Strand/Drumcliff Bay (Sligo Bay), Clew Bay Complex, Kilkieran Bay and Islands, Kenmare River, Rutland Island and Sound
Grey seal*	Good	Roaringwater Bay and Islands, Horn Head and Rinclevan, Slieve Tooey/Tormore Island/ Loughros Beg Bay, Lambay Island, Inishbofin and Inishshark, Slyne Head Islands, Duvillaun Islands, Inishkea Islands, Saltee Islands, Blasket Islands
Walrus	Unknown	N/A
Otter*	Poor	Blackwater River, Castlemaine Harbour, Clew Bay Complex, Connemara Bog Complex, Galway Bay Complex, Glengarriff Harbour and Woodland, Gweedore Bay and Islands, Kenmare River, Kilkieran Bay and Islands, Lough Melvin, Lough Swilly, Lower River Shannon, Mullet/Blacksod Bay Complex, Mulroy Bay, Mweelrea/Sheeffry/Erriff Complex, North Inishowen coast, River Barrow/River Nore, Roaringwater Bay and Islands, Slaney River Valley, Slieve Tooey/Tormore Island/Loughros Beg Bay, The Twelve Bens/Garraun Complex, Tralee Bay and Magharees Peninsula, West of Ardara/Maas Road

Source: NPWS, 2008

*Included on Annex II of the EU Habitats Directive and requiring designation of Special Areas of Conservation (SAC)

Baseline description (summary of baseline characteristics and situation)

Cetaceans

24 species of cetacean are recorded in Irish waters, of which 10 are considered to be resident (Atlantic white-sided dolphin, harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin, white-beaked dolphin, killer whale, bottlenose whale, pilot whale and sperm whale). Seven species are considered migratory (blue whale, fin whale, sei whale, minke whale, northern right whale, humpback whale and striped dolphin), and the remaining 5 species are vagrants (Gervais' beaked whale, True's beaked whale, pygmy sperm whale, white whale, and false killer whale).

Minke whales (*Balaenoptera acutorostrata)* are the most widespread and frequently recorded baleen whale in Ireland, as well as being the most frequently stranded whale (Berrow & Rogan 1997). They are considered migratory and occur along all coasts and in the Irish Sea, with most records occurring on the south and southwest coasts (Reid *et al*. 2003). They have also been observed over offshore banks (Wall *et al*. 2006), and migrate along the shelf edge. SCANS II abundance estimates were 2,222 individuals in Atlantic coastal Ireland with a further 1,719 in the Celtic Sea, and 1,073 in the Irish Sea.

Blue whales (*Balaenoptera musculus)* sightings are a relatively rare occurrence in Irish waters. They generally travel alone or in small groups, with numbers peaking in October to December (Clark & Charif 1998, Charif *et al*. 2001). Peak detection using acoustic monitoring methods occurs in November and December (Charif & Clark 2009).

Fin whales (*Balaenoptera physalus)* are seasonally abundant off the south coast of Ireland, with numbers increasing during August and September and remaining through to March (Clark & Charif 1998, Charif *et al*. 2001) and highest acoustic detection in December and January (Charif & Clark 2009). High site fidelity and inter-annual occurrence of individuals along the south coast using photo-identification, suggest that these inshore waters are an important habitat (Whooley *et al*. 2005).

Sei whales *(Balaenoptera borealis)* are very rarely sighted in Irish waters, tending to occur in deep water beyond the continental shelf (NPWS 2008). The first validated sighting of sei whales in Irish waters occurred as late as September 2009 (IWDG), and only 3 strandings have been reported along Irish coasts.

Humpback whales (*Megaptera novaeangliae*) have been recorded in small numbers inshore off all coasts including the Irish Sea, with the majority of sightings occurring along the Cork coast (Berrow *et al*. 2002). Humpback whales have been detected through hydrophone recordings, with singing individuals recorded between October and March moving in a south-westerly direction, suggesting that the offshore waters west of Ireland may represent a migration corridor (Charif *et al*. 2001, Charif & Clark 2009). Repeat sightings of individuals shows high site fidelity along the south coast (Whooley *et al*. 2005).

Sperm whales (*Physeter macrocephalus)* tend to occur in deep-water off the western seaboard and over deep gullies and canyons (de Soto *et al*. 2004, Reid *et al*. 2003). While sighting records show them to be most abundant during summer and autumn, stranding records suggest male sperm whales may be present year round (Berrow & Rogan 1997).

Pygmy sperm whales (*Kogia breviceps*) are rarely sighted in Ireland, and only a handful of records of stranded individuals have been made (Berrow & Rogan 1997), the most recent of which occurred in December 2009 (IWDG).

Beluga or White whales (Delphinapterus leucas) are considered vagrants in Irish waters with very few reported sightings (Reid *et al*. 2003).

Long-finned pilot whales (*Globicephala melas)* tend to occur along the shelf edge, and have been observed in surveys off the northwest coast (Gordon *et al*. 1999). They are rarely seen inshore except during strandings, and are most often recorded June-August.

Harbour porpoise (*Phocoena phocoena)* is the most widespread and abundant species in Ireland occurring over the continental shelf and all around the coast. It appears to be more abundant off the southwest coast and in the Irish Sea and is less abundant off the northwest but this could be due to less recording effort (Reid *et al*. 2003). Harbour porpoises rarely occur over deep water as they predominately feed on demersal fish species, but have been observed over shallow offshore banks. Harbour porpoise abundance in Atlantic coastal Ireland was estimated at 10,716 individuals, with a further 80,613 in the Celtic sea and 15,230 in the Irish sea (SCANS-II 2008). The density of harbour porpoises in the Celtic Sea had doubled between the SCANS-I and SCANS-II surveys, but may reflect a change in the overall distribution of harbour porpoises rather than an actual population increase. High densities of harbour porpoise have also been recorded in Galway Bay, Roaringwater Bay, Dublin Bay and the Blasket Islands (Berrow *et al* 2008a,b). As an Annex II species, SACs have been designated for harbour porpoise conservation at the Blasket Islands, Co. Kerry, and Roaringwater Bay, Co. Cork. Within the Blasket Islands SAC, recent surveys give a robust estimate of 303 individuals in 2007 (Berrow *et al*. 2009).

Common dolphins (*Delphinus delphis)* are the second most frequently sighted species in Ireland are most abundant off the southwest and northwest coasts and in the Celtic Sea (Reid *et al*. 2003). They are also observed over deep water, especially along the edge of the continental shelf. Common dolphin abundance estimates from the SCANS-II surveys were 15,327 in Atlantic coastal Ireland, 11,141 in the Celtic Sea, and 366 in the Irish Sea. Between SE Ireland and west Wales, abundance of common dolphins was estimated to be 186 in 2004, 1644 in 2005, and 2166 in 2006 (Evans *et al*. 2007).

Bottlenose dolphins (*Tursiops truncatus*) have a coastal distribution with most sighting records off the western seaboard and in the Celtic Sea (Reid *et al*. 2003). They are also commonly sighted in the Irish Sea and the continental shelf. Ingram *et al*. (2001) found low encounter rates with dolphins from the Shannon Estuary in other areas along the west coast, suggesting that the population in Irish coastal waters is either quite large, or that only local movement from the estuary occurs. More recent photo-identification studies recorded large-scale movements of bottlenose dolphins, with re-sightings of the same individuals at distances of 130 to 650km from each other (O'Brien *et al*. 2008). Bottlenose dolphins using the waters of Connemara also appear to belong to a single, wide-ranging coastal community (Ingram *et al* 2009), The SCANS-II surveys estimated bottlenose dolphin abundance at 313 in coastal Ireland, 235 in the Irish Sea, and 5,370 in the Celtic Sea, representing nearly 50% of the estimated 12,645 bottlenose dolphins in the entire SCANS-II northeast Atlantic survey area. The coastal waters off Mayo may represent a population of considerable significance in Irish waters, and the presence of calves showing birthmarks/neonatal folds, suggests that the region may function as a nursery area (Oudejans *et al* 2008). As an Annex II listed species, the Lower River Shannon has been designated a SAC for bottlenose dolphins conservation. Within the Shannon estuary, mark-recapture estimates give an increasing population of 113 in 1997 (Ingram 2000), 121 in 2003 (Ingram & Rogan 2003), 140 in 2006 (Englund *et al*. 2007), and 114 in 2008 (Englund *et al*. 2008).

Atlantic white-sided dolphins (*Lagenorhynchus acutus)* tend to occur offshore, mainly along the western seaboard and offshore banks (Ó Cadhla *et al*. 2004, Wall *et al*. 2006, Reid *et al*. 2003). They are rarely seen close to land.

Striped dolphins (*Stenella coeruleoalba*) tend to occur well beyond the continental shelf in depths of 1000m or deeper, but have been recorded in shallower waters (Forcada *et al*. 1990). Although rarely seen in Irish waters, striped dolphins are one of the most frequently stranded species in Ireland, commonly occurring on the north and west coasts (Berrow &

Rogan 1997). Striped dolphins are opportunistic feeders, exploiting a wide variety of prey types (O'Brien *et al*. 2009).

Risso's dolphins (*Grampus griseus)* have been recorded throughout the year in Irish waters with a wide distribution. As well as being common in the Irish sea, they are regularly observed both inshore and offshore along the south and west coasts (NPWS 2008) with additional regular sightings inshore off the northwest and southeast coasts (Reid *et al*. 2003).

Killer whales (*Orcinus orca)* have been observed off all coasts and in the Irish Sea but mainly on the continental shelf (Reid *et al*. 2003). Inshore sightings tend to increase during late summer and autumn, with occasional incidences of killer whales entering harbours and estuaries. Spatial and seasonal variation in survey effort makes the species' true distribution patterns difficult to determine.

White-beaked dolphins (*Lagenorhynchus albirostris*) tend to occur in shallow of 50-100m over the continental shelf. They are particularly abundant in the northwest (Ó Cadhla *et al*. 2004, Wall *et al*. 2006, Reid *et al*. 2003). SCANS II surveys estimated abundance of white-beaked dolphins at 267 in Irish coastal waters, and 75 in the Irish Sea.

Beaked whales (northern bottlenose whale, Cuvier's beaked whale, True's beaked whale, Sowerby's beaked whale and Gervais' beaked whale) have been sighted in Irish waters, typically in deeper offshore waters (Reid *et al*. 2003). Beaked whales prefer deep water canyon habitat occurs (MacLeod & Mitchell 2006), which occur to the southwest, the northwest, and the Porcupine Seabight.

Pinnipeds

Grey seals (*Halichoerus grypus*) are widespread in Ireland, but occur in greatest haulout concentrations along exposed southwestern, western and northern coasts (Ó Cadhla & Strong 2007). However, Lambay Island (Co. Dublin) and the Great Saltee (Co. Wexford) are the most important pupping sites in the eastern Irish Sea (Kiely *et al* 2000). The largest populations are found on the Blasket Islands and the Inishkea Island group (See Figure 9.2.5a). Grey seals give birth from September to late November, and haul out in large numbers during the moult from January to April, although some individuals may start the moult as early as November (Ó Cadhla & Strong 2007). Grey seal foraging distribution has been extensively studied in the North Sea and around Scotland using satellite telemetry, and shows repeated local trips to discrete offshore areas as well as distant travel up to 2,100km (McConnell *et al*. 1999). Individuals tend to make repeated foraging trips to the same region, but will occasionally move to a new haul-out and begin foraging in a new region. Approximately 40% of their time is spent in the region of their haul-out sites (McConnell *et al*. 1999). Studies on the foraging distribution of grey seals in southwest Ireland are currently being undertaken by the CMRC and recent evidence suggests movements of grey seals between SW Ireland and NW Scotland (Figure A1). Sampling effort is limited to the southwest of Ireland, and at this stage, it is not known whether similar foraging ranges are utilized by grey seals along the rest of the Irish coast. Grey seals are opportunistic feeders, consuming a wide variety of prey. Recent estimates of grey seal abundance in Ireland are a minimum 5,509-7,083 grey seals of all ages based on estimated pup production in 2005 (Ó Cadhla *et al*. 2005), and 5,343 moulting individuals in 2007 (Ó Cadhla & Strong 2007). Increases in annual pup production have been recorded at several key regional breeding sites (Ó Cadhla *et al*. 2005).

As an Annex II species under the Habitats Directive, 10 SACs have been designated for grey seals (Table 1; Figure 9.2.5b).

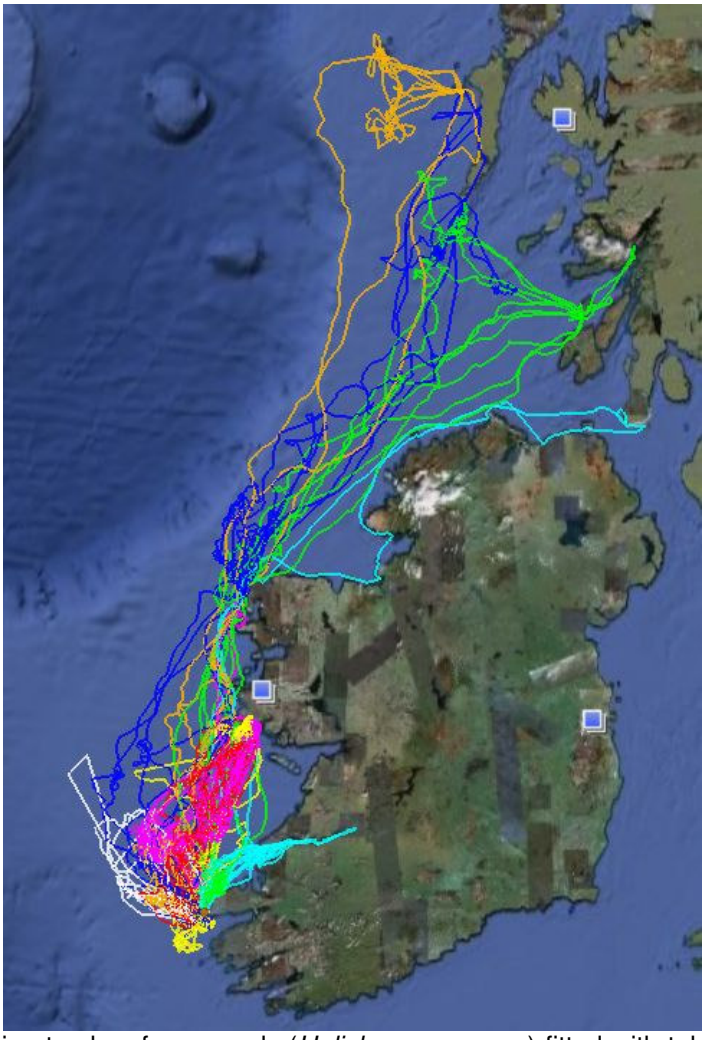

Figure A1. Foraging tracks of grey seals (*Halichoerus grypus*) fitted with telemetry devices in southwest Ireland, illustrating far-ranging foraging trips.
(CMRC data on Google Earth satellite image)

Harbour seals *(Phoca vitulina)* are generally considered to be a relatively sedentary coastal species undertaking limited seasonal movements. Haul-out groups tend to be found on tidally exposed areas of rock, sandbanks or mud in inshore bays and islands, coves and estuaries (Lockley 1966, Summers *et al*. 1980).

Harbour seals pup in June and July, and in Ireland the annual moult is thought to occur from late July through August. The moult represents peak abundance at haulout locations, which is used to give a minimum population estimate. The most recent national survey in 2003 calculated a minimum population of 2905 harbour seals (Cronin *et al*. 2007). Satellite tagged harbour seals in the UK foraged mostly within 40km of haul-out sites, but longer distance trips of up to 200km and 850km from haul-out sites have been recorded in the UK and US respectively (Rehberg & Small 2001, Sharples *et al*. 2005). Recent research on the at-sea distribution of harbour seals in southwest Ireland suggests more limited movement, with tagged seals generally foraging no further than 20km from the haul-out sites (Figure A2). This suggests that harbour seals in southwest Ireland may display a more local foraging distribution (Cronin *et al*. 2008). However, sampling effort is limited to the southwest of Ireland, and it is unclear whether this pattern is consistent at the population level. Harbour seals are opportunistic feeders, consuming a wide variety of prey species. Overall the most common species of prey consumed around southwest Ireland were *Trisopterus spp,* dragonet, sandeels and sole (Cronin *et al*. 2008). As an Annex II species under the Habitats Directive, 11 SACs have been designated for harbour seal conservation (Table 1; Figure 9.2.5b).

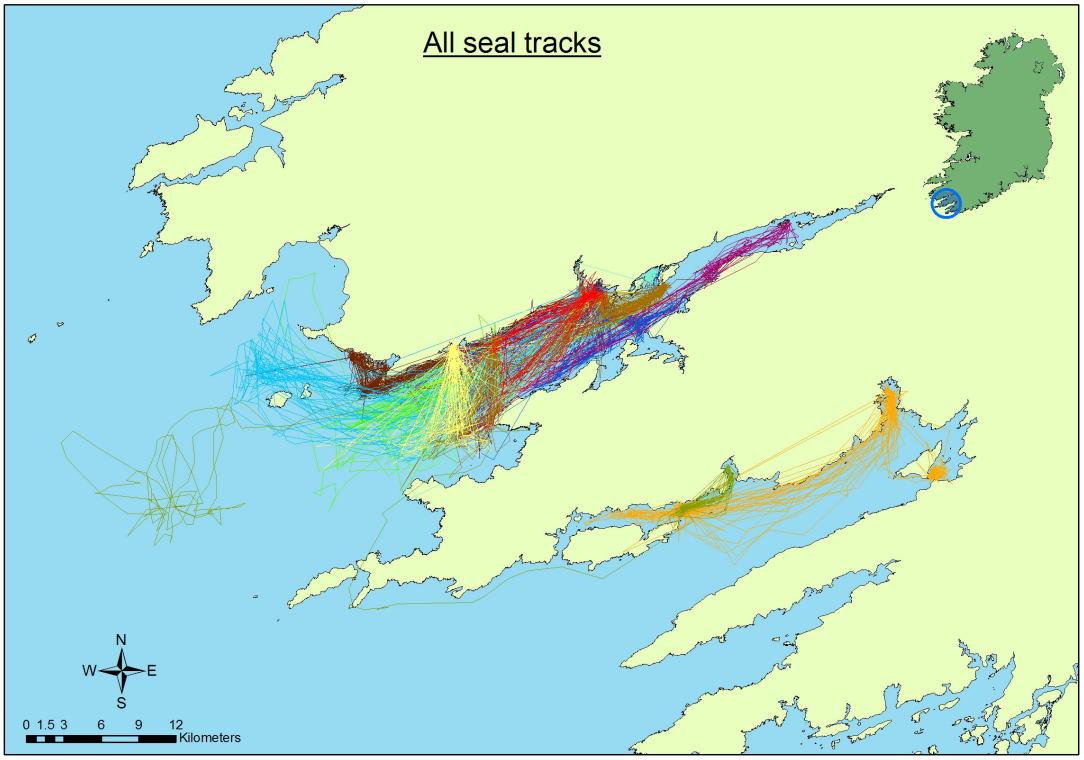

Figure A2. Foraging distribution of tagged harbour seals (*Phoca vitulina*) illustrating localized trips of generally less than 20km from haul-out sites.

Otters

Otters (*Lutra lutra*) occupy both freshwater and coastal habitats, and Ireland is considered to hold one of the most important otter populations remaining in Western Europe (Whilde 1993). Surveys carried out in the early 1980s, early 1990s and early 2000s confirmed the species to be widespread throughout the country (Bailey & Rochford 2006). The Irish population is estimated to be between 10,000 and 20,000 adults (NPWS 2008). As an Annex II listed species, 44 SACS have been designated for otter conservation, 23 of which are in offshore coastal areas.

Key Issues and Future Trends

Legislation: All marine mammals are listed in Annex IV (species of community interest in need of strict protection) under the 1992 EC Habitats Directive (92/43/EC). Ireland is also legally obliged to designate Special Areas of Conservation (SAC) for Annex II species; grey seals, harbour seals, harbour porpoise, bottlenose dolphins and otters. Additional protection for marine mammals is granted under the Wildlife (Amendment) Act (1976-2005) including protection of 'resting places' and from 'wilful interference' up to 12nm (20km) offshore.

Ireland has also ratified the Bern Convention on the Conservation of European Wildlife and Natural Habitats (1979), the Convention on Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention), the OSPAR Convention (which seeks to protect the marine environment and establish marine protected areas for threatened species), and The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Ireland has been a signatory to the International Whaling Commission since 1985, and in 1991 the Irish government declared all Irish waters, extending to the outer Continental shelf, a whale and dolphin sanctuary.

By catch: The incidental capture and entanglement in fishing nets is one of the main threats to marine mammals (Lewison *et al*. 2004). Harbour porpoise, common dolphin, striped dolphin, bottlenose dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso's dolphin, sperm whale, long-finned pilot whale, minke whale, humpback whale, fin whale and grey seals have all been reported bycaught in Ireland (Couperus 1995, Tregenza *et al*. 1997a, Tregenza *et al*. 1997b, Berrow & Rogan 1998, Morizur *et al* 1999, Rogan & Mackey 2007). Although difficult to quantify, illegal killing of individual seals at fishing gear also occurs (Duggan 2003). Ireland is subject to the EU's Bycatch Regulation 812/2004, which requires monitoring of cetacean bycatch in pelagic trawl fisheries and use of acoustic deterrents (pingers) on vessels using bottom-set or entangling gillnets off the south and southwest coasts.

Phocine distemper virus: (PDV) outbreaks in 1988 and 2002 caused widespread mortality in the European harbour seal population (Hall *et al*. 2006). During the 2002 outbreak, approximately 3,990 deaths were confirmed in the UK and Northern Ireland, and positive pathology was recorded from an individual found on the Aran Islands (NPWS, unpublished data). However, it is unclear to what extent the disease affected Irish populations. While harbour seals are highly susceptible to infection, sympatric grey seals appear resistant, but could be important asymptomatic carriers of the disease as they are far-ranging (Härkönen *et al*. 2006).

Climate change: An increase in sea temperatures caused by global warming could have many effects on marine mammals. Potential changes in prey availability and distribution, abundance and migration patterns, community structure, susceptibility to disease and contaminants as a consequence of climate change were discussed by Learmonth *et al.* (2006). Cetacean strandings and sightings off the west coast of Scotland have also shown a trend towards increasing warmer water species and decreasing colder waters species (MacLeod *et al*. 2005). Changes to the shoreline as a result of rising sea levels may also decrease available haul out sites for seals.

Habitat disturbance or loss: Fishing activity may degrade the seafloor and its resident benthic fauna (Piet *et al*. 2000). Coastal development including harbour developments e.g. pier construction, channel dredging etc can cause significant disturbance to marine mammals, and seals in particular can be affected at their terrestrial haul-out sites, resulting in change in habitat use.

Resource Competition: As top predators marine mammals and humans share a common resource of fish. Overfishing will potentially impact negatively on marine mammals directly through reducing the biomass of fish available, and indirectly by causing changes in the marine ecosystem.

Pollution: High concentrations of PCBs have been associated with an increase in disease in cetaceans in UK waters (Jepson *et al*. 2005), and toxic algal blooms have also been linked to deaths and neurological dysfunction of marine mammals (Scholin *et al*. 2000). Plastics represent an additional threat to marine mammals, with a large number of species known to be harmed and/or killed by plastic debris through entanglement or ingestion (Derraik 2002).

Noise: Noise is considered an acoustic pollutant, and the expansion of renewable energy devices into the marine environment may create additional sources of underwater noise causing disruption of behaviour during construction and, to a lesser degree, during operation (Madsen *et al*. 2006). Detailed studies of the impact of wind farm construction on cetaceans, mainly harbour porpoises, were carried out in association with the Horns Reef and Nysted windfarms in Denmark. Displacement of harbour porpoises has been shown to occur during construction (Carstensen *et al*. 2006), and simulated underwater noise from a 2MW wind-turbine resulted in avoidance behaviour by both harbour seals and harbour porpoises

(Koschinski *et al*. 2003). The impact on baleen whales is likely to be greater as they are more sensitive to low frequency sounds. The impact of wave and tidal devices on marine mammals is also not well researched and understood. Shipping is an important source of such ambient noise, which may also mask the low frequency sounds produced by baleen whales for communication and navigation.

Appendix F: Commercial Fisheries

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Appendix F: Fisheries and Aquaculture

Data Sources

The following data sources have been used in describing fisheries and aquaculture within the assessment area.

- The Rising Tide: A Review of the Bottom Grown (BG) Mussel Sector on the Island of Ireland. Bottom Grown Mussel Review Group. 2008.
- Atlas of the Commercial Fisheries around Ireland. 2009. Marine Institute.
- The Stock Book 2009. Marine Institute Fisheries Science Services.
- The Status of Irish Aquaculture 2007. Report compiled by MERC Consultants.
- Department of Agriculture, Fisheries and Food Annual Review & Outlook for 2008.
- Fishing Activity, Biological Features and Suggested Management Measures for the Biologically Sensitive Area off the Irish Coast. Paula Harrison MSC thesis, UCC, 2007
- MIDA (2010). Marine Irish Digital Atlas (MIDA). http://mida.ucc.ie
- The Shrimp Fishery: Analysis of the Resource 2003-2007. BIM 2008.

Background

According to the Department of Agriculture, Fisheries and Food (DAFF), the Irish seafood industry (covering fisheries, aquaculture and processing) provided 11,000 jobs and €780m in revenue in 2008. In 2008 there were approximately 2,000 fishing vessels on the fleet register and although overall fleet tonnage has declined by 25%, the number of vessels has risen. This is mainly due to the replacement of larger vessels with new inshore vessels.

There is significant fishing activity in Irish waters from the following foreign fleets:

- UK - operating in all Irish waters particularly on Nephrops grounds and in deeper water off the west coast with gillnets,
- France - mainly in the Celtic Sea and west coast targeting Nephrops, whitefish and deep water species,
- Spain - mainly in the western Celtic Sea and along the shelf edge targeting Hake, monkfish, megrim and Nephrops with trawls, gillnets and longlines.
- Belgium - using beam trawls targeting flatfish and concentrated in the Irish Sea and off the southeast coast,
- Netherlands - targeting pelagic species off the west coast
- Norway - targeting Blue Whiting in deep water off the west coast.

Due to the intensity of fishing effort in Irish coastal waters it is a reasonable assumption that any location within the study area will be subject to commercial fishing of some sort. Available recent maps of fishing effort in Irish waters are drawn from Vessel Monitoring System (VMS) data and do not include smaller vessels (under 15m). Hence areas that may appear to have less fishing activity may well have significant numbers of smaller vessels operating there, particularly in summer using static gear for shellfish. The study area covers all current Irish aquaculture operations and their distribution tends to be much more localized and is mainly concentrated in sheltered or semi-sheltered bays.

Baseline Description

Commercial fisheries

Table 1 highlights the most economically valuable species landed by Irish vessels.

Table 1: Top 20 most economically valuable species landed by Irish vessels in 2008

Species	Live weight (Tonnes)	Landed weight (Tonnes)	Value (€)
Mackerel	44,767	44,767	€39,959,734
Nephrops	9,179	5,685	€31,610,454
Horse mackerel	36,631	36,631	€11,521,366
monkfish	2,837	2,269	€9,658,905
Edible crab	6,979	6,945	€8,324,799
Lobster	497	497	€6,918,843
Haddock	3,715	3,397	€6,208,644
Herring	27,975	27,975	€6,154,596
Megrim	1,745	1,662	€6,118,324
Albacore tuna	1,522	1,522	€5,321,422
cod	1,524	1,292	€3,582,421
Hake	1,392	1,244	€3,509,386
Whiting	2,564	2,451	€3,453,799
Blue whiting	22,852	22,852	€3,141,641
Scallop	1,071	1,071	€2,744,116
Black sole	212	202	€2,214,319
Whelk	1,816	1,816	€2,027,405
Shrimp	156	156	€1,950,000
Ray	1,237	1,083	€1,851,590
pollack	702	617	€1,530,590

Source: Atlas of Commercial Irish Fisheries, 2009

Pelagic fisheries

Pelagic fisheries target shoaling fish mainly found swimming in the water column and are mainly operated by large, modern vessels known as refrigerated rea water or RSW vessels. However lower volumes of pelagic species are also caught by other fleet sectors such as the polyvalent and inshore fleets.

Mackerel: Mackerel was the most valuable Irish fishery in 2008 at almost €40m and also the largest fishery by volume at 44,000 tonnes. The pattern of landings by the larger pelagic and polyvalent RSW vessels tend to follow the shelf break in depths of approximately 200m and as such a substantial proportion of that fishing activity would be outside of the assessment area. This fishery is seasonally focused in winter and spring and follows the schools of Mackerel in a southerly direction during that period. The main fishing method used by these vessels is pair-pelagic trawling and purse seine. Mackerel fishing in summer and autumn (mainly July – October) tends to be conducted by inshore vessels using a variety of gear including handlines, jigging machines and gillnets.

Horse Mackerel: Horse Mackerel is almost exclusively targeted by pelagic and polyvalent vessels, mainly equipped with RSW. This fishery is also seasonal with the majority of catches being made in winter and spring. Like Mackerel the Horse Mackerel fishery is concentrated around the 200m depth contour but the pattern of landings has a more Northerly focus. The main fishing method used by these vessels is pair-pelagic trawling and purse seine.

Blue whiting: The fishery for Blue Whiting started as an industrial fishery (i.e. for production of fish meal) but is now also targeted for human consumption. It is an exclusively RSW fishery i.e. large pelagic vessels. It is

mainly conducted in deep water north of the Porcupine Bank and the majority of the fishing effort occurs outside of the assessment area.

Herring: The Irish Herring fishery has a far more inshore focus than other Irish pelagic fisheries and accordingly it is targeted by a greater size range and number of vessels which include boats of less than 10m to vessels of over 70m. The fishery, although conducted along the Irish coast, has 2 main focal areas which are Donegal and Waterford/Cork. These represent two separate spawning stock components, North-West of Ireland Herring and Celtic Sea Herring. Both fisheries are conducted mainly between October to January although in the Celtic Sea there has been in some years a more offshore summer fishery. The majority of vessels fish using pair-pelagic trawling sometimes in very shallow water of less than 50 m depth.

Albacore Tuna: The Irish Albacore Tuna fishery began as a drift net fishery in the early 1990's fishing in the summer months from the Bay of Biscay up to the Porcupine Seabight. The distribution of tuna shoals and associated commercial catches are highly variable from year to year and are dependent on oceanographic stratification and sea surface temperature conditions. During years of above average sea-surface temperatures off the Southwest of Ireland Albacore can be caught closer to the Irish coast. Since drift-netting for this species was banned in 2002 Irish vessels have mainly targeted the fishery using pair-pelagic trawling. Some mainly smaller vessels have also used the trolling method of tuna fishing which involves multiple lines with lures towed behind the vessel and fish caught using this method can achieve a much higher market price than trawled fish.

Demersal fisheries

Demersal fisheries target species on or near the sea bed, where fish tend to occur in a diverse mixtures of species. Important demersal fisheries in Irish waters include, cod, haddock, whiting, hake, plaice, sole, rays, monkfish and megrim. These fisheries are usually targeted using trawls, gill-nets and long-lines. The semi-discrete demersal fisheries which exist in Irish waters which may be grouped as in Table 9.4.1b.

Table2: Main demersal fisheries in Irish waters

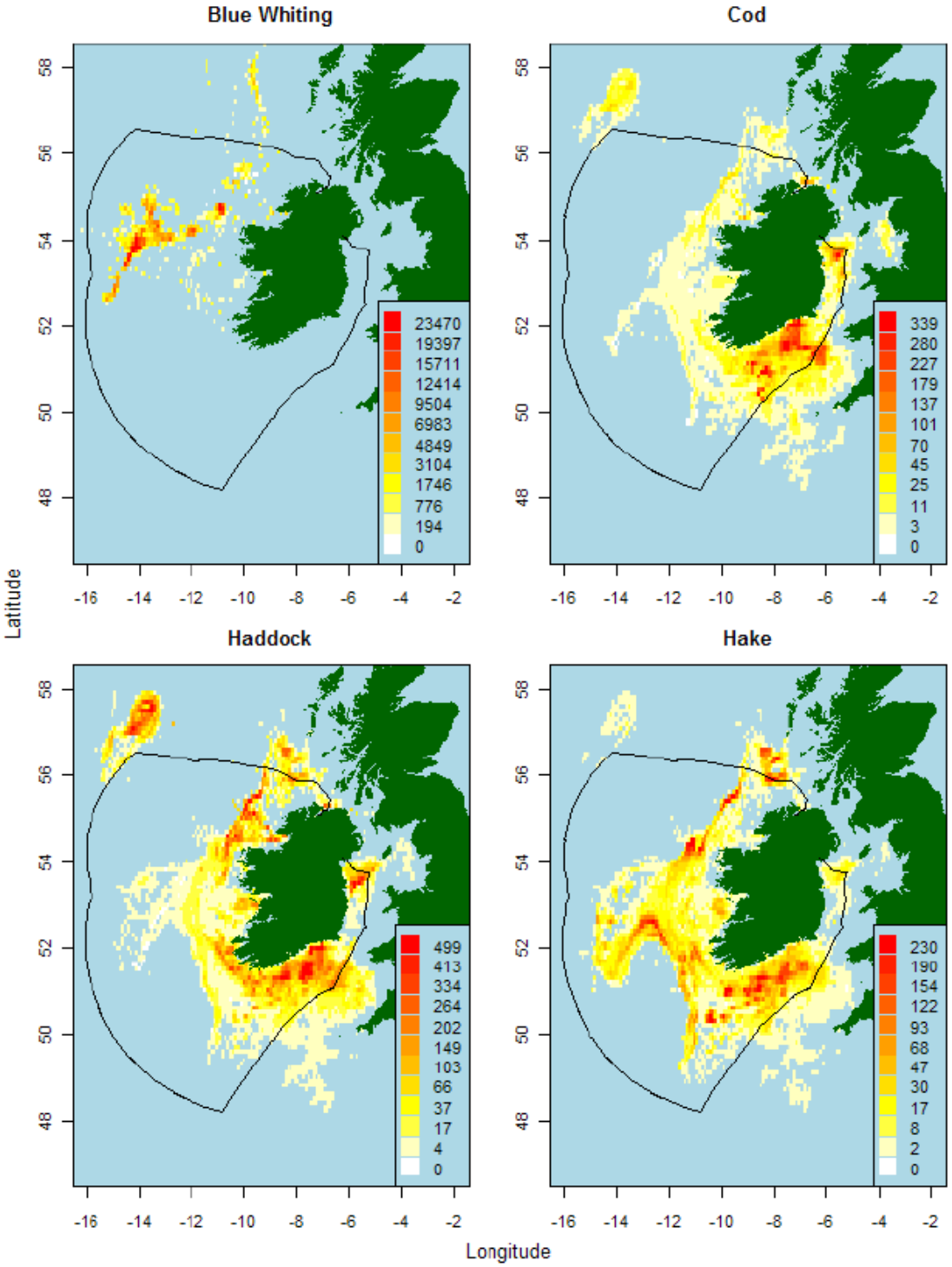
Gear	Area	Species	Country
Beam trawl	Irish Sea, Celtic Sea	black sole, plaice, lemon sole, rays, mixed whitefish	Ireland, UK, Belgium
Gill Nets	Eastern Celtic Sea and inshore areas around coast	cod, pollock	Ireland, UK
	Celtic Sea	turbot, monkfish	Ireland, UK
	South-west, West & North-west	hake, monkfish	Spain, France, UK, Ireland
	South-west, West & North-west in deep water	deep water fish and sharks	France, Spain
Trawl	Irish Sea	cod, whiting, haddock	Ireland
	Celtic Sea	cod, whiting, haddock,	Ireland, France, UK
	Western Celtic Sea	monkfish, megrim	Spain, France, Ireland
	Western Shelf Break	monkfish, megrim, other whitefish and deepwater sp.	Ireland, Spain, France
	Rockall	haddock, megrim and other whitefish	Ireland, France, Spain
Seine nets	Celtic Sea, Irish Sea	hake, whiting, cod, haddock	Ireland
Longlines	Shelf areas and shelf	hake, deepwater species	Spain, Ireland

	break on South-west, West & North-west		

Source: from Harrison, 2008

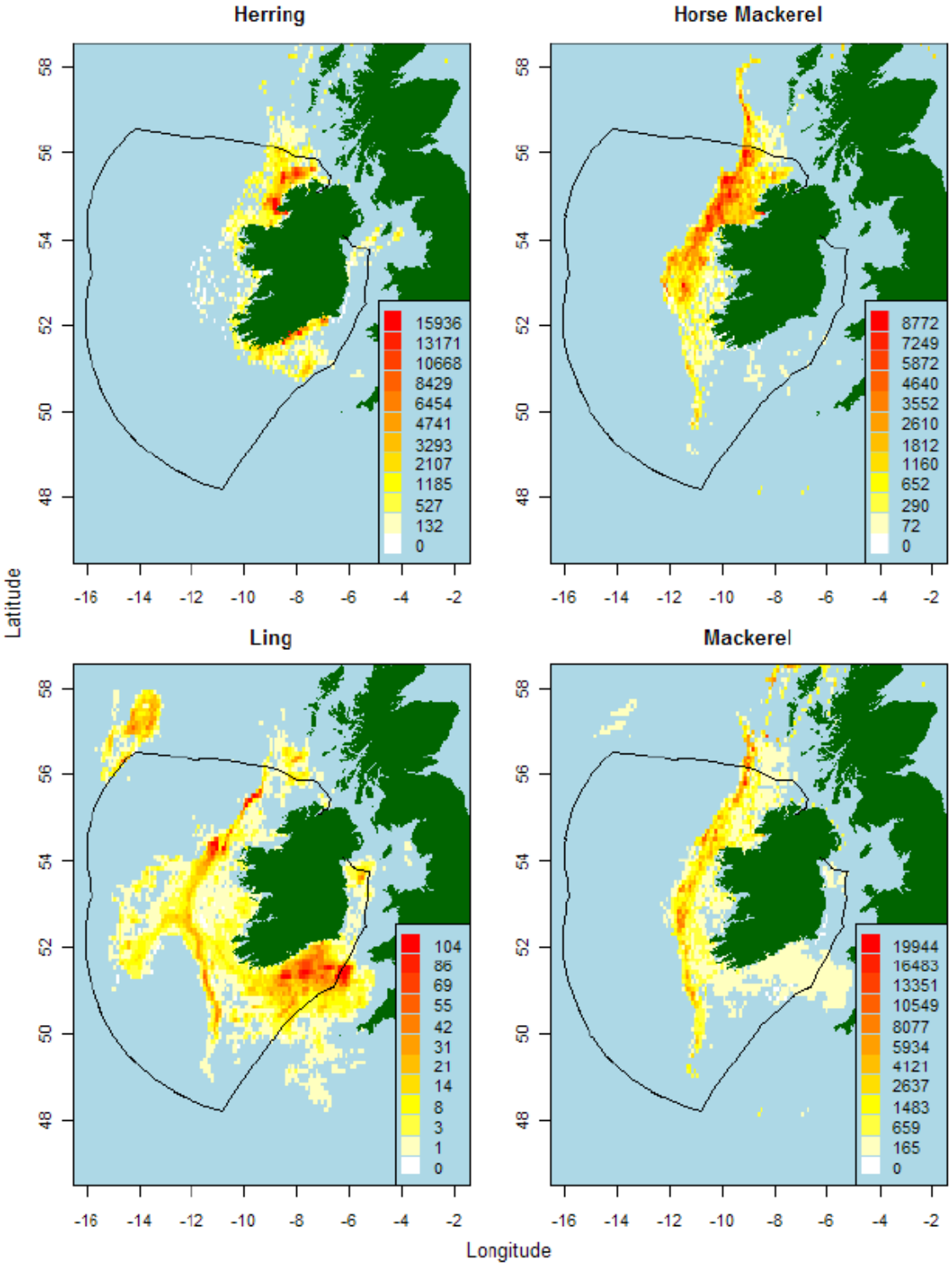
Figures 1 - 4 show the distribution of averaged annual landings from Irish vessels over 15 m for the period 2006 – 2008.

Figure 1: Average annual landings (whiting, cod, haddock and hake) of Irish vessels >15m (2006-2008)



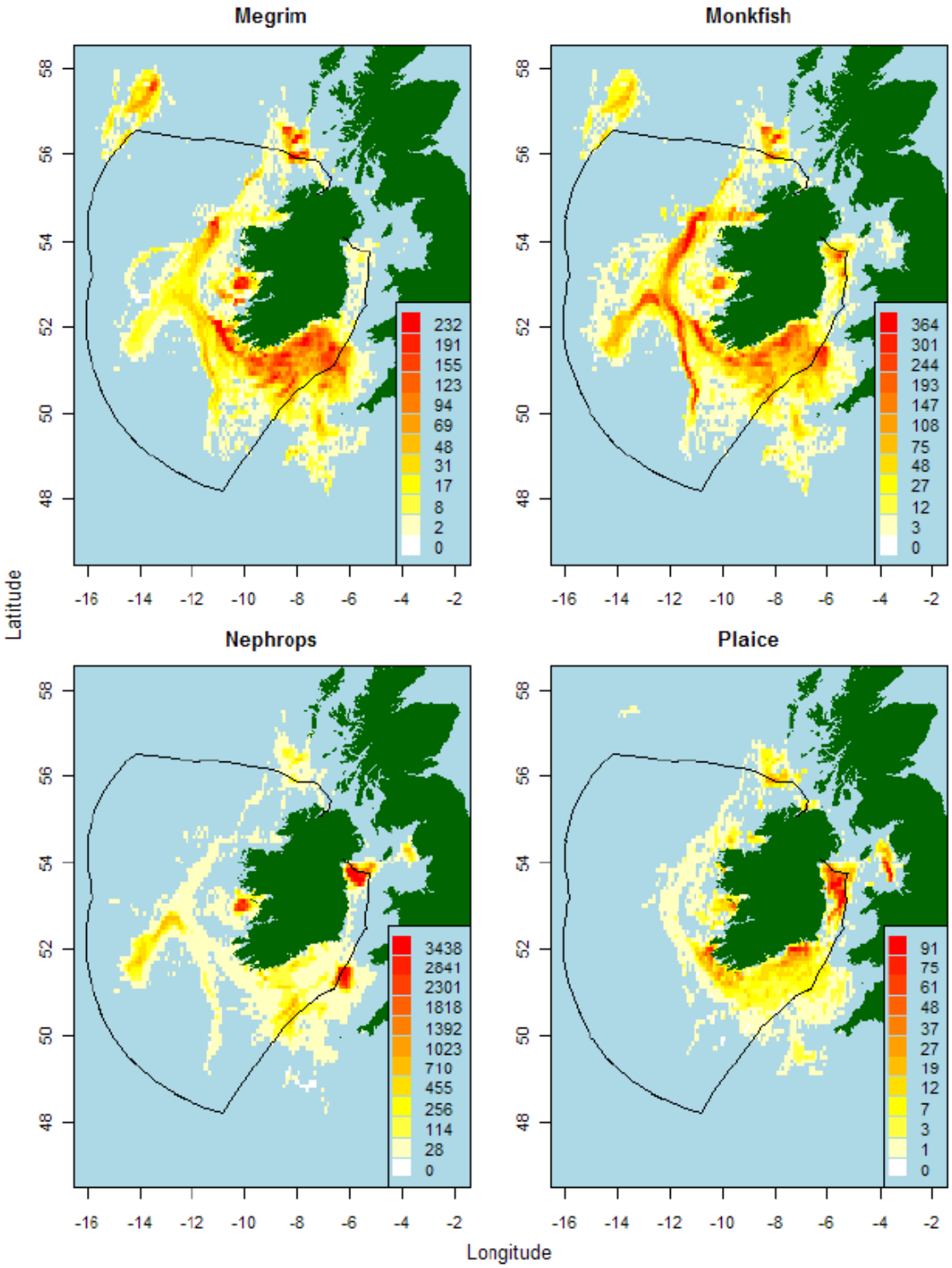
Source: Marine Institute (from VMS database and Irish Logbooks database). [Note: Data is expressed as liveweight (kg) per square nautical mile.]

Figure 2:Average annual landings (herring, horse mackerel, ling, mackerel) of Irish vessels >15m (2006-2008)



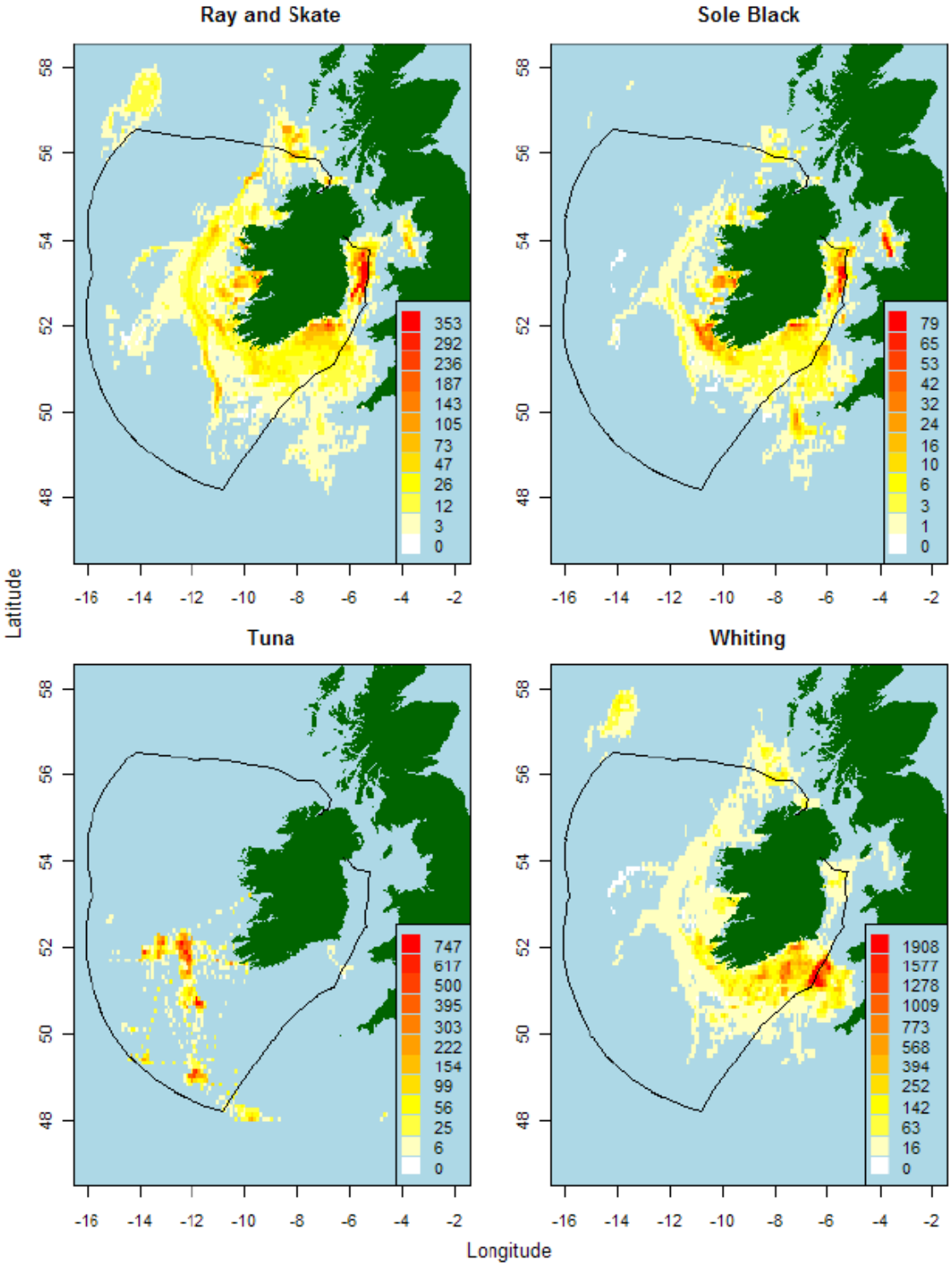
Source: Marine Institute (from VMS database and Irish Logbooks database). [Note: Data is expressed as liveweight (kg) per square nautical mile.]

Figure 3: Average annual landings (megrim, monkfish, nephrops, plaice) of Irish vessels >15m (2006-2008)



Source: Marine Institute (from VMS database and Irish Logbooks database). [Note: Data is expressed as liveweight (kg) per square nautical mile.]

Figure 4: Average annual landings (ray and skate, black sole, tuna and whiting) of Irish vessels >15m (2006-2008)



Source: Marine Institute (from VMS database and Irish Logbooks database). [Note: Data is expressed as liveweight (kg) per square nautical mile.]

Shellfisheries – trawling

Fisheries for Shellfish in Irish waters can be split into two broad categories, those using trawls (mainly for Nephrops) and those using pots (for Edible Crab, Lobster, Shrimp, Whelk).

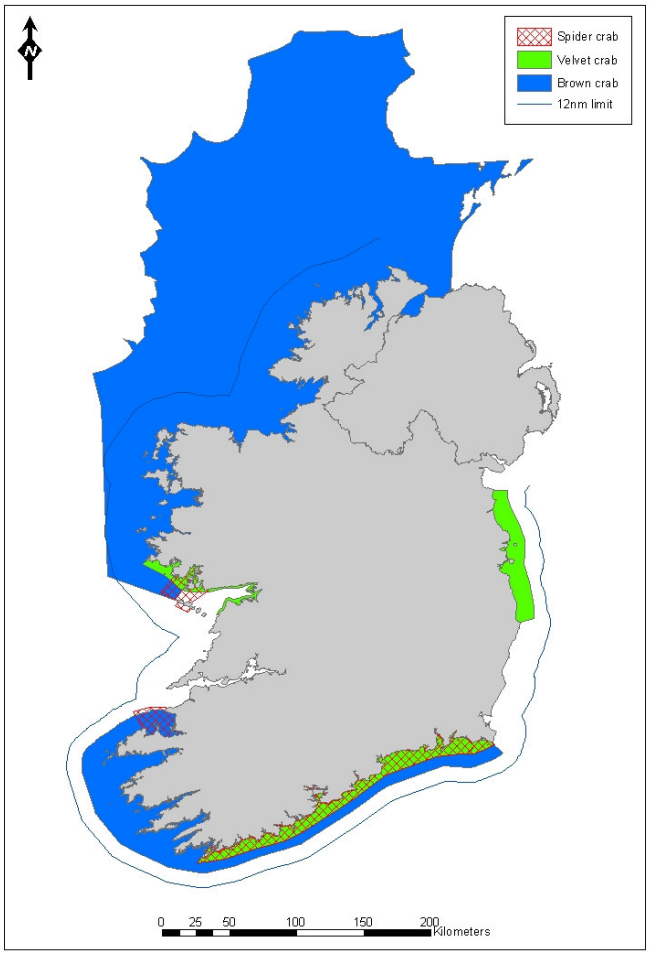
Nephrops (or Dublin Bay Prawn): Nephrops is the second most valuable fishery for Irish vessels. The fishery has increased in importance to the Irish fishing fleet in recent years as stocks of other fisheries have declined and landings of Nephrops increased from a value of €13.7 million in 2004 to €31 million in 2008.

The fishery is concentrated in a number of fairly discrete areas around the coast. The reason for this is that Nephrops require a particular ground type and only fine mud habitats can support large Nephrops populations. The animals build long burrows within the mud from which they emerge depending on tidal conditions and it is at this time that they are liable to be caught by trawls.

The main Nephrops fishing grounds within the assessment areas are clearly visible in Figure 9.4.1b in the Irish Sea, straddling the boundary line with UK waters in the Celtic Sea (the Smalls ground) and west of the Aran Islands. There is also a significant Nephrops fishery on the Porcupine Bank but due to stock recruitment problems it has been agreed to close this fishery in 2010. It also falls outside of the OESEA assessment area. The Nephrops fishery in the Irish Sea is targeted mainly by Irish and UK vessels, in the Celtic Sea it is targeted by Irish, UK and French vessels and at the Aran grounds it is targeted mainly by Irish and French vessels. There is also a more widespread Nephrops fishery throughout the Western Celtic Sea. All of these fisheries, apart from the Porcupine fishery which is further offshore, include the involvement of smaller vessels (<15m) up to vessels of 30m in length. They all also catch species other than Nephrops and bycatches of juvenile whitefish such as Whiting and Hake are common although technical developments such as the use of square mesh panels is helping to reduce these.

Shellfisheries – potting

Figure 5: Edible crab fishing grounds



Source: B.I.M website

Edible Crab: The fishery for edible crab is conducted by an inshore fleet and offshore vivier fleet (which hold crab live in sea water tanks) using pots. The fishing effort for the vivier fleet in mainly focused in offshore waters off the North West coast and due to fishing effort restrictions in ICES Area VI these vessels have in the past few years spent part of the year fishing in the North Sea. Fishing effort for the inshore fleet is widely distributed in inshore waters (inside the 12 mile limit) from Wexford to Donegal and to a lesser extent in the Irish Sea. For the inshore fleet this fishery is not conducted year round but mainly occurs from March-April to October. The map shown is reproduced from BIM and shows the main crab fishing grounds in Irish waters.

Lobster: The fishery for lobster has traditionally been one of Irelands most important inshore fisheries and it remains an extensive one right around Irish coasts. The majority of lobster fishing effort is concentrated inside the 6 mile limit. The fishing method used is with pots and as with other inshore pot fisheries the number of pots used has been increasing over the past few years due

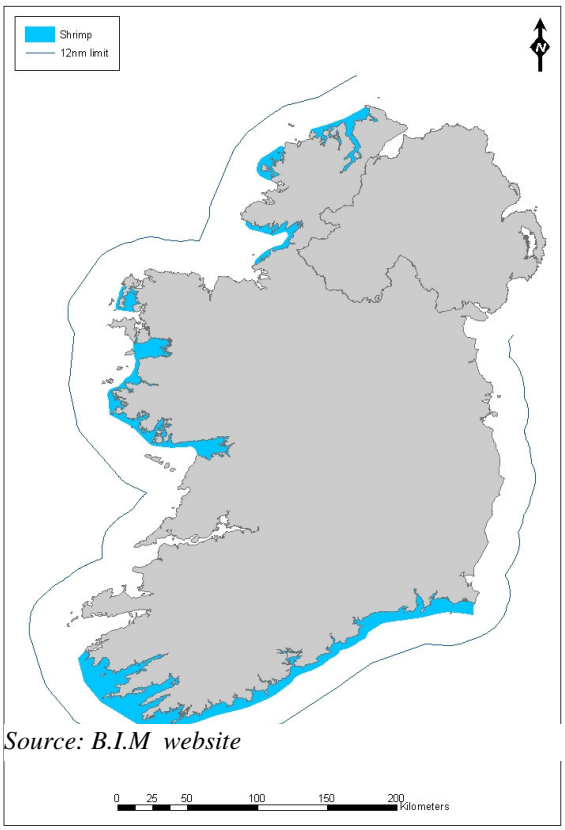
partly to displaced effort from the closure of the Salmon drift-net fishery. Due to heavy fishing pressure lobster stocks in some areas have become depleted. Some recovery has been achieved in areas where v-notching schemes have been implemented. These schemes prohibit the landing of notched or berried lobsters. The relatively open-access nature of the fishery at present (i.e. anyone with a fishing licence can target lobster) may be changed if BIM's lobster management plan, which has been in development for several years, is implemented.

Shrimp: Shrimp live in groups in crevices and under stones in shallow water areas up to a depth of 40m. They are also found in estuaries and in sea-grass beds.

Shrimp fishing began in southwest Ireland in the 1970s, and has since spread to Waterford, Connemara, Donegal and other areas. These fishing areas are shown in the map (BIM). The only management measure for Shrimp is a closed season from May 1st to August 1st. Otherwise the fishery is open access with a trend of increasing effort. BIM is attempting to develop a Shrimp Management Plan to address sustainability issues.

Whelk: The whelk fishery is confined mainly to the Irish Sea and with some activity in the adjoining part of the Celtic Sea. There is also a small whelk fishery in the area known as the Cape off Malin Head in Co. Donegal. Whelks are covered by Bord Iascaigh Mhara's Shellfish Management Framework, which aims for the sustainable exploitation of fishery resources.

Figure 5: Shrimp fishing grounds



Source: B.I.M website

Aquaculture

Although volumes and value of aquaculture production have declined somewhat in recent years (mainly due to difficult conditions in the farmed salmon market and a poor year in 2007 for bottom grown mussels1) it remains a significant industry around the Irish coast. The Status of Irish Aquaculture 2007 report states that aquaculture provided a total of 1,981 full and part-time jobs. There were 573 active aquaculture licenses of which 494 were for shellfish, 75 were for finfish and 4 were for algae. Of the shellfish licences 268 were for oysters and 167 were for mussels. Figure 9.4.1e shows the distribution and locations of aquaculture licences in the assessment area. Despite some recent setbacks continued growth of aquaculture in Ireland is likely as the sector has so far been successful in targeting the market for seafood which declining wild catches have been unable to supply.

Shellfish aquaculture

Three main sectors are predominant in Irish shellfish aquaculture, collectively comprising 99% of production by volume and 94% by value. These sectors are bottom grown mussels, rope mussels and Pacific oysters.

Table 3: highlights the contribution of various species to the total aquaculture production in Irish waters in 2007.

[1] Figures in this section are derived mainly from the report "Status of Irish Aquaculture 2007" which is the most recent comprehensive report on Irish aquaculture production.

Table 3: Total shellfish aquaculture production in Irish waters 2007

Species	Volume (Tonnes)	Value (€000's)
Bottom mussel	18,270	20,906
Rope mussel	11,200	7,784
Gigas oyster	7,032	15,390
Native oyster	382	1,630
Clam	170	1,038
Scallop	58	339
Other shellfish*	N/A	204
Total	**37,112**	**47,291**

*Other shellfish is expressed as individuals, and a value for tonnage is therefore not available.

Bottom grown mussels comprise 50% of shellfish aquaculture volume and 45% of its value. The sector depends on the dredging of seed mussel from a number of areas, mainly in the South Irish Sea, Lough Swilly, Lough Foyle, Carlingford Lough and Cromane Co. Kerry and subsequent relaying of the seed in ongrowing areas for later harvest. The areas licenced for ongrowing are Carlingford Lough, Wexford and Waterford Harbours, Cromane, Co Kerry, Lough Swilly and Lough Foyle. There has also been a recent development of rope grown mussels which could not be marketed due to negative biotoxin assessments in rope mussel production areas being relaid as bottom grown mussels. This has helped to offset some of the shortfall in supply of wild seed mussel which has been outstripped by demand due to the rapid development of this sector.

Rope mussels make up 30% of shellfish production by volume and 16% by value. In this method, mussels are suspended from ropes connected to barrels on the surface. This method is mainly concentrated in sheltere bays in the South-West in Cork and Kerry, in the West in Galway and Mayo and in the North-West in Donegal.

Pacific or Gigas oysters (*Crassostrea gigas*) make up 19% by volume and 33% by value of shellfish aquaculture production. Gigas oyster cultivation began here in the 1970's as a response to a decline in stocks of the native oyster. The cultivation method in this sector mainly used is that of laying down seed oyster in mesh bags on intertidal trestles. Gigas oyster production sites are widely distributed around the coast but with particular concentrations in Waterford, West Cork, Kerry, Galway Mayo and Donegal.

The balance of shellfish production is made up by native oyster, scallop, clams and new species such as abalone, sea urchins and lobster.

