Arklow Bank Wind Park 2

Environmental Impact Assessment Report

Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology

sse Renewables

Revision	Date	Status	Author	Reviewed by	Approved by
1.0	10/05/2024	Final (External)	APEM	APEM / GoBe Consultants	Sure Partners Limited

Statement of Authority

Experts	Qualifications	Relevant Experience
APEM: Edward Rickard Author	MRes Marine Biology, University of Plymouth (2018). BSc (Hons) Marine Biology, Swansea University (2017).	Edward Rickard is a Senior Consultant at APEM, with over 5 years of experience in the consultancy industry. He has a strong background working on a diverse range of marine fisheries projects, including Fish and Shellfish Scoping and EIA chapters, pre and post construction surveys of fish, shellfish and benthic assemblages, shellfish stock assessment surveys, desk based acoustic tracking data analysis / reporting and port sampling of commercial fish and shellfish catches.
APEM: Nicola Teague Technical reviewer	MSc Marine Resource Development and Protection, Heriot-Watt University (2003). BSc (Hons) Zoology, University of Sheffield (2002).	Nicola is a Sector Director at APEM responsible for APEMs fisheries division. She has extensive experience of undertaking all types of environmental assessment including EIA's, HRA's and SEA's. She has been involved in such assessments for numerous large developments in the UK including Willington Power Station, Hinkley Power Station, Mersey Tidal Power Study and Argyll Array offshore windfarm. Additionally, she advises on conservation measures for the protection of fish species and other areas of aquatic ecology and is actively involved in the process of condition assessment monitoring including the development of new sampling techniques and management measures.

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Glossary

Term	Meaning
Arklow Bank Wind Park 1 (ABWP1)	Arklow Bank Wind Park 1 consists of seven wind turbines, offshore export cable and inter-array cables. Arklow Bank Wind Park 1 has a capacity of 25.2 MW. Arklow Bank Wind Park 1 was constructed in 2003/04 and is operated by Arklow Energy Limited. It remains the first and only operational offshore windfarm in Ireland.
Arklow Bank Wind Park 2 – Offshore Infrastructure	"The Proposed Development", Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements under the existing Maritime Area Consent (MAC).
Arklow Bank Wind Park 2 (ABWP2) (the Project)	Arklow Bank Wind Park 2 (ABWP2) (the Project) is the onshore and offshore infrastructure. This EIAR is being prepared for the Offshore Infrastructure. Consent for the Onshore Grid Infrastructure and Operations Maintenance Facility has been granted in May and June 2022, respectively. • Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements to be consented in accordance with the Maritime Area Consent. This is the subject of this EIAR and will be referred to as 'the Proposed Development' in the EIAR. • Arklow Bank Wind Park 2 Onshore Grid Infrastructure (OGI): This relates to the onshore grid infrastructure for which planning approval has been granted. • Arklow Bank Wind Park 2 Operations and Maintenance Facility (OMF): This includes the onshore and nearshore infrastructure at the OMF, for which planning permission has been granted. • Arklow Bank Wind Park 2 EirGrid Upgrade Works: any non-contestable grid upgrade works, consent to be sought and works to be completed by EirGrid.
Array Area	The Array Area is the area within which the Wind Turbine Generators (WTGs), the Offshore Substation Platforms (OSPs), and associated cables (export, inter- array and interconnector cabling) and foundations will be installed.
Benthic	Live on or near the sea bottom, irrespective of the depth of the sea.
Benthopelagic	Benthopelagic fish usually float in the water column just above the sea floor and can occupy either shallow coastal waters or deep waters offshore.
Cable Corridor and Working Area	The Cable Corridor and Working Area is the area within which export, inter-array and interconnector cabling will be installed. This area will also facilitate vessel jacking operations associated with installation of WTG structures and associated foundations within the Array Area.
Demersal	Fish species that live close to the sea floor.

Diadromous	Fish which move between the sea and freshwater at different stages of their life cycle.
Elasmobranchs	Elasmobranchs include sharks, rays and skates and have a skeleton composed entirely of cartilage.
Environmental Impact Assessment (EIA)	An Environmental Impact Assessment (EIA) is a statutory process by which certain planned Projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the Directive 2011/92/EU on the assessment of the effects of certain public and private Projects on the environment as amended by Directive 2014/52/EU of the European Parliament and of the Council (EIA Directive) and the regulations transposing the EIA Directive (EIA Regulations).
EirGrid	State-owned electric power transmission system operator (TSO) in Ireland and Transmission Asset Owner (TAO) for the Project's transmission assets.
Important Ecological Features (IEF)	Species considered to be important for ecological, commercial and/or conservation reasons within the Fish, Shellfish and Sea Turtle Ecology Study Area.
Landfall	The area in which the offshore export cables make landfall and is the transitional area between the offshore cabling and the onshore cabling.
MAC Area	The area in which the Proposed Development is seeking consent. The MAC Area includes the offshore export cable corridors and Array Area.
Maritime Area Consent (MAC)	A consent to occupy a specific part of the maritime area on a non-exclusive basis for the purpose of carrying out a Permitted Maritime Usage strictly in accordance with the conditions attached to the MAC granted on 22nd December 2022 with reference number 2022-MAC-002.
Mitigation Measure	Measure which would avoid, reduce, or remediate an impact.
Pelagic	Fish species that inhabit open water.
Permitted Maritime Usage	The construction and operation of an offshore windfarm and associated infrastructure (including decommissioning and other works required on foot of any permission for such offshore windfarm).
The Application	The full set of documents that will be submitted to An Bord Pleanála in support of the consent application.
The Developer	Sure Partners Limited

The Project	All components of ABWP2 together. That is the Offshore Infrastructure, Onshore Grid Infrastructure, Operations and Maintenance Facility and EirGrid Upgrade Works.
The Proposed Development	Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements to be consented in accordance with the Maritime Area Consent and comprises the development proposed in this application to An Bord Pleanála. This is the subject of this EIAR.

Acronyms

Term	Meaning
AA	Appropriate Assessment
ABWP1	Arklow Bank Wind Park 1
ABWP2	Arklow Bank Wind Park 2
AC	Alternating Current
BAS	Burial Assessment Study
CIA	Cumulative Impact Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CITES	Convention on International Trade in Endangered Species
CMS	Conservation of Migratory Species
CSTP	Celtic Sea Trout Project
DAHG	Department of the Arts, Heritage and the Gaeltacht
DC	Direct Current
DCCAE	Department of Communications, Climate Action and Environment
DDV	Drop Down Video
DECC	Department of the Environment, Climate and Communications
DEFRA	Department for the Environment, Food and Rural Affairs
DHLGH	Department of Housing, Local Government and Heritage
EEZ	Economic Exclusive Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report

EIS	Environmental Impact Statement
EMF	Electromagnetic Field
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EVMP	Environmental Vessel Management Plan
HDD	Horizontal Directional Drilling
HVDC	High Voltage Direct Current
HWM	High Water Mark
ICES	International Council for the Exploration of the Sea
IEF	Important Ecological Features
IFI	Inland Fisheries Ireland
IMO	International Maritime Organisation
IUCN	International Union for Conservation of Nature
IWEA	Irish Wind Energy Association
MarLIN	Marine Life Information Network
MMMP	Marine Mammal Mitigation Plan
MMO	Marine Management Organisation
MPCP	Marine Pollution Contingency Plan
MSFD	Marine Strategy Framework Directive
NBAP	National Biodiversity Action Plan
NIS	Natura Impact Statement
NMPF	National Marine Planning Framework
NPWS	National Parks and Wildlife Service
OREDPII	Offshore Renewable Energy Development Plan

OSP	Offshore Substation Platforms
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
OWF	Offshore Windfarm
PAH	Polycyclic Aromatic Hydrocarbon
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SEL	Sound Exposure Level
SSC	Suspended Sediment Concentration
TNT	Trinitrotoluene
TTS	Temporary Threshold Shift
UNCLOS	United Nations Convention of the Law of the Sea
UWN	Underwater Noise
UXO	Unexploded Ordnance
WFD	Water Framework Directive
WTG	Wind Turbine Generator
ZoI	Zone of Influence

Units

Unit	Description
%	Percentage
dB	Decibel (unit used to measure the intensity of sound)
km	Kilometres
kV	Kilovolt
m	Metre
m/s	Metres per second
mg/l	Milligrams per litre
mG	Milligauss
mT	Militesla
mV/m	Millivolts per meter
MW	Megawatt
µT	Microtesla
µV/cm	Microvolts per meter

10 Fish, Shellfish and Sea Turtle Ecology

10.1 Introduction

10.1.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) presents the assessment of the potential impacts of the Arklow Bank Wind Park 2 (ABWP2) Offshore Infrastructure (hereafter referred to as 'Proposed Development') on fish, shellfish and sea turtle ecology. Specifically, this chapter considers the potential impact of the Proposed Development below the High Water Mark (HWM) during the construction, operational and maintenance, and decommissioning phases.

10.1.1.2 The assessment presented herein is informed and should be read in conjunction with the following technical reports and chapters:

- Chapter Volume II, Chapter 6 – Coastal Processes;
- Volume II, Chapter 9 – Benthic Subtidal and Intertidal Ecology;
- Volume III, Appendix 9.1 – Benthic Subtidal and Intertidal Ecology Technical Report;
- Volume III, Appendix 10.1 – Fish, Shellfish and Sea Turtle Ecology Technical Report;
- Volume II, Chapter 11 – Marine Mammals;
- Volume III, Appendix 11.1 – Underwater Noise Assessment; and
- Volume II, Chapter 14 – Commercial Fisheries and Aquaculture.

10.1.1.3 It is intended that the EIAR will provide stakeholders with sufficient information to determine the potential significant impacts of the Proposed Development on the receiving environment. In particular this chapter:

- Presents the existing environmental baseline established from desk studies, site-specific surveys and consultation;
- Identifies any assumptions and limitations encountered in compiling the environmental information;
- Presents the potential environmental effects on fish, shellfish and sea turtle ecology arising from the Proposed Development, based on the information gathered and the analysis and assessments undertaken; and
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects of the Proposed Development on fish, shellfish and sea turtle ecology.