Finfish Aquaculture

Irish finfish production in 2007 was 11,238 tonnes with a value of €58.4 million. This sector is dominated by Salmon production which makes up 88% by volume and value. Freshwater trout makes up 7% by volume of finfish production and Sea Trout makes up 5%. The balance of production is made up by Salmon smolts and novel finfish species such as Cod and Turbot.

The main finfish production areas can be seen in Figure 9.4.1e. They are quite tightly focussed in three main production areas where conditions for the growth of finfish (water quality, currents, wave shelter and access to landing sites) are optimal. These areas are West Cork/Kerry, West Galway/South Mayo and Donegal.

Appendix G: Assessment Area Assessment Matrices

Table Appendix G1: East Coast - North (Area 1: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Bathymetry	**The information presented in this chapter has been used to inform the results of the assessment. No specific impacts on bathymetry are expected.**							
Geology, geomorphology and sediment processes	**Changes in hydrodynamic/ coastal processes and seabed morphology**	Installation Decommissioning	• Cable trenching/removal • Foundations Installation/ removal	**Fixed Wind Floating Wind**	**Negligible**	Seabed sediments in the zone generally comprise mud, sand and muddy sand, with beach sands and estuarine muds. There is a lack of detailed information on seabed sediment and sediment transport processes in the assessment zone. Cable burial and turbine foundation installation/ removal would have a localised effect on the seabed morphology. In areas of mud where relatively low tidal energy conditions prevail, effects will be less temporal than in higher energy environments where sands and gravels are encountered.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm is located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Negligible**
	Changes in hydrodynamic/ coastal processes and seabed morphology	Operation	• Devices using seabed foundations	**Fixed Wind Floating Wind**	**Significant adverse**	Seabed sediments in the zone generally comprise mud, sand and muddy sand, with beach sands and estuarine muds. Relatively low tidal stream velocities and low to moderate fetch limited wave energy conditions prevail. The physical presence of monopile or tripod foundations and transition pieces on and above the seabed will cause hydrodynamic changes. Research suggests that such hydrodynamic changes will extend up to 50 m from devices and is therefore localised to the vicinity of the device array. Nearfield changes in scour, sedimentation, sediment suspension, seabed composition and seabed morphology may arise due to these hydrodynamic changes. Farfield changes may occur, particularly in relation to large arrays of turbines, where alteration to the local hydrodynamics interrupts sediment transport processes e.g. longshore drift, possibly having an overall impact to stabilise sediments in the area of the wind farm, while increasing erosion in other areas along coast. This impact is relevant to installation of piled devices, which would be in the nearshore area, out to 60 m water depth.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm is located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Unknown - negligible**
Seabed Contamination and Water Quality	**Accidental Contamination (hydraulic fluids or vessel cargo/fuel)**	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. This will degrade water quality with potential for adverse effects on the receiving environment. Any accidental spillage of slick forming chemicals could be carried into inshore waters, where the effects on water quality will be greater than those in open waters. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects in this area would be of adverse significance. Sensitive receptors in this area include a UNESCO biosphere reserve, Ramsar sites, coastal SACs, licensed aquaculture sites and bathing beaches, There is a risk of transboundary contamination following spillages in the Irish Sea	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan)	**Negligible**
	Disturbance of contaminated sediment	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negligible to Significant adverse**	There are seven dredging spoil disposal sites within and one immediately adjacent to Area 1. There is also a relict sewage sludge disposal site. These potential areas of contamination could therefore be disturbed by seabed activities. Any contaminated material released is likely to be widely dispersed and diluted and the effect on open sea water quality is likely to be of negligible significance. Munitions migrated relict from wartime activities may be encountered. Disturbance could result in significant adverse effects.	Available mitigation includes avoidance of potentially contaminated seabed areas. Identification and avoidance of areas of munitions contamination through site survey at the project stage. If munitions are encountered advice such as that given in Department of the Marine and Natural Resources 2001 (Marine Notice No. 16 of 2001. (i.Explosives picked up at sea in trawls or sighted; and ii. The removal of explosive items from wrecks)) should be followed.	**Negligible**

Table Appendix G1: East Coast - North (Area 1: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Protected Sites	**Degradation of protected sites**	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negative – significant adverse**	There are Ramsar, SAC, SPA, NHA and pNHA protected sites within Wind Assessment Area 1 as well as an UNESCO Biosphere Reserve (Bull Island). These sites are all adjacent to the coast, although in some cases (e.g. Dundalk Bay SPA), extend up to a maximum of 8 km offshore. Significant adverse impacts on protected sites could occur as a result of turbine or export cable installation, through physical disturbance and loss of substratum, or direct disturbance impacts on the species supported in the protected area. Significant adverse impacts could be expected if direct disturbance is caused to Natura 2000 species or habitats that do not recover well, such as saltmarshes or biogenic reef.	Impacts on protected areas could be mitigated by careful site selection avoiding sensitive sites for devices and export cables (i.e. existing and proposed national and European protected sites). Whether avoidance is an appropriate mitigation should be assessed on a site specific basis. A very extensive area is available to site floating wind technology away from protected sites. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of protected sites. However in the case of Assessment Area 1, there is still the potential to locate piled wind arrays, and their export cables away from protected sites. Impacts may still arise through indirect impacts on sediment movements during installation and operation, and would need to be assessed in more detail at the project stage. Possible mitigation measures relevant to the specific interest features of the sites and their seasonal and other sensitivities are described elsewhere in this table for the relevant topic areas.	**Negligible – significant adverse**
	Impacts on protected species	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	Impacts on protected benthic ecology, mammals, birds, fish and reptiles in the zone are covered under the specific species sections of this table.			
Benthic ecology	**Physical disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negative**	Assessment Area 1 is located across an area of sublittoral sand and muddy sand/gravel habitat which grades into deep sea mud habitat further offshore. This habitat is widely represented on the east coast where the inshore seabed is almost entirely sediment, ranging from sand, shell, gravel and cobbles to stones and small boulders. Disturbance to benthic habitat from installation activities would include disturbance through bed preparation prior to turbine installation, disturbances from piling or alternatively from excavation of bed material for gravity foundations, disturbances to sediment from the feet of jack up platforms and disturbances to sediment from cable burial. Trenching of interturbine and export cables would cause the greatest levels of physical disturbance with complete displacement of localised benthic communities and temporary smothering of adjacent areas. Impacts would include damage and possible mortality, particularly to smaller, thinner shelled bivalves. Mobile species such as amphipods, gastropods and small crustacea are likely to survive displacement, however larger crabs and sea urchins may be crushed from disturbed boulders and cobbles. Permanently attached, sessile species such as bryozoans, sponges and hydroids on areas of coarser substratum cannot reattach to the substratum if removed, and may be damaged or destroyed if substratum is displaced. Physical disturbance will be localised and recoverability of benthic species is generally expected to be high due to repair and regrowth of damaged individuals and/or recruitment within the community from surviving colonies and individuals. Greater significance can be attached to impacts associated with physical disturbance to species considered to have high sensitivity and / or low recoverability, especially threatened and/or declining species or habitats. Within assessment Area 1 this includes the distribution of key habitats such as saltmarsh and intertidal sand and mudflats (e.g. Dundalk Bay), sea-pen and burrowing megafauna communities (Irish Sea muds), Zostera beds (Carlingford Lough, Boyne Coast & Estuary, Malahide Estuary, Ballydoyle Bay and South Dublin Bay), and potential biogenic and rocky reef habitat.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) especially in areas with known sensitive intertidal and subtidal benthic habitats, such as intertidal mudflat and biogenic and rocky reef habitat. Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Smothering	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negative**	Smothering of benthic communities by sediment displaced by activities such as cable trenching may cause a very local decline in biotope species richness due to the loss of more sensitive species due to clogging of their filtration apparatus and potential short term anoxia under the sediment layer. Smothering impacts will be localised to the immediate vicinity of the seabed disturbing activities during installation. Benthic communities along the East Coast are characteristic of areas subject to sediment scour and natural variations in suspended sediment levels and will therefore be generally be tolerant of increases in suspended sediment.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection). Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative**
	Contamination – from sediment disturbance	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negligible**	There is a potential for contaminated sediment, such as from spoil dumping sites to be remobilised during seabed disturbing installation works including cable burial. It is likely that any habitats with the potential to be adversely affected by contamination from these sites have already been subject to disturbance during the original dredging and deposition of material. Fine contaminated material will be diluted and dispersed, settling over a wide area with negligible effect on the Benthic ecology. Coarse material will be rapidly redeposited within the immediate area of installation operations.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection). Avoidance of areas of known potential contamination for seabed disturbing works. Potential effects on areas of unknown benthic habitat will need to be assessed through site survey at the project stage.	**Negligible**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. The water depth is such that small spillages (< 1tonne) are unlikely to affect the benthos. Similarly small spillages are unlikely to come ashore. Large spillages have the potential to have a significant adverse effect, particularly on the intertidal ecology of the adjacent shoreline coastline, and, for example, on the rich mud flat and sand flat invertebrate communities found in adjacent estuaries e.g. Carlingford Shore SAC, Dundalk Bay SAC, the Boyne Coast and Estuary SAC, Rogerstown Estuary SAC, Ballydoyle Bay SAC and Dublin Bay SACs. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on Benthic ecology would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan). Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**
	Substrate change	Installation Operation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse**	All benthic communities can be expected to be sensitive to substratum loss through the removal and possible mortality of populations of the associated infauna and sessile epifauna. The long term loss of substratum due to the presence of devices that are attached to the seabed will therefore have a potentially significant adverse effect on any rare or important benthic habitats, such as those protected under the Habitats Directive. There is potential for colonisation of structures leading to increased biodiversity. Although this has potential to be a positive impact, species colonising underwater structures may also lead to undesirable changes in community structure.	Effects on benthic ecology from substratum loss can be reduced through avoidance (careful site selection) Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible - Significant adverse**
Fish and Shellfish	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negative**	Smothering effects are likely to be more of an issue for less mobile (shellfish) than mobile (finfish) species. Area 1 contains shellfish populations of nephrops, cockles,razor clams and periwinkles. Periwinkles are found throughout Area 1 in the intertidal area of semi-exposed to sheltered rocky shores particularly around Carlingford Lough, Co. Louth, Rush and Skerries, Co. Dublin. Cockles are found mainly in inner Dundalk Bay while razor clams are found mainly off Gormanstown Co.Meath with beds also found off Carlingford Lough, Dundalk Bay and Malahide. With the exception of Nephrops shellfish beds in the area are quite localised. The Nephrops stock in the area however is extensive and covers much of the floating wind resource area in the Zone and also extends into much of the fixed wind area. Of these shellfish species which live on, near or in the bottom sediments of the seabed the most sensitive to smothering are oysters and periwinkles. The impact of smothering will be localised to the immediate vicinity of seabed disturbing activities and limited to during installation.	For devices that require piling, and cable trenching, potential effects could be minimised by using techniques which cause minimal seabed disturbance, and avoiding sensitive seasons for certain species. The southern part of the zone (south of Dublin) may offer more opportunities for avoidance of shellfish grounds for both fixed and floating wind devices.	**Negligible**

Table Appendix G1: East Coast - North (Area 1: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Noise	Survey	• Acoustic survey	**Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for fish, in particular fish with swim bladders are particularly sensitive to noise disturbance. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to fish species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) would also minimise any impacts on fish species.	**Negligible**
		Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Fixed Wind Floating Wind**	**Unknown**	High levels of noise such as during pile installation or underwater blasting may cause physiological or displacement effects to marine fish although the extent to which this may occur is unknown. In particular, herring and cod are known to be highly sensitive to noise and may be able to detect piling noise up to 80km. Both species are present in Area 1. It is expected that noise levels from piling and the removal of piled devices will be greater than those generated by operational devices, and although pile driving only occurs during installation the effects may last for longer than the piling activities as fish may not immediately return to the area.	The potential effects of noise from piling or blasting could be reduced through undertaking studies to determine site specific noise effects, and/or avoiding piling or blasting activities during sensitive spawning periods. Where possible less noisy alternatives can be considered such as protecting cables where they cannot be buried with mattressing or rock placement.	**Unknown**
		Operation	• Turbine noise transmitted through steelwork	**Fixed Wind Floating Wind**	**Unknown**	There is potential for noise from operational devices to lead to long term species displacement which could increase pressures on fish populations in other locations and force fish into predator habitats.	No specific mitigation measures have been identified	**Unknown**
	Collision	Operation	• Mooring chains/cables	**Floating wind**	**Unknown**	There is potential risk that all mobile fish species could collide with turbines, moving parts of submerged devices, or mooring chains/cables. Larger animals, such as basking sharks, and pelagic species are considered to be of greater risk. Basking shark and other pelagic fish species are present throughout Area 1. However, due to uncertainties with data and knowledge on the interactions between fish and devices, the potential significance of collision risk effects is unknown.	Potential effects associated with collision risk and fish could be reduced through device design e.g. use of protective nets or grids. Devices could also be sited to avoid sensitive areas e.g. migration routes, spawning and nursery grounds.	**Unknown**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. Small spillages are likely to have a negligible impact. Large spillages, particularly where they impinge on the coastline or enter sheltered bays and loughs could have a significant adverse impact.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude fish from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. It is not possible to determine the potential significance of this effect. The presence of offshore wind arrays may also have a positive effect on fish populations through fish stock recovery, should certain types of fisheries be excluded from the array.	No specific mitigation identified	**Unknown**
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse**	Substrate loss could have a significant adverse effect on shellfish (nephrops, razor clams, cockles). With the exception of Nephrops shellfish beds in the area are quite localised. The Nephrops stock in the area however is extensive and covers much of the floating wind resource area in the Zone and also extends into much of the fixed wind area. The fixed wind resource area overlaps with cockle and razor clam grounds.	The potential effects of substratum loss on shellfish could be reduced by avoiding key shellfish grounds. The southern part of the zone (south of Dublin) may offer more opportunities for avoidance of shellfish grounds for both fixed and floating wind devices. Better information on fish and shellfish distribution is required in order to confirm the potential for avoidance mitigation, and identify areas. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts. Targeted surveys by site developers may also be undertaken by individual projects.	**Negative - Negligible**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Barrier to movement	Operation	• Devices that occupy seabed/water column	**Fixed Wind Floating Wind**	**Unknown**	Some species, such as Atlantic salmon, trout and eels spent part of their lifecycle in freshwater and part at sea. Migration between these two water bodies is important for the survival of the species. The river Boyne and its tributary the Blackwater have been designated as SACs due to their significant Salmon populations. The presence of wind devices could present a perceptual barrier to migration, although the exact impacts on fish species is unknown.	Available mitigation includes avoiding placing devices close to the entrances to key spawning rivers.	**Negligible - Unknown**
	EMF	Operation	• Inter-array and export cables	**Fixed Wind Floating Wind**	**Unknown - negligible**	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 renewable array power cable, but the field would not cause an avoidance reaction. Atlantic salmon, eels and Sea Trout are believed to be sensitive to magnetic fields. However, the level of impact associated with inter-turbine arrays will be more concentrated than those for export cables. There is no evidence to indicate that existing cables have caused any significant effect on migration patterns of these species. However, the significance of potential effects cannot be adequately quantified on the basis of current information.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength.	**Unknown - negligible**
Marine Birds	**Physical disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Significant adverse - negligible**	There are several seabird breeding colonies within Area 1 with SPA status, including Howth Head, Ireland's Eye, Lambay Island, Rockabill and Skerries Islands. Waters in the vicinity of these colonies are important feeding and resting areas for several breeding species occurring in nationally important numbers. At-sea data coverage within Area 1 is incomplete, however, high densities (>5 birds/km^2) of Fulmar, Manx Shearwater, Herring Gull, Kittiwake, Guillemot and Razorbill were recorded in inshore waters off the east coast between July and September. Herring Gulls were also recorded in the area at high densities between November and February. Dundalk Bay, Boyne Estuary, Carlingford Lough, Braganstown, Dublin Bay, Rogerstown Estuary, Malahide Estuary, Baldoyle Bay, and the Skerries islands regularly hold internationally and nationally important numbers of wildfowl and waders during spring and autumn passage and in winter months. Physical disturbance during construction or decommissioning could lead to short- or long-term displacement of feeding or resting birds, depending on the species involved, and the time of year. Physical disturbance would be likely to be of particular importance close to seabird breeding colonies in the breeding season.	Effects on seabird breeding colonies could be reduced by avoiding sensitive sites e.g. SPAs and by timing installation activities to avoid the most sensitive seasons e.g. breeding and moulting. Site-specific surveys would be required at project level to identify the presence of key foraging hotspots and/or resting areas and to aid site selection.	**Negligible**
	Noise	Installation Decommissioning	• Devices using piled foundations	**Fixed Wind**	**Significant adverse - negative Negative - negligible**	Based on studies of bird behaviour on land it is evident that some species have acute hearing. However, there is limited understanding of birds ability to hear underwater. Although it is not possible to determine the level of significance of noise effects on seabirds, it is likely that impacts arising from operational noise will be less than impacts arising from installation (specifically from piling noise). It is likely that some degree of habituation will occur, depending on the species involved, as has been recorded with terrestrial species nesting in working quarries.	There are some mitigation measures available for piling operations that have been shown to reduce noise e.g. bubble curtains around the pile. The application of these should be reviewed and considered. Piling operations should be timed to avoid the most sensitive seasons e.g. breeding and moulting.	**Unknown Negligible**
		Operation	• Turbine noise transmitted through steelwork	**Fixed Wind Floating Wind**				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. All seabirds are sensitive to hydraulic fluid and fuel oil contamination. In addition wading birds in estuaries may experience negative effects, if the spill reaches these areas. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine birds could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of Oil Spill Contingency Plans.	**Negligible**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Fixed Wind Floating wind**	**Significant Adverse**	Collision impacts could potentially be significant adverse for offshore wind farms, depending on the species involved. Typically, larger, less agile species such as divers, gannets, swans, geese terns and seaducks, have been highlighted as likely to be particularly sensitive to collision with offshore wind turbines (Langston & Pullan 2002). Collision impacts could be significant during spring and autumn if developments are located on a major migration route or flyway. Diving seabirds would be unlikely to collide with underwater cables associated with wave and tidal devices. Collision impacts for operating wave and tidal devices would be negligible.	Available mitigation includes - Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/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 e.g. resting and foraging areas; - Shut-down of turbines at night with bad weather/visibility and high migration intensity; - Avoiding large-scale continuous illumination; - Measures to make wind turbines more recognisable to birds	**Negative – negligible**
	Habitat exclusion	Operation	• Devices that occupy sea surface/water column	**Fixed Wind Floating Wind**	**Negative - negligible**	If seabirds avoid a development after construction, then the area of avoidance can be considered as lost habitat for the species involved. Seabirds may be displaced from the development area and the surrounding waters, depending on their avoidance response. There is limited information on precise foraging and resting "hotspots" for seabird species around Ireland, although waters adjacent to breeding colonies will be important for these activities during the breeding season. Although birds are mobile and can avoid development sites, the potential effects of doing so may increase competitive pressures on adjacent waters. The energetic costs of site avoidance need to be considered, as do cumulative and in-combination impacts arising from birds avoiding other neighbouring developments. Post-construction habitat loss could therefore potentially have a significant adverse effect during the breeding season and a negative significant effect on seabirds at other times of the year.	Appropriate siting of developments e.g. away from important feeding/roosting areas.	**Negligible**
	Barrier to movement	Operation	• Devices that occupy air column to a significant height above sea surface	**Fixed Wind Floating Wind**	**Significant adverse - negative**	There is some indication that wind turbines may act as barriers to bird movement, depending on the species involved. Such movements may be seasonal migrations to/from breeding or wintering grounds, or may be daily movements to/from feeding or roosting areas. Instead of flying between or over the turbines, birds may fly around the outside of the wind farm development, potentially adding considerable distance to their route, and disrupting their energy budgets. This barrier to movement could therefore potentially have a significant adverse effect for regular feeding/roosting movements of birds and a negative significant impact on seasonal migration patterns, depending on the species involved.	Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/roosting areas, nearshore areas and "migration corridors"; Studies would be needed at the project level to identify the presence of key foraging and resting areas in the development area, to aid site selection.	**Negative – negligible**
Marine Mammals	**Physical Disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negative – Significant adverse**	A small number of breeding and haul out sites for harbour and grey seals occur along the coast of Assessment Area 1, and Carlingford Lough at the north of the zone appears to be a particularly important harbour seal haul out. Cetacean species are regularly sighted in Area 1. A single SAC has been designated for grey seal conservation around Lambay Island. The presence of boat traffic and construction equipment may result in flight behaviour, particularly if they occur in shallower coastal waters near seal breeding and haul out sites. Increased boat traffic associated with construction and decommissioning will increase ambient noise in the area and may disturb marine mammals. Impacts on seabed flora and fauna could cause changes in food web structure and function and could have negative impacts on top predators in the food web such as marine mammals.	Monitoring surveys would be required to establish distribution of seals and cetaceans at sea in order to design a suitable mitigation plan. Cetaceans may be seasonally abundant in these waters, and the effects of installation activities could be reduced by avoiding certain times of year. The effects of installation activities on seal colonies could be reduced by avoiding the breeding and moulting seasons as well as avoiding development in inshore areas close to seal haul out locations. Disturbance impacts from export cable installation could be avoided by avoiding seal breeding colonies or haul out sites.	**Unknown-Negative**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Noise	Survey	• Acoustic survey	**Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for marine mammals. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to mammal species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) should be considered.	**Negligible**
		Installation Decommissioning	• Devices using piled foundation • Underwater blasting	**Fixed Wind Floating Wind**	**Significant adverse**	Piling and underwater blasting generate high levels of noise. Seals and cetaceans can detect piling noise up to a distance of 80km, and previous studies have demonstrated displacement of porpoises up to 15km during construction of wind farms. Behavioural responses could be expected at 20km, although this will depend on the level of existing background noise, which may be high in this zone. Physiological impacts such as temporary or permanent threshold shift in hearing could occur at distances of 400m for harbour seals, and 1.8km for harbour porpoise. However, evidence suggests that it is unlikely that an animal would choose to remain in close proximity to a source of loud noise that would result in temporary or permanent hearing damage. Noise can mask signals used by cetaceans to navigate, locate prey, and communicate effectively. It is also possible that noise sources may mask biologically relevant signals. The potential for noise to affect marine mammals is therefore considered to be “significant adverse”. Increased shipping associated with installation will also raise ambient noise levels in the area.	Monitoring surveys would be required to establish distribution of seals and cetacean at sea in order to design a suitable mitigation plan. Seasonal or area restrictions could also be imposed so noisy activities would be timed not to coincide with sensitive times such as seal moulting or pupping and porpoise breeding seasons. A range of measures are available to further reduce noise impacts including Marine Mammal Observers, exclusion zones, passive acoustic monitoring, pingers, soft starts/ramp up and/or bubble curtains. Consideration could also be given to using non-piled foundations, and protecting cables where they cannot be buried using rock placement or mattressing.	**Negative-Significant Adverse**
		Operation	• Turbine noise transmitted through steelwork	**Fixed Wind Floating Wind**	**Unknown - Negative**	Wind turbines can produce low frequency noise and vibrations that can pass into the water column and can potentially affect seals and cetaceans ability to navigate, locate prey and communicate. Operational noise from wind turbines may be heard by seals and porpoises up to 200m, and simulated noise from a 2MW wind turbine has resulted in avoidance behaviour by harbour seals and harbour porpoises. The cumulative effect of many devices operating together or when combined with operational noise from other marine use is also unknown.	Noise from operating turbines can be reduced by efficient design, reducing vibration, and using isolators.	**Unknown**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negligible - negative**	Marine mammals can potentially collide with vessels and equipment used during installation. Increased shipping activity during installation will increase this risk. Generally most fatal injuries arise with collisions with ships travelling over 13kts. Vessels associated with construction activities would usually not be travelling at these speeds.	Consider setting speed limits for construction vessels operating in sensitive areas. Establish a code of conduct to avoid disturbance to marine mammals both during construction activities and in transit to the construction area if entering areas of high abundance.	**Negligible**
		Operation	• Mooring chains/cables	**Floating Wind**	**Unknown - negative**	Risk of collision with wind turbines is small for seals and small cetaceans, since pylons are large and static. However collision may be a concern for larger baleen whales, which do not have the manoeuvrability of smaller cetaceans. All marine mammals may have difficulty detecting the presence of mooring/tethering cables for floating wind installations. These cables are likely to have a small cross-section and provide fewer sensory cues to approaching mammals, so the risk of collision for these types of installation will be greater. While a number of cetacean species occur in both inshore and offshore waters in this zone, abundance and habitat use is unknown, so the collision risk with offshore renewable energy installations is difficult to quantify.	Measures to make turbine foundations more visible to marine mammals could reduce the risk of collisions. Consider the use of acoustic pingers/deterrents on mooring/tethering lines.	**Unknown - negative**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants, or hydraulic fluids during installation could have an adverse effect on marine mammal health. A collision between ships or between a ship and an offshore renewable installation could result in fluid spills which could have serious environmental consequences. While the likelihood of accidental contamination from devices is low, should it occur the potential effects on marine mammals would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**

Table Appendix G1: East Coast - North (Area 1: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Habitat exclusion	Operation	• Devices that occupy sea surface/ seabed/ water column	**Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude mammals from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. The cumulative effect of many installations within an area is unknown. Displacement of fishing activity during installation and operation may result in increased resource competition between fisheries and marine mammals in non-impacted areas. Installations may however, provide increased habitat as artificial reefs and attract fish aggregations that may provide increased foraging opportunities for marine mammals.	Surveys of habitat use by marine mammals and avoid heavily used areas and migration corridors.	**Unknown**
	Barrier to movement	Operation	• Devices that occupy sea surface/ seabed/ water column	**Fixed Wind Floating Wind**	**Unknown - Significant adverse**	The presence of large arrays may cause a barrier effect for migrating marine mammals. The importance of Area 1 for marine mammal migration is unknown, making barrier effects difficult to quantify.	Detailed study would be required to examine coastal distribution in order to mitigate for this risk and avoid large installations in migratory corridors.	**Unknown - Significant adverse**
	EMF impacts	Operation	• Inter-array and export cables	**Fixed Wind Floating Wind**	**Unknown - negligible**	There is only circumstantial evidence that cetaceans have ferromagnetic organelles capable of determining small differences in relative magnetic field strength. Magnetic fields could potentially affect animals using geomagnetic cues during migration. However, cetaceans regularly cross cables, and there is no apparent evidence that existing electricity cables have influenced cetacean migration. The level of impact associated with inter-turbine arrays will be more concentrated than those for export cables and further study is required before this impact can be fully understood.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength, where possible	**Unknown - negligible**
Marine Reptiles	**Collision**	Installation Decommissioning	• Vessels and equipment used for installation and decommissioning	**Fixed Wind Floating Wind**	**Negative**	Assessment Area 1 has had comparably few turtle sightings when compared with other zones. One of the main threats to marine turtles in Irish coastal seas is entanglement in mooring ropes (for pot fisheries) and subsequent drowning. It is not known how mooring chains/cables used in operating devices impact on turtles but it's likely they offer more of a collision risk than entanglement. Turtles may be less likely to collide with large installations but much is unknown about how sea turtles, especially leatherbacks, interact with man made barriers/obstacles. There is a slight possibility that leatherback turtles could swim into operating devices as they are generally oceanic animals unaccustomed to solid structures. Loggerheads are more likely to swim around such structures. Sea turtles can potentially collide with vessels and equipment used during installation, and devices during operation. Increased shipping activity transiting to the area during installation will increase this risk.	Possible mitigation includes planning installation to take place at times when there are fewer turtles present (December-May) or avoiding known areas of high abundance. Arrays could also benefit sea turtles as such installations may provide habitats for jellyfish polyps (as has been shown for marinas) and subsequently lead to an increase in jellyfish abundance (turtle food). Site specific survey to identify areas of high turtle abundance, and avoidance of such areas.	**Negligible - unknown**
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Floating Wind**				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants and hydraulic fluids could have an effect on turtle health. Although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine reptiles would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Barrier to movement	Operation	• Devices that occupy sea surface/water column • Vessels and equipment used for installation and decommissioning • Turbines/moving parts of devices	**Floating Wind**	**Unknown**	The movement of marine turtles around the coast of Ireland is unknown so it is difficult to quantify the level of barrier effect. However arrays could be perceived as a barrier affecting turtle movements or routes to feeding areas. An array placed perpendicular to the coastline would increase the likelihood of the barrier effect. Arrays could potentially corral turtles into a corner/trap that they may not be able to get out without human intervention.	Orientating arrays parallel to the coastline rather than perpendicular to the coastline may help minimise a barrier effect as turtles swim past. No other mitigation measures identified.	**Unknown**
	Noise	Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Fixed Wind Floating Wind**	**Unknown**	Avoidance responses of sea turtles to low frequency sounds have been demonstrated, however, the study of sensory biology in sea turtles is still in its infancy, so there is a large unknown component.	No specific mitigation identified.	**Unknown**

Table Appendix G1: East Coast - North (Area 1: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Fixed Wind Floating Wind**				
	EMF impacts	Operation	• Inter-array and export cables	**Fixed Wind Floating Wind**	**Negligible - Unknown**	Sea turtles may be able to detect EMF fields such as those generated by export and interturbine cables and thereby could adversely affect turtles using geomagnetic cues during foraging and migration, although the importance of these cues remains unclear. However, as turtles are generally present at the surface and in the water column, they are unlikely to come into close proximity with the EMF field at the seabed.	EMF impacts could be reduced through ensuring that cables are buried, reducing the EMF at the seabed. Cable design and orientation to minimise generated EMF.	**Negligible - Unknown**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Fixed Wind Floating Wind**	**Neutral**	The construction of arrays in jellyfish hotspots could exclude turtles from this critical habitat. In this zone jellyfish populations are likely to be extremely widespread (over 10-100kms) and composed of several different species, but by providing new habitat for jellyfish polyps, arrays could actually increase the abundance of jellyfish in adjacent waters through a process of advection.	No specific mitigation identified.	**Neutral**
Marine and coastal archaeology and wrecks	**Direct disturbance of unknown and known sites**	Installation	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse - Negative**	Area 1 includes depositional zones where preservation of archaeological sites by burial is likely to have been favoured. It also includes areas where there is a potential for early settlement sites. There are numerous recorded wreck sites along the adjacent coastline and within Area 1. There is potential for the installation of wind devices and export cables to impact submarine archaeology through direct disturbance of known and unknown sites on the seabed, or through changes to sediment movements causing an artefact to become buried and preventing later discovery. There are a large number of National Monuments on the adjacent coastline including those in State care. Locally, regionally and nationally important archaeological remains and sites are also present along the coast. Numerous listed buildings are also present on the coastline adjacent to the area. Cable installation in the vicinity of these protected sites could cause direct destruction of archaeologically important features. All archaeological monuments and wrecks greater than 100 years old are protected under the National Monuments Acts 1930 – 2004. Wartime wrecks are not currently covered under the Acts but are likely to be included in the near future.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Avoid sites of interest and exclusion zones for marine archaeology. Submit any artefacts recovered to the National Monuments Service. For known submarine and terrestrial sites the main form of mitigation is to avoid protected and other sites of interest. In addition to desk based studies it will be necessary to carry out field walkovers in preferred terrestrial site locations to determine need for site investigations (geophysical surveys/trial trenching) in consultation with the National Monuments Service and Local Authorities. With respect to cabling there is considerable opportunity to avoid or reduce effects. The siting of export cables will be important in determining their residual impact.	**Negligible**
	Changes to sediment regime	Operation	• Devices using seabed foundations	**Fixed Wind Floating Wind**	**Significant adverse- Positive**	Area 1 includes areas where there is a potential for early settlement sites and unrecorded wrecks. Changes in sedimentation may either expose or increase the burial depth of archaeological features at such sites. Where sites are exposed there is a potential for discovery of or damage to or loss of artefacts or sites. Where features are subject to deeper burial the potential for discovery of or damage to artefacts or sites is likely to be decreased.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
	Data acquisition	Installation	• Pre-installation survey	**Fixed Wind Floating Wind**	**Unknown**	There is a potential for archaeological sites and wrecks to be discovered within Area 1 as a result of site surveys, providing additional data for inclusion in the archaeological record of the area.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
Commercial Fisheries	**Direct disturbance**	Installation Decommissioning	• Devices using seabed foundations	**Fixed Wind Floating Wind**	**Negative to Significant adverse**	Area 1 contains the most intensely fished Nephrops grounds in Ireland which overlaps with the majority of the floating wind resource area and some of the fixed wind resource area. The fixed wind resource area also overlaps with	Avoidance mitigation is likely to be possible for fixed wind due to the spatially confined distribution of inshore shellfish fisheries in Area 1. However for floating wind the potential	**Negative - negligible**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
			• Cable trenching/removal			inshore cockle (Dundalk Bay) and razor clam fisheries (Gormanstown, Co Meath). Although direct disturbance may have an impact on all fishery types it is likely to be more significant in the case of shellfish than finfish as shellfish are generally much less mobile. Shellfish fisheries which may be impacted in Area 1 include Nephrops, cockle, razor clams and whelk. Inshore finfish grounds are however also sensitive to direct disturbance as these are generally exploited by small vessels which are less able to exploit alternative grounds. Area 1 also contains extensive spawning grounds for Cod, Haddock, Plaice and Whiting and associated seasonal fisheries which may be subject to direct disturbance. The fisheries for whitefish are focussed in the southern half of Area 1.	for avoiding key commercial fishing grounds may be limited due to the widespread nature of offshore fishing activity in the zone. Early liaison with the fishing industry could help identify key fishing areas, particularly in the area where there is a lack of fishing effort distribution information for vessels under 15m. The effects could also be minimised by using procedures and structures that minimise the area of seabed disturbed for turbine foundations.	
	Temporary displacement from traditional fishing grounds	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negative**	Inshore fishing grounds tend to be more constrained than offshore areas. Temporary displacement from these areas may lead to the concentration of fishermen in smaller areas, fishermen being unable to fish for short periods or fishermen being displaced to alternative, possibly less productive fishing grounds. Temporary displacement will potentially have a negative effect on commercial fisheries.	Effects can be reduced by avoiding key commercial fishing grounds or by phasing construction activities to specific areas within Area 1. However the potential for avoiding key commercial fishing grounds may be limited due to the widespread nature of fishing activity in the zone. Liaison with the fishing community to keep them informed of installation operations is also key to managing the level of this impact.	**Negative - negligible**
	Long term displacement from traditional fishing grounds	Operation	• Devices that occupy sea surface/water column/seabed	**Fixed Wind Floating Wind**	**Significant adverse**	All types of commercial fisheries could be affected by long term displacement from traditional fishing grounds. The potential effects could be of adverse significance for spatially constrained inshore fisheries and for bottom trawl and pot fisheries which may be restricted by installations and cable routes. Conversely, long term exclusion of mobile gear from an area could be of benefit to fish stocks in the wider area although spillover effects, particularly for mobile fish species are poorly understood. Key bottom trawl fisheries in Area 1 are for: Nephrops, Whiting, Haddock, Black Sole and Plaice. Whelk are exploited by pots while razor clams and cockles are exploited by mechanical dredging gear. The effects of long term displacement on trawl fisheries in particular will depend on the scale of the arrays and the extent to which fishing vessels are excluded from the area. Use of rock armour, if required for cable protection, will introduce an obstruction for trawling activity, but could also create new habitat which could have a positive impact of fish stocks.	The potential for avoiding key commercial fishing grounds may be limited due to the widespread nature of fishing activity in the zone. Early liaison with the fishing industry could help identify key fishing areas, particularly in the area where there is a lack of fishing effort distribution information for vessels under 15m. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts on commercial fisheries.	**Negative**
Aquaculture	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negligible**	Shellfish aquaculture production in Area 1 is concentrated almost exclusively in Carlingford Lough and consists mainly of Pacific oysters, mussels and clams. Production of these species could be adversely affected by any significant and prolonged rise in suspended solids. However, increases in suspended sediment is expected to be short term and localised to the immediate vicinity of the seabed disturbing works. Intrusion of sediment plumes into aquaculture areas would therefore only result if the export cables were routed in the immediate vicinity. There could therefore be a negligible impact from offshore energy development.	Impacts from cable trenching could be reduced by using procedures that minimise the mobilisation of suspended solids, such as plough installation.	**Negligible**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	Shellfish are highly sensitive to reductions in water quality caused by hydraulic fluids or tainting from other chemical substances. There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. It should be noted that the quantity of hydraulic fluid in devices is likely to be very small, reducing the potential for significant environmental effects. Therefore, although the likelihood of accidental contamination from devices is low, the potential effects of any significant intrusion of hydraulic fluids into aquaculture production areas could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, and contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse**	Shellfish production in Assessment Area 1 could be adversely affected should installations be sited in or cables routed through shellfish cultivation areas.	The key mitigation measure in terms of reducing effects on shellfish farms is avoidance. In practice, consent is unlikely to be achievable to site renewable energy arrays or cables within existing fish farms.	**Negligible**

Table Appendix G1: East Coast - North (Area 1: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Ports, Shipping and Navigation	Displacement of shipping	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	Fixed Wind Floating Wind	Significant adverse	Shipping intensity in Area 1 is high, with a significant number of vessels transiting the Zone in a North/South direction from the north channel to ports further south and in an east/west direction from the Port of Dublin to the UK and mainland Europe. Shipping intensity is increased in the approaches to busy ports, of which there are a number in Area 1. Patterns in shipping intensity imply that ships use distinct routes. There is Traffic Separation Scheme (TSS) in Dublin Bay. Siting devices in close proximity to this navigational feature could have a significant adverse impact. The re-routing of vessels to avoid safety zones (during installation), operational devices and decommissioning activity would result in greater transit time and use of fuel, with the associated costs to the vessel operator, and could lead to displacement of vessels to areas that already have moderate vessel densities, potentially having knock-on impacts on collision risk, trade/supply and visibility. The effect of displacement of shipping would potentially have a significant adverse impact.	The potential for these effects to be reduced would depend entirely upon the ability to site devices in relation to key routes for shipping. Potentially significant adverse effects could be reduced or avoided by siting devices away from areas of high vessel densities. Although much of Area 1 is utilised for shipping there are some areas where shipping activity is less intense. There is potential to site both fixed wind turbines, in the 10-60m depth region, and floating structures, deeper than 60m in these areas of lower shipping intensity. The scale of potential effect on vessel traffic will need to be investigated further as part of project specific EIAs.	Negative – Negligible
		Operation	• Devices that occupy sea surface/water column	Fixed Wind Floating Wind	Significant adverse			Negative - Negligible
	Decreased trade/supply	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	Fixed Wind Floating Wind	Significant adverse	There are four main commercial ports (Dublin, Drogheda, Dun Laoghaire, Greenore) and a number of fishing ports (Balbriggan, Clogherhead, Dun Laoghaire, Howth and Skerries) within Area 1. The presence of installation/maintenance vessels, presence of devices and Decommissioning activity could create temporary to long-term reductions in access to ports and harbours. Reduced access to these harbours could have a significant adverse effect on goods transport and accessibility.	Site selection for device arrays should take into account the requirement for continued access to port and harbours. A potentially significant adverse effect would be avoided by siting devices away from the entrances/approaches to ports and harbours. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance and decommissioning.	Negligible
		Operation	• Devices that occupy sea surface/water column	Fixed Wind Floating Wind	Significant adverse			Negligible
	Reduced visibility	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	Fixed Wind Floating Wind	Significant adverse	Vessels and other equipment used during the installation/maintenance/ decommissioning of devices, and the operational devices themselves could obstruct views of other vessels and navigation features such as buoys, lights and the coastline. This is particularly important in areas of high vessel densities, constrained channels or areas where there is particular dependence on visual navigation aids as reduced visibility increases the risk of collision with other ships and other structures in the water (natural and manmade). The effect of reduced visibility will potentially be significant adverse in Area 1 due to the high vessel densities and the adjacent entrances to ports and harbours.	Significant adverse effects associated with reduced visibly can be reduced by avoiding areas of high vessel densities and areas constrained by land e.g. adjacent to the entrances of ports and Loughs. In busy shipping areas, potential effects may be reduced by minimising the period of installation, the number of vessels required and the area occupied during installation would reduce the potential impact on visibility. Any vessels and devices should be lit and marked in accordance with the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) guidelines, in agreement with the Commissioners of Irish Lights.	Negligible
		Operation	• Devices that occupy sea surface	Fixed Wind Floating Wind	Significant adverse			Negligible
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	Fixed Wind Floating Wind	Significant adverse	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. Area 1 is not constrained by land or bathymetry to any great extent but it is constrained by entrances to major ports, shipping routes and high vessel densities and so the risk of collision will potentially be significant adverse. The significance of the impact will also increase dependent on the number of arrays which could potentially be present on either side of the channel, restricting potential for vessels using the main shipping lanes to re-route in emergencies.	The risk of collision could be reduced by avoiding areas of high shipping densities and regularly used shipping routes. In busy shipping areas, potential effects may be reduced by minimising the period of installation, the number of vessels required and the area occupied during installation. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance, and decommissioning.	Negative - Negligible
		Operation	• Devices that occupy sea surface/water column	Fixed Wind Floating Wind	Significant adverse			Negative - Negligible

Table Appendix G1: East Coast - North (Area 1: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Recreation and Tourism	**Access Restrictions**	Installation Operation Decommissioning	• Structures in the sea reducing or excluding access	**Fixed Wind Floating Wind**	**Negative**	The key receptor affected is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs. Offshore wind farm developments in this zone, if located on routes used by recreational yachting could cause vessels to re-route, or restrict access to key areas.	A very extensive area is available to site floating wind technology away from cruising routes. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of cruising routes. However in the case of Assessment Zone1 there is still the potential to locate piled wind arrays, and their export cables away from cruising routes.	**Negligible**
	Noise	Installation Decommissioning	• On and offshore machinery and vessels	**Fixed Wind Floating Wind**	**Negative**	There are numerous Blue Flag beaches along the coastline in Assessment Area 1, and at least one area used for wildlife watching at Howth Head. Noise from machinery and vessels has the potential to impact on the use of beaches that are close to the source of the noise and could disturb wildlife in the area. However any noise from installation or decommissioning will be limited to the duration of construction activities. Piling is a particularly noisy activity, and greater significance impacts will be associated with this activity. Noise from operation will be longer term; however noise levels during operation will to be significantly lower than during installation or decommissioning. Impacts associated with piled wind will be located closer inshore and are likely to be of greater significance compared to floating wind developments located further offshore.	Mitigation measures aimed at reducing or avoiding disturbance to recreation could include timing particularly noisy activities such as piling to avoid key recreational periods.	**Negative**
		Operation	• Turbines/flexing joints/device components above sea surface		**Negligible – Negative**			**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negative**	The key receptor is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs. The location of offshore wind developments close to yachting areas could potentially increase collision risk, especially if located in areas where ability to manoeuvre is restricted by other factors such as water depth. There is also collision risk associated with the installation vessels.	A very extensive area is available to site floating wind technology away from cruising routes. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of cruising routes. However in the case of Assessment Zone1 there is still the potential to locate piled wind arrays, and their export cables away from cruising routes. Safety measures including lighting and marking and informing users of the locations of devices will help to negate any potential impact.	**Negligible**
		Operation	• Devices that occupy sea surface/water column		**Negative**			**Negligible**
	Disturbance to Wildlife	Installation Operation Decommissioning	• Installation/decommissioning activity • Devices that occupy seabed/ sea surface/water column	**Fixed Wind Floating Wind**	**Negligible**	Effects on local tourism would occur where disturbance and/or exclusion from an area overlaps with the locations frequented by visitors and touring vessels. The east coast of Ireland is not considered to be of particular importance for recreational wildlife watching in comparison to the west coast of Ireland where there are many more areas used for wildlife watching.	A very extensive area is available to site floating wind technology away from tourism and recreational areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of tourism and recreational areas. However in the case of Assessment Zone1 there is still the potential to locate piled wind arrays, and their export cables away from tourism and recreational areas. Other mitigation measures aimed at reducing or avoiding disturbance to wildlife including sea mammals and birds is set out in the relevant parts of this table.	**Negligible**
Aviation	**Collision**	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Negative**	There are three aerodromes in the vicinity of Assessment Area 1 (two civil and one military). Assessment Area 1 is also covered by the Dublin Search and Rescue region. The main collision risk is with the Search and Rescue activities that are ongoing in this area.	Available mitigation includes ensuring wind devices are lit with aviation lights in accordance with OAM 09/02 “Offshore Wind Farms Conspicuity Requirements”. As required under the Obstacles to Aircraft in Flight Order, S.I. 215 of 2005, notification of the erection of wind devices provided to the IAA.	**Negligible**
	Radar Interference	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Unknown - negative**	There are currently no “potential to interfere” areas set out for Irish waters and therefore it is difficult to accurately state how much of Assessment Area 1 would fall within these areas. There is likely to be a negative impact on aviation either from intermittent detections of turbines by air traffic controllers or from “shadowing” where radar signals become weaker behind turbines.	Consultation with the IAA will be required and the location of wind devices supplied so they can be accurately plotted on the radar and any signals received from that area will not be confused with aeroplanes.	**Negligible**

Table Appendix G1: East Coast - North (Area 1: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Military Activity	**Disruption to general activities**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Significant adverse**	Assessment Area 1 overlaps with the Gormanstown Department of Defence danger area, located in north east of the Zone the danger is approximately 270km^2. There are no other danger areas in Area 1 but military use may include fishery protection and search and rescue operations. The development of offshore renewables in Department of Defence danger areas is not permitted (Department of Communications, Marine and Natural Resources, 2000) and therefore the impact must be considered as significant adverse.	Development within Department of Defence danger areas is prohibited and so avoidance is a required mitigation measure. This is possible as wind resource is present throughout Area 1. Consultation with the Department of Defence will be undertaken as part of project specific EIA.	**Negligible**
		Operation	• Devices that occupy sea surface/water column					
Cables and Pipelines	**Direct damage**	Installation Operation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse**	There are numerous telecommunications cables within Assessment Area 1.The proposed East West Interconnector cable will pass through the Zone, landing at Rush Beach. Two gas pipelines link the gas networks of Ireland and the UK. Direct damage to an existing cables or pipeline could occur during installation of device arrays and cables but also could occur during maintenance and decommissioning. The impact is considered to be significant adverse (should it occur) as serious effects regarding transfer of electricity or gas could arise or international telecommunications could be seriously disrupted.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**No effect**
	Access restrictions	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Significant adverse**	There is potential that the presence of devices in waters close to existing cables could restrict access to the cables for maintenance purposes. Due to the potential implications for electricity supplies and telecommunications, the potential significance of this effect, if it occurred, could be significant adverse.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Dredging and Disposal areas	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negative**	There are nine dredge disposal sites within Assessment Area 1. Construction operations and the presence of wind devices have the potential to restrict normal access to these sites. There are no existing aggregate dredging areas within Assessment Area 1 however; two areas have been identified as areas that could potentially be exploited for aggregate extraction. There is potentially a negative impact from wind device installation restricting access to potential future dredging grounds.	A very extensive area is available to site floating wind technology away from existing dredging and disposal areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of existing dredging and disposal areas. However in the case of Assessment Zone1 there is still the potential to locate piled wind arrays, and their export cables away from existing dredging and disposal areas.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Existing Renewable Infrastructure	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Significant adverse**	There is no existing offshore renewable infrastructure in Area 1. There are two wind farm application areas within Area 1, Oriel Windfarm, to the north, and Dublin Array, at the southern border of the Zone (this area overlaps Assessment Zones 1 and 2). Both wind farms are in the process of applying for a foreshore lease. Development of offshore renewable devices has the potential to cause maintenance access restrictions to existing or proposed wind farms during	Site selection will need to factor in the access needs of existing infrastructure to ensure that the proposed site does not conflict with their activities. Access restriction impacts during construction and decommissioning can be managed through good planning and communication with existing wind farm operators.	**No effect**

Table Appendix G1: East Coast - North (Area 1: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables			construction, operation and decommissioning.		
	Removal of energy resource	Operation	• Devices using energy generated by wind	**Fixed Wind Floating Wind**	**Unknown**	During operation removal of wind energy could potentially be an issue, depending on the relative locations of existing and new sites.	Careful site selection taking into account resource assessment and modelling to determine if and how commercial scale arrays could coexist with the existing renewable infrastructure.	**Negligible - Unknown**
Natural Gas and CO_2 Storage	**Sterilisation of region**	Operation	• Devices using seabed foundations	**Fixed Wind Floating Wind**	**Unknown**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for CO_2 or natural gas storage. There is currently insufficient data to establish potential for use of the marine environment for storage of CO_2. Therefore, whilst no sites are currently under consideration for natural gas or CO_2 storage in this zone, the significance of this possible future impact is unknown.	None identified	**Unknown**
Oil and Gas Activity	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Unknown - negative**	There are currently no areas of active oil and gas development in Assessment Area 1. However a 'Licensing Option' area exists in the south of the zone which contains three exploration wells which were drilled and then abandoned. There are also two gas interconnector pipelines which run through Area 1. Siting of renewable devices in Area 1 may limit access to the 'Licensing Option' area. However the impacts on possible future oil and gas developments are impossible to quantify at this stage. Impacts on pipelines are discussed in the relevant section of this table.	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices. There is the potential to locate devices away from the areas of oil and gas activity.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Unknown - Negative**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. There are currently no areas of active oil and gas development in Assessment Area 1. However a 'Licensing Option' area exists in the north of the zone which contains three exploration wells which were drilled and then abandoned. There are also two gas interconnector pipelines which run through Area 1. Siting of renewable devices in Area 1 has the potential for conflicts with vessels involved in developing the 'Licensing Option' area with regard to collision risk. However the impacts on possible future oil and gas developments are impossible to quantify at this stage. Impacts on pipelines are discussed in the relevant section of this table.	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices and there is the potential to locate devices away from existing and proposed oil and gas activity.	**Unknown - negligible**
		Operation	• Devices that occupy sea surface/water column					**Unknown - negligible**
	Sterilisation of region	Operation	• Devices using seabed foundations	**Fixed Wind Floating Wind**	**Unknown - negative**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for oil and gas exploitation. There is currently insufficient data to establish possible future exploitation of oil and gas from this zone. As it is possible that future oil and gas activities may take place in this zone is it not feasible to rule out any potential impacts from offshore renewable devices. However the impacts on possible future oil and gas developments are impossible to quantify at this stage	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices and as There is the potential to locate devices away from oil and gas activity.	**Unknown**

Table Appendix G1: East Coast - North (Area 1: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Effects on seascape type 3 Low Plateau Landscape	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Moderate Effect (between 0 and 15km offshore from the coast) Slight Moderate Effect to Slight Neutral Effect(between 15km and 24km from the coast) Slight Neutral Effect (between 24km and 35km from the coast)	Offshore Wind Zone 1 extends along the east coast of Ireland from Greystones (Wicklow) in the south to Carlingford Lough (Louth) in the north. Consideration has been also been given to the effects on transboundary areas of KilKeel, Dundrum Bay and Ards Peninsula in County Down Northern Ireland. The seascape types associated with this stretch of the coastline include: 3. Low plateau landscape- slightly elevated sea views from flat or low rolling open rural plateau landscape with low cliffs and narrow curving sandy bays with rocky headlands. Open and expansive slightly elevated sea views from the coastal edge with low intervisibility from the hinterland. 4. Low lying coastal plain –large to medium scale, very flat and exposed rural, coastal plains and lowlands with expansive views out to sea; includes estuaries, sandy beaches and curved bays. 7. Plateau and High Cliffs - visually dramatic seascape with great vertical scale where cliffs plunge abruptly to an narrow coastal edge with open expansive and elevated views to sea and a sense of wildness. 8. Large bay – Large long sweeping bays often with sand dunes, expansive sands and tidal flats and rocky headlands. Very long open views framed by landmass, both across the bay and out to the wide horizon of the open sea. T1. Large scale sea loughs with associated low-lying coastal plain and raised hinterland and headlands. Large scale open views along windswept low lying shorelines are contained by landmass. Long smaller scale contained views to the open sea are framed by headlands T.2 Low lying coastal plain – rural, diverse and changeable, large to medium scale, very flat and exposed coastal plains and lowlands with expansive views out to sea. Estuaries, sandy beaches and curved bays. There are no national level landscape designations in this area. Parts of this coastline are also covered by a number of county level landscape designations including: • Areas of Outstanding Natural Beauty, - AONB- (Wicklow) • Special Amenity Zones –(Wicklow) • Protected Views and Prospects (Dun Loachaire) • Areas Of High Landscape Amenity (Fingal) • Sensitive and Exceptional Landscape Value areas (Meath) • Landscape Value and Sensitivity (Louth) National level designations in transboundary areas of Northern Ireland • Lecale Coast AONB • Mourne AONB. The majority of coastline of Assessment Zone 1 is low lying plateau or flat land dominated by a long linear coastal edge, mainly rural with areas of dense urban development including Dublin, Drogheda (Meath) and Dundalk (Louth). Sections of the coast are divided from the hinterland by railway infrastructure. Though much of the coastline is made up of seascapes type 3 Low Plateau and 4 Low lying coastal plain which are the least sensitive seascapes to this type of development the potential effects in certain locations within 0 to 15km from the coast, could range from moderate adverse to slight depending on where wind farms are sited. For example in certain locations in the north of Assessment Zone 1 effects on long views from Mourne AONB (Northern Ireland) may increase local seascape sensitivity. Conversely the higher sensitivity of landscape types arround Dublin Bay 7 Cliffs and 8 Large Bays may be reduced in some locations by the presence of existing development and infrastructure. At distances greater than 35 km effects are likely to be slight neutral to neutral in all locations. Atmospheric conditions may reduce visibility thresholds.	Potential adverse effects on seascape can be reduced through the sensitive siting of offshore wind farms. Key factors to be considered in locating an offshore wind farm include: • Wind farms should not be sited where they appear to block or close the entrance to bays/loughs/narrows/sounds or where they separate a bay from the open sea; • Wind farms should reflect the shape of the coastline and align with the dominant coastal edge; • Wind farms should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate; • Wind farms should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Wind farms should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms; • Consideration should be given to locating devices in already industrialised and developed seascapes;	**Slight to Substantial** **(See Figure 12.15 for more detail)**
	Effects on seascape type 4. Low Lying Coastal Plain	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Moderate Effect (between 0 and 15km offshore from the coast) Slight Moderate Effect to Slight Neutral Effect(between 15km and 24km from the coast) Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on seascape type 7. Plateau and High Cliffs	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast) Substantial Effect to Moderate Effect (between 15km and 24km from the coast) Moderate Effect to Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on seascape types 8. Large Bay	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect to Moderate Effect (between 0 and 15km offshore from the coast) Moderate Effect to Slight Effect (between 15km and 24km from the coast) Slight Effect to Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on transboundary seascape type T1. Large Open or Partially Open Sea Lough	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast)			

Table Appendix G1: East Coast - North (Area 1: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
					Substantial Effect to Moderate Effect (between 15km and 24km from the coast)			
					Moderate Effect to Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on transboundary seascape type T2. Low Lying Coastal Plain	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Moderate Effect (between 0 and 15km offshore from the coast)			
					Slight Moderate Effect to Slight Neutral Effect(between 15km and 24km from the coast)			
					Slight Neutral Effect (between 24km and 35km from the coast)			
Climate	Carbon Impacts	Operation	Wind turbines	**Wind**	**Positive**	It is recognised that development of offshore wind farms will contribute towards achieving the Ireland's target for 40% energy to be provided from renewable energy sources. In meeting this target Ireland will be working towards the wider European and international commitment to combat global climate change and reduce the potential associated adverse environmental effects e.g. changing population distributions, species extinction, sea level rise etc. However, whilst seeking to combat climate change there is also a need to respond to it in terms of: • Protecting the existing environment and increasing its robustness and ability to adapt to climate change • Protecting existing and future infrastructure from effects of climate change e.g. increased storm events , flooding and sea level rise	Ensure that coastal infrastructure is sited in locations that are at lower risk from flooding, sea level rise and storm damage and do not increase the risk of flooding or damage to coastal infrastructure elsewhere. This will require close consultation at the project design stage with the relevant land use planning authority.	**Positive**
	Carbon Storage	Installation Operation	Wind turbines	**Wind**	**No effect**	Based on current available information no existing or proposed carbon or gas storage sites have been identified within this area (Assessment Area 1) therefore there will be no effect resulting from the development of offshore wind farms.	None required	**No effect**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Bathymetry	**The information presented in this chapter has been used to inform the results of the assessment. No specific impacts on bathymetry are expected.**							
Geology, geomorphology and sediment processes	**Changes in hydrodynamic/ coastal processes and seabed morphology**	Installation Decommissioning	• Cable trenching/removal • Foundations Installation/ removal	**Tidal Fixed Wind Floating Wind**	**Negligible**	Seabed sediments in the zone sand and sandy gravel. There is a lack of detailed information on seabed sediment and sediment transport processes in the assessment zone. Cable burial and tidal/ wind turbine foundation installation/ removal would have a localised effect on the seabed morphology. Such effects would be temporary in the prevailing relatively high tidal current regime.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm is located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Negligible**
	Changes in hydrodynamic/ coastal processes and seabed morphology	Operation	• Devices using seabed foundations • Devices which extract tidal energy	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	Seabed sediments in the zone generally comprise sand and sandy gravel. Relatively high tidal stream velocities and low to moderate fetch limited wave energy conditions prevail. The physical presence of monopile or tripod foundations and transition pieces on and above the seabed and tidal turbines on the seabed will cause hydrodynamic changes. The removal of tidal current energy will also affect the hydrodynamic regime. Research suggests that such hydrodynamic changes will extend up to 50 m from devices and is therefore localised to the vicinity of the device array. Nearfield changes in scour, sedimentation, sediment suspension, seabed composition and seabed morphology may arise due to these hydrodynamic changes. Farfield changes may occur, particularly in relation to large arrays of wind or tidal turbines, where alteration to the local hydrodynamics interrupts sediment transport processes e.g. longshore drift, possibly having an overall impact to stabilise sediments in the area of the wind farm or tidal device array, while increasing erosion in other areas along coast. The impact of piled wind devices is relevant to installation of piled devices, which would be in the nearshore area, out to 60 m water depth.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm or tidal turbines are located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Negligible - Unknown**
Seabed Contamination and Water Quality	**Accidental Contamination (hydraulic fluids or vessel cargo/fuel)**	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. This will degrade water quality with potential for adverse effects on the receiving environment. Any accidental spillage of slick forming chemicals could be carried into inshore waters, where the effects on water quality will be greater than those in open waters. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects in this area would be of adverse significance. Sensitive receptors in this area include Ramsar sites, coastal SACs, licensed aquaculture sites and bathing beaches. There is a risk of transboundary contamination following spillages in the Irish Sea	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan)	**Negligible**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Disturbance of contaminated sediment	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Negligible - Significant adverse**	There are four dredging disposal sites, one mixed fish waste and dredging disposal site and one fish waste disposal site within Area 2. These potential areas of contamination could therefore be disturbed by seabed activities. Any contaminated material released is likely to be widely dispersed and diluted and the effect on open sea water quality is likely to be of negligible significance. Munitions migrated relict from wartime activities may be encountered. Disturbance could result in significant adverse effects.	Available mitigation includes avoidance of potentially contaminated seabed areas. Identification and avoidance of areas of munitions contamination through site survey at the project stage. If munitions are encountered advice such as that given in Department of the Marine and Natural Resources 2001 (Marine Notice No. 16 of 2001. (i.Explosives picked up at sea in trawls or sighted; and ii. The removal of explosive items from wrecks)) should be followed.	**Negligible**
Protected Sites	**Degradation of protected sites**	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Negative – significant adverse**	There are Ramsar, SAC, SPA, NHA and pNHA protected sites within Assessment Area 2. These sites are all adjacent to the coast, although in some cases (e.g. Carnsore Point SAC, Wicklow Reef SAC and Long Bank SAC), extend up to a maximum of 9 km offshore. Significant adverse impacts on protected sites could occur as a result of turbine or export cable installation, through physical disturbance and loss of substratum, or direct disturbance impacts on the species supported in the protected area. Significant adverse impacts could be expected if direct disturbance is cause to Natura 2000 species or habitats that do not recover well, such as saltmarshes or biogenic reef.	Impacts on protected areas could be mitigated by careful site selection avoiding sensitive sites for devices and export cables (i.e. existing and proposed national and European protected sites). Whether avoidance is an appropriate mitigation should be assessed on a site specific basis. A very extensive area is available to site floating wind technology away from protected sites. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of protected sites. However in the case of Assessment Area 2, there is still the potential to locate piled wind arrays, and their export cables away from protected sites. Impacts may still arise through indirect impacts on sediment movements during installation and operation, and would need to be assessed in more detail at the project stage. Possible mitigation measures relevant to the specific interest features of the sites and their seasonal and other sensitivities are described elsewhere in this table for the relevant topic areas.	**Negligible – significant adverse**
	Impacts on protected species	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	Impacts on protected benthic ecology, mammals, birds, fish and reptiles in the zone are covered under the specific species sections of this table.			

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Benthic ecology	**Physical disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	Assessment Area 2 is located across an area of current swept coarse sediment. This habitat is widespread along the east coast and includes important areas of reef habitat including Wicklow Reef SAC which is designated for the presence of *Sabellaria* sp 'reef' habitat. Disturbance to benthic habitat from installation activities would include minor disturbances through bed preparation prior to device foundation installation, disturbances from piling or alternatively from excavation of bed material for gravity foundations, disturbances to sediment from the feet of jack up platforms and disturbances to sediment from cable burial. Localised scouring around the base of turbines may cause a loss of benthic habitat or smother the existing habitat due to deepening of seabed. The degree of scour will be dependent upon the final choice of foundation design. Trenching inter turbine and export cables would cause the greatest levels of physical disturbance with complete displacement of localised benthic communities and temporary smothering of adjacent areas. Impacts would include damage and possible mortality, particularly to smaller, thinner shelled bivalves. Mobile species such as amphipods, gastropods and small crustacea are likely to survive displacement however larger crabs and sea urchins may be crushed from disturbed boulders and cobbles. Permanently attached, sessile species such as bryozoans, sponges and hydroids on areas of coarser substratum cannot reattach to the substratum if removed, and may be damaged or destroyed if substratum is displaced. Physical disturbance will be localised and recoverability of benthic species is expected to be high due to repair and regrowth of damaged individuals and/or recruitment within the community from surviving colonies and individuals. Greater significance can be attached to impacts associated with physical disturbance to species considered to have high sensitivity and / or low recoverability, especially threatened and/or declining species or habitats. Within assessment Area 2 this includes the distribution of key habitats such as saltmarsh and intertidal mudflats (e.g. in Ballyteige Burrow, Bannow Bay,), biogenic and rocky reef habitat (*Sabellaria* habitat, Wicklow Reef SAC, intertidal and subtidal geogenic reef habitat at Carnsore Point with important seasquirt and sponge communities), sea-pen and burrowing megafauna communities (Lambay Head) and sandbank meiofauna habitat at Longbank.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) especially in areas with known sensitive subtidal benthic habitats e.g. Wicklow Reef SAC. Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative – negligible**
	Smothering	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Negative**	Smothering of benthic communities by sediment displaced by activities such as cable trenching may cause a very local decline in biotope species richness due to the loss of more sensitive species due to clogging of their filtration apparatus and potential short term anoxia under the sediment layer. Disturbed sediments should be dispersed rapidly especially in areas with higher tidal flow associated with the location of tidal devices, with only localised impacts associated with displaced sediment. Many of the benthic species associated with this habitat will be adapted to living in a perturbed environment. Smothering impacts will be localised to the immediate vicinity of the seabed disturbing activities during installation.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection). Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**
	Contamination – from sediment disturbance	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Negligible**	There is a potential for contaminated sediment such as from spoil dumping sites to be remobilised during seabed disturbing installation works and cable burial. It is likely that any habitats with the potential to be adversely affected by contamination from these sites have already been subject to disturbance during the original dredging and deposition of material. Fine contaminated material will be diluted and dispersed, settling over a wide area with negligible effect on the Benthic ecology. Coarse material will be rapidly redeposited within the immediate area of installation operations.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) . Avoidance of areas of known potential contamination for seabed disturbing works. Potential effects on areas of unknown benthic habitat will need to be assessed through site survey at the project stage.	**Negligible**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. The water depth is such that small spillages (< 1 tonne) are unlikely to affect the benthos. Similarly small spillages from wind 1 are unlikely to come ashore. Large spillages have the potential to have a significant adverse effect, particularly on the intertidal ecology of the adjacent shoreline coastline e.g. Bannow Bay SAC and Slaney River Valley SAC. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on Benthic ecology would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan). Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**
	Changes in tidal flow	Operation	• Devices using energy generated by tidal current	**Tidal**	**Significant adverse**	Installation of tidal turbine units may affect the wave regime and the tidal current regime. Changes to sedimentation and the hydrodynamic regime may give rise to an alteration in the composition of benthic habitats. 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, particularly to filter feeding organisms. Tidal rapid and reef habitats are all highly sensitive to changes in tidal flow, and may be present throughout the area, i.e. not restricted to Wicklow Reef SAC and Carnsore Point. Given the potential for these priority habitats to be present in tidal resource areas, the effects could potentially be of adverse significance	Avoidance of these important habitats though careful site selection would reduce the potential effects of energy extraction. Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative**
	Substrate change	Installation Operation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	All benthic communities can be expected to be sensitive to removal of their habitat. The long term loss of substratum due to the presence of devices that are attached to the seabed will therefore have a potentially significant adverse effect on any rare or important benthic habitats, such as those protected under the Habitats Directive. There is potential for colonisation of structures leading to increased biodiversity. Although this has potential to be a positive impact, species colonising underwater structures may also lead to undesirable changes in community structure.	Effects on benthic ecology from substratum loss can be reduced through avoidance (careful site selection). Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible - Significant adverse**
Fish and Shellfish	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Negative**	Smothering effects are more relevant to less mobile (shellfish) than mobile (finfish) species. Area 2 contains shellfish populations of edible crab, scallops, oysters, periwinkles and whelks. The greatest densities of Whelk are found in shallow water (<20m) and in strong tidal currents. Periwinkles are mainly found at the extreme southern end of Area 2 around Hook Head and Rosslare Harbour in the intertidal area. Of these shellfish species which live on, near or in the bottom sediments of the seabed the most sensitive to smothering are oysters and periwinkles. The impact of smothering will be localised to the immediate vicinity of seabed disturbing activities and limited to during installation.	For devices that require piling, and cable trenching, potential effects could be minimised by using techniques which cause minimal seabed disturbance, and avoiding sensitive seasons for certain species. Avoidance of all shellfish areas may be difficult as there is a significant overlap between Whelk distribution and fixed wind and tidal resource areas in the western, inshore shallow waters of the zone. The deeper water in the west of the zone, suitable for fixed wind devices overlap with the main area of scallop distribution.	**Negligible - Negative**
	Noise	Survey	• Acoustic survey	**Tidal Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for fish, in particular fish with swim bladders are particularly sensitive to noise disturbance. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to fish species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) would also minimise any impacts on fish species.	**Negligible**
		Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Tidal Fixed Wind Floating Wind**	**Unknown**	High levels of noise such as during pile installation may cause physiological or displacement effects to marine fish although the extent to which this may occur is unknown. In particular, herring and cod are known to be highly sensitive to noise and may be able to detect piling noise up to 80km. Both species are present in Area 2. It is expected that noise levels from piling and the removal of piled devices will be greater than those generated by operational devices, and although pile driving only occurs during installation the effects may last for longer than the piling activities as fish may not immediately return to the area.	The potential effects of noise from piling or blasting could be reduced through undertaking studies to determine site specific noise effects, and/or avoiding piling or blasting activities during sensitive spawning periods. Where possible less noisy alternatives can be considered such as using clump weights or gravity bases, or protecting cables where they cannot be buried with mattressing or rock placement.	**Unknown**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal Fixed Wind Floating Wind**	**Unknown**	There is potential for noise from operational devices to lead to long term species displacement which could increase pressures on fish populations in other locations and force fish into predator habitats.	No specific mitigation measures have been identified	**Unknown**
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal Floating wind**	**Unknown**	There is potential risk that all mobile fish species could collide with turbines, moving parts of submerged devices, or mooring chains/cables. Larger animals, such as basking sharks, and pelagic species are considered to be of greater risk. Basking shark are occasionally present in Area 2 but other pelagic species such as herring and Mackerel are widely distributed in the zone. However, due to uncertainties with data and knowledge on the interactions between fish and devices, the potential significance of collision risk effects is unknown.	Potential effects associated with collision risk and fish could be reduced through device design e.g. use of protective nets or grids. Devices could also be sited to avoid sensitive areas e.g. migration routes, spawning and nursery grounds.	**Unknown**
	Hydraulic injury	Operation	• Shrouded devices (i.e. venturi devices)	**Tidal**	**Unknown**	There is potential risk that mobile fish could suffer injury or mortality through pressure changes occurring within the turbine as water is sucked through it. This effect is only relevant for shrouded tidal devices such as venturi devices, which use shrouding to constrict the flow, thus leading to a pressure low after the constriction. This effect is likely to be more significant for smaller species. Larger species sucked through the turbine would be more likely to suffer collision impacts.	Possible impacts associated with shrouded turbines can be addressed by using screens to prevent marine organisms from entering the device. Devices could also be sited to avoid sensitive areas e.g. migration routes, spawning and nursery grounds.	**No impact**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. Small spillages are likely to have a negligible impact. Large spillages, particularly where they impinge on the coastline or enter sheltered bays and loughs could have a significant adverse impact.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Tidal Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude fish from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. It is not possible to determine the potential significance of this effect. The presence of offshore wind and tidal arrays may also have a positive effect on fish populations through fish stock recovery, should certain types of fisheries be excluded from the array.	No specific mitigation identified	**Unknown**
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	Substrate loss could have a significant adverse effect on shellfish (crab, whelk, scallop). For more sedentary shellfish species it could have an effect through all life history stages. There is significant overlap in Area 2 between Whelk spawning and wind and tidal resource areas. There is a significant overlap between Whelk distribution and fixed wind and tidal resource areas in the western, inshore shallow waters of the zone. The deeper water in the west of the zone, suitable for fixed wind devices overlap with the main area of scallop distribution.	The potential effects of substratum loss on shellfish could be reduced by avoiding key shellfish grounds. Better information on fish and shellfish distribution is required in order to confirm the potential for avoidance mitigation, and identify areas. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts. Targeted surveys by site developers may also be undertaken by individual projects.	**Negative - Negligible**
	Changes in tidal regime	Operation	• Devices extracting tidal energy	**Tidal**	**Unknown - Significant adverse**	Possible changes in water flow associated with removal of tidal energy are likely to be restricted to the immediate vicinity of the device/array. Shellfish species are generally sensitive to tidal flows.	Mitigation measures include spacing devices to minimise the effect on tidal flows. More detailed mapping of the whelk fishing grounds may be required in order to determine key sites to be avoided.	**Unknown - Negligible**
	Barrier to movement	Operation	• Devices that occupy seabed/water column	**Tidal Fixed Wind Floating Wind**	**Unknown**	Some species, such as Atlantic salmon, trout and eels spent part of their lifecycle in freshwater and part at sea. Migration between these two water bodies is important for the survival of the species. The Slaney is the only river designated as an SAC due to its significant Salmon populations. The presence of wind or tidal devices could present a perceptual barrier to migration, although the exact impacts on fish species are unknown.	Available mitigation includes avoiding placing devices close to the entrances to key spawning rivers.	**Negligible - Unknown**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	EMF	Operation	• Inter-array and export cables	**Tidal Fixed Wind Floating Wind**	**Unknown - negligible**	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 renewable array power cable, but the field would not cause an avoidance reaction. Atlantic salmon, eels and Sea Trout are believed to be sensitive to magnetic fields. However, the level of impact associated with inter-turbine arrays will be more concentrated than those for export cables. There is no evidence to indicate that existing cables have caused any significant effect on migration patterns of these species. However, the significance of potential effects cannot be adequately quantified on the basis of current information.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength.	**Unknown - negligible**
Marine Birds	**Physical disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Significant adverse - negligible**	There are several seabird breeding colonies within Area 2 with SPA status, including Wicklow Head, Kilcoole Marshes, Lady's Island Lake, Tacumshin Lake, Wexford Harbour, The Raven and the Keeragh Islands. Waters in the vicinity of these colonies are important feeding and resting areas for several breeding species occurring in nationally important numbers. At-sea coverage of Area 2 is incomplete, however, high densities (>5 birds/km^2) of Manx Shearwater, Kittiwake, Common and Arctic Terns, Guillemot and Razorbill were recorded in inshore waters off the east coast between April and September. Nationally important numbers of Red-throated Divers and high numbers of Little Gulls and Kittiwakes have been recorded over the Arklow Bank in winter. Wexford Harbour & Slobs, Tacumshin Lake and the North Wicklow Coastal Marshes regularly hold internationally and nationally important numbers of wildfowl and waders during spring and autumn passage and in winter months. Physical disturbance during construction or decommissioning could lead to short- or long-term displacement of feeding or resting birds, depending on the species involved, and the time of year. Physical disturbance would be likely to be of particular importance close to seabird breeding colonies in the breeding season.	Effects on seabird breeding colonies could be reduced by avoiding sensitive sites e.g. SPAs and by timing installation activities to avoid the most sensitive seasons e.g. breeding and moulting. Site-specific surveys would be required at project level to identify the presence of key foraging hotspots and/or resting areas and to aid site selection.	**Negligible**
	Noise	Installation Decommissioning	• Devices using piled foundations	**Tidal Fixed Wind**	**Significant adverse - negative Negative - negligible**	Based on studies of bird behaviour on land it is evident that some species have acute hearing. However, there is limited understanding of birds ability to hear underwater. Although it is not possible to determine the level of significance of noise effects on seabirds, it is likely that impacts arising from operational noise will be less than impacts arising from installation (specifically from piling noise). It is likely that some degree of habituation will occur, depending on the species involved, as has been recorded with terrestrial species nesting in working quarries.	There are some mitigation measures available for piling operations that have been shown to reduce noise e.g. bubble curtains around the pile. The application of these should be reviewed and considered. Piling operations should be timed to avoid the most sensitive seasons e.g. breeding and moulting.	**Unknown Negligible**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal Fixed Wind Floating Wind**				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. All seabirds are sensitive to hydraulic fluid and fuel oil contamination. In addition wading birds in estuaries may experience negative effects, if the spill reaches these areas. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine birds could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of Oil Spill Contingency Plans.	**Negligible**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal Fixed Wind Floating Wind**	**Significant Adverse**	Collision impacts could potentially be significant adverse for offshore wind farms, depending on the species involved. Typically, larger, less agile species such as divers, gannets, swans, geese terns and seaducks, have been highlighted as likely to be particularly sensitive to collision with offshore wind turbines (Langston & Pullan 2002). Collision impacts could be significant during spring and autumn if developments are located on a major migration route or flyway.	Available mitigation includes - Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/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 e.g. resting and foraging areas; - Shut-down of turbines at night with bad weather/visibility and high migration intensity; - Avoiding large-scale continuous illumination; - Measures to make wind turbines more recognisable to birds	**Negative – negligible**
	Habitat exclusion	Operation	• Devices that occupy sea surface/water column	**Tidal Fixed Wind Floating Wind**	**Negative - negligible**	Diving seabirds would be unlikely to collide with underwater cables associated with wave and tidal devices. Collision impacts for operating wave and tidal devices would be negligible.	Appropriate siting of developments e.g. away from important feeding/roosting areas.	**Negligible**
	Barrier to movement	Operation	• Devices that occupy air column to a significant height above sea surface	**Fixed Wind Floating Wind**	**Significant adverse - negative**	If seabirds avoid a development after construction, then the area of avoidance can be considered as lost habitat for the species involved. Seabirds may be displaced from the development area and the surrounding waters, depending on their avoidance response. There is limited information on precise foraging and resting "hotspots" for seabird species around Ireland, although waters adjacent to breeding colonies will be important for these activities during the breeding season. Although birds are mobile and can avoid development sites, the potential effects of doing so may increase competitive pressures on adjacent waters. The energetic costs of site avoidance need to be considered, as do cumulative and in-combination impacts arising from birds avoiding other neighbouring developments. Post-construction habitat loss could therefore potentially have a significant adverse effect during the breeding season and a negative significant effect on seabirds at other times of the year.	Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/roosting areas, nearshore areas and "migration corridors"; Studies would be needed at the project level to identify the presence of key foraging and resting areas in the development area, to aid site selection.	**Negative – negligible**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Marine Mammals	**Physical Disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Negative**	Few breeding populations of harbour and grey seals occur throughout Area 2. There are comparatively few bottlenose dolphin and harbour porpoise sightings compared to other zones, especially given the increased sighting effort in this zone. There are no SACs designated in Area 6 for marine mammals. The presence of boat traffic and construction equipment may result in flight behaviour, particularly if they occur in shallower coastal waters near seal breeding and haulout sites. Increased boat traffic associated with construction and decommissioning will increase ambient noise in the area and may disturb marine mammals. At-sea distribution data for seals is unknown for this area. Cetacean abundance and habitat use is also largely unknown. However, harbour porpoises and bottlenose dolphins commonly forage in areas of high water flow, which has been identified as potential tidal technical resource. Impacts on seabed flora and fauna could cause changes in food web structure and function and could have negative impacts on top predators in the food web such as marine mammals.	Monitoring surveys would be required to establish distribution of seals and cetaceans at sea in order to design a suitable mitigation plan. Cetaceans may be seasonally abundant in these waters, and the effects of installation activities could be reduced by avoiding certain times of year. The effects of installation activities on seal colonies could be reduced by avoiding the breeding and moulting seasons as well as avoiding development in inshore areas close to seal haulout locations. Disturbance impacts from export cable installation could be avoided by avoiding seal breeding colonies or haul out sites.	**Unknown - Negligible**
	Noise	Survey	• Acoustic survey	**Tidal Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for marine mammals. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to mammal species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) should be considered.	**Negligible**
		Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Tidal Fixed Wind Floating Wind**	**Negative**	Piling and underwater blasting generate high levels of noise. Seals and cetaceans can detect piling noise up to a distance of 80km, and previous studies have demonstrated displacement of porpoises up to 15km during construction of wind farms. Behavioural responses could be expected at 20km, although this will depend on the level of existing background noise. Physiological impacts such as temporary or permanent threshold shift in hearing could occur at distances of 400m for harbour seals, and 1.8km for harbour porpoise. However, evidence suggests that it is unlikely that an animal would choose to remain in close proximity to a source of loud noise that would result in temporary or permanent hearing damage. Noise can mask signals used by cetaceans to navigate, locate prey, and communicate effectively. It is also possible that noise sources may mask biologically relevant signals. The potential for noise to affect marine mammals is therefore considered to be “significant adverse”. Increased shipping associated with installation will also raise ambient noise levels in the area.	Monitoring surveys would be required to establish distribution of seals and cetacean at sea in order to design a suitable mitigation plan. Seasonal or area restrictions could also be imposed so noisy activities would be timed not to coincide with sensitive times such as seal moulting or pupping and porpoise breeding seasons. A range of measures are available to further reduce noise impacts including Marine Mammal Observers, exclusion zones, passive acoustic monitoring, pingers, soft starts/ramp up and/or bubble curtains. Consideration could also be given to using non-piled foundations, and protecting cables where they cannot be buried using rock placement or mattressing.	**Negative - negligible**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal Fixed Wind Floating Wind**	**Unknown - Negative**	Wind turbines can produce low frequency noise and vibrations that can pass into the water column and can potentially affect seals and cetaceans ability to navigate, locate prey and communicate. Operational noise from wind turbines may be heard by seals and porpoises up to 200m, and simulated noise from a 2MW wind turbine has resulted in avoidance behaviour by harbour seals and harbour porpoises. The noise impact of tidal devices on marine mammals is not well researched and understood, although based on available information, underwater noise produced by wind devices is considered to be less than that for tidal devices. Recent studies suggest that harbour seal behaviour is largely unaffected by the presence of underwater tidal turbines. The cumulative effect of many devices operating together or when combined with operational noise from other marine use is also unknown.	Noise from operating turbines can be reduced by efficient design, reducing vibration, and using isolators.	**Unknown - negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Negligible - negative**	Marine mammals can potentially collide with vessels and equipment used during installation. Increased shipping activity during installation will increase this risk. Generally most fatal injuries arise with collisions with ships travelling over 13kts. Vessels associated with construction activities would usually not be travelling at these speeds.	Consider setting speed limits for construction vessels operating in sensitive areas. Establish a code of conduct to avoid disturbance to marine mammals both during construction activities and in transit to the construction area if entering areas of high abundance.	**Negligible**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal Floating Wind**	**Unknown - negative**	Risk of collision with wind turbines is small for seals and small cetaceans, since pylons are large and static. However collision may be a concern for larger baleen whales, which do not have the manoeuvrability of smaller cetaceans. All marine mammals may have difficulty detecting the presence of mooring/tethering cables for tidal installations. These cables are likely to have a small cross-section and provide fewer sensory cues to approaching mammals, so the risk of collision for these types of installation will be greater. Moving underwater turbines could potentially contribute a significant impact risk, especially in areas of high flow where manoeuvrability may be compromised. Limited information available suggests that harbour seal behaviour is largely unaffected by the presence of tidal turbines, but the impact of tidal devices on marine mammals is poorly researched. While a number of cetacean species occur in both inshore and offshore waters in this zone, abundance and habitat use is unknown, so the collision risk with offshore renewable energy installations is difficult to quantify.	Measures to make turbine foundations more visible to marine mammals could reduce the risk of collisions. Consider the use of acoustic pingers/deterrents on mooring/tethering lines.	**Unknown - negative**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants, or hydraulic fluids during installation could have an adverse effect on marine mammal health. A collision between ships or between a ship and an offshore renewable installation could result in fluid spills which could have serious environmental consequences. While the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine mammals would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy sea surface/ seabed/ water column	**Tidal Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude mammals from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. The cumulative effect of many installations within an area is unknown. Displacement of fishing activity during installation and operation may result in increased resource competition between fisheries and marine mammals in non-impacted areas. Installations may however, provide increased habitat as artificial reefs and attract fish aggregations that may provide increased foraging opportunities for marine mammals.	Surveys of habitat use by marine mammals and avoid heavily used areas and migration corridors.	**Unknown**
	Barrier to movement	Operation	• Devices that occupy sea surface/ seabed/ water column	**Tidal Fixed Wind Floating Wind**	**Unknown - Significant adverse**	The presence of large arrays may cause a barrier effect for migrating marine mammals. The importance of Area 2 for marine mammal migration is unknown, so barrier effect is difficult to quantify.	Detailed study would be required to examine coastal distribution in order to mitigate for this risk and avoid large installations in migratory corridors.	**Unknown - Significant adverse**
	EMF impacts	Operation	• Inter-array and export cables	**Tidal Fixed Wind Floating Wind**	**Unknown - negligible**	There is only circumstantial evidence that cetaceans have ferromagnetic organelles capable of determining small differences in relative magnetic field strength. Magnetic fields could potentially affect animals using geomagnetic cues during migration. However, cetaceans regularly cross cables, and there is no apparent evidence that existing electricity cables have influenced cetacean migration. The level of impact associated with inter-turbine arrays will be more concentrated than those for export cables and further study is required before this impact can be fully understood.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength, where possible	**Unknown - negligible**
Marine Reptiles	**Collision**	Installation Decommissioning	• Vessels and equipment used for installation and decommissioning	**Tidal Fixed Wind Floating Wind**	**Negative**	Historically, Assessment Area 2 has had far fewer sightings of turtles than zones 3-6; however it does hold a major jellyfish hotspot located in Rosslare and Wexford Bays. More recently, there has been an increase in sightings from County Wexford. One of the main threats to marine turtles in Irish coastal seas is entanglement in mooring ropes (for pot fisheries) and subsequent drowning. It is not known how mooring chains/cables used in operating devices impact on turtles but it's likely they offer more of a collision risk than entanglement. Turtles may be less	Possible mitigation includes planning installation to take place at times when there are fewer turtles present (December-May) or avoiding known areas of high abundance. Arrays could also benefit sea turtles as such installations may provide habitats for jellyfish polyps (as has been shown for marinas) and subsequently lead to an increase in jellyfish abundance (turtle food).	**Negligible - unknown**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal Floating Wind**		likely to collide with large installations but much is unknown about how sea turtles, especially leatherbacks, interact with man made barriers/obstacles. There is a slight possibility that leatherback turtles could swim into operating devices as they are generally oceanic animals unaccustomed to solid structures. Loggerheads are more likely to swim around such structures. Sea turtles can potentially collide with vessels and equipment used during installation, and devices during operation. Increased shipping activity transiting to the area during installation will increase this risk.	Site specific survey to identify areas of high turtle abundance, and avoidance of such areas.	
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants and hydraulic fluids could have an effect on turtle health. Although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine reptiles would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Barrier to movement	Operation	• Devices that occupy sea surface/water column • Vessels and equipment used for installation and decommissioning • Turbines/moving parts of devices	**Tidal Floating Wind**	**Unknown**	The movement of marine turtles around the coast of Ireland is unknown so it is difficult to quantify the level of barrier effect. However arrays could be perceived as a barrier affecting turtle movements or routes to feeding areas. An array placed perpendicular to the coastline would increase the likelihood of the barrier effect. Arrays could potentially corral turtles into a corner/trap that they may not be able to get out without human intervention.	Orientating arrays parallel to the coastline rather than perpendicular to the coastline may help minimise a barrier effect as turtles swim past. No other mitigation measures identified.	**Unknown**
	Noise	Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Tidal Fixed Wind Floating Wind**	**Unknown**	Avoidance responses of sea turtles to low frequency sounds have been demonstrated, however, the study of sensory biology in sea turtles is still in its infancy, so there is a large unknown component.	No specific mitigation identified.	**Unknown**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal Fixed Wind Floating Wind**				
	EMF impacts	Operation	• Inter-array and export cables	**Tidal Fixed Wind Floating Wind**	**Negligible - Unknown**	Sea turtles may be able to detect EMF fields such as those generated by export and interturbine cables and thereby could adversely affect turtles using geomagnetic cues during foraging and migration, although the importance of these cues remains unclear. However, as turtles are generally present at the surface and in the water column, they are unlikely to come into close proximity with the EMF field at the seabed.	EMF impacts could be reduced through ensuring that cables are buried, reducing the EMF at the seabed. Cable design and orientation to minimise generated EMF.	**Negligible - Unknown**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Tidal Fixed Wind Floating Wind**	**Unknown - Negative**	The construction of arrays in jellyfish hotspots could exclude turtles from this critical habitat. In Rosslare and Wexford Bays enormous aggregations of barrel jellyfish are found each year. These jellyfish hotspots may be sufficiently consistent in space and time to drive long-term foraging associations between leatherbacks and jellyfish. However, by providing new habitat for jellyfish polyps, arrays could increase the abundance of jellyfish in adjacent waters through a process of advection.	Avoidance of known jellyfish hotspots. No other specific mitigation identified.	**Unknown - negative**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Marine and coastal archaeology and wrecks	**Direct disturbance of unknown and known sites**	Installation	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Significant adverse - Negative**	Area 2 includes depositional zones where preservation of archaeological sites by burial is likely to have been favoured. It also includes areas where there is a potential for early settlement sites. There are numerous recorded wreck sites along the adjacent coastline and within Area 2. There is potential for the installation of tidal and wind devices and export cables to impact submarine archaeology through direct disturbance of known and unknown sites on the seabed, or through changes to sediment movements causing an artefact to become buried and preventing later discovery. There is also a potential positive impact associated with development related seabed survey providing additional data for inclusion in the archaeological record of the area. There are a large number of National Monuments on the adjacent coastline including those in State care. Locally, regionally and nationally important archaeological remains and sites are also present along the coast. Numerous listed buildings are also present on the coastline adjacent to the area. All archaeological monuments and wrecks greater than 100 years old are protected under the National Monuments Acts 1930 – 2004. Wartime wrecks are not currently covered under the Acts but are likely to be included in the near future.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Avoid sites of interest and exclusion zones for marine archaeology. Submit any artefacts recovered to the National Monuments Service. For known submarine and terrestrial sites the main form of mitigation is to avoid protected and other sites of interest. In addition to desk based studies it will be necessary to carry out field walkovers in preferred terrestrial site locations to determine need for site investigations (geophysical surveys/trial trenching) in consultation with the National Monuments Service and Local Authorities. With respect to cabling there is considerable opportunity to avoid or reduce effects. The siting of export cables will be important in determining their residual impact.	**Negligible**
	Changes to sediment regime	Operation	• Devices using seabed foundations • Devices using energy generated by tidal current	**Tidal Fixed Wind Floating Wind**	**Significant adverse - Positive**	Area 2 includes areas where there is a potential for early settlement sites and unrecorded wrecks. Changes in sedimentation may either expose or increase the burial depth of archaeological features at such sites. Where sites are exposed there is a potential for discovery of or damage to or loss of artefacts or sites. Where features are subject to deeper burial the potential for discovery of or damage to artefacts or sites is likely to be decreased.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
	Data acquisition	Installation	• Pre-installation survey	**Tidal Fixed Wind Floating Wind**	**Unknown**	There is a potential for archaeological sites and wrecks to be discovered within Area 2 as a result of site surveys, providing additional data for inclusion in the archaeological record of the area.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
Commercial Fisheries	**Direct disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Negative to Significant adverse**	Although direct disturbance may have an impact on all fishery types it is likely to be more significant in the case of shellfish than finfish as shellfish are generally much less mobile. Shellfish fisheries which may be impacted in Area 2 include whelk and scallop. Whelk fisheries are distributed throughout the inshore part of Area 2 while scallop fisheries are mainly concentrated in the southern offshore part of the Zone. Inshore finfish grounds are however also sensitive to direct disturbance as these are generally exploited by small vessels which are less able to exploit alternative grounds. Area 2 also contains spawning grounds and associated fisheries for Cod (Northern edge) and ray species (central and southern area) which may be subject to direct disturbance.	Potential impacts could be minimised through avoiding peak fishing periods. In the nearshore area (fixed wind, and part of the tidal resource area), the potential for avoiding key commercial fishing grounds may be limited due to the widespread nature of fishing activity in inshore part of the zone. There is more scope for avoiding impacts from floating wind and tidal devices in the deeper tidal resource area of Area 2 as there is less whelk fishing in deeper water. Installation outside of the provided that seasonal Cod (spring) and ray (autumn) fisheries would also minimise impacts. Early liaison with the fishing industry could help identify key fishing areas, particularly in the area where there is a lack of fishing effort distribution information for vessels under 15m. The effects could also be minimised by using procedures and structures that minimise the area of seabed disturbed for turbine foundations.	**Negative - negligible**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Temporary displacement from traditional fishing grounds	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Negative**	Inshore fishing grounds tend to be more constrained than offshore areas. Temporary displacement from these areas may lead to the concentration of fishermen in smaller areas, fishermen being unable to fish for short periods or fishermen being displaced to alternative, possibly less productive fishing grounds. Temporary displacement will potentially have a negative effect on commercial fisheries.	Effects can be reduced by phasing construction activities to specific areas within Area 2. The potential for avoiding key commercial fishing grounds may be limited due to the widespread nature of fishing activity in the zone. Liaison with the fishing community to keep them informed of installation operations is also key to managing the level of this impact.	**Negative - negligible**
	Long term displacement from traditional fishing grounds	Operation	• Devices that occupy sea surface/water column/seabed	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	All types of commercial fisheries could be affected by long term displacement from traditional fishing grounds. The potential effects could be of adverse significance for spatially constrained inshore fisheries and for bottom trawl and pot fisheries which may be restricted by installations and cable routes. Conversely, long term exclusion of mobile gear from the area could be of benefit to fish stocks in the wider area although spillover effects, particularly for mobile fish species are poorly understood. The key bottom trawl fisheries in Area 2 are for Black Sole, Plaice, Rays and Cod. Whelk are exploited by pots while scallops are exploited by mechanical dredging gear. The effects of long term displacement on trawl fisheries in particular will depend on the scale of the arrays and the extent to which fishing vessels are excluded from the area. Use of rock armour, if required for cable protection, will introduce an obstruction for trawling activity, but could also create new habitat which could have a positive impact of fish stocks.	Potential impacts could be minimised through spacing of turbines at wide enough intervals to permit use of mobile fishing gear. The potential for avoiding key commercial fishing grounds may be limited due to the widespread nature of fishing activity in the zone. Early liaison with the fishing industry could help identify key fishing areas, particularly in the area where there is a lack of fishing effort distribution information for vessels under 15m. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts on commercial fisheries.	**Negative**
Aquaculture	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Negligible**	The only aquaculture production in Area 2 is of mussels in the Rosslare harbour area which could be adversely affected by any significant and prolonged rise in suspended solids. However, increases in suspended sediment is expected to be short term and localised to the immediate vicinity of the seabed disturbing works. Intrusion of sediment plumes into aquaculture areas would therefore only result if the export cables were routed in the immediate vicinity. There could therefore be a negligible impact from offshore energy development.	Impacts from cable trenching could be reduced by using procedures that minimise the mobilisation of suspended solids, such as plough installation.	**Negligible**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	Shellfish are highly sensitive to reductions in water quality caused by hydraulic fluids or tainting from other chemical substances. There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. It should be noted that the quantity of hydraulic fluid in devices is likely to be very small, reducing the potential for significant environmental effects. Therefore, although the likelihood of accidental contamination from devices is low, the potential effects of any significant intrusion of hydraulic fluids into aquaculture production areas could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, and contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	Shellfish production in Assessment Area 2 could be adversely affected should installations be sited in or cables routed through shellfish cultivation areas.	The key mitigation measure in terms of reducing effects on shellfish farms is avoidance. In practice, consent is unlikely to be achievable to site renewable energy arrays or cables within existing fish farms.	**Negligible**
Ports, Shipping and Navigation	**Displacement of shipping**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	Shipping intensity in Area 2 is high, with a significant number of vessels transiting the Zone in a North/South direction from the north channel and ports within the Irish Sea en route to international ports. There is also significant vessel traffic, predominately passenger vessels, in an east/west direction from Rosslare to Wales. Shipping intensity also increases in the approaches to the ports of Arklow and Wicklow. Patterns in shipping intensity imply that ships use distinct routes.	The potential for these effects to be reduced would depend entirely upon the ability to site devices in relation to key routes for shipping. Potentially significant adverse effects could be reduced or avoided by siting devices away from areas of high vessel densities. Area 2 is characterised by high shipping densities and much of the Zone is utilised for shipping. Wind resource is present	**Negative**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Devices that occupy sea surface/water column	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	The re-routing of vessels to avoid safety zones (during installation), operational devices and decommissioning activity would result in greater transit time and use of fuel, with the associated costs to the vessel operator, and could lead to displacement of vessels to areas that already have moderate vessel densities, potentially having knock-on impacts on collision risk, trade/supply and visibility. The Tuskar Rock International Maritime Organisation (IMO) Traffic Separation Scheme (TSS) is located within Area 2 and overlaps both tidal and wind resource areas within the zone. Siting of devices in approaches to the TSS or within the TSS itself is prohibited as part of the 'Offshore electricity generating stations – note for intending developers' and would have a significant adverse impact on shipping. The effect of displacement of shipping would potentially have a significant adverse impact.	throughout the Zone and there is potential to site both fixed wind turbines, in the 10-60m depth region, and floating structures, deeper than 60m in areas of lower shipping intensity. There is less scope for siting tidal devices outside of busy shipping regions due to the size and location of the tidal resource in relation to the areas used by shipping. There are areas of lower shipping intensity that could accommodate tidal devices and thereby reduce displacement of shipping. The scale of potential effect on vessel traffic will need to be investigated further as part of project specific EIAs.	**Negative**
	Decreased trade/supply	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	Rosslare is the only major commercial port within Area 2 although there are fishing ports and smaller commercial ports (Arklow, Wicklow and Courtown) that vessels access regularly. The presence of installation/maintenance vessels, presence of devices and decommissioning activity could create temporary to long-term reductions in access to ports and harbours. Reduced access to the harbours mentioned above could have a significant adverse effect on goods transport and accessibility.	Site selection for device arrays should take into account the requirement for continued access to port and harbours, and devices sited away from the entrances/approaches to ports and harbours and thereby avoid impacting on trade and supply. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance and decommissioning.	**Negligible**
		Operation	• Devices that occupy sea surface/water column	**Tidal Fixed Wind Floating Wind**	**Significant adverse**			**Negligible**
	Reduced visibility	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	Vessels and other equipment used during the installation/maintenance/ decommissioning of devices, and the operational devices themselves could obstruct views of other vessels and navigation features such as buoys, lights and the coastline. This is particularly important in areas of high vessel densities, constrained channels or areas where there is particular dependence on visual navigation aids as reduced visibility increases the risk of collision with other ships and other structures in the water (natural and manmade). The effect of reduced visibility will potentially be significant adverse in Area 2 due to the high vessel densities and the adjacent entrances to ports and harbours.	Significant adverse effects associated with reduced visibly can be reduced by avoiding areas of high vessel densities and areas constrained by land e.g. adjacent to the entrances of ports and Loughs. In busy shipping areas, potential effects may be reduced by using fully submerged devices tidal which have minimal restrictions on visibility. Also minimising the period of installation, the number of vessels required and the area occupied during installation would reduce the potential impact on visibility. Any vessels and devices should be lit and marked in accordance with the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) guidelines, in agreement with the Commissioners of Irish Lights.	**Negligible**
		Operation	• Devices that occupy sea surface	**Tidal Fixed Wind Floating Wind**	**Significant adverse**			**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. Area 2 is not constrained by land or bathymetry to any great extent but it is constrained by shipping routes and high vessel densities and so the risk of collision will potentially be significant adverse. The significance of the impact will also increase dependent on the number of arrays which could potentially be present on either side of the channel, restricting potential for vessels using the main shipping lanes to re-route in emergencies.	The risk of collision could be reduced by avoiding areas of high shipping densities and regularly used shipping routes. There is limited scope for avoiding high shipping density within the region of tidal resource although there are discreet areas that could accommodate tidal devices. In busy shipping areas, potential effects may be reduced by minimising the period of installation, the number of vessels required and the area occupied during installation. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance, and decommissioning.	**Negative**
		Operation	• Devices that occupy sea surface/water column	**Tidal Fixed Wind Floating Wind**	**Significant adverse**			**Negative**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Recreation and Tourism	**Access Restrictions**	Installation Operation Decommissioning	• Structures in the sea reducing or excluding access	**Tidal Fixed Wind Floating Wind**	**Negative**	The key receptor affected is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs. Offshore wind or tidal developments in this zone, if located on routes used by recreational yachting could cause vessels to re-route, or restrict access to key areas.	A very extensive area is available to site floating wind technology away from cruising routes. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of cruising routes. However in the case of Assessment Zone2 there is still the potential to locate piled wind arrays, and their export cables away from cruising routes. The use of tidal device types which lie below the surface at a depth below the maximum draft of recreational vessels in a given area could also mitigate this impact. This mitigation measure is not available for offshore wind sites, however.	**Negligible**
	Noise	Installation Decommissioning	• On and offshore machinery and vessels	**Tidal Fixed Wind Floating Wind**	**Negative**	There are numerous Blue Flag beaches along the coastline in Assessment Area 2. Noise from machinery and vessels has the potential to impact on the use of beaches that are close to the source of the noise. However any noise from installation or decommissioning will be limited to the duration of construction activities. Piling is a particularly noisy activity, and greater significance impacts will be associated with this activity. Noise from operation will be longer term; however noise levels during operation will to be significantly lower than during installation or decommissioning. Impacts associated with piled wind will be located closer inshore and are likely to be of greater significance compared to floating wind developments located further offshore.	Mitigation measures aimed at reducing or avoiding disturbance to recreation could include timing particularly noisy activities such as piling to avoid key recreational periods.	**Negative**
		Operation	• Turbines/flexing joints/device components above sea surface		**Negligible - Negative**			**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Negative**	The key receptor is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs. The location of offshore wind and tidal developments close to yachting areas could potentially increase collision risk, especially if located in areas where ability to manoeuvre is restricted by other factors such as water depth. There is also collision risk associated with the installation vessels.	A very extensive area is available to site floating wind technology away from cruising routes. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of cruising routes. However in the case of Assessment Area 2 there is still the potential to locate piled wind arrays, and their export cables away from cruising routes. The use of tidal device types which lie below the surface at a depth below the maximum draft of recreational vessels in a given area could also mitigate this impact. This mitigation measure is not available for offshore wind sites, however. Collision risk can also be reduced through implementing safety measures including lighting and marking and informing users of the locations of devices.	**Negligible**
		Operation	• Devices that occupy sea surface/water column		**Negative**			**Negligible**
	Disturbance to Wildlife	Installation Operation Decommissioning	• Installation/decommissioning activity • Devices that occupy seabed/ sea surface/water column	**Tidal Fixed Wind Floating Wind**	**Negligible**	Effects on local tourism would occur where disturbance and/or exclusion from an area overlaps with the locations frequented by visitors and touring vessels. The east coast of Ireland is not considered to be of particular importance for recreational wildlife watching in comparison to the west coast of Ireland.	There is the potential to avoid impacts through locating tidal devices away from tourism and recreational areas. A very extensive area is available to site floating wind technology away from tourism and recreational areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of tourism and recreational areas. However in the case of Assessment Area 2 there is still the potential to locate piled wind arrays, and their export cables away from tourism and recreational areas Other mitigation measures aimed at reducing or avoiding disturbance to wildlife including sea mammals and birds is set out in the relevant parts of this table.	**Negligible**
Aviation	**Collision**	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Negative**	There are no aerodromes in the vicinity; however there are three to the north and one to the south of Assessment Area 2. Area 2 is also covered by the Dublin Search and Rescue region. The main collision risk is with the Search and Rescue activities that are ongoing in this area. Collision risk with civil aviation is negligible.	Available mitigation includes ensuring wind devices are lit with aviation lights in accordance with OAM 09/02 “Offshore Wind Farms Conspicuity Requirements”. As required under the Obstacles to Aircraft in Flight Order, S.I. 215 of 2005, notification of the erection of wind devices provided to the IAA.	**Negligible**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Radar Interference	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Unknown - Negative**	There are currently no "potential to interfere" areas set out for Irish waters and therefore it is difficult to accurately state how much of Assessment Area 2 would fall within these areas. There is likely to be a negative impact on aviation either from intermittent detections of turbines by air traffic controllers or from "shadowing" where radar signals become weaker behind turbines.	Consultation with the IAA will be required and the location of wind devices supplied so they can be accurately plotted on the radar and any signals received from that area will not be confused with aeroplanes.	**Negligible**
Military Activity	**Disruption to general activities**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Negligible**	There are no Department of Defence danger areas within Assessment Area 2, although, military use of the Zone will include fishery protection and search and rescue operations. The development of offshore renewables is considered to have a negligible impact on fishery protection and search and rescue operations in Area 2.	Consultation with the Department of Defence will be required as part of project specific EIA.	**Negligible**
		Operation	• Devices that occupy sea surface/water column					
Cables and Pipelines	**Direct damage**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	There are two telecoms cables and a Windfarm electricity export cable present within Assessment Area 2. Direct damage to an existing cable or pipeline could occur during installation of device arrays and cables but also could occur during maintenance and decommissioning. The impact is considered to be significant adverse (should it occur) as international telecommunications could be seriously disrupted as could the electricity transfer to the grid.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**No effect**
	Access restrictions	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	There is potential that the presence of devices in waters close to existing cables could restrict access to the cables for maintenance purposes. Due to the potential implications for electricity supplies and telecommunications, the potential significance of this effect, if it occurred, could be significant adverse.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Dredging and Disposal areas	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Negative**	There are three dredge disposal sites, one fish waste disposal site and one fish waste and dredge disposal site within Assessment Area 2. Construction operations and the presence of wind devices have the potential to restrict normal access to these sites. There are no existing aggregate dredging areas within Assessment Area 2 however; eleven areas have been identified as areas that could potentially be exploited for aggregate extraction. There is potentially a negative impact from wind device installation restricting access to potential future dredging grounds.	There is the potential to locate tidal devices away from existing dredging and disposal areas. A very extensive area is available to site floating wind technology away from existing dredging and disposal areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of existing dredging and disposal areas. However in the case of Assessment Area 2 there is still the potential to locate piled wind arrays, and their export cables away from existing dredging and disposal areas.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Existing Renewable Infrastructure	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Significant adverse**	Arklow Bank offshore wind farm is within Area 2, it consists of 7 turbines approximately 10km of Co. Wicklow. Consent is in place for a total of 200 turbines. In addition to Arklow Bank there are two potential wind farm areas to the north of the Zone, the Dublin Array application area (overlapping the boundary with Assessment Area 1) and Codling Bank lease area. There is no existing wave and tidal infrastructure in Area 2. Development of offshore renewable devices has the potential to cause maintenance access restrictions to existing or proposed wind/tidal arrays during construction, operation and decommissioning.	Site selection will need to factor in the access needs of existing infrastructure to ensure that the proposed site does not conflict with their activities. Access restriction impacts during construction and decommissioning can be managed through good planning and communication with existing operators.	**No effect**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
	Removal of energy resource	Operation	• Devices using energy generated by wind or tidal current	**Tidal Fixed Wind Floating Wind**	**Unknown**	During operation removal of wind/tidal energy could potentially be an issue, depending on the relative locations of existing and new sites.	Careful site selection taking into account resource assessment and modelling to determine if and how commercial scale arrays could coexist with the existing renewable infrastructure.	**Negligible - Unknown**
Natural Gas and CO_2 Storage	**Sterilisation of region**	Operation	• Devices using seabed foundations	**Tidal Fixed Wind Floating Wind**	**Unknown**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for CO_2 or natural gas storage. There is currently insufficient data to establish potential for use of the marine environment for storage of CO2. Therefore, whilst no sites are currently under consideration for natural gas or CO_2 storage in this zone, the significance of this possible future impact is unknown.	None identified	**Unknown**
Oil and Gas Activity	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Unknown - negative**	There are currently no areas of active oil and gas development in Assessment Area 2. However a small 'Licensing Option' area exists in the north of the zone and an 'Exploration Licence' area can be found to the south. Area 2 also contains eight exploration wells which were drilled and then abandoned. Siting of renewable devices in Area 2 may limit access to the 'Licensing Option' and 'Exploration Licence' areas. However the impacts on possible future oil and gas developments are impossible to quantify at this stage.	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices and there is the potential to locate devices where they will have minimal, if any impact on oil and gas activity.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					**Unknown - negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Fixed Wind Floating Wind**	**Unknown - Negative**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. There are currently no areas of active oil and gas development in Assessment Area 2. However a 'Licensing Option' area exists in the north of the zone and an 'Exploration Licence' area can be found to the south. Area 2 also contains eight exploration wells which were drilled and then abandoned. Siting of renewable devices in Area 2 has the potential for conflicts with vessels involved in developing the 'Licensing Option' and 'Exploration Licence' areas with regard to collision risk. However the impacts on possible future oil and gas developments are impossible to quantify at this stage.	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices and there is the potential to locate devices away from existing and proposed oil and gas activity	**Unknown - negative**
		Operation	• Devices that occupy sea surface/water column					**Unknown - negligible**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Sterilisation of region	Operation	• Devices using seabed foundations	**Tidal Fixed Wind Floating Wind**	**Unknown - negative**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for oil and gas exploitation. There is currently insufficient data to establish possible future exploitation of oil and gas from this zone. As it is possible that future oil and gas activities may take place in this zone is it not feasible to rule out any potential impacts from offshore renewable devices. However the impacts on possible future oil and gas developments are impossible to quantify at this stage.	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices and as There is the potential to locate devices away from oil and gas activity.	**Unknown**
	Effects on seascape type 3 Low Plateau Landscape	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Moderate Effect (between 0 and 15km offshore from the coast) Slight Moderate Effect to Slight Neutral Effect(between 15km and 24km from the coast) Slight Neutral Effect (between 24km and 35km from the coast)	Offshore Wind Zone 2 extends along the south east coast of Ireland from Greystones (Wicklow) in the North to Kilmore Quay (Wexford) on the south coast. The seascape types associated with this stretch of the coastline include: 3. Low plateau landscape- slightly elevated sea views from flat or low rolling open rural plateau landscape with low cliffs and narrow curving sandy bays with rocky headlands. Open and expansive slightly elevated sea views from the coastal edge with low intervisibility from the hinterland. 4. Low lying coastal plain –large to medium scale, very flat and exposed rural, coastal plains and lowlands with expansive views out to sea; includes estuaries, sandy beaches and curved bays. There are no national level landscape designations along the coast in this area. There are potential distant views to the coast and open sea from Wicklow Mountains National Park. Parts of this coastline are also covered by a number of county level landscape designations including: • Areas of Outstanding Natural Beauty, AONB- (Wicklow) • Special Amenity Zones –(Wicklow) • Sensitive and Vulnerable Landscapes (Wexford) The majority of coastline of Assessment Zone 2 is low lying plateau or flat land dominated by a long linear coastal edge, the character mainly rural with areas of ribbon development along coast roads and urban areas such as Wicklow, Arklow and Wexford. Though much of the coastline is made up of seascapes type 3 Low Plateau and 4 Low lying coastal plain which are the least sensitive seascapes to this type of development the potential effects in certain locations within 0 to 15km from the coast, could range from moderate adverse to slight depending on where wind farms are sited. For example although the seascape at Rosslare is classed as type 3 Low Plateau Landscape, the higher sensitivity of type 8 Large Bay at Wexford harbour close by at would increase local sensitivity; conversely sensitivity may be reduced in some locations by the presence of existing development and infrastructure. At distances greater than 35 km effects are likely to be slight neutral to neutral in all locations. Atmospheric conditions may reduce visibility thresholds.	Potential adverse effects on seascape can be reduced through the sensitive siting of offshore wind farms. Key factors to be considered in locating an offshore wind farm include: • Wind farms should not be sited where they appear to block or close the entrance to bays/loughs/narrows/sounds or where they separate a bay from the open sea; • Wind farms should reflect the shape of the coastline and align with the dominant coastal edge; • Wind farms should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate; • Wind farms should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Wind farms should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms; • Consideration should be given to locating devices in already industrialised and developed seascapes;	**Slight to Substantial depending on distance from shore (see Figure 12.15 for more information)**
	Effects on seascape type 4. Low Lying Coastal Plain	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Moderate Effect (between 0 and 15km offshore from the coast) Slight Moderate Effect to Slight Neutral Effect(between 15km and 24km from the coast) Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on seascape types 8. Large Bay	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect to Moderate Effect (between 0 and 15km offshore from the coast) Moderate Effect to Slight Effect (between 15km and 24km from the coast) Slight Effect to Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on seascape type 3 Low Plateau Landscape	Operational	Arrays of surface point structures over 14m above surface	Tidal	Moderate Effect to Slight Effect (between 0 and 5km offshore from the coast) Slight to Slight Neutral Effect (between 5km and 10km from the coast)	Tidal resources within Zone 2 extend along the east coast of Ireland from Greystones (Wicklow) in the North to Carnsore Point (Wexford) in the South. The seascape types associated with this stretch of the coastline include: 3. Low plateau landscape- slightly elevated sea views from flat or low rolling open rural plateau landscape with low cliffs and narrow curving sandy bays with rocky headlands. Open and expansive slightly elevated sea views from the coastal edge with low intervisibility from the hinterland. 4. Low lying coastal plain –large to medium scale, very flat and exposed rural,	Potential adverse effects on seascape can be reduced through the sensitive siting of tidal device arrays. Key factors to be considered in locating a tidal array include: • Identifying opportunities to deploy submerged devices where possible to avoid adverse effects. • Limit the use of markers (buoys and lights) in highly sensitive areas and recognising the requirements in terms of navigational safety. • Maximising the distance from shore of tidal array	**Slight to Moderate/ Substantial depending on distance from shore (see Figure 12.17 for more information)**

Table Appendix G2: East Coast - South (Area 2: Tidal & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
					Slight Neutral Effect to Neutral Effects (between 10km and 15km from the coast)	coastal plains and lowlands with expansive views out to sea; includes estuaries, sandy beaches and curved bays. There are no Irish national level landscape designations along the coast in this area. There are potential distant views to the coast and open sea from Wicklow Mountains National Park. Parts of this coastline are also covered by a number of county level landscape designations including: • Areas of Outstanding Natural Beauty, - AONB- (Wicklow) • Special Amenity Zones –(Wicklow) • Sensitive and Vulnerable Landscapes (Wexford) The majority of coastline of Assessment Zone 2 is low lying plateau or flat land dominated by a long linear coastal edge, the character is mainly rural with areas of ribbon development along coast roads and urban development at Wicklow, Arklow and Wexford. Though much of the coastline is made up of seascape type 3 Low Plateau which is among the least sensitive seascape to this type of development the potential effects in certain locations within 0 to 5km from the coast, could range from Moderate to Slight depending on where tidal arrays are sited. Due to the horizontal scale and low viewpoint Type 4 Low Lying Coastal Plain has a greater sensitivity to the introduction of vertical elements into the seascape. The threshold of visibility (which influences magnitude of change) for tidal devices is lower than for offshore wind, as much of the tidal resource area is at distances greater than 15 km offshore most effects are likely to be neutral.	developments • Avoid deploying tidal arrays that protrude above the water surface in areas where they appear to block or close the entrance to bays/loughs/ narrows/sounds or where they separate a bay from the open sea • Tidal arrays that protrude above the water surface should reflect the shape of the coastline and align with the dominant coastal edge; • Tidal arrays that protrude above the water surface should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate; • Tidal arrays that protrude above the surface should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Tidal arrays that protrude above the surface should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms.	
	Effects on seascape type 4. Low Lying Coastal Plain	Operational	Arrays of surface point structures over 14m above surface	Tidal	Moderate Effect (between 0 and 5km offshore from the coast)			
					Moderate to Slight Effect (between 5km and 10km from the coast)			
					Slight to Neutral Effect (between 10km and 15km from the coast)			
	Effects on seascape types 8. Large Bay	Operational	Arrays of surface point structures over 14m above surface	Tidal	Moderate Effect to Slight Effect (between 0 and 5km offshore from the coast)			
					Slight to Slight Neutral Effect (between 5km and 10km from the coast)			
					Slight Neutral Effect to Neutral Effects (between 10km and 15km from the coast)			
Climate	Carbon Impacts	Operation	Wind turbines and tidal devices	**Wind and Tidal**	**Positive**	It is recognised that development of offshore renewable energy developments will contribute towards achieving the Ireland's target for 40% energy to be provided from renewable energy sources. In meeting this target Ireland will be working towards the wider European and international commitment to combat global climate change and reduce the potential associated adverse environmental effects e.g. changing population distributions, species extinction, sea level rise etc. However, whilst seeking to combat climate change there is also a need to respond to it in terms of: • Protecting the existing environment and increasing its robustness and ability to adapt to climate change • Protecting existing and future infrastructure from effects of climate change e.g. increased storm events , flooding and sea level rise	Ensure that coastal infrastructure is sited in locations that are at lower risk from flooding, sea level rise and storm damage and do not increase the risk of flooding or damage to coastal infrastructure elsewhere. This will require close consultation at the project design stage with the relevant land use planning authority.	**Positive**
	Carbon Storage	Installation Operation	Wind turbines and tidal devices	**Wind and Tidal**	**No effect**	Based on current available information no existing or proposed carbon or gas storage sites have been identified within this area (Assessment Area 2) therefore there will be no effect resulting from the development of offshore renewable energy developments.	None required	**No effect**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Bathymetry	**The information presented in this chapter has been used to inform the results of the assessment. No specific impacts on bathymetry are expected.**							
Geology, geomorphology and sediment processes	**Changes in hydrodynamic/ coastal processes and seabed morphology**	Installation Decommissioning	• Cable trenching/removal • Foundations Installation/ removal	**Fixed Wind Floating Wind**	**Negligible**	Seabed sediments in the zone generally comprise sand and sandy gravel. There is a lack of detailed information on seabed sediment and sediment transport processes in the assessment zone. Cable burial and wind turbine foundation installation/ removal would have a localised effect on the seabed morphology. Such effects would be temporary in the prevailing relatively high tidal current regime.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm is located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Negligible**
	Changes in hydrodynamic/ coastal processes and seabed morphology	Operation	• Devices using seabed foundations	**Fixed Wind Floating Wind**	**Significant adverse**	Sediment generally comprises sand and sandy gravel. Relatively high tidal stream velocities and moderate fetch limited wave energy conditions prevail. The physical presence of monopile or tripod foundations and transition pieces on and above the seabed will cause hydrodynamic changes. Research suggests that such hydrodynamic changes will extend up to 50 m from devices and is therefore localised to the vicinity of the device array. Nearfield changes in scour, sedimentation, sediment suspension, seabed composition and seabed morphology may arise due to these hydrodynamic changes. Farfield changes may occur, particularly in relation to large arrays of turbines, where alteration to the local hydrodynamics interrupts sediment transport processes e.g. longshore drift, possibly having an overall impact to stabilise sediments in the area of the wind farm, while increasing erosion in other areas along coast. This impact is relevant to installation of piled devices, which would be in the nearshore area, out to 60 m water depth.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm is located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Unknown - negligible**
Seabed Contamination and Water Quality	**Accidental Contamination (hydraulic fluids or vessel cargo/fuel)**	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. This will degrade water quality with potential for adverse effects on the receiving environment. Any accidental spillage of slick forming chemicals could be carried into inshore waters, where the effects on water quality will be greater than those in open waters. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects in this area would be of adverse significance. Sensitive receptors in this area include Ramsar sites, SACs, licensed aquaculture sites and bathing beaches, There is a risk of transboundary contamination following spillages in Area 3	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan)	**Negligible**
	Disturbance of contaminated sediment	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse - Negligible**	There are four dredging spoil disposal sites within Area 3. There is also an industrial spoil disposal site. These potential areas of contamination could therefore be disturbed by seabed activities. Any contaminated material released is likely to be widely dispersed and diluted and the effect on open sea water quality is likely to be of negligible significance. Munitions migrated relict from wartime activities may be encountered. Disturbance could result in significant adverse effects.	Available mitigation includes avoidance of potentially contaminated seabed areas. Identification and avoidance of areas of munitions contamination through site survey at the project stage. If munitions are encountered advice such as that given in Department of the Marine and Natural Resources 2001 (Marine Notice No. 16 of 2001. (i.Explosives picked up at sea in trawls or sighted; and ii. The removal of explosive items from wrecks)) should be followed.	**Negligible**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Protected Sites	**Degradation of protected sites**	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negative – significant adverse**	There are Ramsar, SAC, SPA, NHA and pNHA protected sites within Wind Assessment Area 3. These sites are all adjacent to the coast, although in some cases (e.g. Hook Head SAC and Saltee Islands SAC), extend up to a maximum of 17 km offshore. Significant adverse impacts on protected sites could occur as a result of turbine or export cable installation, through physical disturbance and loss of substratum, or direct disturbance impacts on the species supported in the protected area. Significant adverse impacts could be expected if direct disturbance is caused to Natura 2000 species or habitats that do not recover well, such as saltmarshes or biogenic reef.	Impacts on protected areas could be mitigated by careful site selection avoiding sensitive sites for devices and export cables (i.e. existing and proposed national and European protected sites). Whether avoidance is an appropriate mitigation should be assessed on a site specific basis. A very extensive area is available to site floating wind technology away from protected sites. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of protected sites. However in the case of Assessment Area 3, there is still the potential to locate piled wind arrays, and their export cables away from protected sites. Impacts may still arise through indirect impacts on sediment movements during installation and operation, and would need to be assessed in more detail at the project stage. Possible mitigation measures relevant to the specific interest features of the sites and their seasonal and other sensitivities are described elsewhere in this table for the relevant topic areas	**Negligible – significant adverse**
	Impacts on protected species	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	Impacts on protected benthic ecology, mammals, birds, fish and reptiles in the zone are covered under the specific species sections of this table.			