10.2 Regulatory background

10.2.1.1 Legislation, policy and guidelines of relevance to this chapter is outlined in Table 10.1.

10.2.1.2 Further information on relevant planning policy and legislative requirements relating to the Environmental Impact Assessment (EIA) of the Proposed Development is presented in Volume II, Chapter 2: Policy Context.

Table 10.1: Summary of regulatory background

Publisher	Name of document incl. reference	Key provisions
Statutory		
Legislation		
Minister for the Environment, Community and Local Government, 2011	European Communities (Marine Strategy Framework) Regulations 2011 (S.I. No. 249 of 2011);	Transposes EU Directive 2008/56/EC (Marine Strategy Framework Directive) into Irish law. The Marine Strategy Framework Directive (MSFD) sets out the following qualitative descriptors for determining good environmental status that are relevant to fish, shellfish and sea turtle ecology: • Descriptor 1: Biological diversity is maintained. • Descriptor 2: Non-indigenous species do not adversely alter the ecosystem. • Descriptor 4: Elements of food webs ensure long-term abundance and reproduction. • Descriptor 6: The sea floor integrity ensures functioning of the ecosystem. • Descriptor 7: Permanent alteration of hydrographical conditions does not adversely affect the ecosystem. • Descriptor 8: Concentrations of contaminants give no effects. • Descriptor 10: Marine litter does not cause harm. • Descriptor 11: Introduction of energy (including underwater noise) does not adversely affect the ecosystem.

Shellfish Waters Directive (2006/113/EC)	Directive 2006/113/EC of the European Parliament and of the Council on the quality required of shellfish waters;	The aim of the Shellfish Waters Directive is to protect or improve shellfish waters in order to support shellfish life and growth. It is designed to protect the aquatic habitat of bivalve and gastropod molluscs, which include oysters, mussels, cockles, scallops and clams. The Directive requires Member States to designate waters which need protection in order to support shellfish life and growth.
Department of the Arts, Heritage and the Gaeltacht (DAHG), 2000	Wildlife (Amendment) Act, 2000 (S.I. No. 397 of 1985);	Transposes European Communities (Wildlife Act, 1976) into Irish law. The principal national legislation in Ireland providing for the protection of wildlife and the control of some activities that may adversely affect wildlife.
The Minister for the Environment, Heritage and Local Government, 2003	European Communities (Water Policy) Regulations 2003 (S.I. No. 722/2003); Amended by: S.I. No. 93/2010 - European Communities (Water Policy) (Amendment) Regulations, 2010.	Transposes European Communities (Water Framework Directive (WFD)) into Irish law. Requires all Member States to protect and improve water quality in all waters so that they achieve good ecological status by 2015 or, at the latest, by 2027. Fish are one of five biological quality elements to be assessed under the WFD. They are an important component of marine ecological systems and are effective indicators of certain types of disturbance or 'pressure'.
Planning Policy and Development Control		
Department of the Environment, Climate	Strategic Environmental Assessment (SEA) of the Offshore Renewable Energy Development Plan (OREDPII) in Ireland: Environmental Report https://www.gov.ie/en/publication/71e36-	Contains the Appropriate Assessment (AA) screening process and SEA scoping report of the Maritime area associated with OREDPII. This resource has some

and Communications (DECC), 2022	offshore-renewable-energy-development-plan-ii-oredp-ii/#environmental-assessments	important information on existing baseline conditions in the maritime area.
Department of Housing, Local Government and Heritage (DHLGH), 2021	National Marine Planning Framework (https://www.gov.ie/pdf/?file=https://assets.gov.ie/139100/f0984c45-5d63-4378-ab65-d7e8c3c34016.pdf#page=null)	Biodiversity Policy 1: Proposals incorporating features that enhance or facilitate species adaptation or migration, or natural native habitat connectivity will be supported, subject to the outcome of statutory environmental assessment processes and subsequent decision by the competent authority, and where they contribute to the policies and objectives of this National Marine Planning Framework (NMPF). Proposals that may have significant adverse impacts on species adaptation or migration, or on natural native habitat connectivity must demonstrate that they will, in order of preference and in accordance with legal requirements: a) avoid, b) minimise, or c) mitigate significant adverse impacts on species adaptation or migration, or on natural native habitat connectivity.
DHLGH, 2021	National Marine Planning Framework (https://www.gov.ie/pdf/?file=https://assets.gov.ie/139100/f0984c45-5d63-4378-ab65-d7e8c3c34016.pdf#page=null)	Biodiversity Policy 2: Proposals that protect, maintain, restore and enhance the distribution and net extent of important habitats and distribution of important species will be supported, subject to the outcome of statutory environmental assessment processes and subsequent decision by the competent authority, and where they contribute to the policies and objectives of this NMPF. Proposals must avoid significant reduction in the distribution and net extent of important habitats and other habitats that important species depend on,

		including avoidance of activity that may result in disturbance or displacement of habitats.
DHLGH, 2021	National Marine Planning Framework (https://www.gov.ie/pdf/?file=https://assets.gov.ie/139100/f0984c45-5d63-4378-ab65-d7e8c3c34016.pdf#page=null)	Biodiversity Policy 4: Proposals must demonstrate that they will, in order of preference and in accordance with legal requirements: a) avoid, b) minimise, or c) mitigate significant disturbance to, or displacement of, highly mobile species.
DHLGH, 2021	National Marine Planning Framework (https://www.gov.ie/pdf/?file=https://assets.gov.ie/139100/f0984c45-5d63-4378-ab65-d7e8c3c34016.pdf#page=null)	Biodiversity Policy 5: Proposals must demonstrate that they will avoid, minimise, or mitigate significant adverse impacts on marine or coastal natural capital assets, or if it is not possible, proposals should state the case for proceeding.
DHLGH, 2021	National Marine Planning Framework (https://www.gov.ie/pdf/?file=https://assets.gov.ie/139100/f0984c45-5d63-4378-ab65-d7e8c3c34016.pdf#page=null)	Sea-floor and Water Column Integrity Policy 3: Proposals that protect, maintain, restore and enhance coastal habitats for ecosystem functioning and provision of ecosystem services will be supported, subject to the outcome of statutory environmental assessment processes and subsequent decision by the competent authority, and where they contribute to the policies and objectives of this NMPF. Proposals must take account of the space required for coastal habitats, for ecosystem functioning and provision of ecosystem services, and demonstrate that they will, in order of preference and in accordance with legal requirements: a) avoid,

		b) minimise , or c) mitigate for net loss of coastal habitat.
DHLGH, 2021	National Marine Planning Framework (https://www.gov.ie/pdf/?file=https://assets.gov.ie/139100/f0984c45-5d63-4378-ab65-d7e8c3c34016.pdf#page=null)	Fisheries Policy 5: Proposals, regardless of the type of activity they relate to, enhancing essential fish habitat, including spawning, nursery and feeding grounds, and migratory routes should be supported. If proposals cannot enhance essential fish habitat, they must demonstrate that they will, in order of preference: a) avoid; b) minimise; c) mitigate significant adverse impact on essential fish habitat, including spawning, nursery and feeding grounds, and migration route d) If it is not possible to mitigate significant adverse impact on essential fish habitat, proposals must set out the reasons for proceeding
Minister for Communications, Climate Action and Environment, 2020	European Union (Environmental Impact Assessment) (Environmental Protection Agency Act 1992) (Amendment) Regulations 2020 (S.I. No. 191/2020; S.I. No. 191/2020 - European Union (Environmental Impact Assessment) (Environmental Protection Agency Act 1992) (Amendment) Regulations 2020 (irishstatutebook.ie)	Transposes European Communities (Nitrates Directive, 2023) into Irish law.
Minister for Communications, Climate Action and Environment, 2016	European Union (Framework for Maritime Spatial Planning) Regulations 2016 (S.I. No. 352/2016); S.I. No. 352/2016 - European Union (Framework for Maritime Spatial Planning) Regulations 2016. (irishstatutebook.ie)	Transposes European Union Directive 2014/89/EU (Marine planning framework) into Irish law.

DHLGH, 2021	Article 17 update to Ireland's Marine Strategy Part 2: Monitoring Programme (Article 11) 2021; https://www.gov.ie/en/publication/c5d15-marine-strategy-framework-directive-200856ec-article-17-update-to-irelands-marine-strategy-part-2monitoring-programme-article-11/	Update to Ireland's Marine Strategy Part 2: Monitoring Programme (Article 11), under the MSFD.
Guidelines and technical standards		
Department of Communications, Climate Action and Environment (DCCAE), 2018	Guidance on Marine Baseline Ecological Assessments & Monitoring Activities for Offshore Renewable Energy Projects (Parts 1); 2caa8f12-f1e7-4d76-ab34-19174ff5b9e6.pdf (www.gov.ie)	Provides technical guidance for the baseline data requirements and monitoring necessary to evaluate potential environmental impacts of offshore renewable energy projects in the marine area.
DCCAE, 2017	Guidance on Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) Preparation for Offshore Renewable Energy Projects; 76533_6a82b451-e09f-483b-849e-07d4c7baa728.pdf	To assist developers in preparing EIS' and NIS' that may be required for development projects. More specifically, it sets out the type of information that needs to be provided and the assessment approach to be used.
National Parks and Wildlife Service (NPWS)	Ireland's 4th National Biodiversity Action Plan (NBAP) (2024; d424b166-763b-4916-8eba-8afff955c5e5.pdf (www.gov.ie)	The 4th NBAP sets the national biodiversity agenda for the period 2023-2030 through 5 strategic objectives
Non-Statutory		
Planning Policy and Development Control		
Wicklow County Council, 2010	Wicklow Biodiversity Action Plan 2010-2015; County_Wicklow_Biodiversity_Plan_2010-15.pdf	The Wicklow Biodiversity Action Plan provides a focussed approach for the county, identifying priority habitats and species and the action required to secure their future. This includes various species of fish.

Guidelines and technical standards		
Environmental Protection Agency (EPA), 2022	Guidelines on the Information to be Contained in Environmental Impact Assessment Reports https://www.epa.ie/publications/monitoring--assessment/assessment/EIAR_Guidelines_2022_Web.pdf	These Guidelines apply to the preparation of all Environmental Impact Assessment Reports undertaken in the State (Ireland)
Irish Wind Energy Association (IWEA), 2021	Best Practice Guidelines for the Irish Wind Energy Industry, 2021; Microsoft Word - LE11-563-01_Rpt001-2.doc (windenergyireland.com)	Guidance to development of renewable energy in Ireland and includes examples of typical ecology impacts that might be considered within an EIA.
EPA, 2011	Assessment and Monitoring of Ocean Noise in Irish Waters 2011; Water | Environmental Protection Agency (epa.ie)	Guidance on effects of anthropogenic noise in Irish waters.
Chartered Institute of Ecology and Environmental Management (CIEEM), 2018	Guidelines For Ecological Impact Assessment in The UK And Ireland; Combined-EclA-guidelines-2018-compressed.pdf (cieem.net)	Guidelines to the preparation of all Ecological Impact Assessment Reports undertaken in the UK and Ireland.
Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), 2008	Guidance on Environmental Considerations for Offshore Windfarm Development; 08-03e_agreement_consolidated_guidance_for_offshore_windfarms.doc (live.com)	Sets out the potential impacts associated with the development of offshore windfarms.
Tyler-Walters *et al*. 2023	Guidance from the Marine Life Information Network (MarLIN) on assessing habitat sensitivity using Marine Evidence based Sensitivity Assessment (MarESA); TITLE (marlin.ac.uk).	Provides an approach to examine the biology or ecology of a feature, compile the evidence of the effect of a given pressure on the feature (species or habitat) in question, assess the likely sensitivity of the feature to

		the pressure against standard scales, and to document the evidence used and justify assessments made.
Popper *et al*. 2014	Sound Exposure Guidelines	Provides criteria that can be applied to assess the potential effects of noise and vibration on fish and sea turtles from different noise sources.

10.3 Consultation

10.3.1.1 A summary of the key issues raised during consultation activities undertaken to date specific to Fish, Shellfish and Sea Turtle Ecology is presented in Table 10.2 below, together with how and where these issues have been considered in the production of this EIAR chapter.

Table 10.2: Summary of consultation relating to The Fish, Shellfish and Sea Turtle EIAR Chapter

Date	Consultation type	Consultation and key issue raised	Section where provision is addressed
April 2019	Southeast Regional Inland Fisheries Forum – Arklow Engagement Meeting	Potential impact on migratory fish species.	Migratory fish have been identified as an Important Ecological Feature (IEF) and assessed in Sections 10.9 and 10.10.
April 2019	Fisheries information events (Arklow, Courtown and Wicklow)	Potential impact on fish stocks as a result of noise or vibration generated during the construction and operational phases and mitigation proposed; Impact (short and long term) of construction on the natural habitat of the whelk, and planned mitigation; Establishment of environmental baselines (for flora/fauna) in advance of construction work; and Impact resulting from electrical cables on the site during the construction and operational phases, and proposed mitigation.	Fish and Shellfish receptors have been identified through desktop study and site-specific benthic surveys (Section 10.5.2). Whelk have been identified as an IEF and assessed in Sections 10.9 and 10.10. A range of potential impacts have been considered including the Impacts from subsea noise and Electromagnetic Fields (EMFs), presented in Sections 10.9 and 10.10.
May 2019	Wicklow Boat Charters – Letter	Damage to seabed; and Impact of waterborne sediment on habitat (deposition) and predatory fish.	The potential impacts of temporary and permanent habitat loss and increased suspended sediments and associated deposition during the construction, operation and maintenance and/or decommissioning phases

			has been assessed in Sections 10.9 and 10.10.
November 2019	Wicklow Bay Sea Angling Club – Letter	Damage to seabed and resident seasonal fish; and Negative effects of waterborne particles and sediment on seabed (deposition) and predatory fish	The potential impacts of temporary and permanent habitat loss and increased suspended sediments and associated deposition during the construction, operation and maintenance and/or decommissioning phases has been assessed in Sections 10.9 and 10.10.
July 2020	Question raised at Southeast Regional Inland Fisheries Forum meeting – Arklow Engagement Meeting	Impacts of vibration and sediment dispersion.	The potential impact of noise and vibration and increased suspended sediments and associated deposition on IEFs, including shellfish, has been assessed in Sections 10.9 and 10.10.
October 2020	Marine Institute – Scoping Response	Recommended that chemicals to be used offshore are identified and quantified, and that potential impacts of discharge and spillage be considered in the EIAR.	The potential impact of accidental pollution has been assessed in Sections 10.9 and 10.10.
April 2023	Public Webinar Event	A member of the public asked that effects on elasmobranchs are considered within the EIAR.	Several elasmobranch species have been identified as an IEF and are subsequently assessed in Sections 10.9 and 10.10.

10.4 Study area

10.4.1.1 For the purposes of the EIAR herein two study areas have been defined (Figure 10.1):

- **The Fish, Shellfish and Sea Turtle Ecology Study Area**. Defined as the area encompassing the Array Area, Cable Corridor and Working Area and the surrounding area (delineated as one tidal excursion from the Array Area and maximum extent of sediment suspension and deposition – 1,108 km^2 in area); and
- **Western Irish Sea Fish, Shellfish and Sea Turtle Study Area**. To provide wider context and inform assessments of larger scale impacts. Covers an area of 13,748 km^2 from County Wexford to County Down.

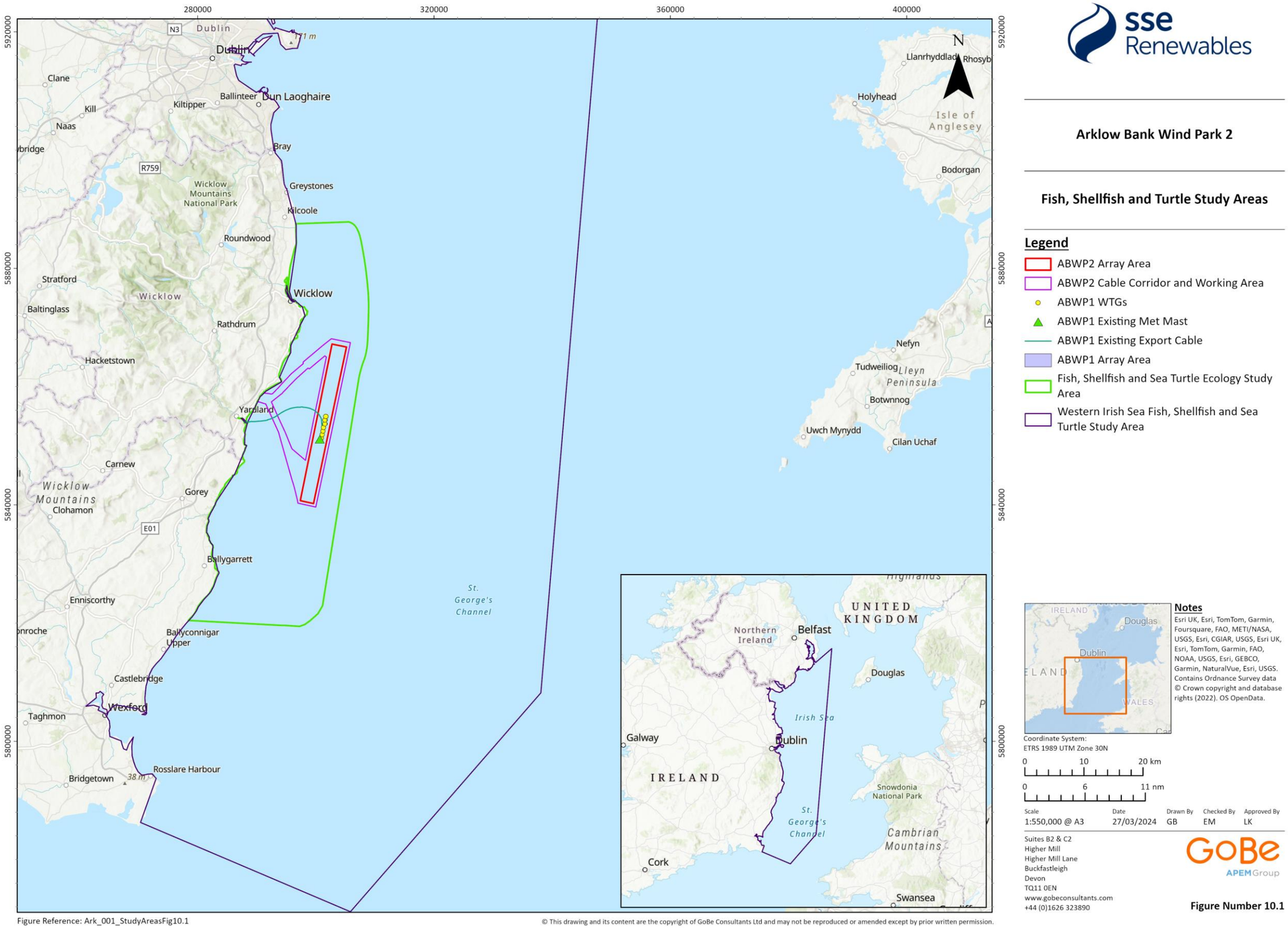

Figure Reference: Ark_001_StudyAreasFig10.1

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Arklow Bank Wind Park 2

Fish, Shellfish and Turtle Study Areas

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 WTGs
- ABWP1 Existing Met Mast
- ABWP1 Existing Export Cable
- ABWP1 Array Area
- Fish, Shellfish and Sea Turtle Ecology Study Area
- Western Irish Sea Fish, Shellfish and Sea Turtle Study Area

Notes

Esri UK, Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS, Esri, CGIAR, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, GEBCO, Garmin, NaturalVue, Esri, USGS. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 10 20 km

0 6 11 nm

Scale	Date	Drawn By	Checked By	Approved By
1:550,000 @ A3	27/03/2024	GB	EM	LK

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Figure Number 10.1

Figure 10.1: The Fish, Shellfish and Sea Turtle Ecology Study Area and Western Irish Sea Fish, Shellfish and Sea Turtle Study Area

10.5 Methodology

10.5.1 Methodology to inform the baseline

Desktop studies

10.5.1.1 Information on fish, shellfish and sea turtle ecology within the Fish, Shellfish and Sea Turtle Ecology Study Area and Western Irish Sea Fish, Shellfish and Sea Turtle Study Area was collected through a detailed desktop review of existing studies and datasets. These reports and data sets are summarised in Table 10.3.