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Benthic ecology	**Physical disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse**	Assessment Area 3 is located across an area of mixed sand/mud and gravel sediments. Disturbance to benthic habitat from installation activities would include minor disturbances through bed preparation prior to turbine foundation installation, disturbances from piling or alternatively from excavation of bed material for gravity foundations, disturbances to sediment from the feet of jack up platforms and disturbances to sediment from cable burial. Localised scouring around the base of turbines or tidal turbine units may cause a loss of benthic habitat or smother the existing habitat due to deepening of seabed. The degree of scour will be dependent upon the final choice of foundation design. Trenching of inter turbine and export cables would cause the greatest levels of physical disturbance with complete displacement of localised benthic communities and temporary smothering of adjacent areas. Impacts would include damage and possible mortality, particularly to smaller, thinner shelled bivalves. Mobile species such as amphipods, gastropods and small crustacea are likely to survive displacement however larger crabs and sea urchins may be crushed from disturbed boulders and cobbles. Permanently attached, sessile species such as bryozoans, sponges and hydroids on areas of coarser substratum cannot reattach to the substratum if removed, and may be damaged or destroyed if substratum is displaced. Physical disturbance will be localised and recoverability of benthic species is expected to be high due to repair and regrowth of damaged individuals and/or recruitment within the community from surviving colonies and individuals. Greater significance can be attached to impacts associated with physical disturbance to species considered to have high sensitivity and / or low recoverability, especially threatened and/or declining species or habitats. Within assessment Area 3 this includes the distribution of key habitats such as the tideswept subtidal reef at the Saltee Islands and Hook Head and the sheltered reefs in Lough Hyne, saltmarsh (e.g Tramore Bay & Courtmacsherry Estuary, intertidal mudflats (e.g. Blackwater River estuary, Clonakilty Harbour outer, Inner Ballymacoda, Inner Dungarvan Harbour, Waterford Harbour, Wexford Harbour, Great Island Channel), Zostera beds (Tramore Bay, Kinsale Harbour).	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) especially in areas with known sensitive intertidal and subtidal benthic habitats, such as intertidal mudflat and biogenic and rocky reef habitat. Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative to negligible**
	Smothering	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negative**	Smothering of benthic communities by sediment displaced by activities such as cable trenching may cause a very local decline in biotope species richness due to the loss of more sensitive species due to clogging of their filtration apparatus and potential short term anoxia under the sediment layer. Smothering impacts will be localised to the immediate vicinity of the seabed disturbing activities during installation.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection). Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**
	Contamination – from sediment disturbance	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negligible**	There is a potential for contaminated sediment, such as from spoil dumping sites to be remobilised during seabed disturbing installation works and cable burial. It is likely that any habitats with the potential to be adversely affected by contamination from these sites have already been subject to disturbance during the original dredging and deposition of material. Fine contaminated material will be diluted and dispersed, settling over a wide area with negligible effect on the Benthic ecology. Coarse material will be rapidly redeposited within the immediate area of installation operations.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection). Avoidance of areas of known potential contamination for seabed disturbing works. Potential effects on areas of unknown benthic habitat will need to be assessed through site survey at the project stage.	**Negligible**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. The water depth is such that small spillages (< 1tonne) are unlikely to affect the benthos. Similarly small spillages from wind 1 are unlikely to come ashore. Large spillages have the potential to have a significant adverse effect, particularly on the intertidal ecology of the adjacent shoreline coastline e.g. River Barrow & River Nore SAC, Tramore Dunes and Backstrand SAC, Clonakilty Bay SAC, Great Island Channel SAC and Courtmacsherry Estuary SAC. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on Benthic ecology would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan). Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Substrate change	Installation Operation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse**	All benthic communities can be expected to be sensitive to removal of their habitat. The long term loss of substratum due to the presence of devices that are attached to the seabed will therefore have a potentially significant adverse effect on any rare or important benthic habitats, such as those protected under the Habitats Directive. There is potential for colonisation of structures leading to increased biodiversity. Although this has potential to be a positive impact, species colonising underwater structures may also lead to undesirable changes in community structure.	Effects on benthic ecology from substratum loss can be reduced through avoidance (careful site selection). However, it may not be possible for this impact to be significantly reduced at this location. Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible - Significant adverse**
Fish and Shellfish	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negative**	Smothering effects are likely to be more of an issue for less mobile (shellfish) than mobile (finfish) species except where finfish species are spawning on the seabed e.g. herring. Area 3 contains shellfish populations of lobster, crayfish, edible crab, velvet crab, shrimp, *nephrops*, scallops and periwinkles. Area 3 has the highest national densities of periwinkles in Ireland. They are found throughout the intertidal area of semi-exposed to sheltered rocky shores of the zone. Of these shellfish species which live on, near or in the bottom sediments of the seabed the most sensitive to smothering are oysters and periwinkles. The impact of smothering will be localised to the immediate vicinity of seabed disturbing activities and limited to during installation.	For devices that require piling, and cable trenching, potential effects could be minimised by using techniques which cause minimal seabed disturbance, and avoiding sensitive seasons for certain species.	**Negligible**
	Noise	Survey	• Acoustic survey	**Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for fish, in particular fish with swim bladders are particularly sensitive to noise disturbance. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to fish species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) would also minimise any impacts on fish species.	**Negligible**
		Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Fixed Wind Floating Wind**	**Unknown**	High levels of noise such as during pile installation or underwater blasting may cause physiological or displacement effects to marine fish although the extent to which this may occur is unknown. In particular, herring and cod are known to be highly sensitive to noise and may be able to detect piling noise up to 80km. Both species are present in Area 3. It is expected that noise levels from piling and the removal of piled devices will be greater than those generated by operational devices, and although pile driving only occurs during installation the effects may last for longer than the piling activities as fish may not immediately return to the area.	The potential effects of noise from piling or blasting could be reduced through undertaking studies to determine site specific noise effects, and/or avoiding piling or blasting activities during sensitive spawning periods. Where possible less noisy alternatives can be considered such as protecting cables where they cannot be buried with mattressing or rock placement.	**Unknown**
		Operation	• Turbine noise transmitted through steelwork	**Fixed Wind Floating Wind**	**Unknown**	There is potential for noise from operational devices to lead to long term species displacement which could increase pressures on fish populations in other locations and force fish into predator habitats.	No specific mitigation measures have been identified	**Unknown**
	Collision	Operation	• Mooring chains/cables	**Floating wind**	**Unknown**	There is potential risk that all mobile fish species could collide with turbines, moving parts of submerged devices, or mooring chains/cables. Larger animals, such as basking sharks, and pelagic species are considered to be of greater risk. Basking shark and other pelagic fish species are present throughout Area 3. However, due to uncertainties with data and knowledge on the interactions between fish and devices, the potential significance of collision risk effects is unknown.	Potential effects associated with collision risk and fish could be reduced through device design e.g. use of protective nets or grids. Devices could also be sited to avoid sensitive areas e.g. migration routes, spawning and nursery grounds.	**Unknown**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. Small spillages are likely to have a negligible impact. Large spillages, particularly where they impinge on the coastline or enter sheltered bays and loughs could have a significant adverse impact.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude fish from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. It is not possible to determine the potential significance of this effect. The presence of offshore wind arrays may also have a positive effect on fish populations through fish stock recovery, should certain types of fisheries be excluded from the array.	No specific mitigation identified	**Unknown**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse**	Substrate loss could have a significant adverse effect on shellfish (crab, lobster, nephrops, scallop) and benthic spawning finfish species such as herring. The effect on finfish is most likely to be an issue where benthic spawning (e.g. herring) and nursery grounds exist. For more sedentary shellfish species it could have an effect through all life history stages. For fixed wind devices the resource area more or less completely overlaps the distribution area for herring, edible crab, lobster, shrimp and in the eastern part of the zone scallop. For floating wind and wave devices the resource area overlaps very extensively with the nephrops stock in the west and with scallop grounds in the east.	The potential effects of substratum loss on shellfish and benthic spawners could be reduced by avoiding sensitive areas e.g. key shellfish or spawning grounds. Better information on fish and shellfish distribution is required in order to confirm the potential for avoidance mitigation, and identify areas. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts. Targeted surveys by site developers may also be undertaken by individual projects.	**Negative - Negligible**
	Barrier to movement	Operation	• Devices that occupy seabed/water column	**Fixed Wind Floating Wind**	**Unknown**	Some species, such as Atlantic salmon, trout and eels spent part of their lifecycle in freshwater and part at sea. Migration between these two waterbodies is important for the survival of the species. Rivers in Area 4 which have been designated as SACs due to their significant Salmon populations include the Suir, the Barrow and the Nore, The presence of wind devices could present a perceptual barrier to migration, although the exact impacts on fish species is unknown.	Available mitigation includes avoiding placing devices close to the entrances to key spawning rivers.	**Negligible - Unknown**
	EMF	Operation	• Inter-array and export cables	**Fixed Wind Floating Wind**	**Unknown - negligible**	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 renewable array power cable, but the field would not cause an avoidance reaction. Atlantic salmon, eels and Sea Trout are believed to be sensitive to magnetic fields. However, the level of impact associated with inter-turbine arrays will be more concentrated than those for export cables. There is no evidence to indicate that existing cables have caused any significant effect on migration patterns of these species. However, the significance of potential effects cannot be adequately quantified on the basis of current information.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength.	**Unknown - negligible**
Marine Birds	**Physical disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Significant adverse - negligible**	There are several seabird breeding colonies within Area 3 with SPA status, including the Saltee Islands, Helvick Head, the Sovereign Islands and the Old Head of Kinsale. Waters in the vicinity of these colonies are important feeding and resting areas for several breeding species occurring in nationally important numbers. At-sea coverage of Area 3 is incomplete, however, high densities (>5 birds/km^2) of Manx Shearwater, Storm Petrel, and Kittiwake were recorded in inshore waters between March and August, with high densities of Guillemot recorded in inshore waters between September and February. In offshore waters, Gannet, Lesser Black-backed Gull and Kittiwake were recorded at high densities (>5 birds/km^2) between February and May, with Kittiwake also recorded at high density between October and January. Fulmar and Storm Petrel were recorded at high densities (>5 birds/km^2) between May and September. Ballyteigue Burrow, Bannow Bay, Cork Harbour, Ballymacoda, Courtmacsherry Bay, Clonakilty Bay, Dungarvan Harbour, Blackwater Estuary & Tramore Backstrand are internationally and nationally important for several species of wildfowl and waders during spring and autumn passage and in winter months. Physical disturbance during construction or decommissioning could lead to short- or long-term displacement of feeding or resting birds, depending on the species involved, and the time of year. Physical disturbance would be likely to be of particular importance close to seabird breeding colonies in the breeding season.	Effects on seabird breeding colonies could be reduced by avoiding sensitive sites e.g. SPAs and by timing installation activities to avoid the most sensitive seasons e.g. breeding and moulting. Site-specific surveys would be required at project level to identify the presence of key foraging hotspots and/or resting areas and to aid site selection.	**Negligible**
	Noise	Installation Decommissioning	• Devices using piled foundations	**Fixed Wind**	**Significant adverse - negative Negative -**	Based on studies of bird behaviour on land it is evident that some species have acute hearing. However, there is limited understanding of birds ability to hear underwater. Although it is not possible to determine the level of significance of noise effects on seabirds, it is likely that impacts arising from	There are some mitigation measures available for piling operations that have been shown to reduce noise e.g. bubble curtains around the pile. The application of these should be reviewed and considered.	**Unknown Negligible**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbine noise transmitted through steelwork	**Fixed Wind Floating Wind**	**negligible**	operational noise will be less than impacts arising from installation (specifically from piling noise). It is likely that some degree of habituation will occur, depending on the species involved, as has been recorded with terrestrial species nesting in working quarries.	Piling operations should be timed to avoid the most sensitive seasons e.g. breeding and moulting.	
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. All seabirds are sensitive to hydraulic fluid and fuel oil contamination. In addition wading birds in estuaries may experience negative effects, if the spill reaches these areas. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine birds could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of Oil Spill Contingency Plans.	**Negligible**
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Fixed Wind Floating wind**	**Significant Adverse**	Collision impacts could potentially be significant adverse for offshore wind farms, depending on the species involved. Typically, larger, less agile species such as divers, gannets, swans, geese terns and seaducks, have been highlighted as likely to be particularly sensitive to collision with offshore wind turbines (Langston & Pullan 2002). Collision impacts could be significant during spring and autumn if developments are located on a major migration route or flyway.	Available mitigation includes - Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/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 e.g. resting and foraging areas; - Shut-down of turbines at night with bad weather/visibility and high migration intensity; - Avoiding large-scale continuous illumination; - Measures to make wind turbines more recognisable to birds	**Negative – negligible**
	Habitat exclusion	Operation	• Devices that occupy sea surface/water column	**Fixed Wind Floating Wind**	**Negative - negligible**	Diving seabirds would be unlikely to collide with underwater cables associated with wave and tidal devices. Collision impacts for operating wave and tidal devices would be negligible.	Appropriate siting of developments e.g. away from important feeding/roosting areas.	**Negligible**
	Barrier to movement	Operation	• Devices that occupy air column to a significant height above sea surface	**Fixed Wind Floating Wind**	**Significant adverse - negative**	If seabirds avoid a development after construction, then the area of avoidance can be considered as lost habitat for the species involved. Seabirds may be displaced from the development area and the surrounding waters, depending on their avoidance response. There is limited information on precise foraging and resting “hotspots” for seabird species around Ireland, although waters adjacent to breeding colonies will be important for these activities during the breeding season. Although birds are mobile and can avoid development sites, the potential effects of doing so may increase competitive pressures on adjacent waters. The energetic costs of site avoidance need to be considered, as do cumulative and in-combination impacts arising from birds avoiding other neighbouring developments. Post-construction habitat loss could therefore potentially have a significant adverse effect during the breeding season and a negative significant effect on seabirds at other times of the year.	Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/roosting areas, nearshore areas and “migration corridors”; Studies would be needed at the project level to identify the presence of key foraging and resting areas in the development area, to aid site selection.	**Negative – negligible**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Marine Mammals	**Physical Disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negative – Significant adverse**	Small, isolated breeding populations of harbour and grey seals occur along the coast of Area 3. However, many cetacean species are commonly sighted off the south coast of Ireland. A single SAC has been designated for grey seal conservation around the Saltee Islands in Area 3. There are a high number of cetacean sightings in Area 3, and anecdotal evidence suggests that this zone represents a migratory corridor for some cetacean species. Fin and humpback whales are seasonally abundant from September-March. The presence of boat traffic and construction equipment may result in flight behaviour, particularly if they occur in shallower coastal waters near seal breeding and haulout sites. Increased boat traffic associated with construction and decommissioning will increase ambient noise in the area and may disturb marine mammals. Impacts on seabed flora and fauna could cause changes in food web structure and function and could have negative impacts on top predators in the food web such as marine mammals.	Monitoring surveys would be required to establish distribution of seals and cetaceans at sea in order to design a suitable mitigation plan. Cetaceans may be seasonally abundant in these waters, and the effects of installation activities could be reduced by avoiding certain times of year. The effects of installation activities on seal colonies could be reduced by avoiding the breeding and moulting seasons as well as avoiding development in inshore areas close to seal haulout locations. Disturbance impacts from export cable installation could be avoided by avoiding seal breeding colonies or haul out sites.	**Unknown-Negative**
	Noise	Survey	• Acoustic survey	**Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for marine mammals. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to mammal species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) should be considered.	**Negligible**
		Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Fixed Wind Floating Wind**	**Significant adverse**	Piling and underwater blasting generate high levels of noise. Seals and cetaceans can detect piling noise up to a distance of 80km, and previous studies have demonstrated displacement of porpoises up to 15km during construction of wind farms. Behavioural responses could be expected at 20km, although this will depend on the level of existing background noise. Physiological impacts such as temporary or permanent threshold shift in hearing could occur at distances of 400m for harbour seals, and 1.8km for harbour porpoise. However, evidence suggests that it is unlikely that an animal would choose to remain in close proximity to a source of loud noise that would result in temporary or permanent hearing damage. Noise can mask signals used by cetaceans to navigate, locate prey, and communicate effectively. It is also possible that noise sources may mask biologically relevant signals. The potential for noise to affect marine mammals is therefore considered to be “significant adverse”. Increased shipping associated with installation will also raise ambient noise levels in the area.	Monitoring surveys would be required to establish distribution of seals and cetacean at sea in order to design a suitable mitigation plan. Seasonal or area restrictions could also be imposed so noisy activities would be timed not to coincide with sensitive times such as seal moulting or pupping and porpoise breeding seasons. A range of measures are available to further reduce noise impacts including Marine Mammal Observers, exclusion zones, passive acoustic monitoring, pingers, soft starts/ramp up and/or bubble curtains. Consideration could also be given to using non-piled foundations, and protecting cables where they cannot be buried using rock placement or mattressing.	**Negative-Significant Adverse**
		Operation	• Turbine noise transmitted through steelwork	**Fixed Wind Floating Wind**	**Unknown - Negative**	Wind turbines can produce low frequency noise and vibrations that can pass into the water column and can potentially affect seals and cetaceans ability to navigate, locate prey and communicate. Operational noise from wind turbines may be heard by seals and porpoises up to 200m, and simulated noise from a 2MW wind turbine has resulted in avoidance behaviour by harbour seals and harbour porpoises. The cumulative effect of many devices operating together or when combined with operational noise from other marine use is also unknown.	Noise from operating turbines can be reduced by efficient design, reducing vibration, and using isolators.	**Unknown**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negligible - negative**	Marine mammals can potentially collide with vessels and equipment used during installation. Increased shipping activity during installation will increase this risk. Generally most fatal injuries arise with collisions with ships travelling over 13kts. Vessels associated with construction activities would usually not be travelling at these speeds.	Consider setting speed limits for construction vessels operating in sensitive areas. Establish a code of conduct to avoid disturbance to marine mammals both during construction activities and in transit to the construction area if entering areas of high abundance.	**Negligible**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Mooring chains/cables	**Floating wind**	**Unknown - negative**	Risk of collision with wind turbines is small for seals and small cetaceans, since pylons are large and static. However collision may be a concern for larger baleen whales, which do not have the manoeuvrability of smaller cetaceans. All marine mammals may have difficulty detecting the presence of mooring/tethering cables for floating wind installations. These cables are likely to have a small cross-section and provide fewer sensory cues to approaching mammals, so the risk of collision for these types of installation will be greater. While a number of cetacean species occur in both inshore and offshore waters in this zone, abundance and habitat use is unknown, so the collision risk with offshore renewable energy installations is difficult to quantify.	Measures to make turbine foundations more visible to marine mammals could reduce the risk of collisions. Consider the use of acoustic pingers/deterrents on mooring/tethering lines.	**Unknown - negative**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants, or hydraulic fluids during installation could have an adverse effect on marine mammal health. A collision between ships or between a ship and an offshore renewable installation could result in fluid spills which could have serious environmental consequences. While the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine mammals would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy sea surface/ seabed/ water column	**Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude mammals from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. The cumulative effect of many installations within an area is unknown. Displacement of fishing activity during installation and operation may result in increased resource competition between fisheries and marine mammals in non-impacted areas. Installations may however, provide increased habitat as artificial reefs and attract fish aggregations that may provide increased foraging opportunities for marine mammals.	Surveys of habitat use by marine mammals and avoid heavily used areas and migration corridors.	**Unknown**
	Barrier to movement	Operation	• Devices that occupy sea surface/ seabed/ water column	**Fixed Wind Floating Wind**	**Unknown - Significant adverse**	The presence of large arrays may cause a barrier effect for migrating marine mammals. The importance of Area 3 for marine mammal migration is unknown, although anecdotal evidence suggests that the south coast may be a migratory corridor for some larger baleen whales. The lack of information on large arrays makes barrier effects difficult to quantify.	Detailed study would be required to examine coastal distribution in order to mitigate for this risk and avoid large installations in migratory corridors.	**Unknown - Significant adverse**
	EMF impacts	Operation	• Inter-array and export cables	**Fixed Wind Floating Wind**	**Unknown - negligible**	There is only circumstantial evidence that cetaceans have ferromagnetic organelles capable of determining small differences in relative magnetic field strength. Magnetic fields could potentially affect animals using geomagnetic cues during migration. However, cetaceans regularly cross cables, and there is no apparent evidence that existing electricity cables have influenced cetacean migration. The level of impact associated with inter-turbine arrays will be more concentrated than those for export cables and further study is required before this impact can be fully understood.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength, where possible	**Unknown - negligible**
Marine Reptiles	**Collision**	Installation Decommissioning	• Vessels and equipment used for installation and decommissioning	**Fixed Wind Floating Wind**	**Negative**	Assessment Area 3 is an important area for leatherback sea turtles. County Cork has the highest number of turtle sightings in Ireland. Many leatherbacks have also been sighted far off shore. One of the main threats to marine turtles in Irish coastal seas is entanglement in mooring ropes (for pot fisheries) and subsequent drowning. It is not known how mooring chains/cables used in operating devices impact on turtles but it's likely they offer more of a collision risk than entanglement. Turtles may be less likely to collide with large installations but much is unknown how sea turtles especially leatherbacks interact with man made barriers/obstacles. There is a slight possibility that leatherback turtles could swim into operating devices as they are generally oceanic animals unaccustomed to solid structures. Loggerheads are more likely to swim around such structures. Sea turtles can potentially collide with vessels and equipment used during installation, and devices during operation. Increased shipping activity transiting to the area during installation will increase this risk.	Possible mitigation includes planning installation to take place at times when there are fewer turtles present (December-May) or avoiding known areas of high abundance. Arrays could also benefit sea turtles as such installations may provide habitats for jellyfish polyps (as has been shown for marinas) and subsequently lead to an increase in jellyfish abundance (turtle food). Site specific survey to identify areas of high turtle abundance, and avoidance of such areas.	**Negligible - unknown**
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Floating Wind**				

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants and hydraulic fluids could have an effect on turtle health. Although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine reptiles would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Barrier to movement	Operation	• Devices that occupy sea surface/water column • Vessels and equipment used for installation and decommissioning • Turbines/moving parts of devices	**Floating Wind**	**Unknown**	The movement of marine turtles around the coast of Ireland is unknown so it is difficult to quantify the level of barrier effect. However arrays could be perceived as a barrier affecting turtle movements or routes to feeding areas. An array placed perpendicular to the coastline would increase the likelihood of the barrier effect. Arrays could potentially corral turtles into a corner/trap that they may not be able to get out without human intervention.	Orientating arrays parallel to the coastline rather than perpendicular to the coastline may help minimise a barrier effect as turtles swim past. No other mitigation measures identified.	**Unknown**
	Noise	Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Fixed Wind Floating Wind**	**Unknown**	Avoidance responses of sea turtles to low frequency sounds have been demonstrated, however, the study of sensory biology in sea turtles is still in its infancy, so there is a large unknown component.	No specific mitigation identified.	**Unknown**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Fixed Wind Floating Wind**				
	EMF impacts	Operation	• Inter-array and export cables	**Fixed Wind Floating Wind**	**Negligible - Unknown**	Sea turtles may be able to detect EMF fields such as those generated by export and interturbine cables and thereby could adversely affect turtles using geomagnetic cues during foraging and migration, although the importance of these cues remains unclear. However, as turtles are generally present at the surface and in the water column, they are unlikely to come into close proximity with the EMF field at the seabed.	EMF impacts could be reduced through ensuring that cables are buried, reducing the EMF at the seabed. Cable design and orientation to minimise generated EMF.	**Negligible - Unknown**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Fixed Wind Floating Wind**	**Neutral**	The construction of arrays in jellyfish hotspots could exclude turtles from this critical habitat. In this zone jellyfish populations are likely to be extremely widespread (over 10-100kms) and composed of several different species, but by providing new habitat for jellyfish polyps, arrays could actually increase the abundance of jellyfish in adjacent waters through a process of advection.	No specific mitigation identified.	**Neutral**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Marine and coastal archaeology and wrecks	**Direct disturbance of unknown and known sites**	Installation	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse - Negative**	Area 3 includes depositional zones where preservation of archaeological sites by burial is likely to have been favoured. It also includes areas where there is a potential for early settlement sites. There are numerous recorded wreck sites along the adjacent coastline and within Area 3, including the wreck of RMS Lusitania. There is potential for the installation of wind devices and export cables to impact submarine archaeology through direct disturbance of known and unknown sites on the seabed, or through changes to sediment movements causing an artefact to become buried and preventing later discovery. There are a large number of National Monuments on the adjacent coastline including those in State care. Locally, regionally and nationally important archaeological remains and sites are also present along the coast. Numerous listed buildings are also present on the coastline adjacent to the area. Cable installation in the vicinity of these protected sites could cause direct destruction of archaeologically important features. All archaeological monuments and wrecks greater than 100 years old are protected under the National Monuments Acts 1930 – 2004. Wartime wrecks are not currently covered under the Acts but are likely to be included in the near future.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Avoid sites of interest and exclusion zones for marine archaeology. Submit any artefacts recovered to the National Monuments Service. For known submarine and terrestrial sites the main form of mitigation is to avoid protected and other sites of interest. In addition to desk based studies it will be necessary to carry out field walkovers in preferred terrestrial site locations to determine need for site investigations (geophysical surveys/trial trenching) in consultation with the National Monuments Service and Local Authorities. With respect to cabling there is considerable opportunity to avoid or reduce effects. The siting of export cables will be important in determining their residual impact.	**Negligible**
	Changes to sediment regime	Operation	• Devices using seabed foundations	**Fixed Wind Floating Wind**	**Significant adverse - Positive**	Area 3 includes areas where there is a potential for early settlement sites and unrecorded wrecks. Changes in sedimentation may either expose or increase the burial depth of archaeological features at such sites. Where sites are exposed there is a potential for discovery of or damage to or loss of artefacts or sites. Where features subject to deeper burial the potential for discovery of or damage to artefacts or sites is likely to be decreased.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
	Data acquisition	Installation	• Pre-installation survey	**Fixed Wind Floating Wind**	**Unknown**	There is a potential for archaeological sites and wrecks to be discovered within Area 3 as a result of site surveys, providing additional data for inclusion in the archaeological record of the area.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
Commercial Fisheries	**Direct disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negative to Significant adverse**	Although direct disturbance may have an impact on all fishery types it is likely to be more significant in the case of shellfish than finfish as shellfish are generally much less mobile. Shellfish fisheries which may be impacted in Area 3 include Nephrops, edible crab, lobster, shrimp, scallop, crayfish and whelk. . Inshore finfish grounds are however also sensitive to direct disturbance as these are generally exploited by small vessels which are less able to exploit alternative grounds. Area 3 also contains extensive spawning grounds for Herring, Cod, Haddock and Whiting and associated seasonal fisheries which may be subject to direct disturbance.	Potential impacts could be minimised through avoiding peak fishing periods. The potential for avoiding key commercial fishing grounds may be limited due to the widespread nature of fishing activity in the zone. Early liaison with the fishing industry could help identify key fishing areas, particularly in the area where there is a lack of fishing effort distribution information for vessels under 15m. The effects could also be minimised by using procedures and structures that minimise the area of seabed disturbed for turbine foundations.	**Negative**
	Temporary displacement from traditional fishing grounds	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negative**	Inshore fishing grounds tend to be more constrained than offshore areas. Temporary displacement from these areas may lead to the concentration of fishermen in smaller areas, fishermen being unable to fish for short periods or fishermen being displaced to alternative, possibly less productive fishing grounds. Temporary displacement will potentially have a negative effect on commercial fisheries.	Effects can be reduced by phasing construction activities to specific areas within Area 3. The potential for avoiding key commercial fishing grounds may be limited due to the widespread nature of fishing activity in the zone. Liaison with the fishing community to keep them informed of installation operations is also key to managing the level of this impact.	**Negative - negligible**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Long term displacement from traditional fishing grounds	Operation	• Devices that occupy sea surface/water column/seabed	**Fixed Wind Floating Wind**	**Significant adverse**	All types of commercial fisheries could be affected by long term displacement from traditional fishing grounds and Area 3 contains the most intense and diverse bottom trawl fisheries in Ireland. The potential effects could be of adverse significance for spatially constrained inshore fisheries and for bottom trawl and pot fisheries which may be restricted by installations and cable routes. Conversely, long term exclusion of mobile gear from an area could be of benefit to fish stocks in the wider area although spillover effects, particularly for mobile fish species are poorly understood. Key bottom trawl fisheries in Area 3 are for: Nephrops, Monkfish, Megrim, Hake, Whiting, Haddock, Black Sole, Plaice and Ling. Crab, lobster and shrimp are exploited by pots, crayfish by fixed bottom set nets, while oysters and scallops are exploited by mechanical dredging gear. The effects of long term displacement on trawl fisheries in particular will depend on the scale of the arrays and the extent to which fishing vessels are excluded from the area. Use of rock armour, if required for cable protection, will introduce an obstruction for trawling activity, but could also create new habitat which could have a positive impact of fish stocks.	Potential impacts could be minimised through spacing of turbines at wide enough intervals to permit use of mobile fishing gear. The potential for avoiding key commercial fishing grounds is extremely limited due to the ubiquitous nature of fishing activity in Area 3. Early liaison with the fishing industry could help identify key fishing areas, particularly in the area where there is a lack of fishing effort distribution information for vessels under 15m. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts on commercial fisheries.	**Negative**
Aquaculture	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Negligible**	The main shellfish aquaculture species in Area 3 is for Pacific oysters with localised production also of mussels and clams. Production of these species could be adversely affected by any significant and prolonged rise in suspended solids. However, increases in suspended sediment is expected to be short term and localised to the immediate vicinity of the seabed disturbing works. Intrusion of sediment plumes into aquaculture areas would therefore only result if the export cables were routed in the immediate vicinity. There could therefore be a negligible impact from offshore energy development.	Impacts from cable trenching could be reduced by using procedures that minimise the mobilisation of suspended solids, such as plough installation.	**Negligible**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Fixed Wind Floating Wind**	**Significant adverse**	Shellfish are highly sensitive to reductions in water quality caused by hydraulic fluids or tainting from other chemical substances. There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. It should be noted that the quantity of hydraulic fluid in devices is likely to be very small, reducing the potential for significant environmental effects. Therefore, although the likelihood of accidental contamination from devices is low, the potential effects of any significant intrusion of hydraulic fluids into aquaculture production areas could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, and contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse**	Shellfish production in Assessment Area 3 could be adversely affected should installations be sited in or cables routed through shellfish cultivation areas.	The key mitigation measure in terms of reducing effects on shellfish farms is avoidance. In practice, consent is unlikely to be achievable to site renewable energy arrays or cables within existing fish farms.	**Negligible**
Ports, Shipping and Navigation	**Displacement of shipping**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Significant adverse**	There is moderate shipping density close inshore in Area 3, largely due to vessels navigating around the Irish coastline. Higher vessel densities exist in the approaches to the main ports of Cork and Waterford, and distinct routes pass to and from these ports through the Zone in a southerly direction. The highest vessel densities are located in a small area centred on the Kinsale gas field and associated platforms. Patterns in shipping density imply that vessels use distinct routes through the Assessment Zone. The Tuskar Rock TSS is directly adjacent to the north western boundary of Area 3, siting devices in the approaches to the TSS would have a significant adverse impact on shipping and is prohibited as part of the 'Offshore electricity generating stations – note for intending developers'. The re-routing of vessels to avoid safety zones (during installation), operational devices and decommissioning activity would result in greater transit time and use of fuel, with the associated costs to the vessel operator, and could lead to displacement of vessel densities to areas that already have moderate vessel densities, potentially having knock-on impacts on collision risk, trade/supply and visibility. The effect of displacement of shipping would potentially have a significant adverse impact in Area 3.	The potential for these effects to be reduced would depend entirely upon the ability to site devices in relation to key routes for shipping. Potentially significant adverse effects could be reduced or avoided by siting devices away from areas of high vessel densities. There are areas within Area 3 that could accommodate wind devices without causing significant displacement of shipping, and there is potential to site both fixed wind turbines, in the 10-60m depth region, and floating structures, deeper than 60m in areas of lower shipping intensity. The scale of potential effect on vessel traffic will need to be investigated further as part of project specific EIAs.	**Negligible**
		Operation	• Devices that occupy sea surface/water column	**Fixed Wind Floating Wind**	**Significant adverse**			**Negligible**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Decreased trade/supply	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Significant adverse**	There are significant vessel movements to an d from the major ports of Cork and Waterford. In addition to these there are numerous fishing ports and smaller commercial ports. The presence of installation/maintenance vessels, presence of devices and decommissioning activity could create temporary to long-term reductions in access to ports and harbours. Reduced access to the harbours mentioned above could have a significant adverse effect on goods transport and accessibility.	Site selection for device arrays should take into account the requirement for continued access to port and harbours, and devices sited away from the entrances/approaches to ports and harbours and thereby avoid impacting on accessibility, trade and supply. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance and decommissioning.	**Negligible**
		Operation	• Devices that occupy sea surface/water column	**Fixed Wind Floating Wind**	**Significant adverse**			**Negligible**
	Reduced visibility	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negative to Significant adverse**	Vessels and other equipment used during the installation/maintenance/ decommissioning of devices, and the operational devices themselves could obstruct views of other vessels and navigation features such as buoys, lights and the coastline. This is particularly important in areas of high vessel densities, constrained channels or areas where there is particular dependence on visual navigation aids as reduced visibility increases the risk of collision with other ships and other structures in the water (natural and manmade). The effect of reduced visibility will potentially be significant adverse to negative in Area 3 due to the presence of distinct shipping routes and the entrances to busy ports and harbours.	Significant adverse effects associated with reduced visibly can be reduced by avoiding areas of high vessel densities and areas constrained by land e.g. adjacent to the entrances of ports and Loughs. In busy shipping areas, potential effects may be reduced by minimising the period of installation, the number of vessels required and the area occupied during installation would reduce the potential impact on visibility. Any vessels and devices should be lit and marked in accordance with the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) guidelines, in agreement with the Commissioners of Irish Lights.	**Negligible**
		Operation	• Devices that occupy sea surface	**Fixed Wind Floating Wind**	**Negative to Significant adverse**			**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Significant adverse**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. Area 3 is not constrained by land or bathymetry to any great extent but it is constrained by shipping routes and some areas of high vessel density, the risk of collision will potentially be significant adverse. The significance of the impact will also increase dependent on the number of arrays which could potentially be present on either side of the channel, restricting potential for vessels using the main shipping lanes to re-route in emergencies.	The risk of collision could be reduced by avoiding areas of high shipping densities and regularly used shipping routes.. In busy shipping areas, potential effects may be reduced by minimising the period of installation, the number of vessels required and the area occupied during installation. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance, and decommissioning.	**Negative**
		Operation	• Devices that occupy sea surface/water column	**Fixed Wind Floating Wind**	**Significant adverse**			**Negative**
Recreation and Tourism	**Access Restrictions**	Installation Operation Decommissioning	• Structures in the sea reducing or excluding access	**Fixed Wind Floating Wind**	**Negative**	The key receptor affected is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs Offshore wind developments in this zone, if located on routes used by recreational yachting could cause vessels to re-route, or restrict access to key areas.	A very extensive area is available to site floating wind technology away from cruising routes. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of cruising routes. However in the case of Assessment Area 3 there is still the potential to locate piled wind arrays, and their export cables away from cruising routes.	**Negligible**
	Noise	Installation Decommissioning	• On and offshore machinery and vessels	**Fixed Wind Floating Wind**	**Negative**	There are numerous Blue Flag beaches, wildlife watching areas and 'surf spots' along the coastline in Assessment Area 3. Noise from machinery and vessels has the potential to impact on the use of beaches that are close to the source of the noise. However any noise from installation or decommissioning will be limited to the duration of construction activities. Piling is a particularly noisy activity, and greater significance impacts will be associated with this activity. Noise from operation will be longer term; however noise levels during operation will to be significantly lower than during installation or decommissioning. Impacts associated with piled wind will be located closer inshore and are likely to be of greater significance compared to floating wind developments located further offshore.	Mitigation measures aimed at reducing or avoiding disturbance to recreation could include timing particularly noisy activities such as piling to avoid key recreational periods.	**Negligible**
		Operation	• Turbines/flexing joints/device components above sea surface		**Negligible - Negative**			**Negligible**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negative**	The key receptor is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs. The location of offshore wind developments close to yachting areas could potentially increase collision risk, especially if located in areas where ability to manoeuvre is restricted by other factors such as water depth. There is also collision risk associated with the installation vessels.	A very extensive area is available to site floating wind technology away from cruising routes. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of cruising routes. However in the case of Assessment Area 3 there is still the potential to locate piled wind arrays, and their export cables away from cruising routes. Safety measures including lighting and marking and informing users of the locations of devices will help to negate any potential impact.	**Negligible**
		Operation	• Devices that occupy sea surface/water column		**Negative**			**Negligible**
	Disturbance to Wildlife	Installation Operation Decommissioning	• Installation/decommissioning activity • Devices that occupy seabed/ sea surface/water column	**Fixed Wind Floating Wind**	**Negative**	Effects on local tourism would occur where disturbance and/or exclusion from an area overlaps with the locations frequented by visitors and touring vessels. The south coast of Ireland is considered to be of moderate importance for recreational wildlife watching in comparison to the west coast of Ireland where there are many more areas used for wildlife watching.	A very extensive area is available to site floating wind technology away from tourism and recreational areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of tourism and recreational areas. However in the case of Assessment Area 3 there is still the potential to locate piled wind arrays, and their export cables away from tourism and recreational areas. Other mitigation measures aimed at reducing or avoiding disturbance to wildlife including sea mammals and birds is set out in the relevant parts of this table.	**Negligible - Negative**
Aviation	**Collision**	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Negative**	There are two aerodromes in the vicinity of Assessment Area 3 (both civil). Assessment Area 3 is partially covered by the Dublin Search and Rescue region and partially by the Valentia Search and Rescue region. The main collision risk is with the Search and Rescue activities that are ongoing in this area.	Available mitigation includes ensuring wind devices are lit with aviation lights in accordance with OAM 09/02 “Offshore Wind Farms Conspicuity Requirements”. As required under the Obstacles to Aircraft in Flight Order, S.I. 215 of 2005, notification of the erection of wind devices provided to the IAA.	**Negligible**
	Radar Interference	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Unknown - negative**	There are currently no “potential to interfere” areas set out for Irish waters and therefore it is difficult to accurately state how much of Assessment Area 3 would fall within these areas. There is likely to be a negative impact on aviation either from intermittent detections of turbines by air traffic controllers or from “shadowing” where radar signals become weaker behind turbines.	Consultation with the IAA will be required and the location of wind devices supplied so they can be accurately plotted on the radar and any signals received from that area will not be confused with aeroplanes.	**Negligible**
Military Activity	**Disruption to general activities**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Significant adverse**	Assessment Area 3 overlaps with Department of Defence danger area D13, located adjacent to the coast in the west of the zone. At its southern extremity the Zone also overlaps an area used for fleet exercises and submarine exercise and transit, although no ammunition firing is undertaken here. Military use in the Zone may also include fishery protection and search and rescue operations. The development of offshore renewables in Department of Defence danger areas is not permitted (Department of Communications, Marine and Natural Resources, 2000) and therefore the impact must be considered as significant adverse.	Development within Department of Defence danger areas is prohibited and so avoidance is a required mitigation measure. This is possible as wind resource is present throughout Area 3. Consultation with the Department of Defence will be undertaken as part of project specific EIA. Any development within the fleet exercise and submarine exercise and transit area will require additional consultation with the Ministry of Defence, UK.	**Negligible**
		Operation	• Devices that occupy sea surface/water column					
Cables and Pipelines	**Direct damage**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Fixed Wind Floating Wind**	**Significant adverse**	There are numerous telecoms cables present within Assessment Area 3. There is also a small network of pipelines involved in exporting gas from the Seven Heads, Ballycotton and Kinsale Head gas fields to the mainland. Direct damage to an existing cable or pipeline could occur during installation of device arrays and cables but also could occur during maintenance and decommissioning. The impact is considered to be significant adverse (should it occur) as international telecommunications could be seriously disrupted as could gas supply.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**No effect**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Access restrictions	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Significant adverse**	There is potential that the presence of devices in waters close to existing cables could restrict access to the cables for maintenance purposes. Due to the potential implications for telecommunications services, the significance of this effect, if it occurred, could be significant adverse.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Dredging and Disposal areas	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negative**	There are five dredge disposal sites, one methanol disposal site, one industrial waste disposal site and one rock dredge disposal site within Assessment Area 3. Construction operations and the presence of wind devices have the potential to restrict normal access to these sites. There are no existing aggregate dredging areas within Assessment Area 3. However; one area has been identified as containing potential for aggregates exploitation. There is potentially a negative impact from wind device installation restricting access to potential future dredging grounds.	A very extensive area is available to site floating wind technology away from existing dredging and disposal areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of existing dredging and disposal areas. However in the case of Assessment Area 3 there is still the potential to locate piled wind arrays, and their export cables away from existing dredging and disposal areas.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Existing Renewable Infrastructure	**There is no existing offshore renewable infrastructure in Area 3**							
Natural Gas and CO_2 Storage	**Sterilisation of region**	Operation	• Devices using seabed foundations	**Fixed Wind Floating Wind**	**Unknown - Negative**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for CO_2 or natural gas storage. There is currently insufficient data to establish potential for use of the marine environment for storage of CO_2. No sites are currently under consideration for CO_2 storage in this zone and therefore the significance of this possible future impact is unknown. Natural gas storage occurs at the Kinsale Head gas field and as such there could potentially be a negative impact from offshore renewable devices.	None identified	**Unknown - negligible**
Oil and Gas Activity	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negative**	Two areas of 'Petroleum Lease' can be found in the middle of Area 3 which exist around the Severn Heads, Ballycotton and Kinsale Head gas fields. The Kinsale Head gas field also has associated platform infrastructure, with pipelines running between the three fields and also to the mainland. Siting of wind arrays in close proximity to the existing oil and gas exploitation areas has potential for access restrictions to vessels transiting to and from the gas fields. Impacts on pipelines are discussed in the relevant section of this table.	Consultation with the field operator would be required prior to siting of any renewable devices. There is the potential to locate devices away from the areas of oil and gas activity.	**Negligible - negative**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Fixed Wind Floating Wind**	**Negative**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices. There is the potential to locate devices away from the areas	**Negative - negligible**

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Devices that occupy sea surface/water column			increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. Siting of wind arrays in close proximity to the existing oil and gas exploitation areas has potential to increase collision risk to vessels transiting to and from the gas fields.	of oil and gas activity. Maintain good communications and issue the appropriate notifications during installation, maintenance, and decommissioning.	**Negligible**
	Sterilisation of region	Operation	• Devices using seabed foundations	**Fixed Wind Floating Wind**	**Unknown**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for oil and gas exploitation. Two areas of 'Petroleum Lease' can be found in the middle of Area 3 which exist around the Severn Heads, Ballycotton and Kinsale Head gas fields. However, there is currently insufficient data to establish further possible future exploitation of oil and gas from the rest of this zone. As oil and gas activity takes place in this zone is it not feasible to rule out any potential impacts from offshore renewable devices. However the impacts on possible future oil and gas developments are impossible to quantify at this stage	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices. There is the potential to locate devices away from oil and gas activity.	**Unknown**
Seascape Effects	Effects on seascape type 3 Low Plateau Landscape	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Moderate Effect (between 0 and 15km offshore from the coast)	Offshore Wind Zone 3 extends along the south coast of Ireland from Kilmore Quay (Wexford) in the east to Glandore Harbour (Cork) in the west. The seascape types associated with this stretch of the coastline include: 3. Low plateau landscape- slightly elevated sea views from flat or low rolling open rural plateau landscape with low cliffs and narrow curving sandy bays with rocky headlands. Open and expansive slightly elevated sea views from the coastal edge with low intervisibility from the hinterland. 4. Low lying coastal plain –large to medium scale, very flat and exposed rural, coastal plains and lowlands with expansive views out to sea; includes estuaries, sandy beaches and curved bays. 8. Large bay – Large long sweeping bays often with sand dunes, expansive sands and tidal flats and rocky headlands. Very long open views framed by landmass, both across the bay and out to the wide horizon of the open sea. There are no national level landscape designations in this area. Parts of this coastline are also covered by a number of county level landscape designations including: • Sensitive and Vulnerable Landscapes (Wexford) • Vulnerable, Normal and Robust Landscapes (Waterford) • Scenic Routes (Waterford) Most of Assessment Zone 3 is made up of large sweeping bays and flat estuarine seascapes, rural agricultural coastal landscapes and areas of urban development iat Waterford Harbour, Tramore, Dungarven, and Cork Harbour. The least sensitive seascapes to this type of development is type 4 Low Lying Coastal Plain situated along the south west coast where the potential effects in certain locations within 0 to 15km from the coast, could range from moderate to slight depending on where wind farms are sited. The majority of the south east coast is made up of a series of large bays which have a lower capacity for characteristics of Off Shore Wind development with Substantial to Moderate effects within 24km prior to mitigation. Local seascape sensitivity may be reduced in some locations by the presence of existing development and infrastructure. At distances greater than 35 km effects are likely to be slight neutral to neutral in all locations.	Potential adverse effects on seascape can be reduced through the sensitive siting of offshore wind farms. Key factors to be considered in locating an offshore wind farm include: • Wind farms should not be sited where they appear to block or close the entrance to bays/loughs/narrows/sounds or where they separate a bay from the open sea; • Wind farms should reflect the shape of the coastline and align with the dominant coastal edge; • Wind farms should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate; • Wind farms should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Wind farms should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms; • Consideration should be given to locating devices in already industrialised and developed seascapes;	**Moderate to Substantial depending on distance from shore (see Figure 12.15 for more information)**
					Slight Moderate Effect to Slight Neutral Effect(between 15km and 24km from the coast)			
					Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on seascape type 4. Low Lying Coastal Plain	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Moderate Effect (between 0 and 15km offshore from the coast)			
					Slight Moderate Effect to Slight Neutral Effect(between 15km and 24km from the coast)			
					Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on seascape types 8. Large Bay	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect to Moderate Effect (between 0 and 15km offshore from the coast)			
					Moderate Effect to Slight Effect (between 15km and 24km from the coast)			
					Slight Effect to Slight Neutral Effect (between 24km and 35km from the coast)			

Table Appendix G3: South Coast (Area 3: Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Climate	Carbon Impacts	Operation	Wind turbines	**Wind**	**Positive**	It is recognised that development of offshore renewable energy developments will contribute towards achieving the Ireland's target for 40% energy to be provided from renewable energy sources. In meeting this target Ireland will be working towards the wider European and international commitment to combat global climate change and reduce the potential associated adverse environmental effects e.g. changing population distributions, species extinction, sea level rise etc. However, whilst seeking to combat climate change there is also a need to respond to it in terms of: • Protecting the existing environment and increasing its robustness and ability to adapt to climate change • Protecting existing and future infrastructure from effects of climate change e.g. increased storm events , flooding and sea level rise	Ensure that coastal infrastructure is sited in locations that are at lower risk from flooding, sea level rise and storm damage and do not increase the risk of flooding or damage to coastal infrastructure elsewhere. This will require close consultation at the project design stage with the relevant land use planning authority.	**Positive**
	Carbon Storage	Installation Operation	Wind turbines	**Wind**	**No effect**	Based on current available information no existing or proposed carbon or gas storage sites have been identified within this area (Assessment Area 3) therefore there will be no effect resulting from the development of offshore wind farms.	None required	**No effect**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Bathymetry	**The information presented in this chapter has been used to inform the results of the assessment. No specific impacts on bathymetry are expected.**							
Geology, geomorphology and sediment processes	**Changes in hydrodynamic/ coastal processes and seabed morphology**	Installation Decommissioning	• Cable trenching/removal • Foundations Installation/ removal	**Wave Fixed Wind Floating Wind**	**Negligible**	Seabed sediments in the zone sand and muddy sand with areas of bedrock. There is a lack of detailed information on seabed sediment and sediment transport processes in the assessment zone. Cable burial and wave/ wind turbine foundation installation/ removal would have a localised effect on the seabed morphology. Such effects would be temporary in the prevailing relatively high wave and tidal current regime.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm is located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Negligible**
	Changes in hydrodynamic/ coastal processes and seabed morphology	Operation	• Devices using seabed foundations	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Sediment generally comprises sand and muddy sand with areas of bedrock. Relatively high tidal stream velocities and high wave energy conditions prevail. The physical presence of monopile or tripod foundations and transition pieces on and above the seabed and wave devices within the water column and at the sea surface will cause hydrodynamic changes. The removal of wave energy will also affect the hydrodynamic regime. Research suggests that such hydrodynamic changes will extend up to 50 m from devices and is therefore localised to the vicinity of the device array. Nearfield changes in scour, sedimentation, sediment suspension, seabed composition and seabed morphology may arise due to these hydrodynamic changes. Farfield changes may occur, particularly in relation to large arrays of wind or wave devices, where alteration to the local hydrodynamics interrupts sediment transport processes e.g. longshore drift, possibly having an overall impact to stabilise sediments in the area of the wind farm or wave devices, while increasing erosion in other areas along coast.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm or wave devices are located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Unknown - negligible**
Seabed Contamination and Water Quality	**Accidental Contamination (hydraulic fluids or vessel cargo/fuel)**	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. This will degrade water quality with potential for adverse effects on the receiving environment. Any accidental spillage of slick forming chemicals could be carried into inshore waters, where the effects on water quality will be greater than those in open waters. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects in this area would be of adverse significance. Sensitive receptors in this area include a UNESCO WHS, Ramsar sites, SACs, pNHAs, licensed aquaculture sites and bathing beaches.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan)	**Negligible**
	Disturbance of contaminated sediment	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse - Negligible**	There are two dredging spoil and two fish waste disposal sites within Area 4. These potential areas of contamination could therefore be disturbed by seabed activities. Any contaminated material released is likely to be widely dispersed and diluted and the effect on open sea water quality is likely to be of negligible significance. Munitions migrated relict from wartime activities may be encountered. Disturbance could result in significant adverse effects.	Available mitigation includes avoidance of potentially contaminated seabed areas. Identification and avoidance of areas of munitions contamination through site survey at the project stage. If munitions are encountered advice such as that given in Department of the Marine and Natural Resources 2001 (Marine Notice No. 16 of 2001. (i.Explosives picked up at sea in trawls or sighted; and ii. The removal of explosive items from wrecks)) should be followed.	**Negligible**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Protected Sites	**Degradation of protected sites**	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negative – significant adverse**	There are Ramsar, SAC, SPA, NHA and pNHA protected sites within Wave and Wind Assessment Area 4. These sites are all adjacent to the coast, although in some cases (e.g. Blasket Islands SAC and Kenmare River SAC), extend up to 19 km offshore. There is also a UNESCO World Heritage Site (Skellig Michael) situated on the island of Great Skellig. However this does not extend into the marine environment. Significant adverse impacts on protected sites could occur as a result of turbine or export cable installation, through physical disturbance and loss of substratum, or direct disturbance impacts on the species supported in the protected area. Significant adverse impacts could be expected if direct disturbance is caused to Natura 2000 species or habitats that do not recover well, such as saltmarshes or biogenic reef.	Impacts on protected areas could be mitigated by careful site selection avoiding sensitive sites for devices and export cables (i.e. existing and proposed national and European protected sites). Whether avoidance is an appropriate mitigation should be assessed on a site specific basis. A very extensive area is available to site floating wind technology away from protected sites. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of protected sites. However in the case of Assessment Area 4, there is still some potential to locate piled wind arrays, and their export cables away from protected sites. Impacts may still arise through indirect impacts on sediment movements during installation and operation, and would need to be assessed in more detail at the project stage. Possible mitigation measures relevant to the specific interest features of the sites and their seasonal and other sensitivities are described elsewhere in this table for the relevant topic areas.	**Negligible – significant adverse**
	Impacts on protected species	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	Impacts on protected benthic ecology, mammals, birds, fish and reptiles in the zone are covered under the specific species sections of this table.			

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Benthic ecology	**Physical disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Assessment Area 4 is located across an area which has a range of sublittoral sand and mud habitats but also areas of sublittoral bedrock and nearshore exposed rock biotopes. Disturbance to benthic habitat from installation activities would include minor disturbances through bed preparation prior to device foundation installation, disturbances from piling or alternatively from excavation of bed material for gravity foundations, disturbances to sediment from the feet of jack up platforms and disturbances to sediment from cable burial. Localised scouring around the base of wind turbine foundations may cause a loss of benthic habitat or smother the existing habitat due to deepening of seabed. The degree of scour will be dependent upon the final choice of foundation design. Trenching of inter turbine and export cables could cause the greatest levels of physical disturbance with complete displacement of localised benthic communities and temporary smothering of adjacent areas. Impacts would include damage and possible mortality, particularly to smaller, thinner shelled bivalves. Mobile species such as amphipods, gastropods and small crustacea are likely to survive displacement however larger crabs and sea urchins may be crushed from disturbed boulders and cobbles. Permanently attached, sessile species such as bryozoans, sponges and hydroids on areas of coarser substratum cannot reattach to the substratum if removed, and may be damaged or destroyed if substratum is displaced. Physical disturbance will be localised and recoverability of benthic species is expected to be high due to repair and regrowth of damaged individuals and/or recruitment within the community from surviving colonies and individuals. Greater significance can be attached to impacts associated with physical disturbance to species considered to have high sensitivity and / or low recoverability, especially threatened and/or declining species or habitats. Within assessment Area 4 this includes the distribution of key habitats such as intertidal mudflats (Castlemaine Harbour), maerl beds (Tralee Bay, Sneem Harbour, Ardgroom Harbour, Valentia Island, Roaringwater Bay, Bantry Bay, Castle Island Sound and Kenmare River), *Ostrea edulis* beds (Tralee Bay), , sea-pen and burrowing megafauna communities (Kenmare River, Sneem Harbour, Lough Hyne, Bantry Bay and Berehaven, Zostera beds (Tralee Bay, Castlemaine Harbour, Valentia Island, Roaringwater Bay, Castle Island Sound) and potential biogenic and rocky reef habitat including in Roaringwater Bay, the Blasket Islands and Valencia Harbour and Portmagee Channel.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) especially in areas with known sensitive intertidal and subtidal benthic habitats, such as intertidal mudflat, maerl beds and biogenic and rocky reef habitat. Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative – Negligible**
	Smothering	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negative**	Smothering of benthic communities by sediment displaced by activities such as cable trenching may cause a very local decline in biotope species richness due to the loss of more sensitive species due to clogging of their filtration apparatus and potential short term anoxia under the sediment layer. Disturbed sediments should be dispersed rapidly, especially in high energy areas associated with wave resource areas, with only localised impacts associated with displaced sediment. Many of the benthic species associated with areas of sediment such as muddy sand *Nephrops* communities habitat will be adapted to living in a perturbed environment. Smothering impacts will be localised to the immediate vicinity of the seabed disturbing activities during installation.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection). Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**
	Contamination – from sediment disturbance	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negligible**	There is a potential for contaminated sediment, such as from spoil dumping sites to be remobilised during seabed disturbing installation works. It is likely that any habitats with the potential to be adversely affected by contamination from these sites have already been subject to disturbance during the original dredging and deposition of material. Furthermore dredged sediment deposited at disposal sites in the area is thought to be relatively uncontaminated. Fine contaminated material will be diluted and dispersed, settling over a wide area with negligible effect on the Benthic ecology. Coarse material will be rapidly redeposited within the immediate area of installation operations.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) . Avoidance of areas of known potential contamination for seabed disturbing works. Potential effects on areas of unknown benthic habitat will need to be assessed through site survey at the project stage.	**Negligible**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. The water depth is such that small spillages (< 1tonne) are unlikely to affect the benthos. Similarly small spillages from wind 1 are unlikely to come ashore. Large spillages have the potential to have a significant adverse effect, particularly on the intertidal ecology of the adjacent shoreline coastline, for example, upon reef and sediment habitats within Roaringwater Bay and Islands SAC, and d Valentia Harbour and Portmagee Channel SAC (intertidal and submerged reefs). Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on Benthic ecology would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan). Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**
	Changes in wave regime	Operation	• Devices using energy generated by waves	**Wave**	**Significant adverse**	There is potential for a decrease in wave exposure resulting from extraction of wave energy. Wave exposed habitats particularly those facing the full force of the Atlantic swell, and those consisting of mobile sediments, generally show reduced species diversity. These environments are likely to be resilient to the removal of wave energy. Beds and patches of maerl are found in south-west bays including Roaringwater Bay, and in Valentia Harour and Portmagee Channel. Maerl beds and *Modiolus* beds are sensitive to decreases in wave energy. Given the potential for these Priority habitats to be present in wave resource areas, the effects could potentially be of adverse significance.	Avoidance of these important habitats though careful site selection would reduce the potential effects of energy extraction,. Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative**
	Substrate change	Installation Operation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse**	All benthic communities can be expected to be sensitive to removal of their habitat. The long term loss of substratum due to the presence of devices that are attached to the seabed will therefore have a potentially significant adverse effect on any rare or important benthic habitats, such as those protected under the Habitats Directive. There is potential for colonisation of structures leading to increased biodiversity. Although this has potential to be a positive impact, species colonising underwater structures may also lead to undesirable changes in community structure.	Effects on benthic ecology from substratum loss can be reduced through avoidance (careful site selection). Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible - Significant adverse**
Fish and Shellfish	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negative**	Smothering effects are likely to be more of an issue for less mobile (shellfish) than mobile (finfish) species except where finfish species are spawning on the seabed eg herring. Area 4 contains shellfish populations of lobster, edible crab, crayfish, velvet crab, shrimp, *nephrops*, scallops, oysters, and periwinkles. Periwinkles are found throughout the intertidal area of semi-exposed to sheltered rocky shores of the zone but at lesser densities than in Area 3 due to the more exposed nature of much of the coastline. Of these shellfish species which live on, near or in the bottom sediments of the seabed the most sensitive to smothering are oysters and periwinkles. The impact of smothering will be localised to the immediate vicinity of seabed disturbing activities and limited to during installation. Tralee Bay and Brandon Bay are the site of the most significant spawning aggregations of Spider crab in Ireland in early summer.	For devices that require piling, and cable trenching, potential effects could be minimised by using techniques which cause minimal seabed disturbance, and avoiding sensitive seasons for certain species.	**Negligible - Negative**
	Noise	Survey	• Acoustic survey	**Wave Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for fish, in particular fish with swim bladders are particularly sensitive to noise disturbance. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to fish species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) would also minimise any impacts on fish species.	**Negligible**
		Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Wave Fixed Wind Floating Wind**	**Unknown**	High levels of noise such as during pile installation or underwater blasting may cause physiological or displacement effects to marine fish although the extent to which this may occur is unknown. In particular, herring and cod are known to be highly sensitive to noise and may be able to detect piling noise up to 80km. Both species are present in Area 4. It is expected that noise levels from piling and the removal of piled devices will be greater than those generated by operational devices, and although pile driving only occurs during installation the effects may last for longer than the piling activities as fish may not immediately return to the area.	The potential effects of noise from piling or blasting could be reduced through undertaking studies to determine site specific noise effects, and/or avoiding piling or blasting activities during sensitive spawning periods. Where possible less noisy alternatives can be considered such using gravity bases or clump weights, or protecting cables where they cannot be buried with mattressing or rock placement.	**Unknown**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Wave Fixed Wind Floating Wind**	**Unknown**	There is potential for noise from operational devices to lead to long term species displacement which could increase pressures on fish populations in other locations and force fish into predator habitats.	No specific mitigation measures have been identified	**Unknown**
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Wave Floating Wind**	**Unknown**	There is potential risk that all mobile fish species could collide with turbines, moving parts of submerged devices, or mooring chains/cables. Larger animals, such as basking sharks, and pelagic species are considered to be of greater risk. Basking shark and other pelagic fish species are present throughout Area 4. However, due to uncertainties with data and knowledge on the interactions between fish and devices, the potential significance of collision risk effects is unknown.	Potential effects associated with collision risk and fish could be reduced through device design e.g. use of protective nets or grids. Devices could also be sited to avoid sensitive areas e.g. migration routes, spawning and nursery grounds.	**Unknown**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. Small spillages are likely to have a negligible impact. Large spillages, particularly where they impinge on the coastline or enter sheltered bays and loughs could have a significant adverse impact.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Wave Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude fish from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. It is not possible to determine the potential significance of this effect. The presence of offshore wind arrays may also have a positive effect on fish populations through fish stock recovery, should certain types of fisheries be excluded from the array.	No specific mitigation identified	**Unknown**
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Substrate loss could have a significant adverse effect on shellfish (crab, lobster, nephrops, scallop) and benthic spawning finfish species such as herring. The effect on finfish is most likely to be an issue where benthic spawning (e.g. herring) and nursery grounds exist. For more sedentary shellfish species it could have an effect through all life history stages. There is some overlap in the inshore areas of Area 4 between herring spawning and resource areas although not nearly to the same extent as Zones 3, 5 and 6. Area 4 shallow water wave and fixed wind resource areas more or less completely overlap with distribution areas for lobster, edible crab, crayfish, shrimp and to a lesser extent with herring spawning areas. For deeper water wave and floating wind resources there is available space for avoidance and thus	The potential effects of substratum loss on shellfish and benthic spawners could be reduced by avoiding sensitive areas e.g. key shellfish or spawning grounds. Better information on fish and shellfish distribution is required in order to confirm the potential for avoidance mitigation, and identify areas. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts. Targeted surveys by site developers may also be undertaken by individual projects.	**Negative - Negligible**
	Changes in wave regime	Operation	• Devices extracting wave energy	**Wave**	**Unknown - Significant adverse**	Possible changes in water flow associated with removal of wave energy are likely to be restricted to the immediate vicinity of the device/array. Shellfish species are generally sensitive to wave flows.	Available mitigation includes avoidance of important shellfish areas and herring spawning sites.	**Unknown - Negligible**
	Barrier to movement	Operation	• Devices that occupy seabed/water column	**Wave Fixed Wind Floating Wind**	**Unknown**	Some species, such as Atlantic salmon, trout and eels spent part of their lifecycle in freshwater and part at sea. Migration between these two waterbodies is important for the survival of the species. Rivers in Area 4 which have been designated as SACs due to their significant Salmon populations include the Maine, the Laune and the Caragh, The presence of wind or wave devices could present a perceptual barrier to migration, although the exact impacts on fish species is unknown.	Available mitigation includes avoiding placing devices close to the entrances to key spawning rivers.	**Negligible - Unknown**
	EMF	Operation	• Inter-array and export cables	**Wave Fixed Wind Floating Wind**	**Unknown - negligible**	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 renewable array power cable, but the field would not cause an avoidance reaction. Atlantic salmon, eels and sea trout are believed to be sensitive to magnetic fields. However, the level of impact associated with inter-turbine arrays will be more concentrated than those for export cables. There is no evidence to indicate that existing cables have caused any significant effect on migration patterns of these species. However, the significance of potential effects cannot be adequately quantified on the basis of current information.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength.	**Unknown - negligible**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Marine Birds	**Physical disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse - negligible**	There are several seabird breeding colonies within Area 4 with SPA status, including the Bull & Cow Rocks, the Skelligs, Puffin Island, Deenish & Scariff islands and the Blasket islands. Waters in the vicinity of these colonies are important feeding and resting areas for several breeding species occurring in nationally important numbers. At-sea coverage of Area 4 is incomplete, however, high densities (>5 birds/km^2) of Manx Shearwater, Storm Petrel were recorded in inshore waters between July and August, while high densities of Lesser Black-backed Gull and Herring Gull were recorded between February and May. Kittiwake was recorded in high density between August and January, while high density of Razorbills were recorded between August and October. Guillemot density was high in inshore waters for most of the year, except May, June & September. Gannet density was high between February and October, while Fulmar was recorded in high density between February and May. Castlemaine Harbour regularly holds internationally important numbers of Light-bellied Brent Goose in winter, and nationally important numbers of 15 other species. Physical disturbance during construction or decommissioning could lead to short- or long-term displacement of feeding or resting birds, depending on the species involved, and the time of year. Physical disturbance would be likely to be of particular importance close to seabird breeding colonies in the breeding season.	Effects on seabird breeding colonies could be reduced by avoiding sensitive sites e.g. SPAs and by timing installation activities to avoid the most sensitive seasons e.g. breeding and moulting. Site-specific surveys would be required at project level to identify the presence of key foraging hotspots and/or resting areas and to aid site selection.	**Negligible**
	Noise	Installation Decommissioning	• Devices using piled foundations	**Wave Fixed Wind**	**Significant adverse - negative Negative - negligible**	Based on studies of bird behaviour on land it is evident that some species have acute hearing. However, there is limited understanding of birds ability to hear underwater. Although it is not possible to determine the level of significance of noise effects on seabirds, it is likely that impacts arising from operational noise will be less than impacts arising from installation (specifically from piling noise). It is likely that some degree of habituation will occur, depending on the species involved, as has been recorded with terrestrial species nesting in working quarries.	There are some mitigation measures available for piling operations that have been shown to reduce noise e.g. bubble curtains around the pile. The application of these should be reviewed and considered. Piling operations should be timed to avoid the most sensitive seasons e.g. breeding and moulting.	**Unknown Negligible**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Wave Fixed Wind Floating Wind**				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. All seabirds are sensitive to hydraulic fluid and fuel oil contamination. In addition wading birds in estuaries may experience negative effects, if the spill reaches these areas. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine birds could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of Oil Spill Contingency Plans.	**Negligible**
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Wave Fixed Wind Floating Wind**	**Significant Adverse**	Collision impacts could potentially be significant adverse for offshore wind farms, depending on the species involved. Typically, larger, less agile species such as divers, gannets, swans, geese terns and seaducks, have been highlighted as likely to be particularly sensitive to collision with offshore wind turbines (Langston & Pullan 2002). Collision impacts could be significant during spring and autumn if developments are located on a major migration route or flyway.	Available mitigation includes - Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/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 e.g. resting and foraging areas; - Shut-down of turbines at night with bad weather/visibility and high migration intensity; - Avoiding large-scale continuous illumination; - Measures to make wind turbines more recognisable to birds	**Negative – negligible**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Habitat exclusion	Operation	• Devices that occupy sea surface/water column	**Wave Fixed Wind Floating Wind**	**Negative - negligible**	Diving seabirds would be unlikely to collide with underwater cables associated with wave and tidal devices. Collision impacts for operating wave and tidal devices would be negligible.	Appropriate siting of developments e.g. away from important feeding/roosting areas.	**Negligible**
	Barrier to movement	Operation	• Devices that occupy air column to a significant height above sea surface	**Fixed Wind Floating Wind**	**Significant adverse - negative**	If seabirds avoid a development after construction, then the area of avoidance can be considered as lost habitat for the species involved. Seabirds may be displaced from the development area and the surrounding waters, depending on their avoidance response. There is limited information on precise foraging and resting "hotspots" for seabird species around Ireland, although waters adjacent to breeding colonies will be important for these activities during the breeding season. Although birds are mobile and can avoid development sites, the potential effects of doing so may increase competitive pressures on adjacent waters. The energetic costs of site avoidance need to be considered, as do cumulative and in-combination impacts arising from birds avoiding other neighbouring developments. Post-construction habitat loss could therefore potentially have a significant adverse effect during the breeding season and a negative significant effect on seabirds at other times of the year.	Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/roosting areas, nearshore areas and "migration corridors"; Studies would be needed at the project level to identify the presence of key foraging and resting areas in the development area, to aid site selection.	**Negative – negligible**
Marine Mammals	**Physical Disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Negative – Significant adverse**	Large breeding populations of both harbour and grey seals occur throughout Area 4. Many cetacean species, including Annex II listed harbour porpoise and bottlenose dolphins also occur regularly throughout this zone. SACs have been designated in Roaringwater Bay, Blasket Islands, Kenmare River, and Glengarriff Harbour for Annex II listed species in Area 4. The Blasket Islands have been identified as an important breeding and haul-out location for grey seals. Telemetry studies in Area 4 have shown that harbour seals have a limited foraging range, typically within 20km of haul out sites, while grey seals have a much larger offshore foraging distribution. Little information on habitat use is available presently. At-sea distribution and habitat use for cetaceans is unknown, although there are regular sightings along this coast. Harbour porpoise seem to be most abundant along the south-west coast in shallower waters, although this may be related to sighting effort. Much of the potential wind and wave resource in this zone is located close to the coast, and the presence of boat traffic near seal breeding and haul out sites may result in flight behaviour. Increased boat traffic associated with construction and decommissioning will increase ambient noise in the area and may disturb marine mammals. Impacts on seabed flora and fauna could cause changes in food web structure and function and could have negative impacts on top predators in the food web such as marine mammals.	Monitoring surveys would be required to establish distribution of seals and cetaceans at sea in order to design a suitable mitigation plan. Cetaceans may be seasonally abundant in these waters, and the effects of installation activities could be reduced by avoiding certain times of year. The effects of installation activities on seal colonies could be reduced by avoiding the breeding and moulting seasons as well as avoiding development in inshore areas close to seal haul out locations. Disturbance impacts from export cable installation could be avoided by avoiding seal breeding colonies or haul out sites.	**Unknown-Negative**
	Noise	Survey	• Acoustic survey	**Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for marine mammals. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to mammal species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) should be considered.	**Negligible**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Noise	Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Piling and underwater blasting generate high levels of noise. Seals and cetaceans can detect piling noise up to a distance of 80km, and previous studies have demonstrated displacement of porpoises up to 15km during construction of wind farms. Behavioural responses could be expected at 20km, although this will depend on the level of existing background noise. Physiological impacts such as temporary or permanent threshold shift in hearing could occur at distances of 400m for harbour seals, and 1.8km for harbour porpoise. However, evidence suggests that it is unlikely that an animal would choose to remain in close proximity to a source of loud noise that would result in temporary or permanent hearing damage. Noise can mask signals used by cetaceans to navigate, locate prey, and communicate effectively. It is also possible that noise sources may mask biologically relevant signals. The potential for noise to affect marine mammals is therefore considered to be "significant adverse". Increased shipping associated with installation will also raise ambient noise levels in the area.	Monitoring surveys would be required to establish distribution of seals and cetacean at sea in order to design a suitable mitigation plan. Seasonal or area restrictions could also be imposed so noisy activities would be timed not to coincide with sensitive times such as seal moulting or pupping and porpoise breeding seasons. A range of measures are available to further reduce noise impacts including Marine Mammal Observers, exclusion zones, passive acoustic monitoring, pingers, soft starts/ramp up and/or bubble curtains. Consideration could also be given to using non-piled foundations, and protecting cables where they cannot be buried using rock placement or mattressing.	**Negative-Significant Adverse**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Wave Fixed Wind Floating Wind**	**Unknown - Negative**	Wind turbines can produce low frequency noise and vibrations that can pass into the water column and can potentially affect seals and cetaceans ability to navigate, locate prey and communicate. Operational noise from wind turbines may be heard by seals and porpoises up to 200m, and simulated noise from a 2MW wind turbine has resulted in avoidance behaviour by harbour seals and harbour porpoises. The noise impact of wave devices on marine mammals is not well researched and understood. The cumulative effect of many wind turbines or wave installations operating together or when combined with operational noise from other marine use is unknown.	Noise from operating turbines can be reduced by efficient design, reducing vibration, and using isolators.	**Unknown**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Negligible - negative**	Marine mammals can potentially collide with vessels and equipment used during installation. Increased shipping activity during installation will increase this risk. Generally most fatal injuries arise with collisions with ships travelling over 13kts. Vessels associated with construction activities would usually not be travelling at these speeds.	Consider setting speed limits for construction vessels operating in sensitive areas. Establish a code of conduct to avoid disturbance to marine mammals both during construction activities and in transit to the construction area if entering areas of high abundance.	**Negligible**
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Wave Floating Wind**	**Unknown - negative**	Risk of collision with wind turbines is small for seals and small cetaceans, since pylons are large and static. However collision may be a concern for larger baleen whales, which do not have the manoeuvrability of smaller cetaceans. All marine mammals may have difficulty detecting the presence of mooring/tethering cables for wave devices, as well as floating wind devices in deeper water. These cables are likely to have a small cross-section and provide fewer sensory cues to approaching mammals, so the risk of collision for these types of installation will be greater. The impact of wave devices on marine mammals is poorly researched, but floating devices may attract seals as potential haul out locations, with associated risk of injury from moving parts. While a number of cetacean species occur in both inshore and offshore waters in this zone, abundance and habitat use is unknown, so the collision risk with offshore renewable energy installations is difficult to quantify.	Measures to make turbine foundations more visible to marine mammals could reduce the risk of collisions. Consider the use of acoustic pingers/deterrents on mooring/tethering lines.	**Unknown - negative**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants, or hydraulic fluids during installation could have an adverse effect on marine mammal health. A collision between ships or between a ship and an offshore renewable installation could result in fluid spills which could have serious environmental consequences. While the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine mammals would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Habitat exclusion	Operation	• Devices that occupy sea surface/ seabed/ water column	**Wave Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude mammals from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. The cumulative effect of many installations within an area is unknown. Displacement of fishing activity during installation and operation may result in increased resource competition between fisheries and marine mammals in non-impacted areas. Installations may however, provide increased habitat as artificial reefs and attract fish aggregations that may provide increased foraging opportunities for marine mammals, or temporary haulouts for seals.	Surveys of habitat use by marine mammals and avoid heavily used areas and migration corridors.	**Unknown**
	Barrier to movement	Operation	• Devices that occupy sea surface/ seabed/ water column	**Wave Fixed Wind Floating Wind**	**Unknown - Significant adverse**	The presence of large arrays may cause a barrier effect for migrating marine mammals. The importance of Area 4 for marine mammal migration is unknown, so barrier effect is difficult to quantify.	Detailed study would be required to examine coastal distribution in order to mitigate for this risk and avoid large installations in migratory corridors.	**Unknown - Significant adverse**
	EMF impacts	Operation	• Inter-array and export cables	**Wave Fixed Wind Floating Wind**	**Unknown - negligible**	There is only circumstantial evidence that cetaceans have ferromagnetic organelles capable of determining small differences in relative magnetic field strength. Magnetic fields could potentially affect animals using geomagnetic cues during migration. However, cetaceans regularly cross cables, and there is no apparent evidence that existing electricity cables have influenced cetacean migration. The level of impact associated with inter-turbine arrays will be more concentrated than those for export cables and further study is required before this impact can be fully understood.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength, where possible	**Unknown - negligible**
Marine Reptiles	**Collision**	Installation Decommissioning	• Vessels and equipment used for installation and decommissioning	**Wave Fixed Wind Floating Wind**	**Negative**	Assessment Area 4 is an important area for leatherback sea turtles (historically Counties Cork and Kerry have the highest and second highest number of turtle records respectively, with many of the Cork records coming from a single observatory from Cape Clear). Many leatherbacks have also been sighted far off shore. One of the main threats to marine turtles in Irish coastal seas is entanglement in mooring ropes (for pot fisheries) and subsequent drowning. It is not known how mooring chains/cables used in operating devices impact on turtles but it's likely they offer more of a collision risk than entanglement. Turtles may be less likely to collide with large installations but much is unknown about how sea turtles especially leatherbacks interact with man made barriers/obstacles. There is a slight possibility that leatherback turtles could swim into operating devices as they are generally oceanic animals unaccustomed to solid structures. Loggerheads are more likely to swim around such structures. Sea turtles can potentially collide with vessels and equipment used during installation, and devices during operation. Increased shipping activity transiting to the area during installation will increase this risk.	Possible mitigation includes planning installation to take place at times when there are fewer turtles present (December-May) or avoiding known areas of high abundance. Arrays could also benefit sea turtles as such installations may provide habitats for jellyfish polyps (as has been shown for marinas) and subsequently lead to an increase in jellyfish abundance (turtle food). Site specific survey to identify areas of high turtle abundance, and avoidance of such areas.	**Negligible - unknown**
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Wave Floating Wind**				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants and hydraulic fluids could have an effect on turtle health. Although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine reptiles would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Barrier to movement	Operation	• Devices that occupy sea surface/water column • Vessels and equipment used for installation and decommissioning • Turbines/moving parts of devices	**Wave Floating Wind**	**Unknown**	The movement of marine turtles around the coast of Ireland is unknown so it is difficult to quantify the level of barrier effect. However arrays could be perceived as a barrier affecting turtle movements or routes to feeding areas. For example, leatherbacks swimming past Cape Clear Island all swim in a westerly direction so an array placed in a north-south bearing would increase the likelihood of the barrier effect. Arrays could potentially corral turtles into a corner/trap that they may not be able to get out without human intervention.	Orientating arrays parallel to the coastline rather than perpendicular to the coastline may help minimise a barrier effect as turtles swim past. No other mitigation measures identified.	**Unknown**
	Noise	Installation Decommissioning	• Devices using piled foundations • Underwater Blasting	**Wave Fixed Wind Floating Wind**	**Unknown**	Avoidance responses of sea turtles to low frequency sounds have been demonstrated, however, the study of sensory biology in sea turtles is still in its infancy, so there is a large unknown component.	No specific mitigation identified.	**Unknown**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Wave Fixed Wind Floating Wind**				
	EMF impacts	Operation	• Inter-array and export cables	**Wave Fixed Wind Floating Wind**	**Negligible - Unknown**	Sea turtles may be able to detect EMF fields such as those generated by export and interturbine cables and thereby could adversely affect turtles using geomagnetic cues during foraging and migration, although the importance of these cues remains unclear. However, as turtles are generally present at the surface and in the water column, they are unlikely to come into close proximity with the EMF field at the seabed.	EMF impacts could be reduced through ensuring that cables are buried, reducing the EMF at the seabed. Cable design and orientation to minimise generated EMF.	**Negligible - Unknown**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Wave Fixed Wind Floating Wind**	**Neutral**	The construction of arrays in jellyfish hotspots could exclude turtles from this critical habitat. In this zone jellyfish populations are likely to be extremely widespread (over 10-100kms) and composed of several different species, but by providing new habitat for jellyfish polyps, arrays could actually increase the abundance of jellyfish in adjacent waters through a process of advection.	No specific mitigation identified.	**Neutral**
Marine and coastal archaeology and wrecks	**Direct disturbance of unknown and known sites**	Installation	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**	Area 4 includes areas where there is a potential for early settlement sites, although preservation is probably limited to sheltered, inshore waters. There are numerous recorded wreck sites along the adjacent coastline and within Area 4. There is potential for the installation of wind and wave devices and export cables to impact submarine archaeology through direct disturbance of known and unknown sites on the seabed, or through changes to sediment movements causing an artefact to become buried and preventing later discovery. There are a large number of National Monuments on the adjacent coastline including those in State care. Locally, regionally and nationally important archaeological remains and sites are also present along the coast. Numerous listed buildings are also present on the coastline adjacent to the area. Cable installation in the vicinity of these protected sites could cause direct destruction of archaeologically important features. All archaeological monuments and wrecks greater than 100 years old are protected under the National Monuments Acts 1930 – 2004. Wartime wrecks are not currently covered under the Acts but are likely to be included in the near future.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Avoid sites of interest and exclusion zones for marine archaeology. Submit any artefacts recovered to the National Monuments Service. For known submarine and terrestrial sites the main form of mitigation is to avoid protected and other sites of interest. In addition to desk based studies it will be necessary to carry out field walkovers in preferred terrestrial site locations to determine need for site investigations (geophysical surveys/trial trenching) in consultation with the National Monuments Service and Local Authorities. With respect to cabling there is considerable opportunity to avoid or reduce effects. The siting of export cables will be important in determining their residual impact.	**Negligible**
	Changes to sediment regime	Operation	• Devices using seabed foundations • Devices using energy generated by waves	**Wave Fixed Wind Floating Wind**	**Significant adverse - Positive**	Area 4 includes areas where there is a potential for early settlement sites and unrecorded wrecks. Changes in sedimentation may either expose or increase the burial depth of archaeological features at such sites. Where sites are exposed there is a potential for discovery of or damage to or loss of artefacts or sites. Where features subject to deeper burial, the potential for discovery of or damage to artefacts or sites is likely to be decreased.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
	Data acquisition	Installation	• Pre-installation survey	**Wave Fixed Wind Floating Wind**	**Unknown**	There is a potential for archaeological sites and wrecks to be discovered within Area 4 as a result of site surveys, providing additional data for inclusion in the archaeological record of the area.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
Commercial Fisheries	**Direct disturbance**	Installation Decommissioning	• Devices using seabed foundations	**Wave Fixed Wind Floating Wind**	**Negative to Significant adverse**	Although direct disturbance may have an impact on all fishery types it is likely to be more significant in the case of shellfish than finfish as shellfish are generally much less mobile.	Potential impacts could be minimised through avoiding peak fishing periods.	**Negative**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
			• Cable trenching/removal			Shellfish fisheries which may be impacted in Area 4 include edible crab, lobster, shrimp, spider crab, Nephrops, scallop and crayfish. The edible crab and Nephrops fisheries generally extend further offshore while other shellfish fisheries in the Zone are mainly restricted to the nearshore area within the sheltered bays. Inshore finfish grounds are however also sensitive to direct disturbance as these are generally exploited by small vessels which are less able to exploit alternative grounds. Finfish spawning grounds for the following species exist within Area 4 which may be subject to direct disturbance: Herring, Whiting, Megrim and Haddock.	The potential for avoiding key commercial fishing grounds may be limited due to the widespread nature of fishing activity in the zone. Early liaison with the fishing industry could help identify key fishing areas, particularly in the area where there is a lack of fishing effort distribution information for vessels under 15m. The effects could also be minimised by using procedures and structures that minimise the area of seabed disturbed for turbine foundations.	
	Temporary displacement from traditional fishing grounds	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Negative**	Inshore fishing grounds tend to be more constrained than offshore areas. Temporary displacement from these areas may lead to the concentration of fishermen in smaller areas, fishermen being unable to fish for short periods or fishermen being displaced to alternative, possibly less productive fishing grounds. Temporary displacement will potentially have a negative effect on commercial fisheries.	Effects can be reduced by phasing construction activities to specific areas within Area 4. The potential for avoiding key commercial fishing grounds may be limited due to the widespread nature of fishing activity in the zone. Liaison with the fishing community to keep them informed of installation operations is also key to managing the level of this impact.	**Negative - negligible**
	Long term displacement from traditional fishing grounds	Operation	• Devices that occupy sea surface/water column/seabed	**Wave Fixed Wind Floating Wind**	**Significant adverse**	All types of commercial fisheries could be affected by long term displacement from traditional fishing grounds. The potential effects could be of adverse significance for spatially constrained inshore fisheries and for bottom trawl and pot fisheries which may be restricted by installations and cable routes. Conversely, long term exclusion of mobile gear from the area could be of benefit to fish stocks in the wider area although spillover effects, particularly for mobile fish species are poorly understood. The key bottom trawl fisheries in Area 4 are for Monkfish, Megrim, Black Sole, Plaice, Hake, Haddock, and *Nephrops*, crab, lobster and shrimp are exploited by pots, crayfish by fixed bottom set nets, while oysters and scallops are exploited by mechanical dredging gear. The effects of long term displacement on trawl fisheries in particular will depend on the scale of the arrays and the extent to which fishing vessels are excluded from the area. Use of rock armour, if required for cable protection, will introduce an obstruction for trawling activity, but could also create new habitat which could have a positive impact of fish stocks.	Potential impacts could be minimised through spacing of turbines at wide enough intervals to permit use of mobile fishing gear. The potential for avoiding key commercial fishing grounds is particularly limited for fixed wind and shallow water wave installations due to the ubiquitous nature of inshore and shallow water fishing activity in the zone. For floating wind and deeper water wave devices there may be some potential for avoidance. Early liaison with the fishing industry could help identify key fishing areas, particularly in the area where there is a lack of fishing effort distribution information for vessels under 15m. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts on commercial fisheries.	**Significant adverse - negative**
Aquaculture	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negligible**	Area 4 contains extensive shellfish cultivation areas for mussels, Pacific oysters, scallop and urchins which could be adversely affected by any significant and prolonged rise in suspended solids. However, increases in suspended sediment is expected to be short term and localised to the immediate vicinity of the seabed disturbing works. Intrusion of sediment plumes into aquaculture areas would therefore only result if the export cables were routed in the immediate vicinity. There could therefore be a negligible impact from offshore energy development.	Impacts from cable trenching could be reduced by using procedures that minimise the mobilisation of suspended solids, such as plough installation.	**Negligible**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Shellfish are highly sensitive to reductions in water quality caused by hydraulic fluids or tainting from other chemical substances. There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. It should be noted that the quantity of hydraulic fluid in devices is likely to be very small, reducing the potential for significant environmental effects. Therefore, although the likelihood of accidental contamination from devices is low, the potential effects of any significant intrusion of hydraulic fluids into aquaculture production areas could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, and contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Shellfish production in Assessment Area 4 could be adversely affected should installations be sited in or cables routed through shellfish cultivation areas.	The key mitigation measure in terms of reducing effects on shellfish farms is avoidance. In practice, consent is unlikely to be achievable to site renewable energy arrays or cables within existing fish farms.	**Negligible**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Ports, Shipping and Navigation	**Displacement of shipping**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**	Shipping intensity in Area 4 is generally moderate to low with a clearly defined route of higher vessel density parallel to the coastline. Bantry Bay and Castletownbere are the only commercial ports in Area 4. The shipping intensity in the approaches to these ports would be higher. Patterns in shipping density imply that vessels use distinct routes through the Assessment Zone. The Fastnet Rock TSS is located in the west of Area 3 overlapping the wind resource and partially overlapping wave resource. Siting of devices in approaches to the TSS or within the TSS itself is prohibited as part of the 'Offshore electricity generating stations – note for intending developers' and would have a significant adverse impact on shipping. The re-routing of vessels to avoid safety zones (during installation), operational devices and decommissioning activity would result in greater transit time and use of fuel, with the associated costs to the vessel operator, and could lead to displacement of vessels to areas that already have moderate vessel densities, potentially having knock-on impacts on collision risk, trade/supply and visibility. The effect of displacement of shipping would potentially have a significant adverse to negative impact in Area 4.	The potential for these effects to be reduced would depend entirely upon the ability to site devices in relation to key routes for shipping. Potentially significant adverse effects could be reduced or avoided by siting devices away from areas of high vessel densities. There appear to be areas within Area 4 that could accommodate both floating wind structures (deeper than 60m), fixed wind turbines, in the 10-60m depth region, and wave devices without causing significant displacement of shipping. The scale of potential effect on vessel traffic will need to be investigated further as part of project specific EIAs.	**Negligible - Negative**
		Operation	• Devices that occupy sea surface/water column	**Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**			**Negligible - Negative**
	Decreased trade/supply	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Bantry Bay and Castletownbere are the only commercial ports in Assessment Area 4, both of which are located within the inlet of Bantry Bay. There are also numerous fishing ports along the coast of Area 4, Castletownbere and Dingle being the busiest. The west Ireland coastline is characterised by small islands, bays and inlets, between which access is often essential for local communities. The presence of installation/maintenance vessels, presence of devices and decommissioning activity could create temporary to long-term reductions in access to ports and harbours. Reduced access to the harbours mentioned above could have a significant adverse effect on local communities in terms of goods transport and accessibility.	Site selection for device arrays should take into account the requirement for continued access to port and harbours. There is limited potential to site fixed wind arrays away from the entrances to ports and harbours and there could therefore be an impact on accessibility, trade and supply. However there is sufficient floating wind and wave resource to site devices away from the entrances to ports and harbours and thereby avoid impacting on accessibility, trade and supply. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance and decommissioning.	**Negligible - Negative**
		Operation	• Devices that occupy sea surface/water column	**Wave Fixed Wind Floating Wind**	**Significant adverse**			**Negligible**
	Reduced visibility	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Vessels and other equipment used during the installation/maintenance/ decommissioning of devices, and the operational devices themselves could obstruct views of other vessels and navigation features such as buoys, lights and the coastline. This is particularly important in areas of high vessel densities, constrained channels or areas where there is particular dependence on visual navigation aids as reduced visibility increases the risk of collision with other ships and other structures in the water (natural and manmade). The effect of reduced visibility will potentially be significant adverse in Area 4 due to the constrained nature of this area (islands and channels), the presence of a distinct shipping route and the entrances to numerous ports and harbours.	Significant adverse effects associated with reduced visibly can be reduced by avoiding areas of high vessel densities and areas constrained by land e.g. adjacent to the entrances of ports and inlets. In busy shipping areas, potential effects may be reduced by using fully submerged wave devices which have minimal restrictions on visibility. Also minimising the period of installation, the number of vessels required and the area occupied during installation would reduce the potential impact on visibility. Any vessels and devices should be lit and marked in accordance with the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) guidelines, in agreement with the Commissioners of Irish Lights.	**Negligible**
		Operation	• Devices that occupy sea surface	**Wave Fixed Wind Floating Wind**	**Significant adverse**			**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. The impact on collision of siting devices in Area 4 would be significant adverse to negative. This is due to the constrained coastline (numerous inlets and islands) and the presence of a distinct shipping route, all relatively close to shore, however, as distance from shore increases the collision risk decreases. The significance of the impact will also increase dependent on the number of arrays which could potentially be present on either side of the channel, restricting potential for vessels using the main shipping lanes to re-route in emergencies.	The risk of collision could be reduced by avoiding areas of high shipping densities, regularly used shipping routes and constrained stretches of coastline. There is sufficient floating wind, and wave resource within Area 4 to site devices away from these areas. There would appear to be limited potential to site fixed wind turbines in the 10 – 60 m depth region away from the entrances to ports and harbours. In busy shipping areas, potential effects may be reduced by minimising the period of installation, the number of vessels required and the area occupied during installation. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance, and decommissioning.	**Negligible - Negative**
		Operation	• Devices that occupy sea surface/water column	**Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**			**Negligible - Negative**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Recreation and Tourism	**Access Restrictions**	Installation Operation Decommissioning	• Structures in the sea reducing or excluding access	**Wave Fixed Wind Floating Wind**	**Negative**	The key receptor is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs. Offshore wind or wave developments in this zone, if located on routes used by recreational yachting could cause vessels to re-route, or restrict access to key areas. There are also 'surf spots' along the coastline in Area 4 which wave devices located close to the shore could restrict access to.	There is the potential to avoid impacts through locating wave devices away from existing cruising routes and surf spots. A very extensive area is available to site floating wind technology away from cruising routes. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of cruising routes. However in the case of Assessment Area 4 there is still some potential to locate piled wind arrays, and their export cables away from cruising routes. The use of wave device types which lie below the surface at a depth below the maximum draft of recreational vessels in a given area could also mitigate this impact. This mitigation measure is not available for offshore wind sites, however.	**Negligible - Negative**
	Noise	Installation Decommissioning	• On and offshore machinery and vessels	**Wave Fixed Wind Floating Wind**	**Negative**	There are numerous Blue Flag beaches, wildlife watching areas and 'surf spots' along the coastline in Assessment Area 4. Noise from machinery and vessels has the potential to impact on the use of beaches that are close to the source of the noise and also impact on wildlife in the area. However any noise from installation or decommissioning will be limited to the duration of construction activities. Piling is a particularly noisy activity, and greater significance impacts will be associated with this activity. Noise from operation will be longer term; however noise levels during operation will to be significantly lower than during installation or decommissioning. Impacts associated with piled wind will be located closer inshore and are likely to be of greater significance compared to floating wind developments located further offshore	Mitigation measures aimed at reducing or avoiding disturbance to recreation could include timing particularly noisy activities such as piling to avoid key recreational periods.	**Negative**
		Operation	• Turbines/flexing joints/device components above sea surface		**Negligible - Negative**			**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Negative**	The key receptor is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs. The location of offshore wind or wave developments close to yachting areas could potentially increase collision risk, especially if located in areas where ability to manoeuvre is restricted by other factors such as water depth. There is also collision risk associated with the installation vessels.	There is the potential to avoid impacts through locating wave devices away from existing cruising routes. A very extensive area is available to site floating wind technology away from cruising routes. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of cruising routes. However in the case of Assessment Area 4 there is still the potential to locate piled wind arrays, and their export cables away from cruising routes. The use of wave device types which lie below the surface at a depth below the maximum draft of recreational vessels in a given area could also mitigate this impact. This mitigation measure is not available for offshore wind sites, however. Safety measures including lighting and marking and informing users of the locations of devices will help to negate any potential impact.	**Negligible**
		Operation	• Devices that occupy sea surface/water column		**Negative**			**Negligible**
	Disturbance to Wildlife	Installation Operation Decommissioning	• Installation/decommissioning activity • Devices that occupy seabed/ sea surface/water column	**Wave Fixed Wind Floating Wind**	**Negative**	Effects on local tourism would occur where disturbance and/or exclusion from an area overlaps with the locations frequented by visitors and touring vessels. The south coast of Ireland is considered to be of moderate importance for recreational wildlife watching in comparison to the west coast of Ireland where there are many more areas used for wildlife watching.	There is the potential to avoid impacts through wave devices away from existing cruising routes. A very extensive area is available to site floating wind technology away from tourism and recreational areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of tourism and recreational areas. However in the case of Assessment Area 4 there is still the potential to locate piled wind arrays, and their export cables away from tourism and recreational areas. Other mitigation measures aimed at reducing or avoiding disturbance to wildlife including sea mammals and birds is set out in the relevant parts of this table.	**Negligible - negative**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Aviation	**Collision**	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Negative**	There are two aerodromes in the vicinity of Assessment Area 4 (both civil). Assessment Area 4 is partially covered by the Valentia Search and Rescue region. The main collision risk is with the Search and Rescue activities that are ongoing in this area.	Available mitigation includes ensuring wind devices are lit with aviation lights in accordance with OAM 09/02 "Offshore Wind Farms Conspicuity Requirements". As required under the Obstacles to Aircraft in Flight Order, S.I. 215 of 2005, notification of the erection of wind devices provided to the IAA.	**Negligible**
	Radar Interference	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Unknown - negative**	There are currently no "potential to interfere" areas set out for Irish waters and therefore it is difficult to accurately state how much of Assessment Area 4 would fall within these areas. There is likely to be a negative impact on aviation either from intermittent detections of turbines by air traffic controllers or from "shadowing" where radar signals become weaker behind turbines.	Consultation with the IAA will be required and the location of wind devices supplied so they can be accurately plotted on the radar and any signals received from that area will not be confused with aeroplanes.	**Negligible**
Military Activity	**Disruption to general activities**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Assessment Area 4 overlaps with Department of Defence danger area D14, located off the coast of Bantry Bay in the middle of the Zone. There are no other danger areas in Area 4 but military use may include fishery protection and search and rescue operations. The development of offshore renewables in Department of Defence danger areas is not permitted (Department of Communications, Marine and Natural Resources, 2000) and therefore the impact must be considered as significant adverse.	Development within Department of Defence danger areas is prohibited and so avoidance is a required mitigation measure. The area overlaps both wind and wave resource although there is sufficient resource in the Zone to accommodate devices outside of the danger area. Consultation with the Department of Defence will be undertaken as part of project specific EIA.	**Negligible**
		Operation	• Devices that occupy sea surface/water column					
Cables and Pipelines	**Direct damage**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Only the Hibernia Atlantic 'D' telecoms cable passes through the Area 4, located to the south. Direct damage to this cable could occur during installation of device arrays and cables but also could occur during maintenance and decommissioning. The impact is considered to be significant adverse (should it occur) as international telecommunications could be seriously disrupted.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**No effect**
	Access restrictions	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential that the presence of devices in waters close to the existing cable could restrict access to the cables for maintenance purposes. Due to the potential implications for telecommunications supply, the significance of this effect, if it occurred, could be significant adverse.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Dredging and Disposal areas	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Negative**	There are three dredge disposal sites, two fish waste disposal sites and one rock dredge disposal site within Assessment Area 4. Construction operations and the presence of wind and wave devices have the potential to restrict normal access to these sites. There are no existing aggregate dredging areas within Assessment Area 4 and no areas have been identified as areas that could potentially be exploited for aggregate extraction. There is potentially a negative impact from wind device installation restricting access to potential future dredging grounds	There is the potential to locate wave devices away from existing dredging and disposal areas. A very extensive area is available to site floating wind technology away from existing dredging and disposal areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of existing dredging and disposal areas. However in the case of Assessment Area 4 there is still the potential to locate piled wind arrays, and their export cables away from existing dredging and disposal areas.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Existing Renewable Infrastructure	**There is no existing offshore renewable infrastructure in Area 4**							
Natural Gas and CO_2 Storage	**Sterilisation of region**	Operation	• Devices using seabed foundations	**Wave Fixed Wind Floating Wind**	**Unknown**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for CO_2 or natural gas storage. There is currently insufficient data to establish potential for use of the marine environment for storage of CO2. Therefore, whilst no sites are currently under consideration for natural gas or CO_2 storage in this zone, the significance of this possible future impact is unknown.	None identified	**Unknown**
Oil and Gas Activity	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Unknown**	There are currently no areas of active oil and gas development in Assessment Area 4 and no areas that have been marked as being either a 'Licensing Option', 'Exploration Licence' or 'Petroleum Licence' area. The impacts on possible future oil and gas developments are impossible to quantify at this stage.	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices and there is the potential to locate devices where they will have minimal, if any impact on oil and gas activity.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**No impact**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. There are currently no areas of active oil and gas development in Assessment Area 4 and no areas that have been marked as being either a 'Licensing Option', 'Exploration Licence' or 'Petroleum Licence' area.	None identified	**Unknown**
		Operation	• Devices that occupy sea surface/water column					**No impact**
	Sterilisation of region	Operation	• Devices using seabed foundations	**Wave Fixed Wind Floating Wind**	**Unknown**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for oil and gas exploitation. There is currently insufficient data to establish possible future exploitation of oil and gas from this zone. As it is possible that future oil and gas activities may take place in this zone is it not feasible to rule out any potential impacts from offshore renewable devices. However the impacts on possible future oil and gas developments are impossible to quantify at this stage.	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices.	**Unknown**
Seascape Effects	Effects on seascape type 2 Rugged Peninsulas	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast)	Offshore Wind Zone 4 is situated on the south west coast along the outer coast lines of peninsulas and narrow bays. This seascape type is highly distinctive and is described below: 2. Rugged Peninsulas - Long rugged hilly or mountainous ridges are separated by large V shaped drowned valleys narrowing towards the valley head. The outer bay seascape is exposed with rocky promontories and islands. Inner bays are sheltered with numerous small islands and fertile and low lying land sloping down to the shore. The steep exposed wild coastline with long peninsulas, sounds and islands provides a range of seascape scales and dramatic sea views ranging from small scale tranquil inner lochs and bays to rugged headlands with expansive open views.	Potential adverse effects on seascape can be reduced through the sensitive siting of offshore wind farms. Key factors to be considered in locating an offshore wind farm include: • Wind farms should not be sited where they appear to block or close the entrance to bays/loughs/narrows/sounds or where they separate a bay from the open sea; • Wind farms should reflect the shape of the coastline and align with the dominant coastal edge;	TBC
					Substantial to Moderate Effect (between 15km and 24km from the coast)			

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Seascape Effects	Effects on seascape type 2 Rugged Peninsulas	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Moderate to Slight Effect (between 24km and 35km from the coast)	There is one national level landscape designations along the coast in this area. WHS - Skellig Michael, (Kerry) Designated for outstanding cultural value as a very early monastic site and remote hermitage The Skelligs are steep rocky volcanic islands situated 12k south west of Inveragh Peninsula. The wild and dramatic setting of the ancient monuments is an integral part of the character and atmosphere of the WHS. Killarney National Park (Kerry) situated between Mangerton Mountain and the MacGillicuddy Reeks has distant views to the Kenmare River inner bay. Parts of this coastline are also covered by a number of county level landscape designations including: • Rural Prime Special Amenity Areas (Kerry) • Rural Secondary Special Amenity (Kerry) • Identified views and prospects (Kerry) • Areas of Very High Landscape Value (Cork) • Areas of Very High Sensitivity (Cork) • Scenic Areas and Scenic Routes (Cork) The coastline of Assessment Zone 4 is made up of exposed and rugged peninsulas and headlands with expansive elevated views and sheltered inner sounds with small scale views framed by landmass, the character is mainly rural with areas of wildness. The complexity and distinctiveness of this seascape make it highly sensitive to development of this type with potential effects in within 0 to 24km from the coast, could range from Substantial to Moderate depending on where wind farms are sited, reducing from Moderate to Slight Neutral between 24km and 35km. For example the intrusion of wind device characteristics into the narrow horizon of the long incised bays between peninsulas would increase local sensitivity; conversely sensitivity may be reduced in some locations by distance and the wide horizons of the outer shore. The wild and dramatic setting of the ancient monuments of Skellig Micheal is an integral part of the character and atmosphere of the WHS therefore local sensitivity would be increased in this area. At distances greater than 35 km dependent on distance and location effects are likely to be Slight Neutral as atmospheric conditions and elevated viewpoints from the rugged hinterland the peninsulas may increase visibility thresholds.	• Wind farms should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate; • Wind farms should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Wind farms should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms; • Consideration should be given to locating devices in already industrialised and developed seascapes;	**Substantial/ Moderate to Substantial (depending on distance from shore – see Figure 12.15 for more information)**
	Effects on seascape type 2 Rugged Peninsulas	Operational	Arrays of on-surface linear structures	Wave	Substantial to Moderate Substantial Effect (between 0 and 5km offshore from the coast)	Offshore Wave resources Zone 4 the south west coast along the inshore waters of peninsulas and outer bays. This seascape type is highly distinctive and is described below: 2. Rugged Peninsulas - Long rugged hilly or mountainous ridges are separated by large V shaped drowned valleys narrowing towards the valley head. The outer bay seascape is exposed with rocky promontories and islands. Inner bays are sheltered with numerous small islands and fertile and low lying land sloping down to the shore. The steep exposed wild coastline with long peninsulas, sounds and islands provides a range of seascape scales and dramatic sea views ranging from small scale tranquil inner lochs and bays to rugged headlands with expansive open views.	Potential adverse effects on seascape can be reduced through the sensitive siting of wave device arrays and fixed coastal structures. Key factors to be considered in locating a wave array include: • Wave arrays should not be sited where they appear to block or close the entrance to bays/loughs/ narrows/sounds or where they separate a bay from the open sea; • Wave arrays should reflect the shape of the coastline and align with the dominant coastal edge;	**Moderate to Substantial depending on distance from shore (see Figure 12.16 for more information)**
					Moderate Substantial to Moderate Effect (between 5km and 10km from the coast)			
Seascape Effects					Moderate to Slight Effect (between 10km and 15km from the coast)	There is one national level landscape designations along the coast in this area. WHS - Skellig Micheal , (Kerry) Designated for outstanding cultural value as a very early monastic site and remote hermitage The Skelligs are steep rocky	• Wave arrays should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate;	

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Effects on seascape type 2 Rugged Peninsulas	Operational	Arrays of Oscillating submerged structures connecting to onshore generator	**Wave**	(between 0 and 5km offshore from the coast)	volcanic islands situated 12k south west of Inveragh Peninsula. The wild and dramatic setting of the ancient monuments is an integral part of the character and atmosphere of the WHS. Killarney National Park situated between Mangerton Mountain and the MacGillicuddy Reeks has distant views to the Kenmare River inner bay. Parts of this coastline are also covered by a number of county level landscape designations including: • Rural Prime Special Amenity Areas (Kerry) • Rural Secondary Special Amenity (Kerry) • Identified views and prospects (Kerry) • Areas of Very High Landscape Value (Cork) • Areas of Very High Sensitivity (Cork) • Scenic Areas and Scenic Routes (Cork) The coastline of Assessment Zone 4 is made up of exposed and rugged peninsulas and headlands with expansive elevated views and sheltered inner sounds with small scale views framed by landmass, the character is mainly rural with areas of wildness. The complexity and distinctiveness of this seascape along with elevated viewpoints from the rugged hinterland of the peninsulas make it sensitive to development of Wave (linear on surface) Devices with potential effects in certain locations within 0 to 10km from the coast that could range from Substantial to Moderate Substantial depending on where the arrays are sited, dropping to Moderate to Slight effects between 10Km- 15 Km. The wild and dramatic setting of the ancient monuments of Skellig Micheal is an integral part of the character and atmosphere of the WHS therefore local sensitivity to offshore development would be increased in this area. At distances greater than 15 km effects are likely to be slight to Neutral dependent on location, as in some locations atmospheric conditions and elevated viewpoints may increase visibility thresholds. Sensitivity to wave (oscillating surge) devices is largely dependent on the scale form and pattern of the coastal edge as these devices are located in inshore waters. There is also the effect that a wave (oscillating surge) device may have on a sense of remoteness or wildness. Due to the lower profile and intermittent visibility of offshore elements effects of offshore structures are likely to be less than the effects of linear wave devices, however the effects of fixed onshore elements of the device will remain constant and may be the most noticeable element of the device. There may be potential in some locations to reduce or localise effects through careful siting and use of topography to conceal fixed structures. Type 2. Rugged Peninsulas has a low capacity for Wave (Oscillating Surge) devices at 0- 5km due to the combination of extensive and elevated panoramic views from headlands and hinterland with the complex coastal edge and reduced seascape scale of drowned valleys . The topography would potentially render devices in inshore waters visually prominent over an extended area with potential for onshore fixed structures to conflict with vulnerable and unique seascape qualities. Potential effects of Wave (Oscillating Surge) devices on type 2 Rugged Peninsulas at 0- 5km is therefore substantial.	• Wave arrays should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Wave arrays should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms; • Consideration should be given to locating devices in already industrialised and developed seascapes. • Avoid siting fixed coastal structures where they will conflict with the landscape character of the coastal edge or form dominant features visible over an extensive area	
Climate	Carbon Impacts	Operation	Wind turbines and wave devices	**Wind and wave**	**Positive**	It is recognised that development of offshore renewable energy developments will contribute towards achieving the Ireland's target for 40% energy to be provided from renewable energy sources. In meeting this target Ireland will be working towards the wider European and international commitment to combat global climate change and reduce the potential associated adverse environmental effects e.g. changing population distributions, species extinction, sea level rise etc. However, whilst seeking to combat climate change there is also a need to respond to it in terms of: • Protecting the existing environment and increasing its robustness and ability to adapt to climate change • Protecting existing and future infrastructure from effects of climate change e.g. increased storm events , flooding and sea level rise	Ensure that coastal infrastructure is sited in locations that are at lower risk from flooding, sea level rise and storm damage and do not increase the risk of flooding or damage to coastal infrastructure elsewhere. This will require close consultation at the project design stage with the relevant land use planning authority.	**Positive**

Table Appendix G4: West Coast – South (Area 4: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Carbon Storage	Installation Operation	Wind turbines and Wave devices	**Wind and Wave**	**No effect**	Based on current available information no existing or proposed carbon or gas storage sites have been identified within this area (Assessment Area 4) therefore there will be no effect resulting from the development of offshore renewable energy developments.	None required	**No effect**

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Bathymetry	**The information presented in this chapter has been used to inform the results of the assessment. No specific impacts on bathymetry are expected.**							
Geology, geomorphology and sediment processes	**Changes in hydrodynamic/ coastal processes and seabed morphology**	Installation Decommissioning	• Cable trenching/removal • Foundations Installation/ removal	**Wave Fixed Wind Floating Wind**	**Negligible**	Seabed sediments in the zone sand and muddy sand with areas of glacial till and bedrock. There is a lack of detailed information on seabed sediment and sediment transport processes in the assessment zone. Cable burial and wave/ wind turbine foundation installation/ removal would have a localised effect on the seabed morphology. Such effects would be temporary in the prevailing relatively high wave and tidal current regime.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm is located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Negligible**
	Changes in hydrodynamic/ coastal processes and seabed morphology	Operation	• Devices using seabed foundations	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Seabed sediments in the zone sand and muddy sand with areas of glacial till and bedrock. Relatively high tidal stream velocities and high wave energy conditions prevail. The physical presence of monopile or tripod foundations and transition pieces on and above the seabed and wave energy devices within the water column and at the sea surface will cause hydrodynamic changes. The removal of wave energy will also affect the hydrodynamic regime. Research suggests that such hydrodynamic changes will extend up to 50 m from devices and is therefore localised to the vicinity of the device array. Nearfield changes in scour, sedimentation, sediment suspension, seabed composition and seabed morphology may arise due to these hydrodynamic changes. Farfield changes may occur, particularly in relation to large arrays of wind or wave devices, where alteration to the local hydrodynamics interrupts sediment transport processes e.g. longshore drift, possibly having an overall impact to stabilise sediments in the area of the wind farm or wave devices, while increasing erosion in other areas along coast. Regarding offshore wind, this impact is relevant to installation of piled devices, which would be in the nearshore area, out to 60 m water depth.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm or wave devices are located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Unknown - negligible**
Seabed Contamination and Water Quality	**Accidental Contamination (hydraulic fluids or vessel cargo/fuel)**	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. This will degrade water quality with potential for adverse effects on the receiving environment. Any accidental spillage of slick forming chemicals could be carried into inshore waters, where the effects on water quality will be greater than those in open waters. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects in this area would be of adverse significance. Sensitive receptors in this area include Ramsar sites, SACs, pNHAs, SPAs, licensed aquaculture sites and bathing beaches.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan)	**Negligible**
	Disturbance of contaminated sediment	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negligible to Significant adverse**	There are five coastal dredging spoil disposal sites within Area 5. There is also a fish waste disposal site. These potential areas of contamination could therefore be disturbed by seabed activities. Any contaminated material released is likely to be widely dispersed and diluted and the effect on open sea water quality is likely to be of negligible significance. Munitions migrated relict from wartime activities may be encountered. Disturbance could result in significant adverse effects.	Available mitigation includes avoidance of potentially contaminated seabed areas. Identification and avoidance of areas of munitions contamination through site survey at the project stage. If munitions are encountered advice such as that given in Department of the Marine and Natural Resources 2001 (Marine Notice No. 16 of 2001. (i.Explosives picked up at sea in trawls or sighted; and ii. The removal of explosive items from wrecks)) should be followed.	**Negligible**

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Protected Sites	**Degradation of protected sites**	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negative – significant adverse**	There are Ramsar, SAC, SPA, NHA and pNHA protected sites within Wave and Wind Assessment Area 5. These sites are all adjacent to the coast, although in some cases (e.g. Kerry Head Shoal SAC, Inishmore Island SAC, Kilikieran Bay and Islands SAC and Inishgalloon SAC) extend up to 13 km offshore. Significant adverse impacts on protected sites could occur as a result of turbine or export cable installation, through physical disturbance and loss of substratum, or direct disturbance impacts on the species supported in the protected area. Significant adverse impacts could be expected if direct disturbance is caused to Natura 2000 species or habitats that do not recover well, such as saltmarshes or biogenic reef.	Impacts on protected areas could be mitigated by careful site selection avoiding sensitive sites for devices and export cables (i.e. existing and proposed national and European protected sites). Whether avoidance is an appropriate mitigation should be assessed on a site specific basis. A very extensive area is available to site floating wind technology away from protected sites. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of protected sites. However in the case of Assessment Area 5, there is still some potential to locate piled wind arrays, and their export cables away from protected sites. Impacts may still arise through indirect impacts on sediment movements during installation and operation, and would need to be assessed in more detail at the project stage. Possible mitigation measures relevant to the specific interest features of the sites and their seasonal and other sensitivities are described elsewhere in this table for the relevant topic areas.	**Negligible – significant adverse**
	Impacts on protected species	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	Impacts on protected benthic ecology, mammals, birds, fish and reptiles in the zone are covered under the specific species sections of this table.			