Table 10.3: Summary of key desktop studies and datasets

Title	Source	Year	Author
Biodiversity maps	National portal that compiles biodiversity data from multiple sources	Various (accessed 12/03/2024)	The National Biodiversity Data Centre
Marine Evidence based Sensitivity Assessment (MarESA)	Online resource assessing the sensitivity of various species against a number of pressures	Various (accessed 12/03/2024)	MarESA
FishBase species accounts	Biology of different species of fish	Various (accessed 12/03/2024)	FishBase
International Council for the Exploration of the Sea (ICES) Division VII a technical reports series	Various scientific reports on fish and shellfish ecology from surveys undertaken in the Irish Sea	Various	Cefas
NPWS protected sites	Online resources showing location and citation features of protected areas around the coast of Ireland	Various (accessed 12/03/2024)	NPWS
Data product derived from Northeast Atlantic groundfish data from scientific trawl surveys	Spatially explicit data set on the distribution of fish and shellfish from scientific beam and otter trawl surveys	2022	Lynam and Ribeiro
National Programme: Habitats Directive and	Summary reports of monitoring undertaken by Inland Fisheries Ireland (IFI) in relation to	2022	Gallagher *et al.*

Red Data Book Fish Species	threatened fish species (e.g. lamprey, shad)		
Long-term insights into marine turtle sightings, strandings and captures around the UK and Ireland (1910– 2018)	Sea turtle locations from sightings, strandings and captures in the Irish Sea	2020	Botterell *et al.*
Celtic Seas ecoregion fisheries overview	Summary of commercial fisheries in the Celtic Sea	2018	ICES
Celtic Sea Trout Project (CSTP)	Status, distribution, genetics and ecology of sea trout populations in the Irish Sea	2016	CSTP
Ireland Red List (No. 11)	Red list of cartilaginous fish species for Ireland	2016	Clarke *et al.*
Slaney River Valley Special Area of Conservation (SAC). Site Synopsis (Site Code: 000781)	SAC site selection details	2015	DAHG
Diversity of demersal and megafaunal assemblages inhabiting sandbanks of the Irish Sea	Analyses of demersal communities at three sandbanks in the Irish Sea, including the Arklow sandbank, Blackwater Bank (south of Arklow) and Kish Bank (north of Arklow)	2013	Atalah *et al.*
An Inventory of Irish Herring Spawning Grounds	Herring spawning grounds around the coast of Ireland	2013	O'Sullivan *et al.*
Spawning and nursery grounds of selected fish species in UK Waters	Spawning and nursery areas for key fish species including within the Irish Sea	2012	Ellis *et al.*
Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish	Red list of reptiles and freshwater fish species for Ireland	2011	King *et al*.

Marine turtles in Irish waters	Ecology of marine turtles found in Irish waters and marine turtle recording	2009	King and Berrow
Spatial distribution patterns of basking sharks on the European shelf: preliminary comparison of satellite-tag geolocation, survey and public sightings data	Basking shark locations within the Irish Sea from tag geolocation, survey sightings and public sightings	2005	Southall *et al*.
Demersal assemblages in the Irish Sea, St George's Channel and Bristol Channel	Description of macro-benthic invertebrate and demersal fish assemblages from 101 beam trawl stations within the Irish Sea	2000	Ellis *et al*.
Fisheries Sensitivity Maps in British Waters	Spawning and nursery areas for key fish species including within the Irish Sea	1998	Coull *et al*.

Site specific surveys

10.5.1.2 A summary of the key site-specific surveys used to inform the fish, shellfish and sea turtle ecology baseline environment is outlined in Table 10.4. Existing data from the desktop study was deemed to be sufficient for the Proposed Development and as such, site-specific fish and shellfish surveys were not considered necessary. However, site specific data collected as part of benthic surveys provide some information on the fish and shellfish ecology of the area. Baseline benthic surveys conducted as part of the pre-construction surveys for Arklow Bank Wind Park 1 (ABWP1) were conducted in June 2000, September 2000 and April 2001, using an anchor dredge and for the latter two dates an otter or Agassiz trawl. Additionally, sampling was undertaken on an annual basis from 2004 to 2011 and in September 2021 as part of post construction benthic surveys for ABWP1 using an anchor dredge and beam trawl. Digital aerial bird and marine mammal surveys, carried out between 2018 and 2020, and Marine Mammal Observer observations provide records of marine megafauna.

Table 10.4: Site specific surveys

Data source	Date(s) of survey	Overview of survey	Survey contractor	Reference to further information
Digital aerial marine mammal and bird surveys	March 2018 to April 2020	Digital aerial survey	HiDef Aerial Surveying Limited	Volume III, Appendix 11.2: Marine Mammals Technical Report. Volume III.

GE Wind Energy. Post-construction surveys	June 2010 to September 2021	Anchor dredge Beam trawl	GE Wind Energy	Volume III, Appendix 9.1: Benthic Subtidal and Intertidal Ecology Technical Report.
Arklow Energy Ltd (2010). Post-construction survey	June 2009	Anchor dredge Beam trawl	Arklow Energy Ltd	Volume III, Appendix 9.1: Benthic Subtidal and Intertidal Ecology Technical Report.
HydroServ Projects Ltd. Post-construction surveys.	June 2004 to May 2008	Anchor dredge Beam trawl	HydroServe	Volume III, Appendix 9.1: Benthic Subtidal and Intertidal Ecology Technical Report.
EcoServe (2001). Baseline/pre-construction survey.	April 2001	Anchor dredge Agassiz trawl	EcoServe	Volume III, Appendix 9.1: Benthic Subtidal and Intertidal Ecology Technical Report.
EcoServe (2001). Baseline/pre-construction survey	September 2000	Anchor dredge Otter trawl	EcoServe	Volume III, Appendix 9.1: Benthic Subtidal and Intertidal Ecology Technical Report.
EcoServe (2001). Baseline/pre-construction survey.	June 2000	Anchor dredge	EcoServe	Volume III, Appendix 9.1: Benthic Subtidal and Intertidal Ecology Technical Report.

Identification of designated sites

10.5.1.3 All designated sites within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and qualifying interests that could be affected by the construction, operational and maintenance, and decommissioning phases of the Proposed Development were identified using the three-step process described below:

- Step 1: All designated sites of international, national and local importance within the Fish, Shellfish and Sea Turtle Ecology Study Area were identified using a number of sources. These included the EPA and NPWS websites.
- Step 2: Information was compiled on the relevant qualifying interest for each of these sites which may make them a sensitive receptor in terms of Fish, Shellfish and Sea Turtle Ecology.
- Step 3: Using the above information and expert judgement, sites were included for further consideration if:
  - A designated site directly overlaps with the Proposed Development; or
  - Sites and associated qualifying interests were located within the potential Zone of Influence (ZoI) for impacts associated with the Proposed Development (40 km buffer for Underwater Noise (UWN)).

10.5.1.4 The designated sites and relevant qualifying features for fish, shellfish and sea turtles are presented in Table 10.5 and Figure 10.2.

Table 10.5: Designated sites and relevant qualifying interests for fish, shellfish and sea turtles

Designated Site	Closest Distance to the Array Area (km)	Closest Distance to the Cable Corridor and Working Area (km)	Relevant Qualifying Interest
Slaney River Valley SAC (000781)	22.6	17.2	• Sea Lamprey *Petromyzon marinus* • River Lamprey *Lampetra fluviatilis* • Twaite Shad *Alosa fallax* • Atlantic Salmon *Salmo salar*

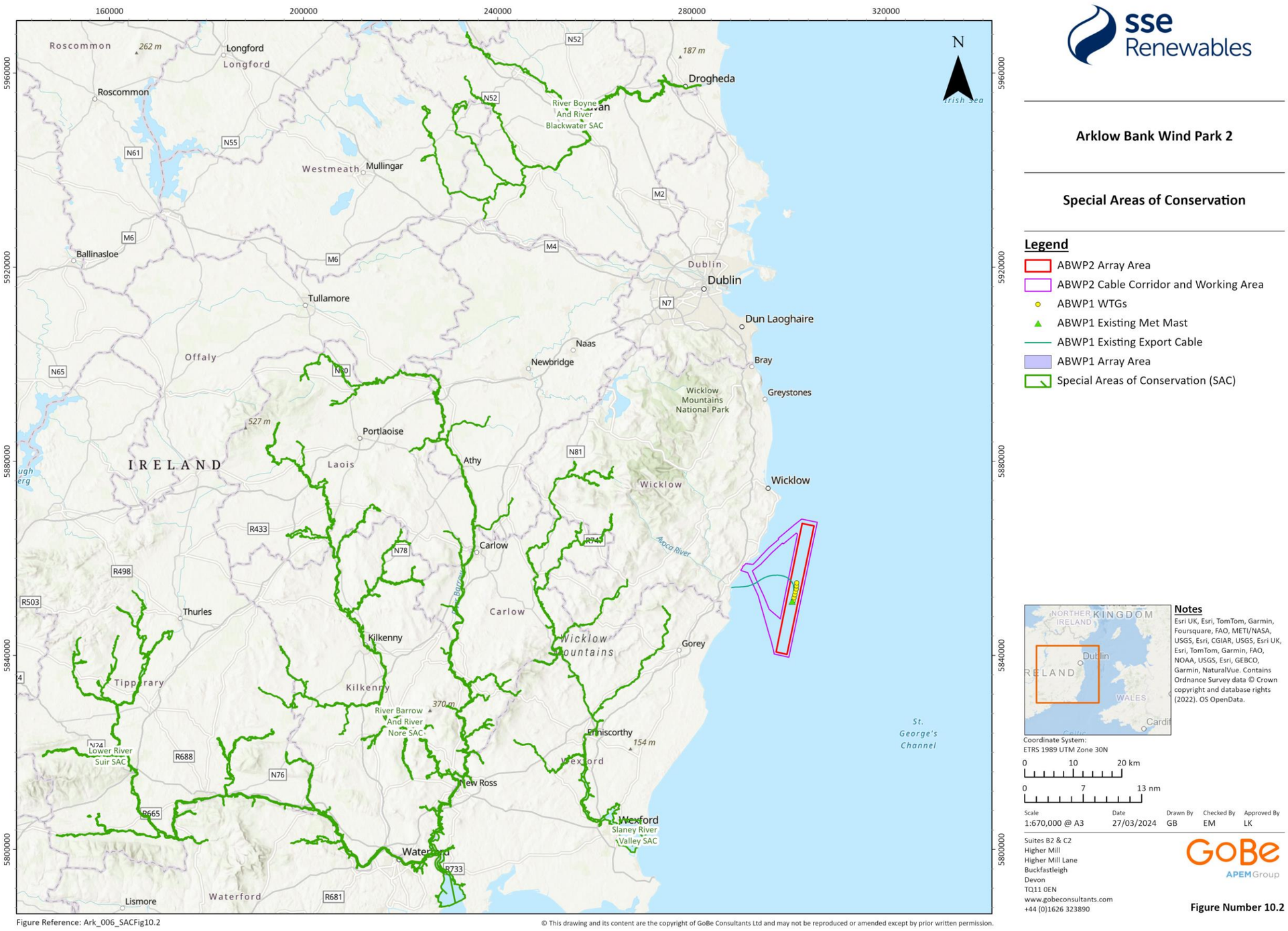

Figure Reference: Ark_006_SACFig10.2

sse Renewables

Arklow Bank Wind Park 2

Special Areas of Conservation

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 WTGs
- ABWP1 Existing Met Mast
- ABWP1 Existing Export Cable
- ABWP1 Array Area
- Special Areas of Conservation (SAC)

Notes

Esri UK, Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS, Esri, CGIAR, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, GEBCO, Garmin, NaturalVue. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 10 20 km

0 7 13 nm

Scale	Date	Drawn By	Checked By	Approved By
1:670,000 @ A3	27/03/2024	GB	EM	LK

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GoBe APEM Group

Figure Number 10.2

Figure 10.2: SACs designated for fish species within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area

10.5.2 Baseline environment

10.5.2.1 The baseline environment has been described in detail within Volume III, Appendix 10.1: Fish, Shellfish and Sea Turtle Ecology Technical Report with a summary provided here. The fish, shellfish and sea turtle receptors that could be potentially impacted by the Proposed Development have been determined by the desktop review. Through this process a number of fish and shellfish species were identified as IEFs.

Fish

10.5.2.2 Fish communities in the Western Irish Sea are dominated by a diversity of flatfish and gadoid species. Particularly abundant flatfish species within the Irish Sea include dab *Limanda limanda*, plaice *Pleuronectes platessa*, solenette *Buglossidium luteum* and sole *Solea solea*, and abundant gadoid species include poor cod *Trisopterus minutus*, whiting *Merlangius merlangus* and cod *Gadus morhua* (Ellis *et al.*, 2000; Parker-Humphreys, 2004; Lynam and Ribeiro, 2022). Additionally, Atlantic herring *Clupea harengus*, hake *Merluccius merluccius*, blue whiting *Micromesistius poutassou* and Atlantic mackerel *Scomber scombrus* are common, particularly in the pelagic and benthopelagic zones of the Irish Sea.

10.5.2.3 Fish assemblages within the Fish, Shellfish and Sea Turtle Study Area are typical of the sandy and gravelly seabeds of the wider Western Irish Sea. Species noted during site specific surveys included plaice, dab, poor cod, sand eel *Ammodytes tobianus*, common dragonet *Callionymus lyra* and sand goby *Pomatoschistus minutus*, with sand eel and sand goby being particularly abundant in some years. Other commercial species noted included whiting, lemon sole *Microstomus kitt*, sole, John dory *Zeus faber* and turbot *Psetta maxima*.

Diadromous

10.5.2.4 The western Irish Sea is home to a number of diadromous fish species that migrate between the sea and freshwater at different stages of their lifecycle. Atlantic salmon *Salmo salar* and sea trout *Salmo trutta* are two commercially important species in the region. The rivers Slaney, Boyne, Dargle and Avoca on the east coast of Ireland are key rivers for migratory fish species (Celtic Sea Trout Project, 2016; Inland Fisheries Ireland, 2022). Sea lamprey *Petromyzon marinus*, river lamprey *Lampetra. fluviatilis*, and twaite shad *Allosa fallax* are known to occur in inshore waters off the coast of county Wicklow (Inland Fisheries Ireland, 2018).

10.5.2.5 With the exception of sea trout, all of these migratory fish species are listed in Annex II of the Habitats Directive (Council Directive 92/43/EEC) which makes provision for their protection through designation of SACs. The Slaney River Valley SAC, River Barrow and River Nore SAC, River Boyne and River Blackwater SAC and Lower River Suir SAC are all within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and have been designated for the protection of migratory fish species. However, only the Slaney River Valley SAC is within the ZoI, which is designated for sea lamprey, river lamprey, twaite shad and Atlantic salmon (Figure 10.2).

10.5.2.6 European eel *Anguilla anguilla* have also been found to occur within the Rivers Slaney and Boyne (Inland Fisheries Ireland, 2015), and may interact with the Proposed Development during their annual migration out to sea to their spawning grounds. European eel are listed as an Annex II species on the Convention on International Trade in Endangered Species (CITES) and the Convention on the Conservation of Migratory species (Bonn convention), and are listed as Critically Endangered on Irelands red list of species (King *et al.*, 2011). They are also protected under the Eels Regulations 2009.

Elasmobranchs

10.5.2.7 Elasmobranchs are diverse and widespread throughout the Western Irish Sea, and include species of ray such as spotted ray *Raja montagui*, blonde ray *Raja brachyura*, thornback ray *Raja clavata* and cuckoo ray *Leucoraja naevus*. Widespread shark species include lesser spotted dogfish *Scyliorhinus canicula,* nursehound *Scyliorhinus stellaris,* spurdog *Squalus acanthias* and stary smooth hound *mustelus asterias*.

10.5.2.8 Elasmobranchs identified within the Fish, Shellfish and Sea Turtle Study Area include lesser spotted dogfish, spotted ray, thornback ray, starry smooth hound and cuckoo ray (Atalah *et al.*, 2013; Lynam and Ribeiro, 2022). While spurdog and tope *Galeorhinus galeus* have not been identified within the Fish, Shellfish and Sea Turtle Study Area, they have been observed 9 and 8 km away, respectively. Given their broad habitat type preference (Martin *et al.* 2010, 2012) and widespread distribution across the Western Irish Sea, it is likely that both species do occur within the Fish, Shellfish and Sea Turtle Study Area.

Shellfish

10.5.2.9 Shellfish communities contribute to the biodiversity of the benthic ecosystem and are an important link in the food chain, both as predators and prey. Key commercial species in Irish waters by volume and value of landings are Norway lobster *Nephrops norvegicus*, great scallop *Pecten maximus*, brown crab *Cancer pagurus*, European lobster *Homarus gammarus*, razor clams *Ensis siliqua* and *E. arcuatus*, whelk *Buccinum undatum* and blue mussel *Mytilus edulis*. Brown crab, lobster, whelk and king scallop constituted the largest estimated value of landings out of the commercial shellfish species in Ireland in 2022 (Marine Institute and Bord, 2022).

10.5.2.10 Common whelk is the most commercially important shellfish species, with the area surrounding Arklow Bank forming part of the eastern Irish fisheries for this species. Mussels are the second most commercially important shellfish. Seed mussel beds occur in inshore areas along the east coast of Ireland with key areas around Wicklow and along the Wexford coastline (Volume III, Appendix 14.1: Commercial Fisheries and Aquaculture Technical Report). A commercial mussel seed farm (the Irish Mussel Seed Company), located between Clogga Bay and Kilmichael Point, near the harbour town of Arklow, Co. Wicklow, gained a Foreshore Licence in 2018 to collect and harvest rope grown mussel spat, for a period of up to 10 years. The sustainability of the natural mussel seed beds and licensed mussel seed farm are key considerations in the EIAR.

10.5.2.11 Whelk has been highlighted as a key species for consideration during consultation with the local fisheries groups. The common whelk is an epibenthic mobile gastropod, inhabiting muddy sand, sand and mixed sediments from depths of 0 m to 50 m. This species is widely distributed from Iceland in the north to the Bay of Biscay, including throughout the Irish Sea. Stocks are likely to be locally discrete due to the absence of a pelagic larval phase and therefore whelk in the Irish Sea may comprise of a number of populations with limited connectivity (Morrissey *et al.*, 2022).

10.5.2.12 *Nephrops* is widely distributed on muddy substrates across the northeast Atlantic. Around Ireland they are found at depths of 20 m to 600 m. *Nephrops* grounds are found 123.5 km south of the Array Area and 62 km north of the Array Area. There is no known overlap of *Nephrops* habitat with Arklow Bank or within the ZoI. The Fish, Shellfish and Sea Turtle Ecology Study Area is therefore, unlikely to support high numbers.

10.5.2.13 Brown crab has been recorded on the South side of Arklow Bank and approx. 800m southwest of the southern fork of the Export Cable Corridor (Atalah *et al.*, 2013; Lynam and Ribeiro 2022), however records are sparse, and abundances were low, with no records from the site-specific benthic surveys. Given the preference of adult European lobsters for rockier sediments and the Fish, Shellfish and Sea Turtle Ecology Study Area consisting mostly of sandy sediment (Sand – Sandy gravel), the area is unlikely to support large populations of European lobster.