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Benthic ecology	**Physical disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Assessment Area 5 is located across an area which has a range of muddy and muddy sand communities with rocky substrates and epifaunal communities found around headlands off the Galway and Mayo coasts. Disturbance to benthic habitat from installation activities would include minor disturbances through bed preparation prior to device foundation installation, disturbances from piling or alternatively from excavation of bed material for gravity foundations, disturbances to sediment from the feet of jack up platforms and disturbances to sediment from cable burial. Localised scouring around the base of wind turbine foundations may cause a loss of benthic habitat or smother the existing habitat due to deepening of seabed. The degree of scour will be dependent upon the final choice of foundation design. Trenching of interturbine and export cables would cause the greatest levels of physical disturbance with complete displacement of localised benthic communities and temporary smothering of adjacent areas. Impacts would include damage and possible mortality, particularly to smaller, thinner shelled bivalves. Mobile species such as amphipods, gastropods and small crustacea are likely to survive displacement however larger crabs and sea urchins may be crushed from disturbed boulders and cobbles. Permanently attached, sessile species such as bryozoans, sponges and hydroids on areas of coarser substratum cannot reattach to the substratum if removed, and may be damaged or destroyed if substratum is displaced. Physical disturbance will be localised and recoverability of benthic species is expected to be high due to repair and regrowth of damaged individuals and/or recruitment within the community from surviving colonies and individuals. Greater significance can be attached to impacts associated with physical disturbance to species considered to have high sensitivity and / or low recoverability, especially threatened and/or declining species or habitats. Within assessment Area 5 this includes the distribution of key habitats such as saltmarsh and intertidal mudflats (Tralee and Brandon (Owenmore) estuaries, Inner Shannon, Inner Galway Bay), maerl beds (Tralee Bay, Mannin Bay, Kilkieran Bay), sea-pen and burrowing megafauna communities (Mannin Bay, Kilkieran Bay), Zostera beds (Poulnasherry Bay – Shannon, Mannin Bay, Kilkieran Bay, Blacksod Bay and Broadhaven) and potential biogenic and rocky reef habitat (notably Magharee Islands, Kerry Head Shoal limestone reef and associated axinellid sponge community, Carrowmore Point to Spanish Point and Islands, Inishmore Island, Slyne Head Islands, Achill Head and Kilkeiran Bay – Gurraig Sound rare sponge community & Namackan Rocks axinellid sponge community and Kilkee Reefs which includes *Mytilus* reef and axinellid sponge community).	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) especially in areas with known sensitive intertidal and subtidal benthic habitats, such as intertidal mudflat, maerl beds and biogenic and rocky reef habitat. Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative to Negligible**
	Smothering	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negative**	Smothering of benthic communities by sediment displaced by activities such as cable trenching may cause a very local decline in biotope species richness due to the loss of more sensitive species due to clogging of their filtration apparatus and potential short term anoxia under the sediment layer. Disturbed sediments should be dispersed rapidly, especially in high energy areas likely to be associated with the location of wave arrays, with only localised impacts associated with displaced sediment. Smothering impacts will be localised to the immediate vicinity of the seabed disturbing activities during installation.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection). Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**
	Contamination – from sediment disturbance	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negligible**	There is a potential for contaminated sediment such as from spoil dumping sites to be remobilised during seabed disturbing installation works. It is likely that any habitats with the potential to be adversely affected by contamination from these sites have already been subject to disturbance during the original dredging and deposition of material. Furthermore dredged sediment deposited at disposal sites in the area is thought to be relatively uncontaminated. Fine contaminated material will be diluted and dispersed, settling over a wide area with negligible effect on the Benthic ecology. Coarse material will be rapidly redeposited within the immediate area of installation operations.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) . Avoidance of areas of known potential contamination for seabed disturbing works. Potential effects on areas of unknown benthic habitat will need to be assessed through site survey at the project stage.	**Negligible**

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. The water depth is such that small spillages (< 1tonne) are unlikely to affect the benthos. Similarly small spillages from are unlikely to come ashore. However, large spillages have the potential to have a significant adverse effect, particularly on the intertidal ecology of the adjacent shoreline coastline, including within Broadhaven Bay and Galway Bay and on the sensitive reef, mud and sandflat habitats of Galway Bay Complex SAC, Clew Bay Complex SAC, Kilkieran Bay and Islands SAC, Kilkee Reefs SAC and Slyne Head Peninsula SAC. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on Benthic ecology would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan). Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**
	Changes in wave regime	Operation	• Devices using energy generated by waves	**Wave**	**Significant adverse**	There is potential for a decrease in wave exposure resulting from extraction of wave energy. Wave exposed habitats particularly those facing the full force of the Atlantic swell, and those consisting of mobile sediments, generally show reduced species diversity. These environments are likely to be resilient to the removal of wave energy.. Beds and patches of maerl have been previously identified in Kilkieran Bay and Galway Bays and are also recorded in Kingstown Bay and Mannin Bay. Maerl beds may be sensitive to decreases in wave energy. Given the potential for these Priority habitats to be present in wave resource areas, the effects could potentially be of adverse significance.	Avoidance of these important habitats though careful site selection would reduce the potential effects of energy extraction. Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative**
	Substrate change	Installation Operation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse**	All benthic communities can be expected to be sensitive to removal of their habitat. The long term loss of substratum due to the presence of devices that are attached to the seabed will therefore have a potentially significant adverse effect on any rare or important benthic habitats, such as those protected under the Habitats Directive. There is potential for colonisation of structures leading to increased biodiversity. Although this has potential to be a positive impact, species colonising underwater structures may also lead to undesirable changes in community structure.	Effects on benthic ecology from substratum loss can be reduced through avoidance (careful site selection). However, it may not be possible for this impact to be significantly reduced at this location. Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible - Significant adverse**
Fish and Shellfish	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negative**	Smothering effects are likely to be more of an issue for less mobile (shellfish) than mobile (finfish) species except where finfish species are spawning on the seabed eg herring. Area 5 contains shellfish populations of lobster, edible crab, crayfish, velvet crab, shrimp, *nephrops*, scallops, oysters, and periwinkles. Periwinkles are found throughout the intertidal area of semi-exposed to sheltered rocky shores of Area 5, but at lesser densities than in Area 3 due to the more exposed nature of much of the coastline. Of these shellfish species which live on, near or in the bottom sediments of the seabed the most sensitive to smothering are oysters and periwinkles. The impact of smothering will be localised to the immediate vicinity of seabed disturbing activities and limited to during installation.	For devices that require piling, and cable trenching, potential effects could be mitigated by avoiding installation during the spawning and nursery seasons of benthic spawning species such as herring.	**Negative**
	Noise	Survey	• Acoustic survey	**Wave Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for fish, in particular fish with swim bladders are particularly sensitive to noise disturbance. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to fish species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) would also minimise any impacts on fish species.	**Negligible**
		Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Wave Fixed Wind Floating Wind**	**Unknown**	High levels of noise such as during pile installation may cause physiological or displacement effects to marine fish although the extent to which this may occur is unknown. In particular, herring and cod are known to be highly sensitive to noise and may be able to detect piling noise up to 80km. Both species are present in Area 5. It is expected that noise levels from piling and the removal of piled devices will be greater than those generated by operational devices, and although pile driving only occurs during installation the effects may last for longer than the piling activities as fish may not immediately return to the area.	The potential effects of noise from piling or blasting could be reduced through undertaking studies to determine site specific noise effects, and/or avoiding piling or blasting activities during sensitive spawning periods. Where possible less noisy alternatives can be considered such as using gravity bases or clump weights, or protecting cables where they cannot be buried with mattressing or rock placement.	**Unknown**

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Wave Fixed Wind Floating Wind**	**Unknown**	There is potential for noise from operational devices to lead to long term species displacement which could increase pressures on fish populations in other locations and force fish into predator habitats.	No specific mitigation measures have been identified	**Unknown**
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Wave Floating Wind**	**Unknown**	There is potential risk that all mobile fish species could collide with turbines, moving parts of submerged devices, or mooring chains/cables. Larger animals, such as basking sharks, and pelagic species are considered to be of greater risk. Basking shark and other pelagic fish species are present throughout Area 5. However, due to uncertainties with data and knowledge on the interactions between fish and devices, the potential significance of collision risk effects is unknown.	Potential effects associated with collision risk and fish could be reduced through device design e.g. use of protective nets or grids. Devices could also be sited to avoid sensitive areas e.g. migration routes, spawning and nursery grounds.	**Unknown**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. Small spillages are likely to have a negligible impact. Large spillages, particularly where they impinge on the coastline or enter sheltered bays and loughs could have a significant adverse impact.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Wave Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude fish from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. It is not possible to determine the potential significance of this effect. The presence of offshore wind arrays may also have a positive effect on fish populations through fish stock recovery, should certain types of fisheries be excluded from the array.	No specific mitigation identified	**Unknown**
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Substrate loss could have a significant adverse effect on shellfish (crab, lobster, nephrops, oyster, whelk, scallop) and benthic spawning finfish species such as herring. The effect on finfish is most likely to be an issue where benthic spawning (e.g. Herring) and nursery grounds exist. For more sedentary shellfish species it could have an effect through all life history stages. Area 5 fixed wind and tidal resource areas more or less completely overlap with distribution areas for lobster, edible crab, nephrops, crayfish, shrimp and to a lesser extent with herring spawning areas. According to Marine Institute maps there are areas off the Clare coast which do not contain significant herring spawning grounds. Nephrops grounds also exist to the west of the Aran islands and the edible crab distribution in the North of the Zone.	The potential effects of substratum loss on shellfish and benthic spawners could be reduced by avoiding sensitive areas e.g. key shellfish or spawning grounds. The opportunities to mitigate impacts through avoidance is very limited for fixed wind and tidal devices. The shallow water wave resource area extends further west and therefore has greater potential for avoidance For deeper water wave and floating wind resources there is available space for avoidance and thus minimising of impacts. Better information on fish and shellfish distribution is required in order to confirm the potential for avoidance mitigation, and identify areas. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts. Targeted surveys by site developers may also be undertaken by individual projects.	**Negative - Negligible**
	Changes in wave regime	Operation	• Devices extracting wave energy	**Wave**	**Unknown - Significant adverse**	Possible changes in water flow associated with removal of wave energy are likely to be restricted to the immediate vicinity of the device/array. Shellfish species are generally sensitive to wave flows. Area 5 also contains extensive herring spawning areas which occur on gravel beds created by high water flow and these beds could be significantly adversely affected by changes in water flow. There is some overlap between herring spawning and 10 to 100m wave resource areas from Galway Bay north to Mayo.	Available mitigation includes avoidance of important herring spawning area and shellfish areas. More detailed mapping of the herring spawning ground may be required in order to define areas to be avoided.	**Unknown - Negligible**

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Barrier to movement	Operation	• Devices that occupy seabed/water column	**Wave Fixed Wind Floating Wind**	**Unknown**	Some species, such as Atlantic salmon, trout and eels spent part of their lifecycle in freshwater and part at sea. Migration between these two waterbodies is important for the survival of the species. Rivers in Area 5 which have been designated as SACs due to their significant Salmon populations include the Shannon and and a number of its tributaries, Clare, Owenriff, Owenduff, Erriff, Bealnabrack, Owenglin, Ballynahinch, Cashla and Newport, . The presence of wind or wave devices could present a perceptual barrier to migration, although the exact impacts on fish species is unknown.	Available mitigation includes avoiding placing devices close to the entrances to key spawning rivers.	**Negligible - Unknown**
	EMF	Operation	• Inter-array and export cables	**Wave Fixed Wind Floating Wind**	**Unknown - negligible**	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 renewable array power cable, but the field would not cause an avoidance reaction. Atlantic salmon, eels and sea trout are believed to be sensitive to magnetic fields. However, the level of impact associated with inter-turbine arrays will be more concentrated than those for export cables. There is no evidence to indicate that existing cables have caused any significant effect on migration patterns of these species. However, the significance of potential effects cannot be adequately quantified on the basis of current information.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength.	**Unknown - negligible**
Marine Birds	**Physical disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse - negligible**	There are several seabird breeding colonies within Area 5 with SPA status, including Kerry Head, the Magharee Islands, Cliffs of Moher, Loop Head, Clare Island (Clare), Cruagh, High Island, Slyne Head Islands, Duvillaun Islands, Inishkea Islands, Clare Island (Mayo), Bills Rocks, Inishglora & Inishkeeragh. Waters in the vicinity of these colonies are important feeding and resting areas for several breeding species occurring in nationally important numbers. At-sea coverage of Area 5 is incomplete, however, high densities (>5 birds/km^2) of Manx Shearwater, Storm Petrel Kittiwake and Puffin were recorded in inshore waters between June and September, while high densities of Razorbill and Gannet were recorded between August and October. Fulmar was recorded in high density between July and January, while Guillemot density was high in inshore waters for most of the year, except March and April. The Shannon & Fergus Estuary, Tralee Bay, Inner Galway Bay, The Mullet, Broad Haven and Blacksod Bays are internationally and nationally important for several species of wildfowl and waders during spring and autumn passage and in winter months. Physical disturbance during construction or decommissioning could lead to short- or long-term displacement of feeding or resting birds, depending on the species involved, and the time of year. Physical disturbance would be likely to be of particular importance close to seabird breeding colonies in the breeding season.	Effects on seabird breeding colonies could be reduced by avoiding sensitive sites e.g. SPAs and by timing installation activities to avoid the most sensitive seasons e.g. breeding and moulting. Site-specific surveys would be required at project level to identify the presence of key foraging hotspots and/or resting areas and to aid site selection.	**Negligible**
	Noise	Installation Decommissioning	• Devices using piled foundations	**Wave Fixed Wind**	**Significant adverse - negative Negative - negligible**	Based on studies of bird behaviour on land it is evident that some species have acute hearing. However, there is limited understanding of birds ability to hear underwater. Although it is not possible to determine the level of significance of noise effects on seabirds, it is likely that impacts arising from operational noise will be less than impacts arising from installation (specifically from piling noise). It is likely that some degree of habituation will occur, depending on the species involved, as has been recorded with terrestrial species nesting in working quarries.	There are some mitigation measures available for piling operations that have been shown to reduce noise e.g. bubble curtains around the pile. The application of these should be reviewed and considered. Piling operations should be timed to avoid the most sensitive seasons e.g. breeding and moulting.	**Unknown Negligible**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Wave Fixed Wind Floating Wind**				

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. All seabirds are sensitive to hydraulic fluid and fuel oil contamination. In addition wading birds in estuaries may experience negative effects, if the spill reaches these areas. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine birds could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of Oil Spill Contingency Plans.	**Negligible**
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Wave Fixed Wind Floating Wind**	**Significant Adverse**	Collision impacts could potentially be significant adverse for offshore wind farms, depending on the species involved. Typically, larger, less agile species such as divers, gannets, swans, geese terns and seaducks, have been highlighted as likely to be particularly sensitive to collision with offshore wind turbines (Langston & Pullan 2002). Collision impacts could be significant during spring and autumn if developments are located on a major migration route or flyway.	Available mitigation includes - Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/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 e.g. resting and foraging areas; - Shut-down of turbines at night with bad weather/visibility and high migration intensity; - Avoiding large-scale continuous illumination; - Measures to make wind turbines more recognisable to birds	**Negative – negligible**
	Habitat exclusion	Operation	• Devices that occupy sea surface/water column	**Wave Fixed Wind Floating Wind**	**Negative - negligible**	Diving seabirds would be unlikely to collide with underwater cables associated with wave and tidal devices. Collision impacts for operating wave and tidal devices would be negligible.	Appropriate siting of developments e.g. away from important feeding/roosting areas.	**Negligible**
	Barrier to movement	Operation	• Devices that occupy air column to a significant height above sea surface	**Fixed Wind Floating Wind**	**Significant adverse - negative**	If seabirds avoid a development after construction, then the area of avoidance can be considered as lost habitat for the species involved. Seabirds may be displaced from the development area and the surrounding waters, depending on their avoidance response. There is limited information on precise foraging and resting “hotspots” for seabird species around Ireland, although waters adjacent to breeding colonies will be important for these activities during the breeding season. Although birds are mobile and can avoid development sites, the potential effects of doing so may increase competitive pressures on adjacent waters. The energetic costs of site avoidance need to be considered, as do cumulative and in-combination impacts arising from birds avoiding other neighbouring developments. Post-construction habitat loss could therefore potentially have a significant adverse effect during the breeding season and a negative significant effect on seabirds at other times of the year.	Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/roosting areas, nearshore areas and “migration corridors”; Studies would be needed at the project level to identify the presence of key foraging and resting areas in the development area, to aid site selection.	**Negative – negligible**

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Marine Mammals	**Physical Disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Negative – Significant adverse**	Breeding populations of both harbour and grey seals occur throughout Area 5. Harbour porpoise and bottlenose dolphins also occur regularly throughout this zone. 6 SACs have been designated for these Annex II listed species in Area 5. At-sea distribution and habitat use data for seals and cetaceans is unknown for this area, although a resident population of bottlenose dolphins occurs in the Shannon river for which a SAC has been designated. The presence of boat traffic and construction equipment may result in flight behaviour, particularly if they occur in shallower coastal waters near seal breeding and haul out sites where much of the potential wind and wave resource in this zone is located. Increased boat traffic associated with construction and decommissioning will increase ambient noise in the area and may disturb marine mammals. Impacts on seabed flora and fauna could cause changes in food web structure and function and could have negative impacts on top predators in the food web such as marine mammals.	Monitoring surveys would be required to establish distribution of seals and cetaceans at sea in order to design a suitable mitigation plan. Cetaceans may be seasonally abundant in these waters, and the effects of installation activities could be reduced by avoiding certain times of year. The effects of installation activities on seal colonies could be reduced by avoiding the breeding and moulting seasons as well as avoiding development in inshore areas close to seal haul out locations. Disturbance impacts from export cable installation could be avoided by avoiding seal breeding colonies or haul out sites.	**Unknown-Negative**
		Survey	• Acoustic survey	**Wave Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for marine mammals. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to mammal species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) should be considered.	**Negligible**
	Noise	Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Piling and underwater blasting generate high levels of noise. Seals and cetaceans can detect piling noise up to a distance of 80km, and previous studies have demonstrated displacement of porpoises up to 15km during construction of wind farms. Behavioural responses could be expected at 20km, although this will depend on the level of existing background noise. Physiological impacts such as temporary or permanent threshold shift in hearing could occur at distances of 400m for harbour seals, and 1.8km for harbour porpoise. However, evidence suggests that it is unlikely that an animal would choose to remain in close proximity to a source of loud noise that would result in temporary or permanent hearing damage. Noise can mask signals used by cetaceans to navigate, locate prey, and communicate effectively. It is also possible that noise sources may mask biologically relevant signals. The potential for noise to affect marine mammals is therefore considered to be “significant adverse”. Increased shipping associated with installation will also raise ambient noise levels in the area.	Monitoring surveys would be required to establish distribution of seals and cetacean at sea in order to design a suitable mitigation plan. Seasonal or area restrictions could also be imposed so noisy activities would be timed not to coincide with sensitive times such as seal moulting or pupping and porpoise breeding seasons. A range of measures are available to further reduce noise impacts including Marine Mammal Observers, exclusion zones, passive acoustic monitoring, pingers, soft starts/ramp up and/or bubble curtains. Consideration could also be given to using non-piled foundations, and protecting cables where they cannot be buried using rock placement or mattressing.	**Negative-Significant Adverse**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Wave Fixed Wind Floating Wind**	**Unknown - Negative**	Wind turbines can produce low frequency noise and vibrations that can pass into the water column and can potentially affect seals and cetaceans ability to navigate, locate prey and communicate. Operational noise from wind turbines may be heard by seals and porpoises up to 200m, and simulated noise from a 2MW wind turbine has resulted in avoidance behaviour by harbour seals and harbour porpoises. The noise impact of wave devices on marine mammals is not well researched and understood. The cumulative effect of many devices operating together or when combined with operational noise from other marine use is also unknown.	Noise from operating turbines can be reduced by efficient design, reducing vibration, and using isolators.	**Unknown**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Negligible - negative**	Marine mammals can potentially collide with vessels and equipment used during installation. Increased shipping activity during installation will increase this risk. Generally most fatal injuries arise with collisions with ships travelling over 13kts. Vessels associated with construction activities would usually not be travelling at these speeds.	Consider setting speed limits for construction vessels operating in sensitive areas. Establish a code of conduct to avoid disturbance to marine mammals both during construction activities and in transit to the construction area if entering areas of high abundance.	**Negligible**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Wave Floating Wind**	**Unknown - negative**	Risk of collision with wind turbines is small for seals and small cetaceans, since pylons are large and static. However collision may be a concern for larger baleen whales, which do not have the manoeuvrability of smaller cetaceans. All marine mammals may have difficulty detecting the presence of mooring/tethering cables for wave devices, as well as floating wind devices in deeper water. These cables are likely to have a small cross-section and provide fewer sensory cues to approaching mammals, so the risk of collision for these types of installation will be greater. The impact of wave devices on marine mammals is poorly researched, but floating devices may attract seals as potential haul out locations, with associated risk of injury from moving parts. While a number of cetacean species occur in both inshore and offshore waters in this zone, abundance and habitat use is unknown, so the collision risk with offshore renewable energy installations is difficult to quantify.	Measures to make turbine foundations more visible to marine mammals could reduce the risk of collisions. Consider the use of acoustic pingers/deterrents on mooring/tethering lines.	**Unknown - negative**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants, or hydraulic fluids during installation could have an adverse effect on marine mammal health. A collision between ships or between a ship and an offshore renewable installation could result in fluid spills, which could have serious environmental consequences. While the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine mammals would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy sea surface/ seabed/ water column	**Wave Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude mammals from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. The cumulative effect of many installations within an area is unknown. Displacement of fishing activity during installation and operation may result in increased resource competition between fisheries and marine mammals in non-impacted areas. Installations may however, provide increased habitat as artificial reefs and attract fish aggregations that may provide increased foraging opportunities for marine mammals, or temporary haul outs for seals.	Surveys of habitat use by marine mammals and avoid heavily used areas and migration corridors.	**Unknown**
	Barrier to movement	Operation	• Devices that occupy sea surface/ seabed/ water column	**Wave Fixed Wind Floating Wind**	**Unknown - Significant adverse**	The presence of large arrays may cause a barrier effect for migrating marine mammals. The importance of Area 5 for marine mammal migration is unknown, although the offshore waters west of Ireland have been suggested as a migratory corridor for humpback whales. Barrier effect is difficult to quantify.	Detailed study would be required to examine coastal distribution in order to mitigate for this risk and avoid large installations in migratory corridors.	**Unknown - Significant adverse**
	EMF impacts	Operation	• Inter-array and export cables	**Wave Fixed Wind Floating Wind**	**Unknown - negligible**	There is only circumstantial evidence that cetaceans have ferromagnetic organelles capable of determining small differences in relative magnetic field strength. Magnetic fields could potentially affect animals using geomagnetic cues during migration. However, cetaceans regularly cross cables, and there is no apparent evidence that existing electricity cables have influenced cetacean migration. The level of impact associated with inter-turbine arrays will be more concentrated than those for export cables and further study is required before this impact can be fully understood.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength, where possible	**Unknown - negligible**
Marine Reptiles	**Collision**	Installation Decommissioning	• Vessels and equipment used for installation and decommissioning	**Wave Fixed Wind Floating Wind**	**Negative**	Assessment Area 5 is an important area for leatherback sea turtles. The northern coast of Kerry is a known hotspot for leatherbacks, and leatherbacks are regularly sighted off Counties Clare, Galway and Mayo. Many leatherbacks have also been sighted far off shore. One of the main threats to marine turtles in Irish coastal seas is entanglement in mooring ropes (for pot fisheries) and subsequent drowning. It is not known how mooring chains/cables used in operating devices impact on turtles but it's likely they offer more of a collision risk than entanglement. Turtles may be less	Possible mitigation includes planning installation to take place at times when there are fewer turtles present (December-May) or avoiding known areas of high abundance. Arrays could also benefit sea turtles as such installations may provide habitats for jellyfish polyps (as has been shown for marinas) and subsequently lead to an increase in jellyfish abundance (turtle food).	**Negligible - unknown**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Wave Floating Wind**		likely to collide with large installations but much is unknown about how sea turtles especially leatherbacks interact with man made barriers/obstacles. There is a slight possibility that leatherback turtles could swim into operating devices as they are generally oceanic animals unaccustomed to solid structures. Loggerheads are more likely to swim around such structures. Sea turtles can potentially collide with vessels and equipment used during installation, and devices during operation. Increased shipping activity transiting to the area during installation will increase this risk.	Site specific survey to identify areas of high turtle abundance, and avoidance of such areas.	
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants and hydraulic fluids could have an effect on turtle health. Although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine reptiles would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Barrier to movement	Operation	• Devices that occupy sea surface/water column • Vessels and equipment used for installation and decommissioning • Turbines/moving parts of devices	**Wave Floating Wind**	**Unknown**	The movement of marine turtles around the coast of Ireland is unknown so it is difficult to quantify the level of barrier effect. However arrays could be perceived as a barrier affecting turtle movements or routes to feeding areas. Barriers such as drift nets located along Co Kerry's northern coast use to catch a lot of leatherback sea turtles. An array placed in a similar fashion (i.e. perpendicular to the coastline) would increase the likelihood of the barrier effect. Arrays could potentially corral turtles into a corner/trap that they may not be able to get out without human intervention.	Orientating arrays parallel to the coastline rather than perpendicular to the coastline may help minimise a barrier effect as turtles swim past. No other mitigation measures identified.	**Unknown**
	Noise	Installation Decommissioning	• Devices using piled foundation • Underwater blasting	**Wave Fixed Wind Floating wind**	**Unknown**	Avoidance responses of sea turtles to low frequency sounds have been demonstrated, however, the study of sensory biology in sea turtles is still in its infancy, so there is a large unknown component.	No specific mitigation identified.	**Unknown**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Wave Fixed Wind Floating Wind**				
	EMF impacts	Operation	• Inter-array and export cables	**Wave Fixed Wind Floating Wind**	**Negligible - Unknown**	Sea turtles may be able to detect EMF fields such as those generated by export and inter-turbine cables and thereby could adversely affect turtles using geomagnetic cues during foraging and migration, although the importance of these cues remains unclear. However, as turtles are generally present at the surface and in the water column, they are unlikely to come into close proximity with the EMF field at the seabed.	EMF impacts could be reduced through ensuring that cables are buried, reducing the EMF at the seabed. Cable design and orientation to minimise generated EMF.	**Negligible - Unknown**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Wave Fixed Wind Floating Wind**	**Neutral**	The construction of arrays in jellyfish hotspots could exclude turtles from this critical habitat. In this zone jellyfish populations are likely to be extremely widespread (over 10-100kms) and composed of several different species, but by providing new habitat for jellyfish polyps, arrays could actually increase the abundance of jellyfish in adjacent waters through a process of advection.	No specific mitigation identified.	**Neutral**

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Marine and coastal archaeology and wrecks	**Direct disturbance of unknown and known sites**	Installation	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**	Area 5 includes sheltered coastal areas where preservation of archaeological sites by burial is likely to have been favoured. It also includes areas where there is a potential for early settlement sites. There are numerous recorded wreck sites along the adjacent coastline and within Area 4. There is potential for the installation of wave and wind devices and export cables to impact submarine archaeology through direct disturbance of known and unknown sites on the seabed, or through changes to sediment movements causing an artefact to become buried and preventing later discovery. There are a large number of National Monuments on the adjacent coastline including those in State care. Locally, regionally and nationally important archaeological remains and sites are also present along the coast. Numerous listed buildings are also present on the coastline adjacent to the area. Cable installation in the vicinity of these protected sites could cause direct destruction of archaeologically important features. All archaeological monuments and wrecks greater than 100 years old are protected under the National Monuments Acts 1930 – 2004. Wartime wrecks are not currently covered under the Acts but are likely to be included in the near future.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Avoid sites of interest and exclusion zones for marine archaeology. Submit any artefacts recovered to the National Monuments Service. For known submarine and terrestrial sites the main form of mitigation is to avoid protected and other sites of interest. In addition to desk based studies it will be necessary to carry out field walkovers in preferred terrestrial site locations to determine need for site investigations (geophysical surveys/trial trenching) in consultation with the National Monuments Service and Local Authorities. With respect to cabling there is considerable opportunity to avoid or reduce effects. The siting of export cables will be important in determining their residual impact.	**Negligible**
	Changes to sediment regime	Operation	• Devices using seabed foundations • Devices using energy generated by waves	**Wave Fixed Wind Floating Wind**	**Significant adverse to Positive**	Area 5 includes areas where there is a potential for early settlement sites and unrecorded wrecks. Changes in sedimentation may either expose or increase the burial depth of archaeological features at such sites. Where sites are exposed there is a potential for discovery of or damage to or loss of artefacts or sites. Where features are subject to deeper burial the potential for discovery of or damage to artefacts or sites is likely to be decreased.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
	Data acquisition	Installation	• Pre-installation survey	**Wave Fixed Wind Floating Wind**	**Unknown**	There is a potential for archaeological sites and wrecks to be discovered within Area 5 as a result of site surveys, providing additional data for inclusion in the archaeological record of the area.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
Commercial Fisheries	**Direct disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negative to Significant adverse**	Although direct disturbance may have an impact on all fishery types it is likely to be more significant in the case of shellfish than finfish as shellfish are generally much less mobile. However finfish could potentially be affected by noise from wave devices. Shellfish fisheries which may be impacted in Area 5 include Nephrops, edible crab, spider crab, lobster, shrimp, oyster and crayfish. The Nephrops fishery south west of the Aran islands is the most intensely fished shellfish fishery in Area 5. Inshore finfish grounds are however also sensitive to direct disturbance as these are generally exploited by small vessels which are less able to exploit alternative grounds. Additionally there may be direct disturbances to finfish spawning grounds within the zone e.g. Herring.	Potential impacts could be minimised through avoiding peak fishing periods. The potential for avoiding key commercial inshore fishing grounds (fixed wind) may be limited due to the widespread nature of fishing activity in the zone. There is greater potential to avoid key fishing offshore areas for wave and floating wind devices. Early liaison with the fishing industry could help identify key fishing areas, particularly in the area where there is a lack of fishing effort distribution information for vessels under 15m. The effects could also be minimised by using procedures and structures that minimise the area of seabed disturbed for turbine foundations.	**Negative**
	Temporary displacement from traditional fishing grounds	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Negative**	Inshore fishing grounds tend to be more constrained than offshore areas. Temporary displacement from these areas may lead to the concentration of fishermen in smaller areas, fishermen being unable to fish for short periods or fishermen being displaced to alternative, possibly less productive fishing grounds. Temporary displacement will potentially have a negative effect on commercial fisheries.	Effects can be reduced by phasing construction activities to specific areas within Area 5. However the potential for avoiding key commercial fishing grounds altogether may be limited due to the widespread nature of fishing activity in the zone. Liaison with the fishing community to keep them informed of installation operations is also key to managing the level of this impact.	**Negative - negligible**

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Long term displacement from traditional fishing grounds	Operation	• Devices that occupy sea surface/water column/seabed	**Wave Fixed Wind Floating Wind**	**Significant adverse**	All types of commercial fisheries could be affected by long term displacement from traditional fishing grounds. The potential effects could be of adverse significance for spatially constrained inshore fisheries and for bottom trawl and pot fisheries which may be restricted by installations and cable routes. Conversely, long term exclusion of mobile gear from the area could be of benefit to fish stocks in the wider area although spillover effects, particularly for mobile fish species are poorly understood. The key bottom trawl fisheries in Area 5 are for *Nephrops*, haddock, Megrim, Black Sole, Hake and monkfish. Crab, lobster and shrimp are exploited by pots, crayfish by fixed bottom set nets, while oysters and scallops are exploited by mechanical dredging gear. The effects of long term displacement on trawl fisheries in particular will depend on the scale of the arrays and the extent to which fishing vessels are excluded from the area. Use of rock armour, if required for cable protection, will introduce an obstruction for trawling activity, but could also create new habitat which could have a positive impact of fish stocks.	Potential impacts could be minimised through spacing of turbines at wide enough intervals to permit use of mobile fishing gear. The fixed wind resource area in Area 5 overlaps very extensively with inshore fishing effort making avoidance difficult. The best potential would be in the deepest and further offshore part of the fixed wind resource area outside of the operating area of smaller inshore pot fishing vessels. The distribution of this fishing effort is not mapped however and would require liaison with industry and BIM to clarify areas of potential. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts on commercial fisheries. Floating wind and offshore wave resource areas may have greater potential for avoidance across possibly 10-15% of the deeper waters of Area 5.	**Negative**
Aquaculture	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Negligible**	Area 5 contains extensive shellfish cultivation areas for mussels, Pacific oysters and clams which could be adversely affected by any significant and prolonged rise in suspended solids. However, increases in suspended sediment is expected to be short term and localised to the immediate vicinity of the seabed disturbing works. Intrusion of sediment plumes into aquaculture areas would therefore only result if the export cables were routed in the immediate vicinity. There could therefore be a negligible impact from offshore energy development.	Impacts from cable trenching could be reduced by using procedures that minimise the mobilisation of suspended solids, such as plough installation.	**Negligible**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Shellfish are highly sensitive to reductions in water quality caused by hydraulic fluids or tainting from other chemical substances. There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. It should be noted that the quantity of hydraulic fluid in devices is likely to be very small, reducing the potential for significant environmental effects. Therefore, although the likelihood of accidental contamination from devices is low, the potential effects of any significant intrusion of hydraulic fluids into aquaculture production areas could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, and contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Shellfish production in Assessment Area 5 could be adversely affected should installations be sited in or cables routed through shellfish cultivation areas.	The key mitigation measure in terms of reducing effects on shellfish farms is avoidance. In practice, consent is unlikely to be achievable to site renewable energy arrays or cables within existing fish farms.	**Negligible**
Ports, Shipping and Navigation	**Displacement of shipping**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**	Shipping intensity in Area 5 is generally moderate to low although vessel activity increases with proximity Galway Bay and the Shannon Estuary. The coastline is constrained by numerous inlets and islands; shipping density is particularly high in the vicinity of the Aran Islands. Again, patterns in shipping density imply that vessels use distinct routes through the Assessment Zone. The re-routing of vessels to avoid safety zones (during installation), operational devices and decommissioning activity would result in greater transit time and use of fuel, with the associated costs to the vessel operator, and could lead to displacement of vessels to areas that already have moderate vessel densities, potentially having knock-on impacts on collision risk, trade/supply and visibility. This impact would be amplified in constrained areas. The effect of displacement of shipping would potentially have a significant adverse to negative impact in Area 5.	The potential for these effects to be reduced would depend entirely upon the ability to site devices in relation to key routes for shipping. Potentially significant adverse effects could be reduced or avoided by siting devices away from constraints and areas of high vessel densities. Wind resource is present throughout the Zone and there is potential to site both fixed wind turbines, in the 10-60m depth region, and floating structures, deeper than 60m in these areas of lower shipping intensity. There are also large areas within Area 5 that could accommodate wave devices without causing significant displacement of shipping. The scale of potential effect on vessel traffic will need to be investigated further as part of project specific EIAs.	**Negligible**
		Operation	• Devices that occupy sea surface/water column	**Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**			**Negligible**

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Decreased trade/supply	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Galway and Shannon Foynes are the main commercial ports adjacent to Area 5, regularly receiving a significant number of vessels. In addition there are numerous smaller ports, including fishing and local ferry ports. Important local ferry crossings operate from the ports of Galway, Rossaveel and Doolin out to the Arran Islands, access to these islands is essential for local communities. The presence of installation/maintenance vessels, presence of devices and decommissioning activity could create temporary to long-term reductions in access to ports and harbours. This is particularly important in island locations which rely on boats for the export and import of goods and as a means of access to other islands and the mainland. Reduced access to ports and harbours in Area 5 could have a significant adverse effect on local communities in terms of goods transport and accessibility.	Site selection for device arrays should take into account the requirement for continued access to port and harbours. There is potential in Area 5 to site devices away from the entrances to ports and harbours and thereby avoid impacting on accessibility, trade and supply. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance and decommissioning.	**Negligible**
		Operation	• Devices that occupy sea surface/water column	**Wave Fixed Wind Floating Wind**	**Significant adverse**			**Negligible**
	Reduced visibility	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Vessels and other equipment used during the installation/maintenance/ decommissioning of devices, and the operational devices themselves could obstruct views of other vessels and navigation features such as buoys, lights and the coastline. This is particularly important in areas of high vessel densities, constrained channels or areas where there is particular dependence on visual navigation aids as reduced visibility increases the risk of collision with other ships and other structures in the water (natural and manmade). The effect of reduced visibility will potentially be significant adverse in Area 5 due to the constrained nature of this area (islands and channels), the presence of a distinct shipping route and the entrances to numerous ports and harbours.	Significant adverse effects associated with reduced visibly can be reduced by avoiding areas of high vessel densities and areas constrained by land e.g. adjacent to the entrances of ports and inlets. In busy shipping areas, potential effects may be reduced by using fully submerged wave devices which have minimal restrictions on visibility. Also minimising the period of installation, the number of vessels required and the area occupied during installation would reduce the potential impact on visibility. Any vessels and devices should be lit and marked in accordance with the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) guidelines, in agreement with the Commissioners of Irish Lights.	**Negligible**
		Operation	• Devices that occupy sea surface	**Wave Fixed Wind Floating Wind**	**Significant adverse**			**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. The impact on collision of siting devices in Area 5 would be significant adverse to negative. This is due to the constrained coastline (numerous inlets and islands) and the presence of a distinct shipping route, all relatively close to shore, however, as distance from shore increases the collision risk decreases. The significance of the impact will increase dependent on the number of arrays which could potentially be present on either side of the channel, restricting potential for vessels using the main shipping lanes to re-route in emergencies.	The risk of collision could be reduced by avoiding areas of high shipping densities, regularly used shipping routes and constrained stretches of coastline. There is potential within Area 5 to site devices away from these areas. In busy shipping areas, potential effects may be reduced by minimising the period of installation, the number of vessels required and the area occupied during installation. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance, and decommissioning.	**Negligible**
		Operation	• Devices that occupy sea surface/water column	**Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**			**Negligible**
Recreation and Tourism	**Access Restrictions**	Installation Operation Decommissioning	• Structures in the sea reducing or excluding access	**Wave Fixed Wind Floating Wind**	**Negative**	The key receptor is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs, Offshore wind and wave developments in this zone, if located on routes used by recreational yachting could cause vessels to re-route, or restrict access to key areas. There are also 'surf spots' along the coastline in Area 5 which wave or wind devices located close to the shore could restrict access to.	There is the potential to locate wave devices away from cruising routes and surf spots. A very extensive area is available to site floating wind technology away from cruising routes. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of cruising routes. However in the case of Assessment Area 5 there is still the potential to locate piled wind arrays, and their export cables away from cruising routes. The use of wave device types which lie below the surface at a depth below the maximum draft of recreational vessels in a given area could also mitigate this impact. This mitigation measure is not available for offshore wind sites, however.	**Negligible**
	Noise	Installation Decommissioning	• On and offshore machinery and vessels	**Wave Fixed Wind Floating Wind**	**Negative**	There are numerous Blue Flag beaches, wildlife watching areas and 'surf spots' along the coastline in Assessment Area 5. Noise from machinery and vessels has the potential to impact on the use of beaches that are close to the source of the noise. However any noise from installation or decommissioning will be limited to the duration of construction activities. Piling is a particularly	Mitigation measures aimed at reducing or avoiding disturbance to recreation could include timing particularly noisy activities such as piling to avoid key recreational periods.	**Negative**

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbines/flexing joints/device components above sea surface		**Negligible - Negative**	noisy activity, and greater significance impacts will be associated with this activity. Noise from operation will be longer term; however noise levels during operation will to be significantly lower than during installation or decommissioning. Impacts associated with piled wind will be located closer inshore and are likely to be of greater significance compared to floating wind developments located further offshore.		**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Negative**	The key receptor is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs. The location of offshore wind developments close to yachting areas could potentially increase collision risk, especially if located in areas where ability to manoeuvre is restricted by other factors such as water depth. There is also collision risk associated with the installation vessels	There is the potential to avoid impacts through locating wave devices away from existing cruising routes. A very extensive area is available to site floating wind technology away from cruising routes. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of cruising routes. However in the case of Assessment Area 5 there is still the potential to locate piled wind arrays, and their export cables away from cruising routes. The use of wave device types which lie below the surface at a depth below the maximum draft of recreational vessels in a given area could also mitigate this impact. This mitigation measure is not available for offshore wind sites, however. Safety measures including lighting and marking and informing users of the locations of devices will help to negate any potential impact.	**Negligible**
		Operation	• Devices that occupy sea surface/water column		**Negligible**			**Negligible**
	Disturbance to Wildlife	Installation Operation Decommissioning	• Installation/decommissioning activity • Devices that occupy seabed/ sea surface/water column	**Wave Fixed Wind Floating Wind**	**Negative**	Effects on local tourism would occur where disturbance and/or exclusion from an area overlaps with the locations frequented by visitors and touring vessels. The west coast of Ireland is considered to be of high importance for recreational wildlife watching as there are many areas used for wildlife watching.	There is the potential to avoid impacts through locating wave devices away from existing cruising routes. A very extensive area is available to site floating wind technology away from tourism and recreational areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of tourism and recreational areas. However in the case of Assessment Area 5 there is still the potential to locate piled wind arrays, and their export cables away from tourism and recreational areas. Other mitigation measures aimed at reducing or avoiding disturbance to wildlife including sea mammals and birds is set out in the relevant parts of this table.	**Negligible**
Aviation	**Collision**	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Negative**	There are eight aerodromes in the vicinity of Assessment Area 5 (civil) and two radar installations. Assessment Area 5 is covered by the Valentia Search and Rescue region and the Malin Head Search and Rescue region. There is also a 'low-fly' exclusion zone that covers the River Shannon for marine rescue helicopters operating out of Shannon Airport. The main collision risk is with the Search and Rescue activities that are ongoing in this area.	Available mitigation includes ensuring wind devices are lit with aviation lights in accordance with OAM 09/02 "Offshore Wind Farms Conspicuity Requirements". As required under the Obstacles to Aircraft in Flight Order, S.I. 215 of 2005, notification of the erection of wind devices provided to the IAA.	**Negligible**
	Radar Interference	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Unknown - negative**	There are currently no "potential to interfere" areas set out for Irish waters and therefore it is difficult to accurately state how much of Assessment Area 5 would fall within these areas. There is likely to be a negative impact on aviation either from intermittent detections of turbines by air traffic controllers or from "shadowing" where radar signals become weaker behind turbines.	Consultation with the IAA will be required and the location of wind devices supplied so they can be accurately plotted on the radar and any signals received from that area will not be confused with aeroplanes.	**Negligible**
Military Activity	**Disruption to general activities**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and	**Wave Fixed Wind Floating Wind**	**Negligible**	There are no Department of Defence danger areas within Assessment Area 5, although, military use of the Zone will include fishery protection and search and rescue operations. The north and north west boundary of the Zone overlaps an area used for fleet exercises and submarine exercise and transit, no ammunition firing is undertaken. The development of offshore renewables may have a negligible impact on	Consultation with the Department of Defence will be undertaken as part of project specific EIA. Any development within the fleet exercise and submarine exercise and transit area will require additional consultation with the Ministry of Defence, UK.	**Negligible**

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
			Decommissioning			fishery protection and search and rescue operations in Area 5. There may also be an impact on fleet and submarine exercise but this will be negligible given the area of overlap between the Zone and exercise area.		
		Operation	• Devices that occupy sea surface/water column					
Cables and Pipelines	**Direct damage**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Wave Fixed Wind Floating Wind**	**Significant adverse**	There are subsea power and telecoms cables connecting from the mainland to Inis Bo Finne and the Aran Islands. There are no other power or telecoms cables, or pipelines in Area 5. Direct damage to these cables could occur during installation of device arrays and cables but also could occur during maintenance and decommissioning. The impact is considered to be significant adverse (should it occur) as community power supply and communications could be seriously disrupted.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**No effect**
	Access restrictions	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential that the presence of devices in waters close to existing cables could restrict access to the cables for maintenance purposes. Due to the potential implications for telecommunications supply, the significance of this effect, if it occurred, could be significant adverse.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Dredging and Disposal areas	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Negative**	There are sixteen dredge disposal sites, one fish waste disposal sites and one rock dredge disposal site within Assessment Area 5. Construction operations and the presence of wind and wave devices have the potential to restrict normal access to these sites. There are no existing aggregate dredging areas within Assessment Area 5 and no areas have been identified as areas that could potentially be exploited for aggregate extraction. There is potentially a negative impact from wind device installation restricting access to potential future dredging grounds	There is the potential to locate wave devices away from existing dredging and disposal areas. A very extensive area is available to site floating wind technology away from existing dredging and disposal areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of existing dredging and disposal areas. However in the case of Assessment Area 5 there is still the potential to locate piled wind arrays, and their export cables away from existing dredging and disposal areas.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Existing Renewable Infrastructure	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Significant adverse**	Within Area 5 is the Galway Bay wave energy test centre and the Sceirde wind farm application area, both of these sites are close to the coast in the vicinity of Galway Bay. The proposed Belmullet wave energy test centre is located at the northern extent of the Zone, adjacent to the border with Area 6. There is no existing or proposed tidal energy infrastructure in Area 5. Development of offshore renewable devices has the potential to cause maintenance access restrictions to existing or proposed wind/wave devices during construction, operation and decommissioning.	Site selection will need to factor in the access needs of existing infrastructure to ensure that the proposed site does not conflict with their activities. Access restriction impacts during construction and decommissioning can be managed through good planning and communication with existing operators.	**No effect**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Removal of energy resource	Operation	• Devices using energy generated by wind, waves	**Wave Fixed Wind Floating Wind**	**Unknown**	During operation removal of wind/wave energy could potentially be an issue, depending on the relative locations of existing and new sites.	Careful site selection taking into account resource assessment and modelling to determine if and how commercial scale arrays could coexist with the existing renewable infrastructure.	**Negligible - Unknown**
Natural Gas and CO_2 Storage	**Sterilisation of region**	Operation	• Devices using seabed foundations	**Wave Fixed Wind Floating Wind**	**Unknown**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for CO_2 or natural gas storage. There is currently insufficient data to establish potential for use of the marine environment for storage of CO2. Therefore, whilst no sites are currently under consideration for natural gas or CO_2 storage in this zone, the significance of this possible future impact is unknown.	None identified	**Unknown**
Oil and Gas Activity	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Unknown - negative**	There are currently no areas of active oil and gas development in Assessment Area 5. However a very small 'Exploration Licence' area towards the north of the zone which contains one exploration well that was drilled and then abandoned. Siting of renewable devices in Area 5 may limit access to the 'Exploration Licence' area. However the impacts on possible future oil and gas developments are impossible to quantify at this stage.	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices. There is the potential to locate devices away from areas of oil and gas activity.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Wave Fixed Wind Floating Wind**	**Unknown – negative**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. There are currently no areas of active oil and gas development in Assessment Area 5. However a very small 'Exploration Licence' area towards the north of the zone which contains one exploration well that was drilled and then abandoned. Siting of renewable devices in Area 5 has the potential for conflicts with vessels involved in developing the 'Exploration Licence' area with regard to collision risk. However the impacts on possible future oil and gas developments are impossible to quantify at this stage.	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices and there is the potential to locate devices away from existing and proposed oil and gas activity.	**Unknown - negative**
		Operation	• Devices that occupy sea surface/water column					**Negligible**
	Sterilisation of region	Operation	• Devices using seabed foundations	**Wave Fixed Wind Floating Wind**	**Unknown - negative**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for oil and gas exploitation. There is currently insufficient data to establish possible future exploitation of oil and gas from this zone. As it is possible that future oil and gas activities may take place in this zone is it not feasible to rule out any potential impacts from offshore renewable devices. However the impacts on possible future oil and gas developments are impossible to quantify at this stage	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices and as There is the potential to locate devices away from oil and gas activity.	**Unknown**
Seascape Effects	Effects on Seascape type 1 Large Open or Partially Open Sea Lough	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast)	Offshore Wind Zone 5 extends along the West coast of Ireland from Sibil Head (Kerry) in the south, to Glendorragh Point (Mayo) in the north. The seascape types associated with this stretch of the coastline include: 1. Large Open or Partially Open Sea Lough - Large scale sea loughs with associated low-lying coastal plain, raised hinterland and headlands. Large scale open views along windswept low lying shorelines are contained by landmass. Long smaller scale contained views to the open sea are framed by headlands	See below	**Moderate/ Substantial to Substantial depending on distance from shore (see Figure 12.15 for more information)**
					Substantial to Moderate Substantial Effect to (between 15km and 24km from the coast)			

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Seascape Effects					Moderate to Slight Neutral Effect (between 24km and 35km from the coast)	2. Rugged Peninsulas - Long rugged hilly or mountainous ridges are separated by large V shaped drowned valleys narrowing towards the valley head. The steep exposed wild coastline with long peninsulas, sounds and islands provides a range of seascape scales and dramatic sea views. 6 Complex Indented Coastline – A varied, complex and incised coastline with, undulating hinterland, small bays, cliffs and islands. Due to the complexity of the landform associated with this distinct seascape type, the experience and views continually change in scale, elevation and exposure. 4 Low lying coastal plain – rural, diverse and changeable, large to medium scale, very flat and exposed coastal plains and lowlands with expansive views out to sea. Including estuaries, sandy beaches, curved bays and flat or very low lying rolling complex islands and peninsulas consisting of moorland or grassland with sparse settlement. 7. Plateau and High Cliffs - visually dramatic seascape with great vertical scale where cliffs plunge abruptly to an narrow coastal edge with open expansive and elevated views to sea and a sense of wildness. 8. Large bay – Large long sweeping bays often with sand dunes, expansive sands and tidal flats and rocky headlands. Very long open views framed by landmass, both across the bay and out to the wide horizon of the open sea. There are no national level landscape designations along the coast in this area. However there are three National Parks that may have views to the coast. The Burren Uplands National Park (Clare) is located inland but may have long views to the coastline. Connemara National Park (Galway) is situated at Diamond Hill and the Twelve Bens with views to the outer coast and islands including Ballynakil Harbour. Distant views of the coast may be possible from the Owenduff /Nephin Mountains in Ballycroy National Park (Mayo). Parts of this coastline are also covered by a number of county level landscape designations including: • Highly Sensitive, Sensitive and Less Sensitive Landscapes (Mayo) • Protected Views, Highly Scenic and Scenic Routes (Mayo) • Unique, Special Sensitivity, and High Sensitivity Landscapes Galway) • Vulnerable Landscapes and Scenic Routes (Clare) • Rural Prime Special Amenity Areas (Kerry) • Rural Secondary Special Amenity (Kerry) • Identified views and prospects (Kerry. The coastline of Assessment Zone 5 is complex, varied and deeply indented with large bays and sea loughs including the mouth of Shannon, Galway and Clew Bays; numerous offshore islands including the Achill and Aran Islands; dramatic high cliffs, peninsulas and headlands such as the Cliffs of Moher and the Dingle Peninsula along with sandy flats and flat or very low lying complex islands and peninsulas such as Blacksod Bay. The landscape character is mainly rural with some remote and undeveloped areas of natural grassland or bog along with areas of dense urban development such as Galway and the busy shipping lanes at the mouth of the Shannon. Due to the complex and indented nature of the coast in certain locations effects on one seascape type are likely to overlap with effects on adjacent seascapes of lower sensitivity, increasing local sensitivity to development of this type.	Potential adverse effects on seascape can b e reduced through the sensitive siting of offshore wind farms. Key factors to be considered in locating an offshore wind farm include: • Wind farms should not be sited where they appear to block or close the entrance to bays/loughs/narrows/sounds or where they separate a bay from the open sea; • Wind farms should reflect the shape of the coastline and align with the dominant coastal edge; • Wind farms should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate; • Wind farms should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Wind farms should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms; • Consideration should be given to locating devices in already industrialised and developed seascapes;	**Moderate/ Substantial to Substantial depending on distance from shore (see Figure 12.15 for more information)**
	Effects on seascape type 2 Rugged Peninsulas	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast) Substantial to Moderate Effect (between 15km and 24km from the coast) Moderate to Slight Effect (between 24km and 35km from the coast)			
	Effects on seascape type 4. Low Lying Coastal Plain	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Moderate Effect (between 0 and 15km offshore from the coast) Slight Moderate Effect to Slight Neutral Effect(between 15km and 24km from the coast) Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on seascape type 6. Complex indented Coastline	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast) Substantial to Moderate Effect (between 15km and 24km from the coast) Moderate to Slight Neutral Effect (between 24m and 35km from the coast)			
	Effects on seascape type 7. Plateau and High Cliffs	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast) Substantial Effect to Moderate Effect (between 15km and 24km from the coast) Moderate Effect to Slight Neutral Effect (between 24km and 35km from the coast)			

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Seascape Effects	Effects on seascape types 8. Large Bay	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect to Moderate Effect (between 0 and 15km offshore from the coast) Moderate Effect to Slight Effect (between 15km and 24km from the coast) Slight Effect to Slight Neutral Effect (between 24km and 35km from the coast)	Most of the seascapes in this region would potentially have substantial to moderate effects between 0- 26 km and moderate to slight effects between 26-35 km. The seascape type 4 Low lying coastal plain is the least sensitive seascape to this type of development the potential effects in certain locations within 0 to 15km from the coast, could range from Moderate to Slight depending on where wind farms are sited. For example local sensitivity to this type of development at the low lying coastal plain and peninsula at Bellmullet and Blacksod Bay may be heightened in consideration of long views from Ballycroy National Park and AchilII island. Conversely effects may potentially be reduced in seascape types of higher sensitivity in some locations by the presence of existing development and infrastructure. At distances greater than 35 km effects are likely to be slight /neutral to neutral, dependent on location, as atmospheric conditions and elevated viewpoints may increase visibility thresholds.	See above	**Moderate/ Substantial to Substantial depending on distance from shore (see Figure 12.15 for more information)**
	Effects on Seascape type 1 Large Open or Partially Open Sea Lough	Operational	Arrays of on-surface linear structures	Wave	Moderate Substantial to Moderate Effect (between 0 and 5km offshore from the coast) Moderate to Slight Effect (between 5km and 10km from the coast) Slight to Neutral Effect (between 10km and 15km from the coast)	See Below	See Below	**Slight to Substantial depending on distance from shore (see Figure 12.16 for more information)**
	Effects on seascape type 2 Rugged Peninsulas	Operational	Arrays of on-surface linear structures	Wave	Substantial to Moderate Substantial Effect (between 0 and 5km offshore from the coast) Moderate Substantial to Moderate Effect (between 5km and 10km from the coast) Moderate to Slight Effect (between 10km and 15km from the coast)			
	Effects on seascape type 4. Low Lying Coastal Plain	Operational	Arrays of on-surface linear structures	Wave	Moderate Effect to Slight Effect (between 0 and 5km offshore from the coast) Slight Effect to Slight Neutral Effect (between 5km and 10km from the coast) Slight Neutral to Neutral Effect (between 10km and 15km from the coast)			

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Seascape Effects	Effects on seascape type 6. Complex indented Coastline	Operational	Arrays of on-surface linear structures	Wave	Substantial to Moderate Effect (between 0 and 5km offshore from the coast)	Sensitivity to wave (oscillating surge) devices is largely dependent on the scale form and pattern of the coastal edge as these devices are located in inshore waters. There is also the effect that a wave (oscillating surge) device may have on a sense of remoteness or wildness. Due to the lower profile and intermittent visibility of offshore elements effects of offshore structures are likely to be less than the effects of linear wave devices, however the effects of fixed onshore elements of the device will remain constant and may be the most noticeable element of the device. There may be potential in some locations to reduce or localise effects through careful siting and use of topography to conceal fixed structures. Wave (Oscillating Surge) devices would have moderate effects at 0-5km on seascape types 4. Low Lying Coastal Plain, 6. Complex Indented Coastline and 8. Large Bay, as offshore arrays may conflict with complex coastal edges while the fixed on shore structures may introduce visually prominent new element in conflict with the local landscape / seascape character. Seascape types 1 Large open Sea Lough, 5, Narrow Coastal Strip with Raised Hinterland and 7. Plateaus and High Cliffs have potential for moderate substantial effects at 0-5km due to elevated panoramic views over an extended area with potential for onshore fixed structures to be in conflict with local seascape and landscape character. Type 2. Rugged Peninsulas has the lowest capacity for Wave (Oscillating Surge) devices at 0- 5km due to the combination of extensive and elevated panoramic views from headlands and hinterland with the complex coastal edge and reduced seascape scale of drowned valleys . The topography would potentially render devices in inshore waters visually prominent over an extended area with potential for onshore fixed structures to conflict with vulnerable and unique seascape qualities. Potential effects of Wave (Oscillating Surge) devices on type 2 Rugged Peninsulas at 0- 5km is therefore substantial.	Potential adverse effects on seascape can be reduced through the sensitive siting of wave device arrays and fixed coastal structures. Key factors to be considered in locating a wave array include: • Wave arrays should not be sited where they appear to block or close the entrance to bays/loughs/ narrows/sounds or where they separate a bay from the open sea; • Wave arrays should reflect the shape of the coastline and align with the dominant coastal edge; • Wave arrays should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate; • Wave arrays should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Wave arrays should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms; • Consideration should be given to locating devices in already industrialised and developed seascapes. • Avoid siting fixed coastal structures where they will conflict with the landscape character of the coastal edge or form dominant features visible over an extensive area	**Slight to Substantial depending on distance from shore (see Figure 12.16 for more information)**
					Moderate to Slight Moderate Effect (between 5km and 10km from the coast)			
					Slight Moderate to Slight Neutral (between 10km and 15km from the coast)			
	Effects on seascape type 7. Plateau and High Cliffs	Operational	Arrays of on-surface linear structures	Wave	Substantial to Moderate Substantial Effect (between 0 and 5km offshore from the coast)			
					Moderate Substantial to Moderate Effect (between 5km and 10km from the coast)			
					Moderate to Slight Effect (between 10km and 15km from the coast)			
	Effects on seascape types 8. Large Bay	Operational	Arrays of on-surface linear structures	Wave	Moderate Effect to Slight Effect (between 0 and 5km offshore from the coast)			
					Slight Effect to Slight Neutral Effect (between 5km and 10km from the coast)			
					Slight Neutral to Neutral Effect (between 10km and 15km from the coast)			
	Effects on Seascape type 1 Large Open or Partially Open Sea Lough	Operational	Oscillating Wave Surge Device	Wave	Moderate Substantial Effect (between 0 and 5km offshore from the coast)			
	Effects on seascape type 2 Rugged Peninsulas	Operational	Oscillating Wave Surge Device	Wave	Substantial Effect (between 0 and 5km offshore from the coast)			
	Effects on seascape type 4. Low Lying Coastal Plain	Operational	Oscillating Wave Surge Device	Wave	Moderate Effect (between 0 and 5km offshore from the coast)			
	Effects on seascape type 6. Complex indented Coastline	Operational	Oscillating Wave Surge Device	Wave	Moderate Effect (between 0 and 5km offshore from the coast)			