Spawning and nursery grounds

10.5.2.14 The Irish Sea supports spawning populations of several commercially important fish species. Species such as whiting, haddock, cod, plaice, mackerel, herring and sandeel spawn within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area (Coull *et al.*, 1998; Ellis *et al.*, 2012). Spawning areas for lemon sole and sprat *Sprattus sprattus* occur throughout the southwest Irish Sea, including the Fish, Shellfish and Sea Turtle Ecology Study Area and within the Proposed Development (Figure 10.3 and Figure 10.5). The Fish, Shellfish and Sea Turtle Ecology Study Area also overlaps, across a small stretch at the northern extent, with spawning grounds for cod, ling *Molva molva*, mackerel, sandeel, sole, plaice and whiting (Figure 10.3 to Figure 10.5).

10.5.2.15 Nursery areas for several species, including herring, mackerel, lemon sole, anglerfish *Lophiiformes*, haddock, cod and whiting are found within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and Fish, Shellfish and Sea Turtle Study Area (Coull *et al.*, 1998; Ellis *et al.*, 2012). Nursery grounds for anglerfish, plaice, sand eel, haddock, cod, whiting, lemon sole and herring overlap with the Fish, Shellfish and Sea Turtle Ecology Study Area (Figure 10.3 to Figure 10.6). Elasmobranchs with nursery grounds in the Fish, Shellfish and Sea Turtle Ecology Study Area include spotted ray, tope and thornback ray. Spurdog nursery grounds do not overlap with the Fish, Shellfish and Sea Turtle Ecology Study Area, however there are high intensity nursery grounds for this species 65 km north.

10.5.2.16 *Nephrops* are known to spawn within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area, but do not overlap with the Proposed Development (Figure 10.5). As mentioned above, the Fish, Shellfish and Sea Turtle Ecology Study Area is unlikely to contain high numbers of *Nephrops* due to a lack of suitable habitat.

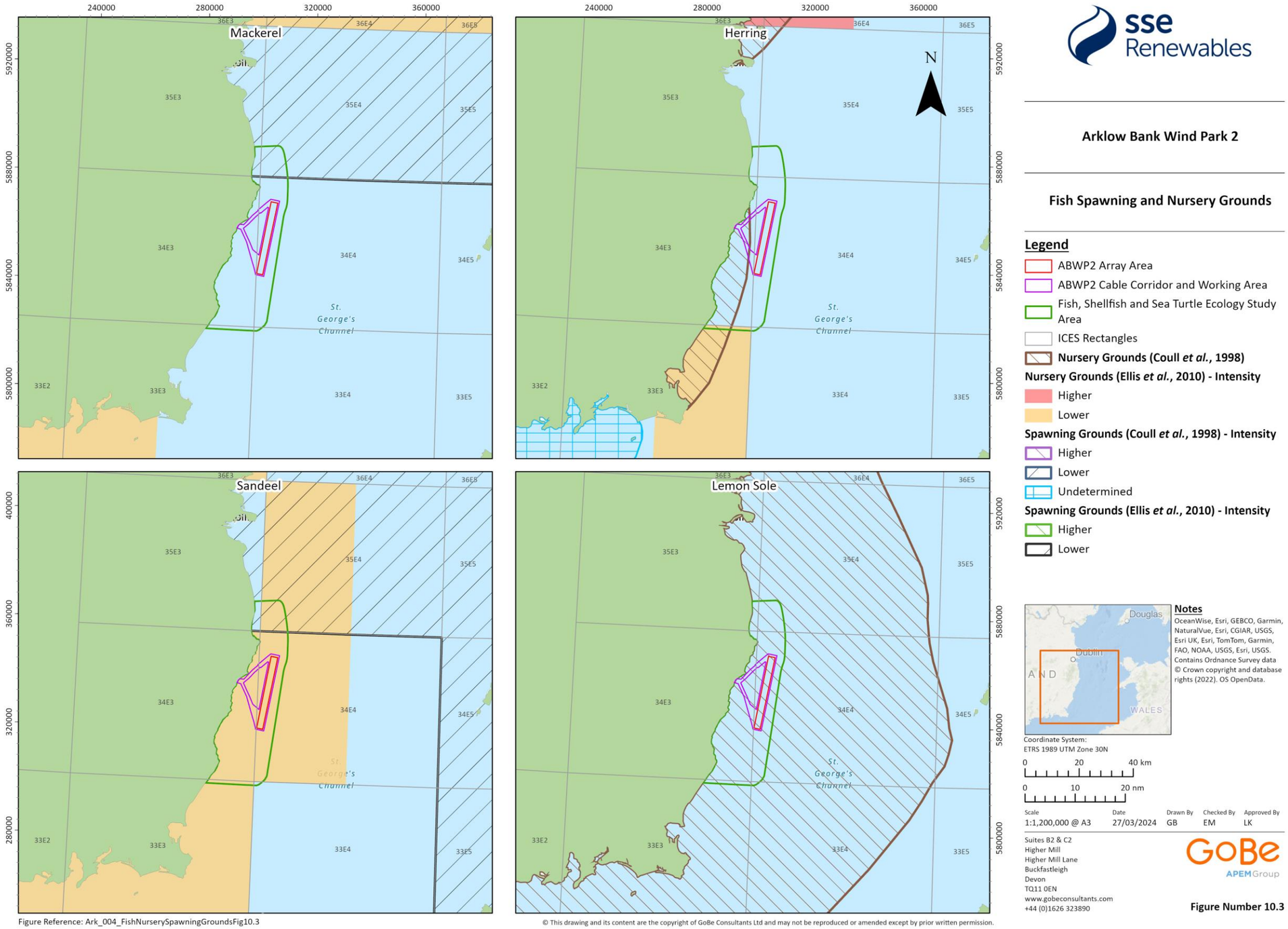

Figure 10.3: Spawning and nursery grounds for mackerel, herring, sandeel and lemon sole

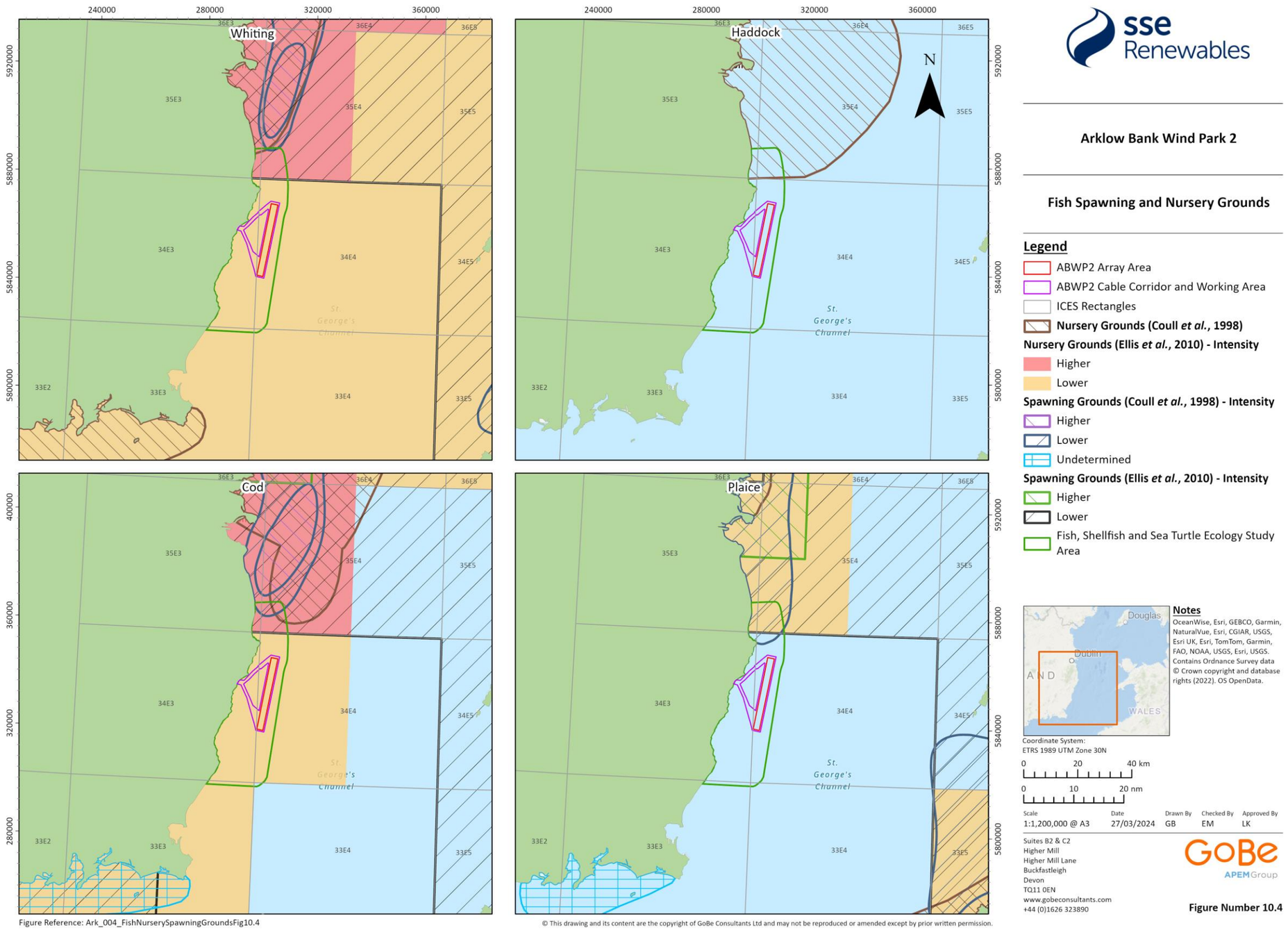

Figure Reference: Ark_004_FishNurserySpawningGroundsFig10.4

Figure 10.4: Spawning and nursery grounds for whiting, haddock, cod and plaice

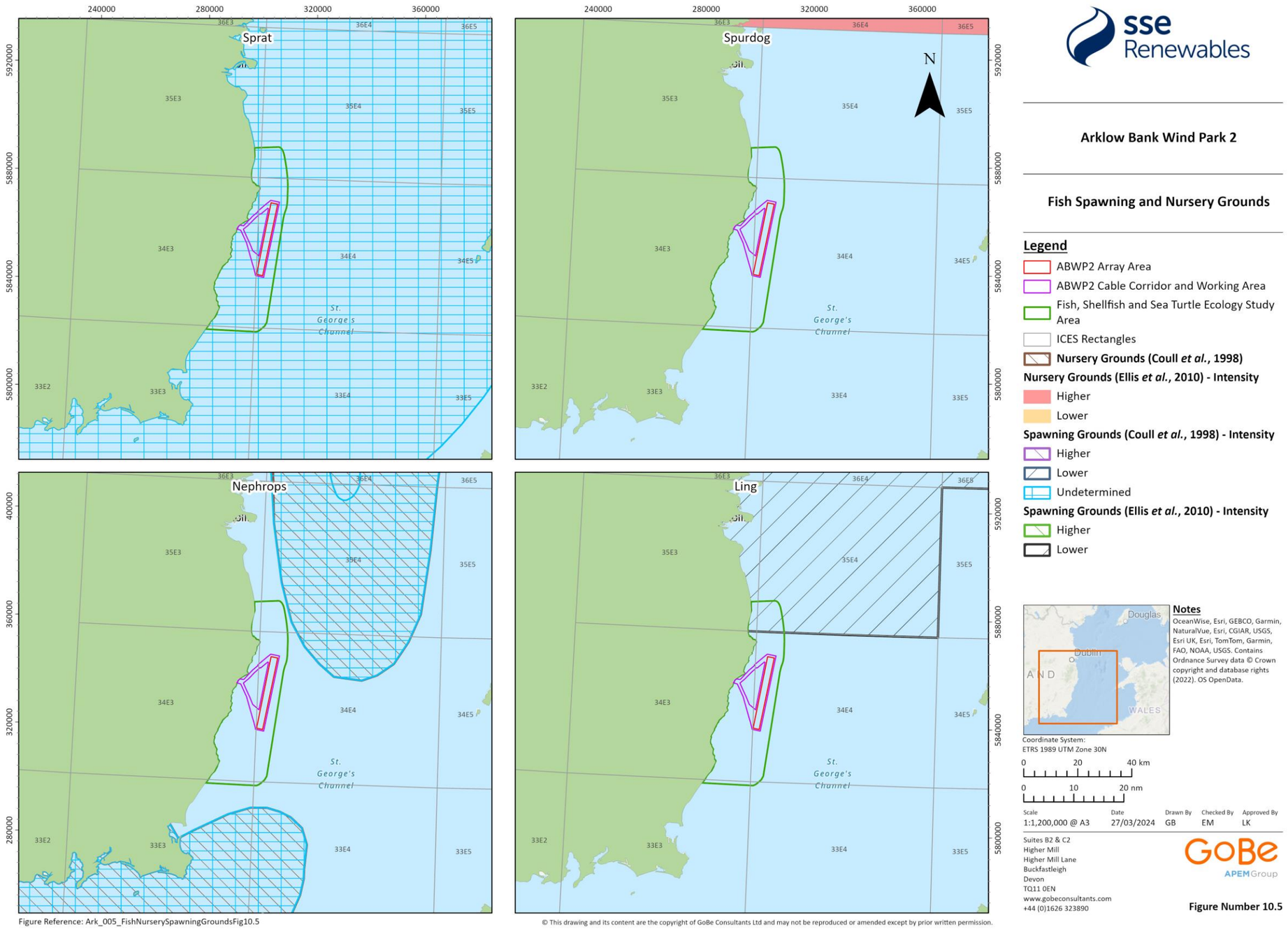

Figure Reference: Ark_005_FishNurserySpawningGroundsFig10.5

Arklow Bank Wind Park 2

Fish Spawning and Nursery Grounds

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- Fish, Shellfish and Sea Turtle Ecology Study Area
- ICES Rectangles
- **Nursery Grounds (Coull *et al.*, 1998)**

Nursery Grounds (Ellis *et al.*, 2010) - Intensity

- Higher
- Lower

Spawning Grounds (Coull *et al.*, 1998) - Intensity

- Higher
- Lower
- Undetermined

Spawning Grounds (Ellis *et al.*, 2010) - Intensity

- Higher
- Lower

Notes

OceanWise, Esri, GEBCO, Garmin, NaturalVue, Esri, CGIAR, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 20 40 km

0 10 20 nm

Scale	Date	Drawn By	Checked By	Approved By
1:1,200,000 @ A3	27/03/2024	GB	EM	LK

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Figure Number 10.5

Figure 10.5: Spawning and nursery grounds for sprat, spurdog, Nephrops and Ling

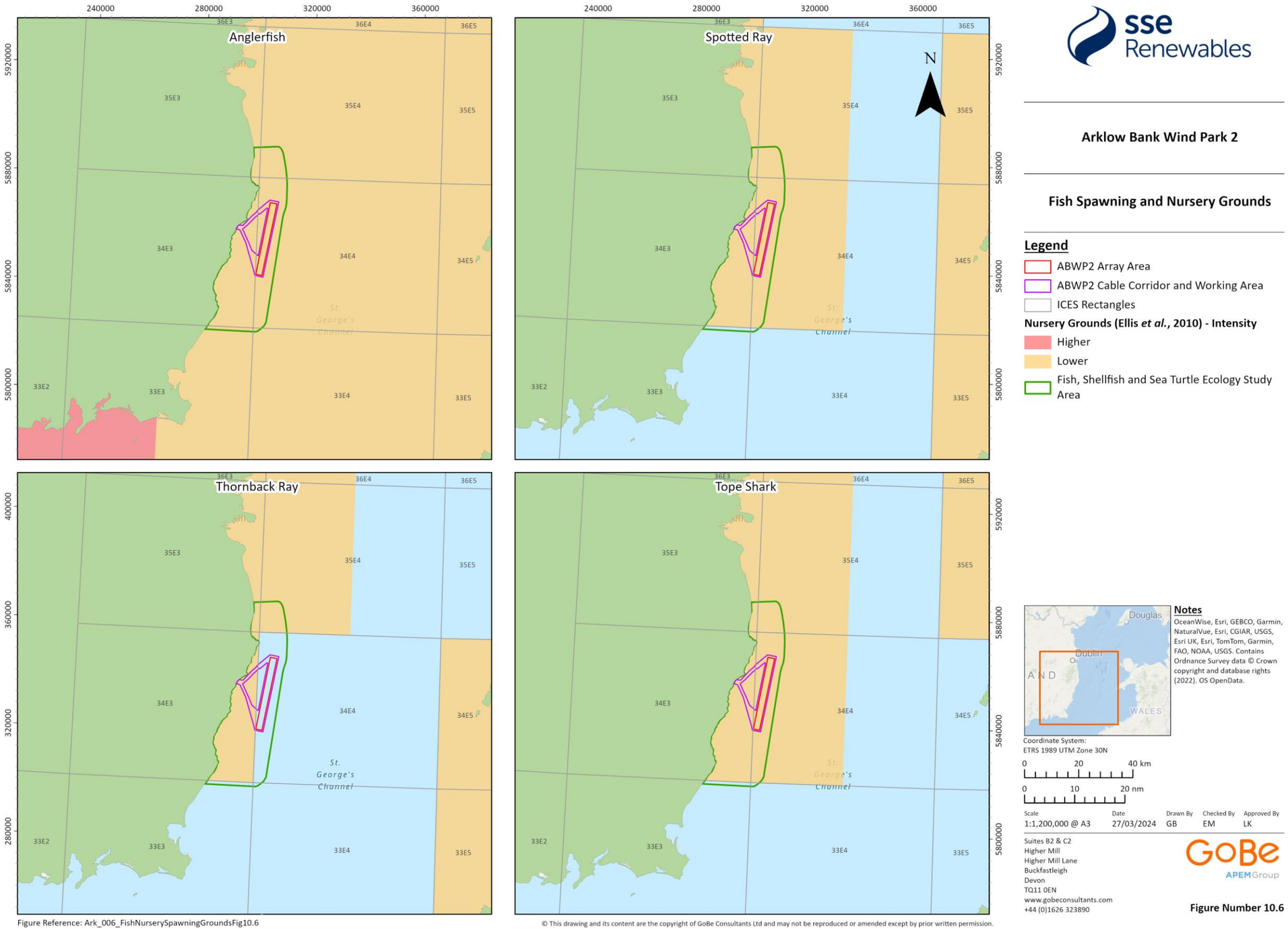


Figure Reference: Ark_006_FishNurserySpawningGroundsFig10.6

Figure 10.6: Nursery grounds for anglerfish, spotted ray, thornback ray and tope

Basking Shark

10.5.2.17 Basking shark migrate through the Irish Sea during spring and summer and migration routes cover large distances from the north of Scotland to North Africa. A tagging study of basking sharks found that half of the tagged sharks entered the Economic Exclusive Zone (EEZ) of Ireland, including the Irish Sea, indicating the importance of this area for overwintering and migration (Doherty *et al.*, 2017).

10.5.2.18 A single basking shark was recorded in October 2019 during two years of site-specific aerial surveys of the Array Area plus 4 km buffer (see Chapter 12: Marine Mammals). Basking shark is listed on the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) list of threatened/declining species including in Region III (Celtic Seas) (OSPAR Commission, 2015), on the International Union for Conservation of Nature (IUCN) Red List as globally Endangered (Rigby *et al.*, 2019), on Ireland's Red list as endangered (Clarke *et al.,* 2016) and protected under the Wildlife Act 1976 (as amended in 2022). In addition, as a highly migratory species, basking shark is protected under various international conventions including Convention on the Conservation of Migratory Species (CMS) (Bonn Convention) and the United Nations Convention of the Law of the Sea (UNCLOS). While present in the area of the Proposed Development, the Fish, Shellfish and Sea Turtle Study Area is unlikely to support high numbers of basking sharks (Southall *et al.*, 2005).