Table Appendix G5: West Coast (Area 5: Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Seascape Effects	Effects on seascape type 7. Plateau and High Cliffs	Operational	Oscillating Wave Surge Device	Wave	Moderate Substantial Effect (between 0 and 5km offshore from the coast)	See above	See above	**See above**
	Effects on seascape types 8. Large Bay	Operational	Oscillating Wave Surge Device	Wave	Moderate Effect (between 0 and 5km offshore from the coast)			
Climate	Carbon Impacts	Operation	Wind turbines	**Wind and Wave**	**Positive**	It is recognised that development of offshore renewable energy developments will contribute towards achieving the Ireland's target for 40% energy to be provided from renewable energy sources. In meeting this target Ireland will be working towards the wider European and international commitment to combat global climate change and reduce the potential associated adverse environmental effects e.g. changing population distributions, species extinction, sea level rise etc. However, whilst seeking to combat climate change there is also a need to respond to it in terms of: • Protecting the existing environment and increasing its robustness and ability to adapt to climate change • Protecting existing and future infrastructure from effects of climate change e.g. increased storm events , flooding and sea level rise	Ensure that coastal infrastructure is sited in locations that are at lower risk from flooding, sea level rise and storm damage and do not increase the risk of flooding or damage to coastal infrastructure elsewhere. This will require close consultation at the project design stage with the relevant land use planning authority.	**Positive**
	Carbon Storage	Installation Operation	Wind turbines	**Wind and Wave**	**No effect**	Based on current available information no existing or proposed carbon or gas storage sites have been identified within this area (Assessment Area 5) therefore there will be no effect resulting from the development of offshore renewable energy development.	None required	**No effect**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Bathymetry	**The information presented in this chapter has been used to inform the results of the assessment. No specific impacts on bathymetry are expected.**							
Geology, geomorphology and sediment processes	**Changes in hydrodynamic/ coastal processes and seabed morphology**	Installation Decommissioning	• Cable trenching/removal • Foundations Installation/ removal	**Tidal**	**Negligible**	Seabed sediments in the area comprise of muddy sediments in the upper estuary with more sandy and sandy gravel sediments in the lower reaches. Relatively high tidal stream velocities prevail, with spring tidal ranges averaging 4.5m at Tarbert Island. Cable burial and tidal turbine foundation installation/ removal would have a localised effect on the seabed morphology. Such effects would be temporary given the relatively high tidal current regime.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the location and method of installation. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect on these processes. Due to the limited amount of space available for a commercial scale array within the estuary, there is very limited potential to avoid impacts through careful site selection.	**Negligible**
	Changes in hydrodynamic/ coastal processes and seabed morphology	Operation	• Devices using seabed foundations	**Tidal**	**Significant adverse**	Seabed sediments in the area comprise of muddy sediments in the upper estuary with more sandy and sandy gravel sediments in the lower reaches. Relatively high tidal stream velocities prevail, with spring tidal ranges averaging 4.5m at Tarbert Island. The physical presence of foundations on and above the seabed and tidal energy devices within the water column will cause hydrodynamic changes. The removal of tidal energy will also affect the hydrodynamic regime. Research suggests that such hydrodynamic changes will extend up to 50 m from devices and is therefore localised to the vicinity of the device array. Nearfield changes in scour, sedimentation, sediment suspension, seabed composition and seabed morphology may arise due to these hydrodynamic changes. Farfield changes may occur, particularly in relation to large arrays of tidal devices, where alteration to the local hydrodynamics interrupts sediment transport processes, possibly having an overall impact to stabilise sediments in the area of the devices, while increasing erosion in other areas.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced and the array size. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Due to the limited amount of space available for a commercial scale array within the estuary, there is very limited potential to avoid impacts through careful site selection.	**Negative - Significant adverse**
Seabed Contamination and Water Quality	**Accidental Contamination (hydraulic fluids or vessel cargo/fuel)**	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. This will degrade water quality with potential for adverse effects on the receiving environment. The effects of any accidental spillage of slick forming chemicals within the estuary would have a greater impact than spills in open waters. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects in this area would be of adverse significance. Sensitive receptors in this area include SACs, pNHAs, SPAs, licensed aquaculture sites and bathing beaches.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan)	**Negative**
	Disturbance of contaminated sediment	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Significant adverse**	There are a number of dredging spoil disposal sites within the Shannon Estuary. These potential areas of contamination could therefore be disturbed by seabed activities. Any contaminated material released is unlikely to be widely dispersed given the restricted nature of the estuary and so the effect on water quality is likely to be of adverse significance. Munitions migrated relict from wartime activities could potentially be encountered. Disturbance could result in significant adverse effects.	Available mitigation includes avoidance of potentially contaminated seabed areas. Identification and avoidance of areas of munitions contamination through site survey at the project stage. If munitions are encountered advice such as that given in Crown Estates 2006 (Dealing with munitions in marine aggregates) should be followed.	**Negligible**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Protected Sites	**Degradation of protected sites**	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Significant adverse**	Zone 5a is an area of high importance for nature conservation. The zone is entirely within the Lower River Shannon SAC, designated for a variety of habitats and species listed in Annex I and II, respectively, of the Habitats Directive. One of the Annex II species for which the site is designated is the Bottlenose dolphin, of which there is a resident population, consisting of more than 50 animals, within the estuary. In addition there are SPAs and pNHAs located within the Shannon Estuary that overlap Zone 5a. Significant adverse impacts on protected sites could occur as a result of commercial scale turbine or export cable installation, through physical disturbance and loss of substratum, or direct disturbance impacts on the species/habitats supported in the protected area. Significant adverse impacts could be expected if direct disturbance is caused to Natura 2000 species or habitats that do not recover well, such as saltmarshes or biogenic reef.	There is no potential to avoid the marine nature conservation designations, which overlap with the entire zone. Careful site selection could be employed to avoid the areas containing the important marine habitats for which the site is designated. However, for a commercial scale array there is very limited potential to mitigate this impact.	**Significant adverse**
	Impacts on protected species	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Tidal**	Impacts on protected benthic ecology, mammals, birds, fish and reptiles in the zone are covered under the specific species sections of this table.			
Benthic and Intertidal Ecology	**Physical disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Significant adverse**	Assessment Zone 5a is located within an area of deep circalittoral mixed sediments which is likely to support a variety of infaunal species with epifaunal species establishing on any hard substrata (shells and stones). Disturbance to benthic habitat from installation activities would include minor disturbances through bed preparation prior to device foundation installation, disturbances from piling or alternatively from excavation of bed material for gravity foundations, disturbances to sediment from the feet of jack up platforms and disturbances to sediment from cable burial. Localised scouring around the base of device foundations may cause a loss of benthic habitat or smother the existing habitat due to deepening of seabed. The degree of scour will be dependent upon the final choice of foundation design. Trenching of inter-array and export cables would cause the greatest levels of physical disturbance with complete displacement of localised benthic communities and temporary smothering of adjacent areas. Impacts would include damage and possible mortality, particularly to smaller, thinner shelled bivalves. Mobile species such as amphipods, gastropods and small crustacea are likely to survive displacement however larger crabs and sea urchins may be crushed from disturbed boulders and cobbles. Permanently attached, sessile species such as bryozoans, sponges and hydroids on areas of coarser substratum cannot reattach to the substratum if removed, and may be damaged or destroyed if substratum is displaced. Physical disturbance will be localised and recoverability of benthic species is expected to be high due to repair and regrowth of damaged individuals and/or recruitment within the community from surviving colonies and individuals. Greater significance can be attached to impacts associated with physical disturbance to species considered to have high sensitivity and / or low recoverability, especially threatened and/or declining species or habitats. Within assessment zone 5a this includes the distribution of key habitats such as sand banks slightly covered by seawater all the time, reefs, mudflats and Zostera beds.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) especially in areas with known habitats. However, for a commercial scale array there is very limited potential to mitigate this impact. Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Significant adverse - Negative**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Smothering	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Negative**	Smothering of benthic communities by sediment displaced by activities such as cable trenching may cause a very local decline in biotope species richness due to the loss of more sensitive species due to clogging of their filtration apparatus and potential short term anoxia under the sediment layer. Disturbed sediments should be dispersed rapidly, especially in high energy areas likely to be associated with the location of tidal arrays, with only localised impacts associated with displaced sediment. Many of the benthic species associated with this habitat will be adapted to living in a perturbed environment Smothering impacts will be localised to the immediate vicinity of the seabed disturbing activities during installation.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection). However, for a commercial scale array there is very limited potential to mitigate this impact. Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative**
	Contamination – from sediment disturbance	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Negligible**	There is a potential for contaminated sediment such as from spoil dumping sites to be remobilised during seabed disturbing installation works. It is likely that any habitats with the potential to be adversely affected by contamination from these sites have already been subject to disturbance during the original dredging and deposition of material. Furthermore dredged sediment deposited at disposal sites in the area is thought to be relatively uncontaminated. Fine contaminated material will be diluted and dispersed, settling over a wide area with negligible effect on the benthic and intertidal ecology. Coarse material will be rapidly redeposited within the immediate area of installation operations.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) . However, for a commercial scale array there is very limited potential to mitigate this impact. Avoidance of areas of known potential contamination for seabed disturbing works. Potential effects on areas of unknown benthic habitat will need to be assessed through site survey at the project stage.	**Negligible**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. Although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on the benthic and intertidal ecology of the estuary would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan). Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**
	Changes in tidal regime	Operation	• Devices extracting energy generated by tidal currents	**Tidal**	**Significant adverse**	Installation of tidal turbine units may affect the wave regime and the tidal current regime. Changes to sedimentation and the hydrodynamic regime may give rise to an alteration in the composition of benthic habitats. 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, particularly to filter feeding organisms.	Avoidance of important habitats though careful site selection would reduce the potential effects of energy extraction. However, for a commercial scale array there is very limited potential to mitigate this impact. Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative – significant adverse**
	Substrate change	Installation Operation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Significant adverse**	All benthic communities can be expected to be sensitive to removal of their habitat. The long term loss of substratum due to the presence of devices that are attached to the seabed will therefore have a potentially significant adverse effect on any rare or important benthic habitats, such as those protected under the Habitats Directive. There is potential for colonisation of structures leading to increased biodiversity. Although this has potential to be a positive impact, species colonising underwater structures may also lead to undesirable changes in community structure.	Effects on benthic ecology from substratum loss can be reduced through avoidance (careful site selection). However, it may not be possible for this impact to be significantly reduced at this location. Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative – Significant adverse**
Fish and Shellfish	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Significant adverse**	Smothering effects are likely to be more of an issue for less mobile (shellfish) than mobile (finfish) species except where finfish species spawn on the seabed. 5 species of fish listed on Annex II of the Habitats Directive are found within the Shannon Estuary, including 3 species of lamprey, twaite shad and salmon. The lamprey and salmon have been observed spawning in the lower Shannon or its tributaries. All of the above species migrate from coastal regions to freshwater via the Shannon Estuary. Shellfish species found in the estuary include the Razor clam (*Enis* sp.) These organisms exhibit low potential for recovery and have restricted mobility, however, they are able to migrate vertically through sediments to avoid temporary disturbance.	For devices that require piling, and cable trenching, potential effects could be mitigated by avoiding installation during migration periods and the spawning and nursery seasons of benthic spawning species	**Negative**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Noise	Survey	• Acoustic survey	**Tidal**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for fish, in particular fish with swim bladders are particularly sensitive to noise disturbance. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to fish species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) would also minimise any impacts on fish species.	**Negligible**
		Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Tidal**	**Significant adverse**	High levels of noise such as during pile installation may cause physiological or displacement effects to marine fish although the extent to which this may occur is unknown. 5 species of fish listed on Annex II of the Habitats Directive are found within the Shannon Estuary, including 3 species of lamprey, twaite shad and salmon. All of the above species migrate from coastal regions to freshwater via the Shannon Estuary. Atlantic salmon are known to be susceptible to underwater noise. Potential impacts include physical injury and acoustic disturbance, which might interfere with migration to and from natal rivers. Lamprey are also migratory and may similarly be susceptible to damage or disturbance from underwater noise. It is expected that noise levels from piling and the removal of piled devices will be greater than those generated by operational devices, and although pile driving only occurs during installation the effects may last for longer than the piling activities as fish may not immediately return to the area. Given the restricted nature of the estuary and that it is used by migratory fish species sensitive to noise this impact is considered to be of adverse significance.	The potential effects of noise from piling or blasting could be reduced through undertaking studies to determine site specific noise effects, and/or avoiding piling or blasting activities during sensitive spawning periods. Where possible less noisy alternatives can be considered such as using gravity bases or clump weights, or protecting cables where they cannot be buried with mattressing or rock placement.	**Negative – Significant adverse**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal**	**Unknown**	There is potential for noise from operational devices to lead to long term species displacement which could increase pressures on fish populations in other locations and force fish into predator habitats.	No specific mitigation measures have been identified	**Unknown**
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal**	**Unknown**	5 species of fish listed on Annex II of the Habitats Directive are found within the Shannon Estuary, including 3 species of lamprey, twaite shad and salmon. There is potential risk that all mobile fish species could collide with turbines, moving parts of submerged devices, or mooring chains/cables. Larger pelagic species are considered to be at greater risk, however, due to uncertainties with data and knowledge on the interactions between fish and devices, the potential significance of collision risk effects is unknown.	Potential effects associated with collision risk and fish could be reduced through device design e.g. use of protective nets or grids. Devices could also be sited to avoid sensitive areas e.g. migration routes, spawning and nursery grounds although, given the restricted nature of the area avoidance would be difficult.	**Unknown**
	Hydraulic injury	Operation	• Shrouded devices (i.e. venturi devices)	**Tidal**	**Unknown**	There is potential risk that mobile fish could suffer injury or mortality through pressure changes occurring within the turbine as water is sucked through it. This effect is only relevant for shrouded tidal devices such as venturi devices, which use shrouding to constrict the flow, thus leading to a pressure low after the constriction. This effect is likely to be more significant for smaller species. Larger species sucked through the turbine would be more likely to suffer collision impacts.	Possible impacts associated with shrouded turbines can be addressed by using screens to prevent marine organisms from entering the device. Devices could also be sited to avoid sensitive areas e.g. migration routes, spawning and nursery grounds where possible. However, for a commercial scale array there is very limited potential to mitigate this impact.	**Unknown**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. Small spillages are likely to have a negligible impact. Large spillages, particularly in the enclosed estuary environment could have a significant adverse impact.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Tidal**	**Significant adverse**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude fish from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. Given the restricted nature of the estuary and the presence of migratory species exclusion from habitat and spawning sites could have a significant adverse impact	Devices could also be sited to avoid sensitive areas e.g. migration routes, spawning and nursery grounds where possible. However, for a commercial scale array there is very limited potential to mitigate this impact.	**Negative – significant adverse**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Significant adverse**	Substrate loss could have a significant adverse effect on shellfish and benthic spawning finfish species. The effect on finfish is most likely to be an issue where benthic spawning and nursery grounds exist. For more sedentary shellfish species it could have an effect through all life history stages.	The potential effects of substratum loss on shellfish and benthic spawners could be reduced by avoiding sensitive areas e.g. key shellfish sites or spawning grounds. The opportunity to mitigate impacts through avoidance is very limited given the restricted nature of the estuary. Better information on fish and shellfish distribution and spawning is required in order to confirm the potential for avoidance mitigation, and identify areas.	**Negative – significant adverse**
	Changes in tidal regime	Operation	• Devices extracting tidal energy	**Tidal**	**Unknown - Significant adverse**	Possible changes in water flow associated with removal of tidal energy are likely to be restricted to the immediate vicinity of the device/array. Shellfish species are generally sensitive to tidal flows.	Mitigation measures include spacing devices to minimise the effect on tidal flows. This will be restricted by the size of the Area.	**Unknown – negative**
	Barrier to movement	Operation	• Devices that occupy seabed/water column	**Tidal**	**Unknown – Significant adverse**	Salmon, twaite, shad and lamprey pass from coastal regions through the Shannon Estuary to the rivers beyond. Migration between the two water bodies is important for the survival of the species and as such the Shannon has been designated as an SAC for these migratory species. The presence of tidal devices could present a perceptual barrier to migration, although the exact impacts on fish species is unknown.	The opportunity to mitigate impacts through avoidance is very limited given the restrictive nature of the estuary.	**Significant adverse - Unknown**
	EMF	Operation	• Inter-array and export cables	**Tidal**	**Unknown - negligible**	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 renewable array power cable, but the field would not cause an avoidance reaction. Atlantic salmon, eels and sea trout are believed to be sensitive to magnetic fields. However, the level of impact associated with inter-turbine arrays will be more concentrated than those for export cables. There is no evidence to indicate that existing cables have caused any significant effect on migration patterns of these species. However, the significance of potential effects cannot be adequately quantified on the basis of current information.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation, where possible can reduce field strength.	**Unknown - negligible**
Marine Birds	**Physical disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal**	**Significant adverse - negligible**	There are no seabird breeding colonies within the Shannon Estuary with SPA status. At-sea coverage of the Shannon Estuary is limited, as it is an inshore area, however, high densities (>5 birds/km2) of Guillemots and moderate densities of Razorbills and Manx Shearwaters were recorded in the outer estuary between July and August. Parts of the Shannon & Fergus Estuary are designated as a Special Protection Area for birds, and hold internationally important numbers of Dunlin, Black-tailed Godwit, Redshank and nationally important numbers of a further 16 species of wildfowl and waders in winter months. Three species that occur regularly are listed on Annex I of the E.U. Birds Directive (Whooper Swan, Golden Plover and Bar-tailed Godwit). Large numbers of birds also pass through on spring and autumn migration. Physical disturbance during construction or decommissioning could lead to short- or long-term displacement of feeding or resting birds, depending on the species involved, and the time of year. Physical disturbance would be likely to be of particular importance close to onshore feeding or roosting areas in autumn and winter.	Effects on wildfowl and wader feeding and roosting areas could be reduced by avoiding the most sensitive sites within the estuary and by timing installation activities to avoid the most sensitive seasons e.g. spring and autumn migration and winter. Site-specific surveys would be required at project level to identify the presence of key foraging hotspots and/or resting areas and to aid site selection. The opportunity to mitigate impacts through avoidance is very limited given the restricted nature of the estuary.	**Negative - Negligible**
	Noise	Installation Decommissioning	• Devices using piled foundations	**Tidal**	**Negative - negligible**	Based on studies of bird behaviour on land it is evident that some species have acute hearing. However, there is limited understanding of birds ability to hear underwater. Although it is not possible to determine the level of significance of noise effects on seabirds, it is likely that impacts arising from operational noise of tidal devices will be very low. Impacts arising from construction/decommissioning of tidal devices will depend on the design and method of installation of the device. Impacts will be highest if piling is required to install the devices on the seabed. It is likely that some degree of habituation will occur, depending on the species involved, as has been recorded with terrestrial species nesting in working quarries.	There are some mitigation measures available for piling operations that have been shown to reduce noise e.g. bubble curtains around the pile. The application of these should be reviewed and considered. Construction/decommissioning operations should be timed to avoid the most sensitive seasons e.g. spring and autumn migration and winter.	**Unknown Negligible**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal**				

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. All seabirds are sensitive to hydraulic fluid and fuel oil contamination. In addition wading birds in estuaries may experience negative effects, if the spill reaches these areas. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine birds could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of Oil Spill Contingency Plans.	**Negligible**
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal**	**Unknown - Negligible**	Diving seabirds would be unlikely to collide with underwater cables associated with wave and tidal devices. Collision impacts for operating wave and tidal devices are largely unknown but would be likely to be negligible.	Appropriate siting of developments e.g. away from known important feeding areas for diving birds, such as mussel beds.	**Unknown - Negligible**
	Habitat exclusion	Operation	• Devices that occupy sea surface/water column	**Tidal**	**Negligible**	Depending on the scale of development, the amount of available habitat lost to diving birds would be likely to be negligible.	Appropriate siting of developments e.g. away from known important feeding areas for diving birds, such as mussel beds. The opportunity to mitigate impacts through avoidance is very limited given the restricted nature of the estuary.	**Negligible**
Marine Mammals	**Physical Disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal**	**Negative – Significant adverse**	Bottlenose dolphins are resident in the Shannon, with schools being encountered throughout the estuary. These dolphins show a high degree of site fidelity, and sightings of neonatal calves suggest that the Shannon is an important nursing and breeding area. As a result, Area 5a has been designated as a SAC for bottlenose dolphin conservation. A number of other cetacean species have been recorded in the Shannon including harbour porpoise, minke whale and common dolphin. The Shannon does not represent important haul out or breeding sites for grey or harbour seals, but telemetry studies show that the waters of the Shannon estuary are an important foraging area for grey seals. The presence of boat traffic and construction equipment may result in avoidance behaviour. Increased boat traffic associated with construction and decommissioning will increase ambient noise in the area and may disturb marine mammals. Impacts on seabed flora and fauna could cause changes in food web structure and function, and could have negative impacts on top predators that forage in the Shannon.	Appropriate siting of developments away from areas of high usage by bottlenose dolphins. Whilst there are some existing data on habitat use of bottlenose dolphins in the estuary information on other cetaceans and seal at-sea distribution/habitat use is scarce. Year round monitoring effort would be necessary to address this. Bottlenose dolphins are encountered throughout the year in the Shannon, but there is a decrease in abundance over the winter. The effects of installation activities could be reduced by avoiding certain times of year.	**Negative– Significant adverse**
	Noise	Survey	• Acoustic survey	**Tidal**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for marine mammals. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to mammal species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) should be considered.	**Negligible**
		Installation Decommissioning	• Devices using piled foundation • Underwater blastings	**Tidal**	**Negative-Significant adverse**	Piling and underwater blasting generate high levels of noise. Seals and cetaceans can detect piling noise up to a distance of 80km, and previous studies have demonstrated displacement of porpoises up to 15km during construction of wind farms. Behavioural responses could be expected at 20km, and although this will depend on the level of existing background noise, the restricted nature of the estuary may mean that disturbance is unavoidable. Physiological impacts such as temporary or permanent threshold shift in hearing could occur at distances of 400m for seals, and 1.8km for harbour porpoise, although evidence suggests that it is unlikely that an animal would choose to remain in close proximity to a source of loud noise that would result in temporary or permanent hearing damage. Noise can mask signals used by cetaceans to navigate, locate prey, and communicate effectively. It is also possible that noise sources may mask biologically relevant signals. The potential for noise to affect marine mammals is therefore considered to be “significant adverse”. Increased shipping associated with installation will also raise ambient noise levels in the area.	Monitoring surveys would be required to establish distribution of seals and cetacean at sea in order to design a suitable mitigation plan. Seasonal or area restrictions could also be imposed so noisy activities would be timed not to coincide with sensitive times such as seal moulting or pupping and porpoise breeding seasons. A range of measures are available to further reduce noise impacts including Marine Mammal Observers, exclusion zones, passive acoustic monitoring, pingers, soft starts/ramp up and/or bubble curtains. Consideration could also be given to using non-piled foundations, and protecting cables where they cannot be buried using rock placement or mattressing.	**Negative-Significant Adverse**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal**	**Unknown - Negative**	Tidal turbines can produce low frequency noise and vibrations that can pass into the water column and can potentially affect seals and cetaceans ability to navigate, locate prey and communicate. Recent studies suggest that harbour seal behaviour is largely unaffected by the presence of underwater tidal turbines. There is potential for noise from operational devices to lead to long term species displacement, and the cumulative effect of many devices operating together or when combined with operational noise from other marine use is unknown.	Noise from operating turbines can be reduced by efficient design, reducing vibration, and using isolators.	**Unknown - Negative**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal**	**Negligible - negative**	Harbour porpoise and bottlenose dolphin commonly forage in areas of high water flow, which are identified as potential tidal resource in Area 5a. Marine mammals can potentially collide with vessels and equipment used during installation. Increased shipping activity during installation will increase this risk. Generally most fatal injuries arise with collisions with ships travelling over 13kts. Vessels associated with construction activities would usually not be travelling at these speeds.	Consider setting speed limits for construction vessels operating in sensitive areas. Establish a code of conduct to avoid disturbance to marine mammals both during construction activities and in transit to the construction area if entering areas of high abundance.	**Negligible**
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal**	**Unknown - negative**	Harbour porpoise and bottlenose dolphin commonly forage in areas of high water flow, which are identified as potential tidal resource in Area 5a. All marine mammals may have difficulty detecting the presence of mooring/tethering cables. These cables are likely to have a small cross-section and provide fewer sensory cues to approaching mammals, so the risk of collision for these types of installation will be greater. Recent studies suggest that harbour seal behaviour is largely unaffected by the presence of underwater tidal turbines. While a number of cetacean species occur in the Shannon, abundance, habitat use, and behaviour around underwater turbines is unknown. Collision risk with renewable energy installations is therefore difficult to quantify.	Measures to make turbine foundations more visible to marine mammals could reduce the risk of collisions. Consider the use of acoustic pingers/deterrents on mooring/tethering lines.	**Unknown - negative**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal**	**Significant adverse**	A spillage of diesel, oil lubricants, or hydraulic fluids during installation could have an adverse effect on marine mammal health. A collision between ships or between a ship and an offshore renewable installation could result in fluid spills, which could have serious environmental consequences. While the likelihood of accidental contamination from devices is low, should it occur in the enclosed estuary environment, the potential effects on marine mammals would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy sea surface/ seabed/ water column	**Tidal**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude mammals from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. The cumulative effect of many installations within an area is unknown. Displacement of fishing activity during installation and operation may result in increased resource competition between fisheries and marine mammals in non-impacted areas. Installations may however, provide increased habitat as artificial reefs and attract fish aggregations that may provide increased foraging opportunities for marine mammals, or temporary haul outs for seals.	Appropriate siting of developments away from areas of high usage by bottlenose dolphins. Whilst there are some existing data on habitat use of bottlenose dolphins in the estuary information on other cetaceans and seal at-sea distribution/habitat use is scarce. Year round monitoring effort would be necessary to address this. However, the opportunity to mitigate impacts through avoidance is very limited given the restricted nature of the estuary.	**Unknown**
	Barrier to movement	Operation	• Devices that occupy sea surface/ seabed/ water column	**Tidal**	**Unknown - Significant adverse**	The presence of commercial scale arrays may cause a barrier effect for marine mammals. While a number of marine mammal species occur in the Shannon, the importance of the estuary for marine mammal migration is unlikely to be high. Barrier effect within the Shannon is difficult to quantify.	Detailed study would be required to examine coastal distribution in order to mitigate for this risk and avoid large installations in heavily utilised areas.	**Unknown – significant adverse**
	EMF impacts	Operation	• Inter-array and export cables	**Tidal**	**Unknown - negligible**	There is only circumstantial evidence that cetaceans have ferromagnetic organelles capable of determining small differences in relative magnetic field strength. Magnetic fields could potentially affect animals using geomagnetic cues during migration. Seals and cetaceans regularly cross cables, and there is no apparent evidence that existing electricity cables have influenced cetacean migration. The level of impact associated with inter-turbine arrays will be more concentrated than those for export cables. Since grey seals are thought to feed on or near the seabed, and thus may come into close proximity with EMF fields at the seabed, further study is required before potential impact on foraging success can be fully understood.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength, where possible	**Unknown - negligible**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Marine Reptiles	**Collision**	Installation Decommissioning	• Vessels and equipment used for installation and decommissioning	**Tidal**	**Negligible - unknown**	Assessment Area 5a is an important area for leatherback sea turtles. The northern coast of Kerry is a known hotspot for leatherbacks, and leatherbacks are regularly sighted off Counties Clare (especially around Loop Head), Galway and Mayo. Many leatherbacks have also been sighted far off shore. Within Area 5a one leatherback was caught in a salmon drift net near Ballylongford Bay. One of the main threats to marine turtles in Irish coastal seas is entanglement in mooring ropes (for pot fisheries) and subsequent drowning. It is not known how mooring chains/cables used in operating devices impact on turtles but it's likely they offer more of a collision risk than entanglement. Turtles may be less likely to collide with large installations but much is unknown about how sea turtles especially leatherbacks interact with man made barriers/obstacles. There is a slight possibility that leatherback turtles could swim into operating devices as they are generally oceanic animals unaccustomed to solid structures. Loggerheads are more likely to swim around such structures. Sea turtles can potentially collide with vessels and equipment used during installation, and devices during operation. Increased shipping activity transiting to the area during installation will increase this risk.	Possible mitigation includes planning installation to take place at times when there are fewer turtles present (December-May) or avoiding known areas of high abundance. Arrays could also benefit sea turtles as such installations may provide habitats for jellyfish polyps (as has been shown for marinas) and subsequently lead to an increase in jellyfish abundance (turtle food). Site specific survey to identify areas of high turtle abundance, and avoidance of such areas. However, the opportunity to mitigate impacts through avoidance is very limited given the restricted nature of the estuary.	**Negligible - unknown**
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal**				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal**	**Significant adverse**	A spillage of diesel, oil lubricants and hydraulic fluids could have an effect on turtle health. Although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine reptiles would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Barrier to movement	Operation	• Devices that occupy sea surface/water column • Vessels and equipment used for installation and decommissioning • Turbines/moving parts of devices	**Tidal**	**Unknown**	The movement of marine turtles around the coast of Ireland is unknown so it is difficult to quantify the level of barrier effect. However arrays could be perceived as a barrier affecting turtle movements or routes to feeding areas. Barriers such as drift nets located along Co Kerry's northern coast used to catch a lot of leatherback sea turtles. An array placed in a similar fashion (i.e. perpendicular to the coastline) would increase the likelihood of the barrier effect. Arrays could potentially corral turtles into a corner/trap that they may not be able to get out without human intervention.	Orientating arrays parallel to the coastline rather than perpendicular to the coastline may help minimise a barrier effect as turtles swim past. No other mitigation measures identified.	**Unknown**
	Noise	Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Tidal**	**Unknown**	Avoidance responses of sea turtles to low frequency sounds have been demonstrated, however, the study of sensory biology in sea turtles is still in its infancy, so there is a large unknown component.	No specific mitigation identified.	**Unknown**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal**				
	EMF impacts	Operation	• Inter-array and export cables	**Tidal**	**Negligible - Unknown**	Sea turtles may be able to detect EMF fields such as those generated by export and inter-turbine cables and thereby could adversely affect turtles using geomagnetic cues during foraging and migration, although the importance of these cues remains unclear. However, as turtles are generally present at the surface and in the water column, they are unlikely to come into close proximity with the EMF field at the seabed.	EMF impacts could be reduced through ensuring that cables are buried, reducing the EMF at the seabed. Cable design and orientation to minimise generated EMF.	**Negligible - Unknown**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Tidal**	**Neutral**	The construction of arrays in jellyfish hotspots could exclude turtles from this critical habitat. In this zone jellyfish populations are likely to be extremely widespread (over 10-100kms) and composed of several different species. It is likely that there are many frontal areas at the mouth of the Shannon Estuary that may aggregate jellyfish and hence may be suitable foraging grounds for leatherbacks. By providing new habitat for jellyfish polyps, arrays could actually increase the abundance of jellyfish in adjacent waters through a process of advection.	No specific mitigation identified.	**Neutral**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Marine and coastal archaeology and wrecks	**Direct disturbance of unknown and known sites**	Installation	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Significant adverse - Negative**	There is considerable archaeological and heritage interest in this area. There are numerous recorded wreck sites within the Shannon Estuary, many of which will be over 100 years old. There is potential for the installation of tidal devices and export cables to impact submarine archaeology through direct disturbance of known and unknown sites on the seabed, or through changes to sediment movements causing an artefact to become buried and preventing later discovery. There are numerous National Monuments and other archaeological site around the Shannon Estuary. Cable installation in the vicinity of these protected sites could cause direct destruction of archaeologically important features. All archaeological monuments and wrecks greater than 100 years old are protected under the National Monuments Acts 1930 – 2004. Wartime wrecks are not currently covered under the Acts but are likely to be included in the near future.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Avoid sites of interest and exclusion zones for marine archaeology. Submit any artefacts recovered to the National Monuments Service. For known submarine and terrestrial sites the main form of mitigation is to avoid protected and other sites of interest. In addition to desk based studies it will be necessary to carry out field walkovers in preferred terrestrial site locations to determine need for site investigations (geophysical surveys/trial trenching) in consultation with the National Monuments Service and Local Authorities. With respect to cabling there is considerable opportunity to avoid or reduce effects. The siting of export cables will be important in determining their residual impact.	**Negative - Negligible**
	Changes to sediment regime	Operation	• Devices using seabed foundations • Devices using energy generated by tidal currents	**Tidal**	**Significant adverse to Positive**	The Shannon Estuary includes areas where there is a potential for early settlement sites and unrecorded wrecks. Changes in sedimentation may either expose or increase the burial depth of archaeological features at such sites. Where sites are exposed there is a potential for discovery of or damage to or loss of artefacts or sites. Where features are subject to deeper burial the potential for discovery of or damage to artefacts or sites is likely to be decreased.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
	Data acquisition	Installation	• Pre-installation survey	**Tidal**	**Unknown**	There is a potential for archaeological sites and wrecks to be discovered within Area 5a as a result of site surveys, providing additional data for inclusion in the archaeological record of the area.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
Commercial Fisheries	**Direct disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Negative**	Although direct disturbance may have an impact on all fishery types it is likely to be more significant in the case of shellfish than finfish as shellfish are generally much less mobile. Shellfish fisheries which may be impacted in Area 5a include lobster and shrimp. Inshore finfish grounds are however also sensitive to direct disturbance as these are generally exploited by small vessels which are less able to exploit alternative grounds.	Potential impacts could be minimised through avoiding peak fishing periods. There is a lack of fishing effort distribution information for vessels under 15m which are involved in pot fisheries in Area 5a and early liaison with local fishermen would help to identify key fishing areas. The effects could also be minimised by using procedures and structures that minimise the area of seabed disturbed for installation foundations.	**Negative - negligible**
	Temporary displacement from traditional fishing grounds	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal**	**Negative**	Inshore fishing grounds tend to be more constrained than offshore areas. Temporary displacement from these areas may lead to the concentration of fishermen in smaller areas, fishermen being unable to fish for short periods or fishermen being displaced to alternative, possibly less productive fishing grounds. Temporary displacement will potentially have a negative effect on commercial fisheries.	Liaison with the fishing community to keep them informed of installation operations is key to managing the level of this impact.	**Negative - negligible**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Long term displacement from traditional fishing grounds	Operation	• Devices that occupy sea surface/water column/seabed	**Tidal**	**Negative-significant adverse**	All types of commercial fisheries could be affected by long term displacement from traditional fishing grounds. The potential effects could be of adverse significance for spatially constrained inshore pot fisheries. Conversely, long term exclusion of mobile gear from the area could be of benefit to fish stocks in the wider area although spill-over effects, particularly for mobile fish species are poorly understood. The effects of long term displacement on fisheries will depend on the scale of the arrays and the extent to which fishing vessels are excluded from the area. The possible re-opening of Eel fisheries after 2012 must also be taken into account when assessing potential fisheries impacts.	A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts on commercial fisheries. In relation to eel fisheries and potential interactions with tidal energy devices in the Shannon estuary a detailed consultation with scientists from Inland Fisheries Ireland (formerly the Central Fisheries Board) would be required.	**Negative-significant adverse**
Aquaculture	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Negligible**	Area 5a contains shellfish cultivation areas for Pacific oysters and mussels which could be adversely affected by any significant and prolonged rise in suspended solids. However, increases in suspended sediment is expected to be short term and localised to the immediate vicinity of the seabed disturbing works. Intrusion of sediment plumes into aquaculture areas would therefore only result if the export cables were routed in the immediate vicinity. There could therefore be a negligible impact from renewable energy development.	Impacts from cable trenching could be reduced by using procedures that minimise the mobilisation of suspended solids, such as plough installation.	**Negligible**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal**	**Significant adverse**	Shellfish are highly sensitive to reductions in water quality caused by hydraulic fluids or tainting from other chemical substances. There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. It should be noted that the quantity of hydraulic fluid in devices is likely to be very small, reducing the potential for significant environmental effects. Therefore, although the likelihood of accidental contamination from devices is low, the potential effects of any significant intrusion of hydraulic fluids into aquaculture production areas could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, and contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Significant adverse**	Shellfish production in Assessment Area 5a could be adversely affected should installations be sited in or cables routed through shellfish cultivation areas.	The key mitigation measure in terms of reducing effects on shellfish farms is avoidance. In practice, consent is unlikely to be achievable to site renewable energy arrays or cables within existing fish farms.	**Negligible**
Ports, Shipping and Navigation	**Displacement of shipping**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal**	**Significant adverse**	Shipping intensity in Area 5a is high, with significant vessel traffic navigating through the Area to access the ports of Shannon Foynes, Kilrush, Carrigaholt and local ferry ports. The zone is narrow and constrained by land with numerous anchorage areas throughout. The re-routing of vessels to avoid safety zones (during installation), operational devices and decommissioning activity would result in greater transit time and use of fuel, with the associated costs to the vessel operator, and could lead to displacement of vessels to areas that already have moderate vessel densities, potentially having knock-on impacts on collision risk, trade/supply and visibility. This impact would be amplified in constrained areas. There effect of displacement of shipping would have a significant adverse to negative impact in Area 5a.	The potential for these effects to be reduced would depend entirely upon the ability to site devices in relation to key routes for shipping. Given the high shipping densities and the constrained nature of the zone it would be very difficult to site devices away from shipping routes. The scale of potential effect on vessel traffic will need to be investigated further as part of project specific EIAs.	**Significant adverse**
		Operation	• Devices that occupy sea surface/water column	**Tidal**	**Significant adverse - Negative**			**Significant adverse**
	Decreased trade/supply	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal**	**Significant adverse**	Shannon Foynes, a major commercial port, is within Assessment Area 5a, with Kilrush and the fishing port of Carrigaholt directly adjacent to the zone. There are also two local ferry ports providing a ferry service across the Shannon. The presence of installation/maintenance vessels, presence of devices and decommissioning activity could create temporary to long-term reductions in access to ports and harbours. Reduced access to ports and harbours in Area 5a could have a significant adverse effect on local communities in terms of goods transport and accessibility.	Site selection for device arrays should take into account the requirement for continued access to port and harbours. There is limited potential in Area 5a to site devices away from the entrances to ports and harbours and thereby avoid impacting on accessibility, trade and supply. Early liaison should be instigated with harbour masters and good communications will need to be maintained with the relevant ports. Appropriate notifications to mariners should be made during installation, maintenance and decommissioning.	**Negative**
		Operation	• Devices that occupy sea surface/water column	**Tidal**	**Significant adverse**			**Negative**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Reduced visibility	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal**	**Significant adverse**	Vessels and other equipment used during the installation/maintenance/ decommissioning of devices, and the operational devices themselves could obstruct views of other vessels and navigation features such as buoys, lights and land. This is particularly important in areas of high vessel densities, constrained channels or areas where there is particular dependence on visual navigation aids as reduced visibility increases the risk of collision with other ships and other structures in the water (natural and manmade). The effect of reduced visibility will be significant adverse in Area 5a due to the constrained nature of the area, the level of shipping and the presence of numerous ports and harbours.	It would be difficult to reduce significant adverse effects associated with reduced visibly avoiding areas of high vessel densities and areas constrained by land in Area 5a. However, in busy shipping areas, potential effects may be reduced by using fully submerged devices which have minimal restrictions on visibility. Also minimising the period of installation, the number of vessels required and the area occupied during installation would reduce the potential impact on visibility. Any vessels and devices should be lit and marked in accordance with the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) guidelines, in agreement with the Commissioners of Irish Lights.	**Negative**
		Operation	• Devices that occupy sea surface	**Tidal**	**Significant adverse**			**Negative**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal**	**Significant adverse**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. The impact on collision of siting devices in Area 5a would be significant adverse. This is due to the constrained nature of the environment and the high shipping densities.	The risk of collision could be reduced by avoiding areas of high shipping densities, regularly used shipping routes and constrained stretches of coastline. There is limited potential within Area 5a to site devices away from these areas. In busy shipping areas, potential effects may be reduced by minimising the period of installation, the number of vessels required and the area occupied during installation. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance, and decommissioning.	**Significant adverse**
		Operation	• Devices that occupy sea surface/water column	**Tidal**	**Significant adverse**			**Significant adverse**
Recreation and Tourism	**Access Restrictions**	Installation Operation Decommissioning	• Structures in the sea reducing or excluding access	**Tidal**	**Significant adverse**	The key receptors are sailing and dolphin watching boat trips. Cruising routes for recreational use are present in the zone as indicated by the presence of sailing clubs, also there are numerous wildlife watching charter vessels. Tidal developments in this Area, if located on routes used by these vessels could cause re-routeing, or restrict access to key areas.	There may be potential to locate devices away from tourist vessel routes but this is limited given the constrained nature of the estuary. The use of device types which lie below the surface at a depth below the maximum draft of recreational vessels in a given area could also mitigate this impact.	**Negative**
	Noise	Installation Decommissioning	• On and offshore machinery and vessels	**Tidal**	**Significant adverse**	The main tourist activity in the Shannon Estuary is wildlife watching, relating to the population of bottle-nose dolphins present in the estuary. Noise from machinery, vessels and the devices themselves may impact the dolphin population and therefore impact on dolphin watching activities. Visual impacts within the estuary are also relevant to wildlife tourist's enjoyment of the area and are described further in the landscape/seascape section.	Monitoring surveys would be required to establish distribution of the dolphins in order to design a suitable mitigation plan. Seasonal or area restrictions could also be imposed so piling activities would be timed not to coincide with sensitive times. A range of measures are available to further reduce noise impacts including Marine Mammal Observers, exclusion zones, passive acoustic monitoring, pingers, soft starts/ramp up and/or bubble curtains.	**Unknown – Significant adverse**
		Operation	• Turbines/flexing joints/device components above sea surface		**Significant adverse**			**Unknown – Significant adverse**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal**	**Significant adverse**	The key receptors are sailing and dolphin watching boat trips. Cruising routes for recreational use are present in the zone as indicated by the presence of sailing clubs, also there are numerous wildlife watching charter vessels. The location of devices close to vessel routes could potentially increase collision risk, especially if located in areas where ability to manoeuvre is restricted by other factors such as water depth. There is also collision risk associated with the installation vessels	There is some potential to avoid impacts through locating devices away from existing cruising routes, although, this is limited given the constrained nature or the estuary. The use of tidal device types which lie below the surface at a depth below the maximum draft of recreational vessels in a given area could also mitigate this impact. Safety measures including lighting and marking and informing users of the locations of devices will help to negate any potential impact.	**Negative**
		Operation	• Devices that occupy sea surface/water column		**Significant adverse**			**Negative**
	Disturbance to Wildlife	Installation Operation Decommissioning	• Installation/decommissioning activity • Devices that occupy seabed/ sea surface/water column	**Tidal**	**Unknown – Significant adverse**	Effects on local tourism would occur where disturbance and/or exclusion from an area overlaps with the locations frequented by visitors and touring vessels. The Shannon contains Ireland's only resident population of bottlenose dolphins and so wildlife watching is key to tourism in the Shannon.	Monitoring surveys would be required to establish distribution of the dolphins in order to design a suitable mitigation plan. Seasonal or area restrictions could also be imposed so piling activities would be timed not to coincide with sensitive times. A range of measures are available to further reduce noise impacts including Marine Mammal Observers, exclusion zones, passive acoustic monitoring, pingers, soft starts/ramp up and/or bubble curtains.	**Unknown – Significant adverse**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Aviation	**No specific impacts on aviation are expected.**							
Military Activity	**Disruption to general activities**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal**	**Negligible**	There are no Department of Defence danger areas within Assessment Area 5a, although, military use of the Zone may include fishery protection and search and rescue operations. The development of offshore renewables may have a negligible impact on fishery protection and search and rescue operations in Area 5a.	Consultation with the Department of Defence will be undertaken as part of project specific EIAs.	**Negligible**
		Operation	• Devices that occupy sea surface/water column					
Cables and Pipelines	**Direct damage**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal**	**Significant adverse**	There are no major subsea cables or pipelines within Area 5a. Although there is an unspecified cable connecting Tarbert Island with Kilkerin point. Direct damage to this cable could occur during installation of device arrays and cables but also could occur during maintenance and decommissioning. The impact could be considered to be significant adverse (should it occur) as community power supply or communications could be disrupted.	Individual project site surveys would detect any additional cables and/or pipelines. The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**No effect**
	Access restrictions	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal**	**Significant adverse**	There is potential that the presence of devices in waters close to existing cables could restrict access to the cables for maintenance purposes. Due to the potential implications for power/telecommunications supply, the significance of this effect, if it occurred, could be significant adverse.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Dredging and Disposal areas	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal**	**Negative**	There are 4 known dredge disposal sites within Assessment Area 5a. Construction operations and the presence of devices have the potential to restrict normal access to these sites. There are no existing aggregate dredging areas within Assessment Area 5a and no areas have been identified as areas that could potentially be exploited for aggregate extraction.	There is the potential to locate devices away from existing dredging and disposal areas.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Existing Renewable Infrastructure	**There is no existing renewable infrastructure in Area 5a and so no impacts are expected.**							

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Natural Gas and CO_2 Storage	**Sterilisation of region**	Operation	• Devices using seabed foundations	**Tidal**	**Unknown**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for CO_2 or natural gas storage. There is currently insufficient data to establish potential for use of the marine environment for storage of CO_2. Therefore, whilst no sites are currently under consideration for natural gas or CO_2 storage in this zone, the significance of this possible future impact is unknown.	None identified	**Unknown**
	Impacts relating to oil/gas tankers transiting the zone are covered under Ports, Shipping and Navigation							
	Sterilisation of region	Operation	• Devices using seabed foundations	**Tidal**	**Unknown - negative**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for oil and gas exploitation. There is currently insufficient data to establish possible future exploitation of oil and gas from this zone. As it is possible that future oil and gas activities may take place in this zone is it not feasible to rule out any potential impacts from offshore renewable devices. However the impacts on possible future oil and gas developments are impossible to quantify at this stage	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices and as There is the potential to locate devices away from oil and gas activity.	**Unknown**
Seascape Effects	Effects on seascape Type 9 Large River Estuary	Operational	Arrays of surface point structures over 14m above surface	Tidal	Moderate Effect to Slight Effect (between 0 and 5km offshore from the coast)	Assessment Zone 5a is located within the Shannon Estuary (Clare, Kerry and Limmerick) with tidal resources identified close to the mouth of the estuary and inshore areas adjacent to Carrig Island and Tarbet (Kerry) . The seascape type is described below: 9. Large River Estuary -Semi enclosed seascape bordered by a low flat or rolling estuarine coastal fringe with mudflats and islands, the scale of the seascape varies from small to large with long open views across the estuary and out to the narrow horizon of the open sea. Large horizontal vistas encompass the surrounding landmass. Islands and vertical elements such as built structures are visually prominent due to the low viewpoint and low profiles of distant shorelines.	Potential adverse effects on seascape can be reduced through the sensitive siting of tidal device arrays. Key factors to be considered in locating a tidal array include: • Identifying opportunities to deploy submerged devices where possible to avoid adverse effects. • Limit the use of markers (buoys and lights) in highly sensitive areas and recognising the requirements in terms of navigational safety. • Maximising the distance from shore of tidal array developments	**Slight to Moderate depending on distance from shore and amount of development that is visible above water.**

Table Appendix G5a: Shannon (Zone 5a: Tidal) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Effects on seascape Type 9 Large River Estuary	Operational	Arrays of surface point structures over 14m above surface	Tidal	Slight to Slight Neutral Effect (between 5km and 10km from the coast)	There are no national level landscape designations along the coast in this area. Parts of this coastline are also covered by a number of county level landscape designations including: • Vulnerable Landscapes (Clare) • Scenic Routes (Clare) • Areas of High Amenity (Clare) • Scenic Views and Prospects, (Limerick)) • Rural Secondary Special Amenity (Kerry) • Identified views and prospects (Kerry. Within Assessment Zone 5a the broad slightly winding Shannon river estuary varies in width along its course widening out as it approaches the enclosing headlands of the narrow river mouth. The topography is made up of low flat or rolling landscapes and estuarine seascape with mudflats and islands, rising to a rolling hinterland. Exposed shorelines are interspersed with sheltered bays. There are busy shipping lanes, and visually prominent industrial features such as pylons and the power station at Money Point along with leisure craft and areas recognised for scenic or amenity value such as Scattery Island and Clonderlaw Bay (Clare). Due to the scale of the seascape all development in this zone will be within 0-10km of the coast The low viewpoints of Seascape type 9 Large River Estuary will increase the prominence of a new vertical element introduced into the broad horizontal vista resulting in moderate to slight effects within 0-5 km dropping to slight to slight neutral between 5-10km. Local sensitivity may increase in proximity to areas recognised as of local scenic or amenity value or may decrease in proximity to existing infrastructure.	• Avoid deploying tidal arrays that protrude above the water surface in areas where they appear to block or close the entrance to bays/loughs/ narrows/sounds or where they separate a bay from the open sea • Tidal arrays that protrude above the water surface should reflect the shape of the coastline and align with the dominant coastal edge; • Tidal arrays that protrude above the water surface should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate; • Tidal arrays that protrude above the surface should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Tidal arrays that protrude above the surface should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms.	**Slight to Moderate depending on distance from shore and amount of development that is visible above water.**
Climate	Carbon Impacts	Operation	Turbines	**Tidal**	**Positive**	It is recognised that development of offshore renewable energy developments will contribute towards achieving the Ireland's target for 40% energy to be provided from renewable energy sources. In meeting this target Ireland will be working towards the wider European and international commitment to combat global climate change and reduce the potential associated adverse environmental effects e.g. changing population distributions, species extinction, sea level rise etc. However, whilst seeking to combat climate change there is also a need to respond to it in terms of: • Protecting the existing environment and increasing its robustness and ability to adapt to climate change • Protecting existing and future infrastructure from effects of climate change e.g. increased storm events , flooding and sea level rise	Ensure that coastal infrastructure is sited in locations that are at lower risk from flooding, sea level rise and storm damage and do not increase the risk of flooding or damage to coastal infrastructure elsewhere. This will require close consultation at the project design stage with the relevant land use planning authority.	**Positive**
	Carbon Storage	Installation Operation	Turbines	**Tidal**	**No effect**	Based on current available information no existing or proposed carbon or gas storage sites have been identified within this area Assessment Area 5a) therefore there will be no effect resulting from the development of tidal arrays.	None required	**No effect**

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Bathymetry	**The information presented in this chapter has been used to inform the results of the assessment. No specific impacts on bathymetry are expected.**							
Geology, geomorphology and sediment processes	**Changes in hydrodynamic/ coastal processes and seabed morphology**	Installation Decommissioning	• Cable trenching/removal • Foundations Installation/ removal	**Tidal Wave Fixed Wind Floating Wind**	**Negligible**	Seabed sediments in the zone coarse sand and gravels. There is a lack of detailed information on seabed sediment and sediment transport processes in the assessment zone. Cable burial and wave/ tidal and wind turbine foundation installation/ removal would have a localised effect on the seabed morphology. Such effects would be temporary in the prevailing relatively high wave and tidal current regime.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm is located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Negligible**
	Changes in hydrodynamic/ coastal processes and seabed morphology	Operation	• Devices using seabed foundations	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	Sediment generally comprises sand and muddy sand with areas of glacial till and bedrock. Relatively high tidal stream velocities and high wave energy conditions prevail. The physical presence of monopile or tripod foundations and transition pieces on and above the seabed and tidal and wave energy devices within the water column and on the sea surface will cause hydrodynamic changes. The removal of tidal and wave energy will also affect the hydrodynamic regime. Research suggests that such hydrodynamic changes will extend up to 50 m from devices and is therefore localised to the vicinity of the device array. Nearfield changes in scour, sedimentation, sediment suspension, seabed composition and seabed morphology may arise due to these hydrodynamic changes. Farfield changes may occur, particularly in relation to large arrays of wind, tidal or wave devices, where alteration to the local hydrodynamics interrupts sediment transport processes e.g. longshore drift, possibly having an overall impact to stabilise sediments in the area of the wind farm, tidal or wave devices, while increasing erosion in other areas along coast. With regard to offshore wind, this impact is relevant to installation of piled devices, which would be in the nearshore area, out to 60 m water depth.	Site specific geophysical and geotechnical survey will be required to establish a baseline and inform the impact assessment for individual developments. The degree of potential impacts depends on the type and size of foundation and structure, how closely individual devices are spaced, the array size and how far offshore the wind farm, wave or tidal devices are located. Modelling of hydrodynamics and sediment transport should be part of pre-project activities to understand the potential effect of offshore structures on these processes. Coastal Impacts will be reduced with increasing distance from the shore. Site selection based on modelling and site survey data will reduce hydrodynamic and sedimentary impacts.	**Unknown - negligible**
Seabed Contamination and Water Quality	**Accidental Contamination (hydraulic fluids or vessel cargo/fuel)**	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. This will degrade water quality with potential for adverse effects on the receiving environment. Any accidental spillage of slick forming chemicals could be carried into inshore waters, where the effects on water quality will be greater than those in open waters. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects in this area would be of adverse significance. Sensitive receptors in this area include a MNR, Ramsar sites, SACs, pNHAs, SPAs, licensed aquaculture sites and bathing beaches. There is a risk of transboundary contamination following spillages in Area 6	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan)	**Negligible**
	Disturbance of contaminated sediment	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse - Negligible**	There are four dredging spoil disposal sites within Area 6. These potential areas of contamination could therefore be disturbed by seabed activities. Any contaminated material released is likely to be widely dispersed and diluted and the effect on open sea water quality is likely to be of negligible significance. Munitions relict from wartime activities may be encountered. Disturbance could result in significant adverse effects.	Available mitigation includes avoidance of potentially contaminated seabed areas. Identification and avoidance of areas of munitions contamination through site survey at the project stage. If munitions are encountered advice such as that given in Department of the Marine and Natural Resources 2001 (Marine Notice No. 16 of 2001. (i.Explosives picked up at sea in trawls or sighted; and ii. The removal of explosive items from wrecks)) should be followed.	**Negligible**

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Protected Sites	**Degradation of protected sites**	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Negative – significant adverse**	There are Ramsar, SAC, SPA, NHA and pNHA protected sites within Assessment Area 6. These sites are all adjacent to the coast, although in some cases (e.g. Broadhaven Bay SAC, Tory Island SAC and Donegal Bay SPA), extend up to a maximum of 9 km offshore. Significant adverse impacts on protected sites could occur as a result of turbine or export cable installation, through physical disturbance and loss of substratum, or direct disturbance impacts on the species supported in the protected area. Significant adverse impacts could be expected if direct disturbance is caused to Natura 2000 species or habitats that do not recover well, such as saltmarshes or biogenic reef	Impacts on protected areas could be mitigated by careful site selection avoiding sensitive sites for devices and export cables (i.e. existing and proposed national and European protected sites). Whether avoidance is an appropriate mitigation should be assessed on a site specific basis. A very extensive area is available to site floating wind technology away from protected sites. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of protected sites. However in the case of Assessment Area 6, there is still the potential to locate piled wind arrays, and their export cables away from protected sites. Impacts may still arise through indirect impacts on sediment movements during installation and operation, and would need to be assessed in more detail at the project stage. Possible mitigation measures relevant to the specific interest features of the sites and their seasonal and other sensitivities are described elsewhere in this table for the relevant topic areas.	**Negligible – significant adverse**
	Impacts on protected species	Installation Operation Decommissioning	• Vessels and equipment used for installation and Decommissioning • Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	Impacts on protected benthic ecology, mammals, birds, fish and reptiles in the zone are covered under the specific species sections of this table.			

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Benthic ecology	**Physical disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	Assessment Area 6 is located across an area which has a range of sandy to coarser gravel communities in sheltered to more exposed bays and rocky coast communities. Disturbance to benthic habitat from installation activities would include minor disturbances through bed preparation prior to device foundation installation, disturbances from piling or alternatively from excavation of bed material for gravity foundations, disturbances to sediment from the feet of jack up platforms and disturbances to sediment from cable burial. Localised scouring around the base of wave, wind or tidal turbine foundations may cause a loss of benthic habitat or smother the existing habitat due to deepening of seabed. The degree of scour will be dependent upon the final choice of foundation design. Trenching of interturbine and export cables would cause the greatest levels of physical disturbance with complete displacement of localised benthic communities and temporary smothering of adjacent areas. Impacts would include damage and possible mortality, particularly to smaller, thinner shelled bivalves. Mobile species such as amphipods, gastropods and small crustacea are likely to survive displacement however larger crabs and sea urchins may be crushed from disturbed boulders and cobbles. Permanently attached, sessile species such as bryozoans, sponges and hydroids on areas of coarser substratum cannot reattach to the substratum if removed, and may be damaged or destroyed if substratum is displaced. Physical disturbance will be localised and recoverability of benthic species is expected to be high due to repair and regrowth of damaged individuals and/or recruitment within the community from surviving colonies and individuals. Greater significance can be attached to impacts associated with physical disturbance to species considered to have high sensitivity and / or low recoverability, especially threatened and/or declining species or habitats. Within assessment Area 6 this includes the distribution of key habitats such as intertidal mudflats (e.g. Killala Bay/Moy Estuary, Ballysadare Bay – Sligo Bay, Cumeen Strand/Drumcliff Bay, Rosses Strand, Gweebarra, Owentocker and Owenea, Donegal Bay, Lough Swilly), maerl beds (St John's Point, Mulroy Bay, Rutland Island), Zostera beds (Inner Drumcliff Bay – Sligo Bay, Aranmore, S. Donegal Bay, Mulroy Bay, Lough Swilly and Lough Foyle), and potential biogenic and rocky reef habitat (including wave exposed subtidal reefs at Rathlin O'Birne Island and Tory Island, rare cobble and boulder reef communites at Slieve League, some of the best examples of reef in Ireland at St. John's Point and *Ostrea edulis* reef in Lough Swilly.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) especially in areas with known sensitive intertidal and subtidal benthic habitats, such as intertidal mudflat, maerl beds and biogenic and rocky reef habitat. Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative – Negligible**
	Smothering	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Negative**	Smothering of benthic communities by sediment displaced by activities such as cable trenching may cause a very local decline in biotope species richness due to the loss of more sensitive species due to clogging of their filtration apparatus and potential short term anoxia under the sediment layer. Disturbed sediments should be dispersed rapidly, especially in high energy areas likely to be associated with the location of wave and tidal devices, with only localised impacts associated with displaced sediment. Smothering impacts will be localised to the immediate vicinity of the seabed disturbing activities during installation.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection) . Potential effects on unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**
	Contamination – from sediment disturbance	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Negligible**	There is a potential for contaminated sediment such as from spoil dumping sites to be remobilised during seabed disturbing installation works. It is likely that any habitats with the potential to be adversely affected by contamination from these sites have already been subject to disturbance during the original dredging and deposition of material. Furthermore dredged sediment deposited at disposal sites in the area is thought to be relatively uncontaminated. Fine contaminated material will be diluted and dispersed, settling over a wide area with negligible effect on the Benthic ecology. Coarse material will be rapidly redeposited within the immediate area of installation operations.	The potential effects on benthic ecology can be reduced through avoidance (careful site selection). Avoidance of areas of known potential contamination for seabed disturbing works. Potential effects on areas of unknown benthic habitat will need to be assessed through site survey at the project stage.	**Negligible**

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. The water depth is such that small spillages (< 1tonne) are unlikely to affect the benthos. Similarly small spillages from wind 1 are unlikely to come ashore. Large spillages have the potential to have a significant adverse effect, particularly on the intertidal ecology of the adjacent shoreline coastline, including within Mulroy Bay SAC, Rutland Island and Sound SAC and Lough Swilly SAC. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on Benthic ecology would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan). Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible**
	Changes in wave regime and tidal flow	Operation	• Devices using energy generated by waves or tidal current	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	Installation of wave and tidal turbine units may affect the wave and tidal current regime. Changes to sedimentation and the hydrodynamic regime may give rise to an alteration in the composition of benthic habitats. 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, particularly to filter feeding organisms. Tidal rapid and reef habitats are all highly sensitive to changes in tidal flow, and may be present throughout the area. Given the potential for these Priority habitats to be present in tidal resource areas, the effects could potentially be of adverse significance There is potential for a decrease in wave exposure resulting from extraction of wave energy. Wave exposed habitats particularly those facing the full force of the Atlantic swell, 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 impact on wave energy can extend up to 20km from the wave device. Coarse gravel with maerl is known to be present at the entrance to Mulroy Bay. Maerl beds may be sensitive to decreases in wave energy. Given the potential for these Priority habitats to be present in tidal resource areas, the effects could potentially be of adverse significance	Avoidance of these important habitats though careful site selection would reduce the potential effects of energy extraction. Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negative**
	Substrate change	Installation Operation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	All benthic communities can be expected to be sensitive to removal of their habitat. The long term loss of substratum due to the presence of devices that are attached to the seabed will therefore have a potentially significant adverse effect on any rare or important benthic habitats, such as those protected under the Habitats Directive. There is potential for colonisation of structures leading to increased biodiversity. Although this has potential to be a positive impact, species colonising underwater structures may also lead to undesirable changes in community structure	Effects on benthic ecology from substratum loss can be reduced through avoidance (careful site selection). Potential effects on areas of unknown benthic habitats will need to be assessed through site survey at the project stage.	**Negligible - Significant adverse**
Fish and Shellfish	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Negative**	Smothering effects are likely to be more of an issue for less mobile (shellfish) than mobile (finfish) species except where finfish species are spawning on the seabed eg herring. Area 6 contains shellfish populations of lobster, edible crab, velvet crab, crayfish, shrimp, *nephrops*, scallops, oysters, cockles, periwinkles and whelks. Periwinkles are found throughout the intertidal area of semi-exposed to sheltered rocky shores of Area 6,but at lesser densities than in Area 3 due to the more exposed nature of much of the coastline. Of these shellfish species which live on, near or in the bottom sediments of the seabed the most sensitive to smothering are oysters and periwinkles. The impact of smothering will be localised to the immediate vicinity of seabed disturbing activities and limited to during installation.	For devices that require piling, and cable trenching, potential effects could be mitigated by avoiding installation during the spawning and nursery seasons of benthic spawning species such as herring.	**Negligible**

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Noise	Survey	• Acoustic survey	**Wave Tidal Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for fish, in particular fish with swim bladders are particularly sensitive to noise disturbance. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to fish species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) would also minimise any impacts on fish species.	**Negligible**
		Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Tidal Wave Fixed Wind**	**Unknown**	High levels of noise such as during pile installation or underwater blasting may cause physiological or displacement effects to marine fish although the extent to which this may occur is unknown. In particular, herring and cod are known to be highly sensitive to noise and may be able to detect piling noise up to 80km. Both species are present in Area 6. It is expected that noise levels from piling and the removal of piled devices will be greater than those generated by operational devices, and although pile driving only occurs during installation the effects may last for longer than the piling activities as fish may not immediately return to the area.	The potential effects of noise from piling or blasting could be reduced through undertaking studies to determine site specific noise effects, and/or avoiding piling or blasting activities during sensitive spawning periods. Where possible less noisy alternatives can be considered such as using clump weights or gravity bases, or protecting cables where they cannot be buried with mattressing or rock placement.	**Unknown**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal Wave Fixed Wind Floating Wind**	**Unknown**	There is potential for noise from operational devices to lead to long term species displacement which could increase pressures on fish populations in other locations and force fish into predator habitats.	No specific mitigation measures have been identified	**Unknown**
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal Wave Floating Wind**	**Unknown**	There is potential risk that all mobile fish species could collide with turbines, moving parts of submerged devices, or mooring chains/cables. Larger animals, such as basking sharks, and pelagic species are considered to be of greater risk. Basking shark and other pelagic fish species are present throughout Area 6. However, due to uncertainties with data and knowledge on the interactions between fish and devices, the potential significance of collision risk effects is unknown.	Potential effects associated with collision risk and fish could be reduced through device design e.g. use of protective nets or grids. Devices could also be sited to avoid sensitive areas e.g. migration routes, spawning and nursery grounds.	**Unknown**
	Hydraulic injury	Operation	• Shrouded devices (i.e. venturi devices)	**Tidal**	**Unknown**	There is potential risk that mobile fish could suffer injury or mortality through pressure changes occurring within the turbine as water is sucked through it. This effect is only relevant for shrouded tidal devices such as venturi devices, which use shrouding to constrict the flow, thus leading to a pressure low after the constriction. This effect is likely to be more significant for smaller species. Larger species sucked through the turbine would be more likely to suffer collision impacts.	Possible impacts associated with shrouded turbines can be addressed by using screens to prevent marine organisms from entering the device. Devices could also be sited to avoid sensitive areas e.g. migration routes, spawning and nursery grounds.	**No impact**
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. Small spillages are likely to have a negligible impact. Large spillages, particularly where they impinge on the coastline or enter sheltered bays and loughs could have a significant adverse impact.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Tidal Wave Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude fish from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. It is not possible to determine the potential significance of this effect. The presence of offshore wind arrays may also have a positive effect on fish populations through fish stock recovery, should certain types of fisheries be excluded from the array.	No specific mitigation identified	**Unknown**

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	Substrate loss could have a significant adverse effect on shellfish (crab, lobster, nephrops, oyster, whelk, scallop) and benthic spawning finfish species such as herring. The effect on finfish is most likely to be an issue where benthic spawning (e.g. herring) and nursery grounds exist. For more sedentary shellfish species it could have an effect through all life history stages. There is significant overlap in the inshore areas of Area 6 between herring and shellfish spawning and resource areas which may be a particular issue for fixed wind installations. Herring and edible crab spawning areas also extend into deeper shelf waters of Area 6. The main overlap for shallow and deep water wave and floating wind resource areas is with the edible crab distribution which covers the entire zone. The tidal resource area overlaps in the South with whelk and with edible crab grounds in the North.	The potential effects of substratum loss on shellfish and benthic spawners could be reduced by avoiding sensitive areas e.g. key shellfish grounds or spawning grounds. Better information on fish and shellfish distribution is required in order to confirm the potential for avoidance mitigation, and identify areas. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts. Targeted surveys by site developers may also be undertaken by individual projects.	**Negative - Negligible**
	Changes in wave and tidal regime	Operation	• Devices extracting tidal or wave energy	**Tidal Wave**	**Unknown - Significant adverse**	Possible changes in water flow associated with removal of tidal and wave energy are likely to be restricted to the immediate vicinity of the device/array. Shellfish species are generally sensitive to wave and tidal flows. Area 6 also contains important herring spawning areas which occur on gravel beds created by high water flow and these beds could be significantly adversely affected by changes in water flow. The tidal resource area North of the Inishowen peninsula overlaps with herring spawning and Cod nursery grounds mapped by the Marine Institute (see Figure 9.2.3a), and shellfish spawning (whelk and edible crab).	Available mitigation includes avoidance of important herring spawning area and shellfish areas. More detailed mapping of the herring spawning ground may be required in order to allow avoidance.	**Unknown - Negligible**
	Barrier to movement	Operation	• Devices that occupy seabed/water column	**Tidal Wave Fixed Wind Floating Wind**	**Unknown**	Some species, such as Atlantic salmon, trout and eels spent part of their lifecycle in freshwater and part at sea. Migration between these two waterbodies is important for the survival of the species. Area 6 has a number of rivers designated as SACs due to their significant Salmon populations. These include the Moy, Eske, Gweebarra, Glenamoy, Leannan, Unshin, Owenmore and Lackagh rivers. The presence of wind, wave or tidal devices could present a perceptual barrier to migration, although the exact impacts on fish species is unknown.	Available mitigation includes avoiding placing devices close to the entrances to key spawning rivers.	**Negligible - Unknown**
	EMF	Operation	• Inter-array and export cables	**Tidal Wave Fixed Wind Floating Wind**	**Unknown - negligible**	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 renewable array power cable, but the field would not cause an avoidance reaction. Atlantic salmon, eels and sea trout are believed to be sensitive to magnetic fields. However, the level of impact associated with inter-turbine arrays will be more concentrated than those for export cables. There is no evidence to indicate that existing cables have caused any significant effect on migration patterns of these species. However, the significance of potential effects cannot be adequately quantified on the basis of current information.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength.	**Unknown - negligible**

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Marine Birds	**Physical disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse - negligible**	There are several seabird breeding colonies within Area 6 with SPA status, including the Stags of Broadhaven, Roaninish, Illaunmaster and Horn Head. Waters in the vicinity of these colonies are important feeding and resting areas for several breeding species occurring in nationally important numbers. At-sea coverage of Area 6 is incomplete, however, high densities (>5 birds/km^2) of Fulmar, Great Black-backed Gull and Kittiwake were recorded in inshore waters between February and May, while high density of Manx Shearwater was recorded between July and August, Guillemot was recorded in high density in inshore waters between March and April and in August. Skuas migrate through Area 6 in spring and autumn in varying numbers. The Mullet, Broad Haven and Blacksod Bays, Ballysadare Bay, Sligo Harbour, Drumcliff Bay EstuaryDonegal Bay and Trawbeaga Bay are internationally and nationally important for several species of wildfowl and waders during spring and autumn passage and in winter months. Physical disturbance during construction or decommissioning could lead to short- or long-term displacement of feeding or resting birds, depending on the species involved, and the time of year. Physical disturbance would be likely to be of particular importance close to seabird breeding colonies in the breeding season.	Effects on seabird breeding colonies could be reduced by avoiding sensitive sites e.g. SPAs and by timing installation activities to avoid the most sensitive seasons e.g. breeding and moulting. Site-specific surveys would be required at project level to identify the presence of key foraging hotspots and/or resting areas and to aid site selection.	**Negligible**
	Noise	Installation Decommissioning	• Devices using piled foundations	**Tidal Wave Fixed Wind**	**Significant adverse - negative Negative - negligible**	Based on studies of bird behaviour on land it is evident that some species have acute hearing. However, there is limited understanding of birds ability to hear underwater. Although it is not possible to determine the level of significance of noise effects on seabirds, it is likely that impacts arising from operational noise will be less than impacts arising from installation (specifically from piling noise). It is likely that some degree of habituation will occur, depending on the species involved, as has been recorded with terrestrial species nesting in working quarries.	There are some mitigation measures available for piling operations that have been shown to reduce noise e.g. bubble curtains around the pile. The application of these should be reviewed and considered. Piling operations should be timed to avoid the most sensitive seasons e.g. breeding and moulting.	**Unknown Negligible**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal Wave Fixed Wind Floating Wind**				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. All seabirds are sensitive to hydraulic fluid and fuel oil contamination. In addition wading birds in estuaries may experience negative effects, if the spill reaches these areas. Therefore, although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine birds could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of Oil Spill Contingency Plans.	**Negligible**
	Collision	Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal Wave Fixed Wind Floating Wind**	**Significant Adverse**	Collision impacts could potentially be significant adverse for offshore wind farms, depending on the species involved. Typically, larger, less agile species such as divers, gannets, swans, geese terns and seaducks, have been highlighted as likely to be particularly sensitive to collision with offshore wind turbines (Langston & Pullan 2002). Collision impacts could be significant during spring and autumn if developments are located on a major migration route or flyway.	Available mitigation includes - Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/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 e.g. resting and foraging areas; - Shut-down of turbines at night with bad weather/visibility and high migration intensity; - Avoiding large-scale continuous illumination; - Measures to make wind turbines more recognisable to birds	**Negative – negligible**

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Habitat exclusion	Operation	• Devices that occupy sea surface/water column	**Tidal Wave Fixed Wind Floating Wind**	**Negative - negligible**	Diving seabirds would be unlikely to collide with underwater cables associated with wave and tidal devices. Collision impacts for operating wave and tidal devices would be negligible.	Appropriate siting of developments e.g. away from important feeding/roosting areas.	**Negligible**
	Barrier to movement	Operation	• Devices that occupy air column to a significant height above sea surface	**Fixed Wind Floating Wind**	**Significant adverse - negative**	If seabirds avoid a development after construction, then the area of avoidance can be considered as lost habitat for the species involved. Seabirds may be displaced from the development area and the surrounding waters, depending on their avoidance response. There is limited information on precise foraging and resting "hotspots" for seabird species around Ireland, although waters adjacent to breeding colonies will be important for these activities during the breeding season. Although birds are mobile and can avoid development sites, the potential effects of doing so may increase competitive pressures on adjacent waters. The energetic costs of site avoidance need to be considered, as do cumulative and in-combination impacts arising from birds avoiding other neighbouring developments. Post-construction habitat loss could therefore potentially have a significant adverse effect during the breeding season and a negative significant effect on seabirds at other times of the year.	Appropriate siting of developments e.g. away from seabird breeding colonies, important feeding/roosting areas, nearshore areas and "migration corridors"; Studies would be needed at the project level to identify the presence of key foraging and resting areas in the development area, to aid site selection.	**Negative – negligible**
Marine Mammals	**Physical Disturbance**	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Negative – Significant adverse**	Breeding populations of both harbour and grey seals occur throughout Area 6. Harbour porpoise and bottlenose dolphins also occur regularly throughout this zone. 8 SACs have been designated in Area 6 for these Annex II species. The presence of boat traffic and construction equipment may result in flight behaviour, particularly if they occur in shallower coastal waters near seal breeding and haul out sites. Increased boat traffic associated with construction and decommissioning will increase ambient noise in the area and may disturb marine mammals. At-sea distribution data for seals is unknown for this area, although movement between this area and Scotland has been recorded for harbour seals, and grey seals typically forage offshore. Cetacean abundance and habitat use is largely unknown. However, harbour porpoise and bottlenose dolphin commonly forage in areas of high water flow, and are regularly sighted in the northeast of Area 6 which has been identified as potential tidal technical resource. Impacts on seabed flora and fauna could cause changes in food web structure and function and could have negative impacts on top predators in the food web such as marine mammals.	Monitoring surveys would be required to establish distribution of seals and cetaceans at sea in order to design a suitable mitigation plan. Cetaceans may be seasonally abundant in these waters, and the effects of installation activities could be reduced by avoiding certain times of year. The effects of installation activities on seal colonies could be reduced by avoiding the breeding and moulting seasons as well as avoiding development in inshore areas close to seal haul out locations. Disturbance impacts from export cable installation could be avoided by avoiding seal breeding colonies or haul out sites.	**Unknown - Negative**
	Noise	Survey	• Acoustic survey	**Tidal Wave Fixed Wind Floating Wind**	**Negligible**	Some of the survey techniques likely to be used for marine renewables projects will generate noise sources at frequencies that are within the audible range for marine mammals. However the volume / magnitude of expected noise sources are unlikely to be great enough to cause any physical injury or disturbance impacts to mammal species.	Adherence to IDWC recommendations to minimise impacts on marine mammals (Irish Whale and Dolphin Group 2005) should be considered.	**Negligible**

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Noise	Installation Decommissioning	• Devices using piled foundations • Underwater blasting	**Tidal Wave Fixed Wind**	**Significant adverse**	Piling and underwater blasting generate high levels of noise. Seals and cetaceans can detect piling noise up to a distance of 80km, and previous studies have demonstrated displacement of porpoises up to 15km during construction of wind farms. Behavioural responses could be expected at 20km, although this will depend on the level of existing background noise. Physiological impacts such as temporary or permanent threshold shift in hearing could occur at distances of 400m for harbour seals, and 1.8km for harbour porpoise. However, evidence suggests that it is unlikely that an animal would choose to remain in close proximity to a source of loud noise that would result in temporary or permanent hearing damage. Noise can mask signals used by cetaceans to navigate, locate prey, and communicate effectively. It is also possible that noise sources may mask biologically relevant signals. The potential for noise to affect marine mammals is therefore considered to be "significant adverse". Increased shipping associated with installation will also raise ambient noise levels in the area.	Monitoring surveys would be required to establish distribution of seals and cetacean at sea in order to design a suitable mitigation plan. Seasonal or area restrictions could also be imposed so noisy activities would be timed not to coincide with sensitive times such as seal moulting or pupping and porpoise breeding seasons. A range of measures are available to further reduce noise impacts including Marine Mammal Observers, exclusion zones, passive acoustic monitoring, pingers, soft starts/ramp up and/or bubble curtains. Consideration could also be given to using non-piled foundations, and protecting cables where they cannot be buried using rock placement or mattressing.	**Negative-Significant Adverse**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal Wave Fixed Wind Floating Wind**	**Unknown - Negative**	Wind turbines can produce low frequency noise and vibrations that can pass into the water column and can potentially affect seals and cetaceans ability to navigate, locate prey and communicate. Operational noise from wind turbines may be heard by seals and porpoises up to 200m, and simulated noise from a 2MW wind turbine has resulted in avoidance behaviour by harbour seals and harbour porpoises. The noise impact of wave and tidal devices on marine mammals is not well researched and understood, although based on available information, underwater noise produced by wave and wind devices is considered to be less than that for tidal devices. Recent studies suggest that harbour seal behaviour is largely unaffected by the presence of underwater tidal turbines. The cumulative effect of many devices operating together or when combined with operational noise from other marine use is also unknown.	Noise from operating turbines can be reduced by efficient design, reducing vibration, and using isolators.	**Unknown - negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Negligible - negative**	Marine mammals can potentially collide with vessels and equipment used during installation. Increased shipping activity during installation will increase this risk. Generally most fatal injuries arise with collisions with ships travelling over 13kts. Vessels associated with construction activities would usually not be travelling at these speeds.	Consider setting speed limits for construction vessels operating in sensitive areas., Establish a code of conduct to avoid disturbance to marine mammals both during construction activities and in transit to the construction area if entering areas of high abundance.	**Negligible**
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal Wave Floating Wind**	**Unknown - negative**	Risk of collision with wind turbines is small for seals and small cetaceans, since pylons are large and static. However collision may be a concern for larger baleen whales, which do not have the manoeuvrability of smaller cetaceans. All marine mammals may have difficulty detecting the presence of mooring/tethering cables for wave and tidal installations, as well as floating wind devices in deeper water. These cables are likely to have a small cross-section and provide fewer sensory cues to approaching mammals, so the risk of collision for these types of installation will be greater. Tidal technical resource is restricted to the northeast area of Area 6. Moving underwater turbines could potentially contribute a significant impact risk, especially in areas of high flow where manoeuvrability may be compromised. Limited information available suggests that harbour seal behaviour is largely unaffected by the presence of tidal turbines, but grey seals, harbour porpoise and bottlenose dolphin also occur in the area and the impact of wave and tidal devices on marine mammals is poorly researched. While a number of cetacean species occur in both inshore and offshore waters in this zone, abundance and habitat use is unknown, so the collision risk with offshore renewable energy installations is difficult to quantify.	Measures to make turbine foundations more visible to marine mammals could reduce the risk of collisions. Consider the use of acoustic pingers/deterrents on mooring/tethering lines.	**Unknown - negative**

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants, or hydraulic fluids during installation could have an adverse effect on marine mammal health. A collision between ships or between a ship and an offshore renewable installation could result in fluid spills which could have serious environmental consequences. While the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine mammals would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Habitat exclusion	Operation	• Devices that occupy sea surface/ seabed/ water column	**Tidal Wave Fixed Wind Floating Wind**	**Unknown**	The presence of devices in the water could lead to habitat exclusion. Devices may exclude mammals from a suitable feeding habitat by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. The cumulative effect of many installations within an area is unknown. Displacement of fishing activity during installation and operation may result in increased resource competition between fisheries and marine mammals in non-impacted areas. Installations may however, provide increased habitat as artificial reefs and attract fish aggregations that may provide increased foraging opportunities for marine mammals.	Surveys of habitat use by marine mammals and avoid heavily used areas and migration corridors.	**Unknown**
	Barrier to movement	Operation	• Devices that occupy sea surface/ seabed/ water column	**Tidal Wave Fixed Wind Floating Wind**	**Unknown - Significant adverse**	The presence of large arrays may cause a barrier effect for migrating marine mammals. The importance of Area 6 for marine mammal migration is unknown, so barrier effect is difficult to quantify.	Detailed study would be required to examine coastal distribution in order to mitigate for this risk and avoid large installations in migratory corridors.	**Unknown - Significant adverse**
	EMF impacts	Operation	• Inter-array and export cables	**Tidal Wave Fixed Wind Floating Wind**	**Unknown - negligible**	There is only circumstantial evidence that cetaceans have ferromagnetic organelles capable of determining small differences in relative magnetic field strength. Magnetic fields could potentially affect animals using geomagnetic cues during migration. However, cetaceans regularly cross cables, and there is no apparent evidence that existing electricity cables have influenced cetacean migration. The level of impact associated with inter-turbine arrays will be more concentrated than those for export cables and further study is required before this impact can be fully understood.	Cable burial, where possible to minimise field effect at the seabed. Cable configuration and orientation can reduce field strength, where possible	**Unknown - negligible**
Marine Reptiles	**Collision**	Installation Decommissioning	• Vessels and equipment used for installation and decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Negative**	Assessment Area 6 is an important area for leatherback sea turtles (historically Donegal has the third highest numbers of sightings in Ireland). One of the main threats to marine turtles in Irish coastal seas is entanglement in mooring ropes (for pot fisheries) and subsequent drowning. It is not known how mooring chains/cables used in operating devices impact on turtles but it's likely they offer more of a collision risk than entanglement. Turtles may be less likely to collide with large installations but much is unknown about how sea turtles especially leatherbacks interact with man made barriers/obstacles. There is a slight possibility that leatherback turtles could swim into operating devices as they are generally oceanic animals unaccustomed to solid structures. Loggerheads are more likely to swim around such structures. Sea turtles can potentially collide with vessels and equipment used during installation, and devices during operation. Increased shipping activity transiting to the area during installation will increase this risk.	Possible mitigation includes planning installation to take place at times when there are fewer turtles present (December-May) or avoiding known areas of high abundance. Arrays could also benefit sea turtles as such installations may provide habitats for jellyfish polyps (as has been shown for marinas) and subsequently lead to an increase in jellyfish abundance (turtle food). Site specific survey to identify areas of high turtle abundance, and avoidance of such areas.	**Negligible - unknown**
		Operation	• Turbines/moving parts of devices • Mooring chains/cables	**Tidal Wave Floating Wind**				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	A spillage of diesel, oil lubricants and hydraulic fluids could have an effect on turtle health. Although the likelihood of accidental contamination from devices is low, should it occur, the potential effects on marine reptiles would be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Barrier to movement	Operation	• Devices that occupy sea surface/water column • Vessels and equipment used for installation and decommissioning • Turbines/moving parts of devices	**Tidal Wave Fixed Wind Floating Wind**	**Unknown**	The movement of marine turtles around the coast of Ireland is unknown so it is difficult to quantify the level of barrier effect. However arrays could be perceived as a barrier affecting turtle movements or routes to feeding areas. An array placed perpendicular to the coastline would increase the likelihood of the barrier effect. Arrays could potentially corral turtles into a corner/trap that they may not be able to get out without human intervention.	Orientating arrays parallel to the coastline rather than perpendicular to the coastline may help minimise a barrier effect as turtles swim past. No other mitigation measures identified.	**Unknown**

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Noise	Installation Decommissioning	• Devices using piled foundation • Underwater blasting	**Tidal Wave Fixed Wind Floating wind**	**Unknown**	Avoidance responses of sea turtles to low frequency sounds have been demonstrated, however, the study of sensory biology in sea turtles is still in its infancy, so there is a large unknown component.	No specific mitigation identified.	**Unknown**
		Operation	• Turbines/flexing joints/device components • Turbine noise transmitted through steelwork	**Tidal Wave Fixed Wind Floating Wind**				
	EMF impacts	Operation	• Inter-array and export cables	**Tidal Wave Fixed Wind Floating Wind**	**Negligible - Unknown**	Sea turtles may be able to detect EMF fields such as those generated by export and interturbine cables and thereby could adversely affect turtles using geomagnetic cues during foraging and migration, although the importance of these cues remains unclear. However, as turtles are generally present at the surface and in the water column, they are unlikely to come into close proximity with the EMF field at the seabed.	EMF impacts could be reduced through ensuring that cables are buried, reducing the EMF at the seabed. Cable design and orientation to minimise generated EMF.	**Negligible - Unknown**
	Habitat exclusion	Operation	• Devices that occupy seabed/water column	**Tidal Wave Fixed Wind Floating Wind**	**Neutral**	The construction of arrays in jellyfish hotspots could exclude turtles from this critical habitat. In this zone jellyfish populations are likely to be extremely widespread (over 10-100kms) and composed of several different species, but by providing new habitat for jellyfish polyps, arrays could actually increase the abundance of jellyfish in adjacent waters through a process of advection.	No specific mitigation identified.	**Neutral**
Marine and coastal archaeology and wrecks	**Direct disturbance of unknown and known sites**	Installation	• Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse to Negative**	Area 6 includes sheltered coastal sites where preservation of archaeological sites by burial is likely to have been favoured. It also includes areas where there is a potential for early settlement sites. There are numerous recorded wreck sites along the adjacent coastline and within Area 6. There is potential for the installation of tidal, wave and wind devices and export cables to impact submarine archaeology through direct disturbance of known and unknown sites on the seabed, or through changes to sediment movements causing an artefact to become buried and preventing later discovery. There are a large number of National Monuments on the adjacent coastline including those in State care. Locally, regionally and nationally important archaeological remains and sites are also present along the coast. Numerous listed buildings are also present on the coastline adjacent to the area. Cable installation in the vicinity of these protected sites could cause direct destruction of archaeologically important features. All archaeological monuments and wrecks greater than 100 years old are protected under the National Monuments Acts 1930 – 2004. Wartime wrecks are not currently covered under the Acts but are likely to be included in the near future.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Avoid sites of interest and exclusion zones for marine archaeology. Submit any artefacts recovered to the National Monuments Service. For known submarine and terrestrial sites the main form of mitigation is to avoid protected and other sites of interest. In addition to desk based studies it will be necessary to carry out field walkovers in preferred terrestrial site locations to determine need for site investigations (geophysical surveys/trial trenching) in consultation with the National Monuments Service and Local Authorities. With respect to cabling there is considerable opportunity to avoid or reduce effects. The siting of export cables will be important in determining their residual impact.	**Negligible**
	Changes to sediment regime	Operation	• Devices using seabed foundations • Devices using energy generated by waves or tidal current	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse to Positive**	Area 6 includes areas where there is a potential for early settlement sites and unrecorded wrecks. Changes in sedimentation may either expose or increase the burial depth of archaeological features at such sites. Where sites are exposed there is a potential for discovery of or damage to or loss of artefacts or sites. Where features are subject to deeper burial the potential for discovery of or damage to artefacts or sites is likely to be decreased.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Carry out seabed investigations in preferred site locations prior to device installation. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Data acquisition	Installation	• Pre-installation survey	**Tidal Wave Fixed Wind Floating Wind**	**Unknown**	There is a potential for archaeological sites and wrecks to be discovered within Area 6 as a result of site surveys, providing additional data for inclusion in the archaeological record of the area.	Conform to the legislative requirements of the National Monuments Acts 1930-2004 and follow the codes of practice published by the National Monument Service. Record and report potential archaeological and vessel remains to the National Monuments Service.	**Unknown - Positive**
Commercial Fisheries	**Direct disturbance**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/remov • al	**Tidal Wave Fixed Wind Floating Wind**	**Negative to Significant adverse**	In a large area of Area 6 fisheries are currently restricted as part of a whitefish recovery plan which was introduced in 2009. However these measures are likely to be temporary and evolving through the issuing of future EU regulations. As such the description of impacts on fisheries in Area 6 is done on the basis of recent rather than current fisheries activity. Although direct disturbance may have an impact on all fishery types it is likely to be more significant in the case of shellfish than finfish as shellfish are generally much less mobile than finfish. Shellfish fisheries which may be impacted in Area 6 include Nephrops, crab, lobster, shrimp and oyster. Inshore finfish grounds are however also sensitive to direct disturbance as these are generally exploited by small vessels which are less able to exploit alternative grounds. Additionally there may be direct disturbances to finfish spawning grounds within the zone e.g. Herring.	Potential impacts could be minimised through avoiding peak fishing periods. The potential for avoiding key commercial fishing grounds may be limited due to the widespread nature of fishing activity in the zone. Early liaison with the fishing industry could help identify key fishing areas, particularly in the area where there is a lack of fishing effort distribution information for vessels under 15m. The effects could also be minimised by using procedures and structures that minimise the area of seabed disturbed for turbine foundations.	**Negative**
	Temporary displacement from traditional fishing grounds	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Negative**	Inshore fishing grounds tend to be more constrained than offshore areas. Temporary displacement from these areas may lead to the concentration of fishermen in smaller areas, fishermen being unable to fish for short periods or fishermen being displaced to alternative, possibly less productive fishing grounds. Temporary displacement will potentially have a negative effect on commercial fisheries.	Effects can be reduced by phasing construction activities to specific areas within Area 6. The potential for avoiding key commercial fishing grounds may be limited due to the widespread nature of fishing activity in the zone. Liaison with the fishing community to keep them informed of installation operations is also key to managing the level of this impact.	**Negative - negligible**
	Long term displacement from traditional fishing grounds	Operation	• Devices that occupy sea surface/water column/seabed	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	All types of commercial fisheries could be affected by long term displacement from traditional fishing grounds. The potential effects could be of adverse significance for spatially constrained inshore fisheries and for bottom trawl and pot fisheries which may be restricted by installations and cable routes. Conversely, long term exclusion of mobile gear from the area could be of benefit to fish stocks in the wider area although spillover effects, particularly for mobile fish species are poorly understood. The key bottom trawl fisheries in Area 6 are for *Nephrops*, cod, haddock, whiting, Megrim, Black Sole, Plaice, Rays and Ling. Crab, lobster, shrimp and whelk are exploited by pots while oysters and scallops are exploited by mechanical dredging gear. The effects of long term displacement on trawl fisheries in particular will depend on the scale of the arrays and the extent to which fishing vessels are excluded from the area. Use of rock armour, if required for cable protection, will introduce an obstruction for trawling activity, but could also create new habitat which could have a positive impact of fish stocks.	Potential impacts could be minimised by spacing of turbines at wide enough intervals to permit use of mobile fishing gear. The fixed wind and tidal resource area in Area 6 overlaps very extensively with inshore fishing effort making avoidance difficult. The best potential would be in the deepest and further offshore part of the fixed wind resource area outside of the operating area of smaller inshore pot fishing vessels. The distribution of this fishing effort is not mapped however and would require liaison with industry and BIM to clarify areas of potential. A first step in better characterising fishing intensity throughout the study area could be a workshop with expert representatives from the Marine Institute, B.I.M., N.P.W.S., industry and other appropriate bodies to examine this issue in greater detail, in order to identify where devices could be sited in order to minimise impacts on commercial fisheries. Floating wind and inshore and offshore wave resource areas may have greater potential for avoidance across possibly 10-15% of the deeper waters of Area 6.	**Negative - negligible**
Aquaculture	**Smothering**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Negligible**	Area 6 contains extensive shellfish cultivation areas for mussels and Pacific oysters which could be adversely affected by any significant and prolonged rise in suspended solids. However, increases in suspended sediment is expected to be short term and localised to the immediate vicinity of the seabed disturbing works. Intrusion of sediment plumes into aquaculture areas would therefore only result if the export cables were routed in the immediate vicinity. There could therefore be a negligible impact from offshore energy development.	Impacts from cable trenching could be reduced by using procedures that minimise the mobilisation of suspended solids, such as plough installation.	**Negligible**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Accidental Contamination (hydraulic fluids or vessel cargo/fuel)	Installation Operation Decommissioning	• Hydraulic fluids • Vessel fuel	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	Shellfish are highly sensitive to reductions in water quality caused by hydraulic fluids or tainting from other chemical substances. There is potential for accidental contamination from devices and vessels to occur as a result of collision, storm damage or device failure. It should be noted that the quantity of hydraulic fluid in devices is likely to be very small, reducing the potential for significant environmental effects. Therefore, although the likelihood of accidental contamination from devices is low, the potential effects of any significant intrusion of hydraulic fluids into aquaculture production areas could be of adverse significance.	Effects associated with contamination from devices could be reduced through careful design, and contingency measures for device failure/component failures. Effects associated with contamination from fuel oil spills could be reduced through good practice and implementation of SOPEP (Shipboard Oil Pollution Emergency Plan).	**Negligible**
	Substrate loss	Installation Operation	• Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	Shellfish production in Assessment Area 6 could be adversely affected should installations be sited in or cables routed through shellfish cultivation areas.	The key mitigation measure in terms of reducing effects on shellfish farms is avoidance. In practice, consent is unlikely to be achievable to site renewable energy arrays or cables within existing fish farms.	**Negligible**
Ports, Shipping and Navigation	**Displacement of shipping**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**	Shipping intensity in Area 6 is generally low although there are areas of higher vessel activity at the approach to Kilybegs Harbour and the approach to Lough Foyle, at the most easterly extent of the Zone. In addition there is increased vessel activity in the south of Area 6 between the coast and the Corrib gas field, approximately 83km offshore. The high vessel density is a temporary effect of the installation of the Corrib offshore gas pipeline in the summer of 2009, although there will be some vessel activity associated with the further development of the Corrib field activity will be significantly less and any vessels involved will mobilise from an established port. Patterns in shipping density imply that vessels use distinct routes through the Assessment Zone. Vessels seem to use a regular route into Killybegs and Sligo, to the south the most used route is parallel to the coast, to the north the most used route is directly north towards Scotland and the rest of Europe. The re-routing of vessels to avoid safety zones (during installation), operational devices and decommissioning activity would result in greater transit time and use of fuel, with the associated costs to the vessel operator, and could lead to displacement of vessels to areas that already have moderate vessel densities, potentially having knock-on impacts on collision risk, trade/supply and visibility. This impact would be amplified in constrained areas. The effect of displacement of shipping would potentially have a significant adverse to negative impact in Area 6.	The potential for these effects to be reduced would depend entirely upon the ability to site devices in relation to key routes for shipping. Potentially significant adverse effects could be reduced or avoided by siting devices away from constraints and areas of high vessel densities. There is potential to site both fixed wind turbines, in the 10-60m depth region, and floating structures, deeper than 60m in these areas of lower shipping intensity. There are also large areas within Area 6 that could accommodate wave devices without causing significant displacement of shipping. The area of tidal resource is relatively small and overlaps a region of moderate shipping density to the north of Lough Foyle, despite this there are areas of lower shipping intensity that could accommodate tidal devices and thereby reduce displacement of shipping. The scale of potential effect on vessel traffic will need to be investigated further as part of project specific EIAs.	**Negligible**
		Operation	• Devices that occupy sea surface/water column	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**			**Negligible**
	Decreased trade/supply	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	Within Area 6 there are 2 commercial ports, Sligo and Killybegs. Killybegs is a deepwater harbour and Ireland's busiest fishing port. There are 5 other fishing ports and numerous local ferry ports. Particularly important are the ports of Bunbeg and Magheraroarty which provide access to the community on Tory Island. The presence of installation/maintenance vessels, presence of devices and decommissioning activity could create temporary to long-term reductions in access to ports and harbours. This is particularly important in island locations which rely on boats for the export and import of goods and as a means of access to other islands and the mainland. Reduced access to ports and harbours in Area 6 could have a significant adverse effect on local communities in terms of goods transport and accessibility.	Site selection for device arrays should take into account the requirement for continued access to port and harbours. There is potential for siting devices away from the entrances/approaches to ports and harbours and thereby avoid impacting on accessibility, trade and supply. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance and decommissioning.	**Negligible**
		Operation	• Devices that occupy sea surface/water column	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**			**Negligible**
	Reduced visibility	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	Vessels and other equipment used during the installation/maintenance/ decommissioning of devices, and the operational devices themselves could obstruct views of other vessels and navigation features such as buoys, lights and the coastline. This is particularly important in areas of high vessel densities, constrained channels or areas where there is particular dependence	Significant adverse effects associated with reduced visibly can be reduced by avoiding areas of high vessel densities and areas constrained by land e.g. adjacent to the entrances of ports and inlets.	**Negligible**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
		Operation	• Devices that occupy sea surface	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	on visual navigation aids as reduced visibility increases the risk of collision with other ships and other structures in the water (natural and manmade). The effect of reduced visibility will potentially be significant adverse in Area 6 due to the constrained nature of this area (islands and channels), the presence of shipping routes and the entrances to ports and harbours.	In busy shipping areas, potential effects may be reduced by using fully submerged wave and tidal devices which have minimal restrictions on visibility. Also minimising the period of installation, the number of vessels required and the area occupied during installation would reduce the potential impact on visibility. Any vessels and devices should be lit and marked in accordance with the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) guidelines, in agreement with the Commissioners of Irish Lights.	**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. The impact on collision of siting devices in Area 6 would be significant adverse to negative. This is due to the constrained coastline (numerous inlets and islands) and the presence of regularly used shipping routes. The significance of the impact will increase dependent on the number of arrays which could potentially be present on either side of the channel, restricting potential for vessels using the main shipping lanes to re-route in emergencies.	The risk of collision could be reduced by avoiding areas of high shipping densities, regularly used shipping routes and constrained stretches of coastline. There is potential to site devices away from these areas. The area of tidal resource overlaps higher density shipping but there is room to site tidal devices in order to reduce the collision risk. In busy shipping areas, potential effects may be reduced by minimising the period of installation, the number of vessels required and the area occupied during installation. Maintain good communications with the relevant ports, and issue the appropriate notifications during installation, maintenance, and decommissioning.	**Negligible**
		Operation	• Devices that occupy sea surface/water column	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse - Negative**			**Negligible**
Recreation and Tourism	**Access Restrictions**	Installation Operation Decommissioning	• Structures in the sea reducing or excluding access	**Tidal Wave Fixed Wind Floating Wind**	**Negative**	The key receptor is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs, Offshore wind, wave and tidal developments in this zone, if located on routes used by recreational yachting could cause vessels to re-route, or restrict access to key areas. There are several 'surf spots' along the coastline in Area 6 which wave, wind or tidal devices located close to the shore could restrict access to.	There is the potential to avoid impacts through locating wave and tidal devices away from existing cruising routes or surf spots. A very extensive area is available to site floating wind technology away from tourism and recreational areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of tourism and recreational areas. However in the case of Assessment Area 6 there is still the potential to locate piled wind arrays, and their export cables away from tourism and recreational areas. The use of wave and tidal device types which lie below the surface at a depth below the maximum draft of recreational vessels in a given area could also mitigate this impact. This mitigation measure is not available for offshore wind sites, however.	**Negligible**
	Noise	Installation Decommissioning	• On and offshore machinery and vessels	**Tidal Wave Fixed Wind Floating Wind**	**Negative**	There are numerous Blue Flag beaches, wildlife watching areas and 'surf spots' along the coastline in Assessment Area 6. Noise from machinery and vessels has the potential to impact on the use of beaches that are close to the source of the noise. However any noise from installation or decommissioning will be limited to the duration of construction activities. Piling is a particularly noisy activity, and greater significance impacts will be associated with this activity. Noise from operation will be longer term; however noise levels during operation will to be significantly lower than during installation or decommissioning. Impacts associated with piled wind will be located closer inshore and are likely to be of greater significance compared to floating wind developments located further offshore	Mitigation measures aimed at reducing or avoiding disturbance to recreation could include timing particularly noisy activities such as piling to avoid key recreational periods.	**Negative**
		Operation	• Turbines/flexing joints/device components above sea surface		**Negligible - Negative**			**Negligible**
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Negative**	The key receptor is sailing. Cruising routes for recreational use are present in the zone as indicated by the presence of coastal sailing clubs. The location of offshore wind, wave or tidal developments close to yachting areas could	There is the potential to avoid impacts through locating wave and tidal devices away from existing cruising routes. A very extensive area is available to site floating wind	**Negligible**

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		Phase	Characteristic	Type				
		Operation	• Devices that occupy sea surface/water column		**Negative**	potentially increase collision risk, especially if located in areas where ability to manoeuvre is restricted by other factors such as water depth. There is also collision risk associated with the installation vessels.	technology away from tourism and recreational areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of tourism and recreational areas. However in the case of Assessment Area 6 there is still the potential to locate piled wind arrays, and their export cables away from tourism and recreational areas. The use of tidal device types which lie below the surface at a depth below the maximum draft of recreational vessels in a given area could also mitigate this impact. This mitigation measure is not available for offshore wind sites, however. Collision risk can also be reduced through implementing safety measures including lighting and marking and informing users of the locations of devices.	**Negligible**
	Disturbance to Wildlife	Installation Operation Decommissioning	• Installation/decommissioning activity • Devices that occupy seabed/ sea surface/water column	**Tidal Wave Fixed Wind Floating Wind**	**Negative**	Effects on local tourism would occur where disturbance and/or exclusion from an area overlaps with the locations frequented by visitors and touring vessels. The west coast of Ireland is considered to be of high importance for recreational wildlife watching as there are many areas used for wildlife watching.	There is the potential to avoid impacts through locating wave and tidal devices away from existing cruising routes. A very extensive area is available to site floating wind technology away from tourism and recreational areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of tourism and recreational areas. However in the case of Assessment Area 6 there is still the potential to locate piled wind arrays, and their export cables away from tourism and recreational areas. Other mitigation measures aimed at reducing or avoiding disturbance to wildlife including sea mammals and birds is set out in the relevant parts of this table.	**Negligible - Negative**
Aviation	**Collision**	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Negative**	There are two aerodromes in the vicinity of Assessment Area 5 (civil) and one radar installation. Area 6 is partially covered by the Malin Head Search and Rescue region. The main collision risk is with the Search and Rescue activities that are ongoing in this area.	Available mitigation includes ensuring wind devices are lit with aviation lights in accordance with OAM 09/02 “Offshore Wind Farms Conspicuity Requirements”. As required under the Obstacles to Aircraft in Flight Order, S.I. 215 of 2005, notification of the erection of wind devices provided to the IAA.	**Negligible**
	Radar Interference	Operation	• Devices present at a significant height above sea surface	**Fixed Wind Floating Wind**	**Unknown - negative**	There are currently no “potential to interfere” areas set out for Irish waters and therefore it is difficult to accurately state how much of Assessment Area 6 would fall within these areas. There is likely to be a negative impact on aviation either from intermittent detections of turbines by air traffic controllers or from “shadowing” where radar signals become weaker behind turbines.	Consultation with the IAA will be required and the location of wind devices supplied so they can be accurately plotted on the radar and any signals received from that area will not be confused with aeroplanes.	**Negligible**
Military Activity	**Disruption to general activities**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Negative**	There are no Department of Defence danger areas within Assessment Area 6, although, military use of the Zone will include fishery protection and search and rescue operations. Much of the area is also in use for fleet exercises and submarine exercise and transit, although, no ammunition firing is undertaken. The development of offshore renewables may have a negative impact on fishery protection and search and rescue operations, and fleet exercises in Area 6. Dependent on the nature and extent of fleet and submarine exercise activities within the area, significance of this effect could be considered to be significant adverse to negligible.	Consultation with the Ministry of Defence, UK will be required to enable appropriate site selection in order to reduce or eliminate the risk of interference on fleet exercises and submarine exercise and transit areas. Consultation with the Department of Defence will be undertaken as part of project specific EIA.	**Negligible**
		Operation	• Devices that occupy sea surface/water column					

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Cables and Pipelines	**Direct damage**	Installation Decommissioning	• Devices using seabed foundations • Cable trenching/removal	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	Only the Hibernia Atlantic 'A' telecoms cable passes through Area 6, located to the north. Direct damage to this cable could occur during installation of device arrays and cables but also could occur during maintenance and decommissioning. The impact is considered to be significant adverse (should it occur) as international telecommunications could be seriously disrupted.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**No effect**
	Access restrictions	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Significant adverse**	There is potential that the presence of devices in waters close to existing cables could restrict access to the cables for maintenance purposes. Due to the potential implications for telecommunication supplies the significance of this effect, if it occurred, could be significant adverse.	The seabed lease pertaining to existing infrastructure will legally need to be observed when selecting sites for devices and export cables. Crossing agreements with existing infrastructure owners will be required for any export cables crossing existing infrastructure.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Dredging and Disposal areas	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Negative**	There are two dredge disposal sites and two rock dredge disposal site within Assessment Area 6. Construction operations and the presence of wind and wave devices have the potential to restrict normal access to these sites. There are no existing aggregate dredging areas within Assessment Area 6 and no areas have been identified as areas that could potentially be exploited for aggregate extraction. There is potentially a negative impact from wind device installation restricting access to potential future dredging grounds	There is the potential to locate wave and tidal devices away from existing dredging and disposal areas. A very extensive area is available to site floating wind technology away from existing dredging and disposal areas. Fixed turbine technology will be limited to the nearshore area (out to 60 m water depth), closer to the majority of existing dredging and disposal areas. However in the case of Assessment Area 6 there is still the potential to locate piled wind arrays, and their export cables away from existing dredging and disposal areas.	**Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					
Existing Renewable Infrastructure	**There is no existing offshore renewable infrastructure in Area 6**							
Natural Gas and CO_2 Storage	**Sterilisation of region**	Operation	• Devices using seabed foundations	**Tidal Wave Fixed Wind Floating Wind**	**Unknown**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for CO_2 or natural gas storage. There is currently insufficient data to establish potential for use of the marine environment for storage of CO2. Therefore, whilst no sites are currently under consideration for natural gas or CO_2 storage in this zone, the significance of this possible future impact is unknown.	None identified	**Unknown**
Oil and Gas Activity	**Access restrictions**	Installation Decommissioning	• Installation and decommissioning safety exclusion zones • Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Unknown - negative**	There are currently no areas of active oil and gas development in Assessment Area 6. However there are areas of 'Exploration Licence' both in the north and south of the zone. There are also four exploration wells in the zone that were drilled and then abandoned. The route for the proposed Corrib pipeline also runs through Assessment Area 6; however this is discussed in the relevant section of the table. Siting of renewable devices in Area 6 may limit access to the 'Exploration Licence' areas. However the impacts on possible future oil and gas developments are impossible to quantify at this stage.	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices. There is the potential to locate devices where they will have minimal, if any impact on oil and gas activity. Tidal resource is located in one particular area; however this appears to be of much lower significance for oil and gas activity at present.	**Unknown - Negligible**
		Operation	• Devices that occupy seabed/sea surface/water column • Inter-array and export cables					**Unknown - negligible**

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
	Collision	Installation Decommissioning	• Vessels and equipment used for installation and Decommissioning	**Tidal Wave Fixed Wind Floating Wind**	**Unknown – Negative**	Collision risk considers the risk of navigating vessels colliding with vessels and equipment used during installation, maintenance and decommissioning, and the devices themselves once operational. Collision risk also considers the increased risk of collision between navigating vessels. In both circumstances the risk of collision is increased in constrained channels and areas with high vessel densities. There are currently no areas of active oil and gas development in Assessment Area 6. However there are areas of 'Exploration Licence' both in the north and south of the zone. There are also four exploration wells in the zone that were drilled and then abandoned. Siting of renewable devices in Area 6 has the potential for conflicts with vessels involved in developing the 'Exploration Licence' area with regard to collision risk. However the impacts on possible future oil and gas developments are impossible to quantify at this stage. Impacts on pipelines are discussed in the relevant section of this table.	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices and there is the potential to locate devices away from existing and proposed oil and gas activity.	**Unknown - negative**
		Operation	• Devices that occupy sea surface/water column					
	Sterilisation of region	Operation	• Devices using seabed foundations	**Tidal Wave Fixed Wind Floating Wind**	**Unknown - negative**	The installation of devices using seabed foundations has the potential to sterilise areas that could have been used for oil and gas exploitation. There is currently insufficient data to establish possible future exploitation of oil and gas from this zone. As it is possible that future oil and gas activities may take place in this zone is it not feasible to rule out any potential impacts from offshore renewable devices. However the impacts on possible future oil and gas developments are impossible to quantify at this stage	Consultation with the relevant regulatory body would be required prior to siting of any renewable devices and as There is the potential to locate devices away from oil and gas activity.	**Unknown**
Seascape Assessment	Effects on Seascape type 1 Large Open or Partially Open Sea Lough	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast)	Offshore Wind Zone 6 extends along the West coast of Ireland from Glendorragh Point (Mayo) in the south to Inishowen Head (Donegal) in the north. Consideration has also been made of the potential effects of on adjacent transboundary areas of Lough Foyle and the Atrim Coast from Magiligan Point to Benbanehead (Northern Ireland), and the south west coast of Islay (Scotland). The seascape types associated with this stretch of the coastline include: 1. Large Open or Partially Open Sea Lough - Large scale sea loughs with associated low-lying coastal plain, raised hinterland and headlands. Large scale open views along windswept low lying shorelines are contained by landmass. Long smaller scale contained views to the open sea are framed by headlands 4. Low lying coastal plain –large to medium scale, very flat and exposed rural, coastal plains and lowlands with expansive views out to sea; includes estuaries, sandy beaches and curved bays and flat or very low lying rolling complex islands and peninsulas consisting of moorland or grassland with sparse settlement. 5. Low narrow coastal strip rising to steep hinterland, with headlands and incised bays. This seascape type is open and expansive with many elevated dramatic views to sea from both the raised hinterland and coastal shelf. The landscape is exposed and rugged with a sense of exposure to the elements and wildness. 6 Complex Indented Coastline – A varied, complex and incised coastline with, undulating hinterland, small bays, cliffs and islands. Due to the complexity of the landform associated with this distinct seascape type, the experience and views continually change in scale, elevation and exposure.	See below	**Slight to Substantial depending on distance from shore (see Figure 12.15 for more information)**
					Substantial to Moderate Substantial Effect to (between 15km and 24km from the coast)			
					Moderate to Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on seascape type 4. Low Lying Coastal Plain	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Moderate Effect (between 0 and 15km offshore from the coast)			
					Slight Moderate Effect to Slight Neutral Effect(between 15km and 24km from the coast)			
					Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on seascape type 5. Narrow Coastal strip with Raised Hinterland	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast)			

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
					Substantial to Moderate Effect (between 15km and 26km from the coast)	7. Plateau and High Cliffs - visually dramatic seascape with great vertical scale where cliffs plunge abruptly to an narrow coastal edge with open expansive and elevated views to sea and a sense of wildness. 8. Large bay – Large long sweeping bays often with sand dunes, expansive sands and tidal flats and rocky headlands. Very long open views framed by landmass, both across the bay and out to the wide horizon of the open sea. Transboundary Seascape Types T1 Large scale sea loughs associated low-lying coastal plain, raised hinterland and headlands. Large scale open views along windswept low lying shorelines are contained by landmass. Long smaller scale contained views to the open sea are framed by headlands. T3 Plateau and High Cliffs - visually dramatic seascape with great vertical scale where cliffs plunge abruptly to an narrow coastal edge with open expansive and elevated views to sea and a sense of wildness. T4 Raised beaches backed by old cliff lines and level coastal terraces with headlands. Rugged open and exposed coastline character. Views seaboard of an uninterrupted expanse of sea. There are no national level landscape designations along the coast in this area. However there may be long views along the coast and out to sea from Derryveagh Mountains (Glenvaeagh National Park) situated inland from Donegal's west coast. Parts of this coastline are also covered by a number of county level landscape designations including: • Highly Sensitive, Sensitive and Less Sensitive Landscapes (Mayo) • Protected Views, Highly Scenic and Scenic Routes (Mayo) • Normal Rural Landscape (Sligo) • Sensitive Rural landscape with an intrinsic scenic quality (Sligo) • Visually Vulnerable Landscape with distinctive natural features (Sligo) • Scenic Routes (Sligo • Areas of Outstanding Natural Beauty, - AONB- (Leitrim) • Areas of High Visual Amenity- AHVA- (Leitrim) • Area Of Especially High Scenic Amenity – EHSA– (Donegal) • Views and Prospects (Donegal)	Potential adverse effects on seascape can be reduced through the sensitive siting of offshore wind farms. Key factors to be considered in locating an offshore wind farm include: • Wind farms should not be sited where they appear to block or close the entrance to bays/loughs/narrows/sounds or where they separate a bay from the open sea; • Wind farms should reflect the shape of the coastline and align with the dominant coastal edge; • Wind farms should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate; • Wind farms should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Wind farms should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms; • Consideration should be given to locating devices in already industrialised and developed seascapes;	**Slight to Substantial depending on distance from shore (see Figure 12.15 for more information)**
	Effects on seascape type 6. Complex indented Coastline	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast)			
					Substantial to Moderate Effect (between 15km and 24km from the coast)			
					Moderate to Slight Neutral Effect (between 24m and 35km from the coast)			
	Effects on seascape type 7. Plateau and High Cliffs	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast)			
					Substantial Effect to Moderate Effect (between 15km and 24km from the coast)			
					Moderate Effect to Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on seascape types 8. Large Bay	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect to Moderate Effect (between 0 and 15km offshore from the coast)			
					Moderate Effect to Slight Effect (between 15km and 24km from the coast)			
					Slight Effect to Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on transboundary seascape type T1. Large Open or Partially Open Sea Lough	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast)			

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Seascape Effects					Substantial Effect to Moderate Effect (between 15km and 24km from the coast)	National level designations in transboundary areas One WHS and two AONB's fall within the areas identified in Northern Island where potential transboundary effects should be considered: • The Giant's Causeway World Heritage Site, Antrim Coast • The Causeway Coast AONB Antrim Coast • The Antrim Coast and Glens Antrim Coast There are no Scottish national level designations within the area of potential transboundary effects. The coastline of Assessment Zone 6 is complex, varied and deeply indented with large bays and sea loughs including Killala Bay, Sligo Bay, Donegal Bay and Swilly Lough; numerous offshore islands including Inishmore, Tory and Aranmore Islands; dramatic high cliffs, peninsulas and headlands such as the Slieve League and St Johns Point; along with sandy flats and flat or very low lying complex islands and peninsulas such as Cruit Island. The landscape character is mainly rural with small coastal towns and includes dense urban development at Donegal. Due to the complex and indented nature of the coast in certain locations effects on one seascape type are likely to overlap with effects on adjacent seascapes of lower sensitivity, increasing local sensitivity to development of this type. Most of the seascapes in this region would potentially have substantial to moderate effects between 0- 26 km and moderate to slight effects between 26-35 km. The seascape type 4 Low Lying Coastal Plain is the least sensitive seascape to this type of development the potential effects in certain locations within 0 to 15km from the coast, could range from Moderate to Slight depending on where wind farms are sited. For example local sensitivity to this type of development off the coast of the low lying coastal plain at Easky may be heightened in consideration of long elevated views from Slieve League and Donegal Bay. Conversely effects may potentially be reduced in seascape types of higher sensitivity in some locations by the presence of existing development and infrastructure. Wind arrays off the north coast of Ireland may potentially have moderate to substantial transboundary effects on Islay (Scotland) and the Antrim Coast (Northern Ireland including the Giants Causeway World Heritage site where development is between 0- 35 km from their respective coast At distances greater than 35 km effects are likely to be slight /neutral to neutral, dependent on location, as atmospheric conditions and elevated viewpoints may increase visibility thresholds.	See above	**Slight to Substantial depending on distance from shore (see Figure 12.15 for more information)**
	Effects on transboundary seascape type T3 Plateau and High Cliffs	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast)			
					Substantial Effect to Moderate Effect (between 15km and 24km from the coast)			
					Moderate Effect to Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on transboundary seascape type T4 Rugged Coastal Shelf and Headlands, Open views to Sea	Operational	Wind turbine arrays of up to 140 m blade height	Wind	Substantial Effect (between 0 and 15km offshore from the coast)			
					Substantial Effect to Moderate Effect (between 15km and 24km from the coast)			
					Moderate Effect to Slight Neutral Effect (between 24km and 35km from the coast)			
	Effects on seascape type 5. Narrow Coastal strip with Raised Hinterland	Operational	Arrays of on-surface linear structures	Wave	Substantial to Moderate Effect (between 0 and 5km offshore from the coast)	Wave resources in Assessment Zone 6 form an offshore band between 35 and 70km in width extending from inshore waters at Benwee Head (Mayo) north to the west coast between Malinbeg and Tory Island (Donegal) then continues north 10-30 km offshore of the north west Donegal coast. The seascape types potentially within 0-15 of the identified wave resources include:	See below	**Slight to Moderate depending on distance See Figure 12.15 for more detail**
Seascape Effects					Moderate to Slight Moderate Effect (between 5km and 10km from the coast)	5. Low narrow coastal strip rising to steep hinterland, with headlands and incised bays. This seascape type is open and expansive with many elevated dramatic views to sea from both the raised hinterland and coastal shelf. The landscape is exposed and rugged with a sense of exposure to the elements	Potential adverse effects on seascape can be reduced through the sensitive siting of wave device arrays and fixed coastal structures. Key factors to be considered in locating a wave array include: • Wave arrays should not be sited where they appear	

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
					Slight Moderate to Slight Neutral (between 10km and 15km from the coast)	and wildness. 6 Complex Indented Coastline – A varied, complex and incised coastline with, undulating hinterland, small bays, cliffs and islands. Due to the complexity of the landform associated with this distinct seascape type, the experience and views continually change in scale, elevation and exposure. 7. Plateau and High Cliffs - visually dramatic seascape with great vertical scale where cliffs plunge abruptly to an narrow coastal edge with open expansive and elevated views to sea and a sense of wildness. There are no national level landscape designations along the coast in this area. However there may be long views along the coast and out to sea from Derryveagh Mountains (Glenvaeagh National Park) situated inland from Donegal's west coast. Parts of this coastline are also covered by a number of county level landscape designations including: • Highly Sensitive, Sensitive and Less Sensitive Landscapes (Mayo) • Protected Views, Highly Scenic and Scenic Routes (Mayo) • Area Of Especially High Scenic Amenity – EHSA– (Donegal) • Views and Prospects (Donegal) The coastline of north Mayo is linear with elevated vistas from cliffs and headlands, the coast of Donegal is complex and varied with steep hinterlands numerous small bays and islands; along with sandy flats and flat or very low lying complex islands and peninsulas such. The landscape character is mainly rural with small coastal towns. The Seascapes type 5 Narrow Coastal Strip with Raised Hinterland, 6 Complex Indented Coast, and 7 Plateaus and High Cliffs have a relatively low capacity for Wave (On Surface Linear Structure) Structures with significance of effects ranging from Substantial within 5km dropping to Moderate to Moderate Substantial after 10 km. This is due to the greater potential visibility of wave (Surface Linear) devices from elevated viewpoints along the coastal edge and the more intimate scale of seascape framed by headlands and islands. Between Horrn Head and Malin Head (Donegal) on the north coast the resource area begins approximately 10 Km offshore so effects in these location would be slight moderate to slight neutral. Where wave resources are more than 15 km offshore effects are likely to be slight /neutral to neutral dependent on location, as atmospheric conditions and elevated viewpoints may increase visibility thresholds.	to block or close the entrance to bays/loughs/ narrows/sounds or where they separate a bay from the open sea; • Wave arrays should reflect the shape of the coastline and align with the dominant coastal edge; • Wave arrays should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate; • Wave arrays should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Wave arrays should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms; • Consideration should be given to locating devices in already industrialised and developed seascapes. • Avoid siting fixed coastal structures where they will conflict with the landscape character of the coastal edge or form dominant features visible over an extensive area	**Slight to Moderate depending on distance (see Figure 12.15 for more information)**
	Effects on seascape type 6. Complex indented Coastline	Operational	Arrays of on-surface linear structures	Wave	Substantial to Moderate Effect (between 0 and 5km offshore from the coast)			
					Moderate to Slight Moderate Effect (between 5km and 10km from the coast)			
					Slight Moderate to Slight Neutral (between 10km and 15km from the coast)			
	Effects on seascape type 7. Plateau and High Cliffs	Operational	Arrays of on-surface linear structures	Wave	Substantial to Moderate Substantial Effect (between 0 and 5km offshore from the coast)			
					Moderate Substantial to Moderate Effect (between 5km and 10km from the coast)			
					Moderate to Slight Effect (between 10km and 15km from the coast)			
	Effects on seascape type 5. Narrow Coastal strip with Raised Hinterland	Operational	Oscillating Wave Surge Device	Wave	Moderate Substantial Effect (between 0 and 5km offshore from the coast)			

Table Appendix G6: West Coast - North (Area 6: Tidal, Wave & Wind) - Summary of Potential Effects

Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Seascape Effects	Effects on seascape type 6. Complex indented Coastline	Operational	Oscillating Wave Surge Device	Wave	Moderate Effect (between 0 and 5km offshore from the coast)	Sensitivity to Wave (oscillating surge) devices is largely dependent on the scale form and pattern of the coastal edge as these devices are located in inshore waters. There is also the effect that a wave (oscillating surge) device may have on a sense of remoteness or wildness. Due to the lower profile and intermittent visibility of offshore elements effects of offshore structures are likely to be less than the effects of linear wave devices; however the effects of fixed onshore elements of the device will remain constant and may be the most noticeable element of the device. There may be potential in some locations to reduce or localise effects through careful siting and use of topography to conceal fixed structures. Wave (Oscillating Surge) devices would potentially have moderate effects at 0-5km on seascape type, 6. Complex Indented Coastline, as offshore arrays may conflict with complex coastal edges while the fixed on shore structures could introduce visually prominent new elements in conflict with the local landscape / seascape character. Seascape types 5, Narrow Coastal Strip with Raised Hinterland and 7 Plateaus and High Cliffs have potential for moderate substantial effects at 0-5km due to elevated panoramic views over an extended area with potential for onshore fixed structures to be in conflict with local seascape and landscape character.	See above	**See above**
	Effects on seascape type 7. Plateau and High Cliffs	Operational	Oscillating Wave Surge Device	Wave	Moderate Substantial Effect (between 0 and 5km offshore from the coast)			
	Effects on seascape type 7. Plateau and High Cliffs	Operational	Arrays of surface point structures over 14m above surface	Tidal	Substantial Effect (between 0 and 5km offshore from the coast) Moderate Substantial to Moderate Effect (between 5km and 10km from the coast)	Tidal resources in assessment Zone 6 are located off the north coast of Donegal from Malin Head to the Coast at Culduff (Donegal) and extending approximately 35km to the north. As the identified resource area is over 15km from the closest section of coast out with Ireland no transboundary areas are affected. The seascape type potentially effected by tidal resources are: 7. Plateau and High Cliffs - visually dramatic seascape with great vertical scale where cliffs plunge abruptly to an narrow coastal edge with open expansive and elevated views to sea and a sense of wildness. There are no national level landscape designations along the coast in this area. Parts of this coastline are also covered by a number of county level landscape designations including: • Area Of Especially High Scenic Amenity – EHSA– (Donegal) • Views and Prospects (Donegal) The coastline of north Donegal is consists principally of linear rolling plateau with elevated vistas from cliffs and headlands such as Malin Head and Glengad Head, and small bays. The landscape character is rugged and mainly rural.	Potential adverse effects on seascape can be reduced through the sensitive siting of tidal device arrays. Key factors to be considered in locating a tidal array include: • Identifying opportunities to deploy submerged devices where possible to avoid adverse effects. • Limit the use of markers (buoys and lights) in highly sensitive areas and recognising the requirements in terms of navigational safety. • Maximising the distance from shore of tidal array developments • Avoid deploying tidal arrays that protrude above the water surface in areas where they appear to block or close the entrance to bays/loughs/ narrows/sounds or where they separate a bay from the open sea • Tidal arrays that protrude above the water surface should reflect the shape of the coastline and align with the dominant coastal edge; • Tidal arrays that protrude above the water surface should not be sited where they have the potential to fill a bay. The open, expansive nature of the water surface area should be allowed to continue to dominate;	**Slight to Moderate depending on distance (see Figure 12.15 for more information)**
Seascape Effects	Effects on seascape type 7. Plateau and High Cliffs	Operational	Arrays of surface point structures over 14m above surface	Tidal	Moderate to Slight Effects (between 10km and 15km from the coast)	The Seascapes type 7. Plateau and High Cliffs has a relatively low capacity for Tidal (on surface point) Devices with significance of effects ranging from Substantial within 5km dropping to Moderate after 10 km. This is due to the greater potential visibility of arrays from elevated viewpoints along the coastal edge. The threshold of visibility (which influences magnitude of change) for tidal devices is lower than for offshore wind, as much of the tidal resource area is at distances greater than 15 km offshore most effects are likely to be slight /neutral to neutral dependent on location, as atmospheric conditions and elevated viewpoints may increase local visibility thresholds.	• Tidal arrays that protrude above the surface should avoid locations near scattered settlements, as the scale of the array has the potential to dominate the fragmented pattern of the settlement; • Tidal arrays that protrude above the surface should be avoided where they conflict with the scale and subtleties of complex, indented coastal forms.	**Slight to Moderate depending on distance (see Figure 12.15 for more information)**

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Topics where POTENTIAL strategic level negative or significant adverse effects may occur	Description of effect	Device Details			Potential effect significance (without Mitigation)	Key sensitivities and impact description	Mitigation	Residual effect significance (With Mitigation)
		Phase	Characteristic	Type				
Climate	Carbon Impacts	Operation	Wind turbines	**Wind**	**Positive**	It is recognised that development of offshore renewable energy developments will contribute towards achieving the Ireland's target for 40% energy to be provided from renewable energy sources. In meeting this target Ireland will be working towards the wider European and international commitment to combat global climate change and reduce the potential associated adverse environmental effects e.g. changing population distributions, species extinction, sea level rise etc. However, whilst seeking to combat climate change there is also a need to respond to it in terms of: • Protecting the existing environment and increasing its robustness and ability to adapt to climate change • Protecting existing and future infrastructure from effects of climate change e.g. increased storm events , flooding and sea level rise	Ensure that coastal infrastructure is sited in locations that are at lower risk from flooding, sea level rise and storm damage and do not increase the risk of flooding or damage to coastal infrastructure elsewhere. This will require close consultation at the project design stage with the relevant land use planning authority.	**Positive**
	Carbon Storage	Installation Operation	Wind turbines	**Wind**	**No effect**	Based on current available information no existing or proposed carbon or gas storage sites have been identified within this area (Assessment Area 5) therefore there will be no effect resulting from the development of offshore renewable energy developments.	None required	**No effect**