Sea Turtles

10.5.2.19 Historical records show that three species of sea turtle are likely to occur in Irish waters including leatherback (or 'leathery') turtle *Dermochelys coriacea*, loggerhead turtle *Caretta caretta* and Kemp's Ridley turtle *Lepidochelys kempii* (King and Berrow, 2009; Botterell *et al.* 2020). Leatherback turtle is the most regularly reported turtle species around the coast of Ireland, accounting for just over 80% of all records (King and Berrow, 2009). Sightings and strandings records for sea turtles suggests that leatherback turtle occur mostly around the south and west coasts of Ireland although there are regular records for the western Irish Sea. There may be distinct coastal 'jellyfish hotspots' in the Irish Sea representing important foraging areas (Houghton *et al.,* 2006). This species has a strong seasonal distribution with most sightings in the Irish Sea in the summer months; most likely driven by an increase in the abundance of jellyfish, as their key prey resource. Most records are from coastal waters although it is likely that animals will range widely into offshore waters to forage. No leatherback turtles were recorded during the site-specific aerial surveys. However, a leatherback turtle was observed in August 2020 as part of the Marine Mammal Observer observations carried out during a programme of site investigation activities.

10.5.2.20 Leatherback turtle is listed on the OSPAR list of threatened and declining species (OSPAR Commission, 2009), on the IUCN Red List as globally vulnerable (Wallace *et al.*, 2013) and Ireland's Red list as least concern (King *et al.,* 2011). This species is also protected under the Irish Wildlife Acts (1976 and 2000) and on Annex II and IV of the European Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (the 'Habitats Directive'). In addition, as a highly migratory species, leatherback turtle is protected under the CMS (Bonn Convention).

Important Ecological Features (IEFs)

10.5.2.21 IEFs are defined as species considered to be important for ecological, commercial and/or conservation reasons within the Fish, Shellfish and Sea Turtle Ecology Study Area and wider Western Irish Sea Fish, Shellfish and Sea Turtle Study Area. The IEFs assessed within this Chapter are presented in Table 10.6.

Table 10.6: Important Ecological Features (IEFs) relevant to fish and shellfish ecology

IEF	Scientific name / Representative species	Importance	Justification
Benthic and Demersal Fish assemblages (Flatfish)	Lemon sole *Microstomus kitt,* Plaice *Pleuronectes platessa*	Regional	Species of commercial importance. Spawning and nursery grounds overlap with study area.
Benthic and Demersal Fish assemblages (Flatfish)	Turbot *Scophthalmus maximus,* dab *Limanda limanda,* common sole *Solea solea,* thickback sole *Microchirus variegatus*	Local	Flatfish species typical of the Irish Sea. Commercially important.
Benthic and Demersel fish assemblages	Sand goby *Pomatoschistus minutus*, *Trisopterus minutus,* pogge *Agonus cataphractus,* dragonet *Callionymus lyra*, black goby *Gobius niger*	Local	Important prey species, with no information available on spawning and nursery grounds and little to no commercial value.
Benthopelagic and pelagic Fish assemblages	Atlantic cod *Gadus morhua,* Whiting *Merlangius merlangus,* Atlantic mackerel *Scomber scombrus*, Atlantic herring *Clupea harengus*, Anglerfish Lophiformes spp., Haddock *Melanogrammus aeglefinus,* sandeel *Ammodytes spp.,* Sprat *Sprattus sprattus*	Regional	Species of commercial importance within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area. Nursery and/or spawning grounds for these species overlap with the Fish, Shellfish and Sea Turtle Ecology Study Area.
Benthopelagic and pelagic Fish assemblages	Ling *Molva molva*	Local	Species of commercial importance within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area. Spawning grounds for this species overlap with the Fish, Shellfish and Sea Turtle Ecology Study Area.

Benthopelagic and pelagic Fish assemblages	European hake *Merluccius merluccius,* blue whiting *Micromesistius poutassou*	Local	Local benthopelagic/pelagic assemblages that are typical of the wider western Irish Sea region. These species are commercially important but have no known spawning or nursery grounds in the region.
Local shellfish assemblages	Hermit crab *Pagurus prideaux*, brown shrimp *Crangon crangon*, pink shrimp *Pandalus boralis*, common hermit crab *Pagurus bernhardus*, velvet swimming crab *Necora puber*, common shore crab *Carcinus maenas*	Local	Local shellfish assemblages that are typical of the wider western Irish Sea region and are important prey species.
Blue mussel and mussel seed beds	*Mytilus edulis*	Regional	The area inshore from Arklow Bank is considered to be of importance for the settlement of mussels and as a seed bed for this commercially important species.
Whelk	*Buccinum undatum*	Regional	Species is a key component of the commercial fisheries within the Fish, Shellfish and Sea Turtle Study Area.
Other commercially important shellfish species	Great scallop *Pecten maximus*, queen scallop *Aequipecten opercularis*, edible crab *Cancer pagurus*, cockle *Cerastoderma edule*, European lobster *Hommarus gammarus*	Regional	Commercially important shellfish that are abundant within the Fish, Shellfish and Sea Turtle Study Area.
Nephrops	*Nephrops norvegicus*	Regional	Spawning areas for *Nephrops* lie to the north and south of the Fish, Shellfish and Sea Turtle Study Area.

Elasmobranchs	Thornback ray *Raja clavata,* Spotted ray *Raja montagui,*	Regional	The Fish, Shellfish and Sea Turtle Study Area overlaps part of the nursery areas for these species. These species are locally abundant and listed as least concern on Ireland's Red List for cartilaginous fish.
Elasmobranchs	Tope *Galeorhinus galeus*	Regional	The Fish, Shellfish and Sea Turtle Study Area overlaps part of the nursery areas for this species. Listed as vulnerable on Ireland's Red List for cartilaginous fish.
Elasmobranchs	Spurdog *Squalus acanthias*	Regional	Endangered on Ireland's Red List for cartilaginous fish. The Fish, Shellfish and Sea Turtle Study Area does not overlap with nursery grounds for this species.
Elasmobranch	Cuckoo ray *Leucoraja naevus* Lesser spotted dogfish *Scyliorhinus canicula*	Local	Abundant within the Fish, Shellfish and Sea Turtle Study Area. Ireland's Red List includes these species as vulnerable (cuckoo ray) and least concern (lesser spotted dogfish).
Basking shark	*Cetorhinus maximus*	International	Internationally protected species, OSPAR listed species, IUCN Red List (endangered) and Ireland's Red List species (endangered). Migrates through the Irish Sea and may pass through the Fish, Shellfish and Sea Turtle Study Area. A single basking shark was recorded in October 2019 during two years of site-specific aerial surveys of the Array Area plus 4 km buffer.

Diadromous species	Atlantic salmon *Salmo salar*, sea trout *Salmo trutta*, sea lamprey *Petromyzon marinus*, river lamprey *L. fluviatilis*, and twaite shad *Allosa fallax*.	International	Diadromous fish species are Annex II species and are qualifying interests of SACs within the western Irish Sea; there is potential connectivity between the SACs and the Fish, Shellfish and Sea Turtle Study Area.
Leatherback or 'leathery' turtle	*Dermochelys coriacea*	International	Internationally protected species, OSPAR listed species, IUCN Red List (vulnerable) and Ireland's Red List species (Least Concern). Migrates through the Irish Sea where there are likely to be hotspots for foraging. May pass through the Fish, Shellfish and Sea Turtle Study Area. No leatherback turtles were recorded during the site-specific aerial surveys, however one individual was noted during Marine Mammal Observer observations in 2020.

10.5.3 'Do nothing' scenario

10.5.3.1 Annex IV of the EIA Directive sets out the information required to be included in an EIAR. This includes "a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge". An assessment of the future conditions without the Proposed Development has been carried out and is described within this section.

10.5.3.2 The baseline environment will exhibit some degree of natural change over time, even if the Proposed Development does not proceed, due to naturally occurring cycles and processes. Therefore, when undertaking impact assessments, it is necessary to place any potential impacts in the context of the envelope of change that might occur naturally over the timescale of the Proposed Development.

10.5.3.3 A key consideration in assessing the future baseline scenario is the potential influence of climate change on fish, shellfish and sea turtle communities. There are numerous models covering the UK and Ireland which simulate possible climate change scenarios and the UK Climate Projections

2018 (UKCP18) indicate there could be increases in mean summer temperatures in the longer term and milder winters (influencing sea water temperature), changes in rainfall distribution and seasonality, more extremes of weather and sea level rise (Defra 2019).

10.5.3.4 There is a broad body of evidence that suggests that climate change plays an important role in changing fish, shellfish and sea turtle distributions and abundances. The biological and physical influence of climate change is also important in considering key life-cycle stages. For example, the dispersal of eggs and larvae by water currents; the timing of spawning in relation to seasonal zooplankton productivity which form key prey items for larvae; the physiological effects of temperature on growth and maturation; and the alteration of migration cues for adult fish (Heath *et al.* 2012). Thus, variability and long-term changes on physical influences may bring direct and indirect changes to fish, shellfish and sea turtle populations and communities in the mid to long term future.

10.5.3.5 Changes in temperature will have an effect on fish at all biological levels (cellular, individual, population, species, community and ecosystem) both directly and indirectly. As sea temperatures rise, the distribution patterns of species may shift unless species are able to adapt. Temperature partitioning may become more apparent with the distribution of cold-water species, such as cod and herring, becoming restricted within the Irish Sea whilst species adapted to warmer water may expand their distribution. Species that have strict habitat associations, such as Raitt's sandeel *Ammodytes marinus*, may be at particular risk from climate change as it may be unable to adapt its distribution to compensate for warming sea temperatures (Heath *et al.*, 2012). Sandeels are a key species linking primary producers with top predators in the food chain. Similarly, such increases in temperature can lead to increased acidification of sea water which in turn can affect the physiology of species; for example, it becomes more difficult for calcifying marine organisms to deposit shell material with rising CO^2 and decreasing pH (Fabry *et al.*, 2008; Vézina and Hoegh-Guldberg, 2008).

10.5.3.6 Any changes that may occur during the design life span of the Proposed Development should be considered in the context of both greater variability and sustained trends occurring on national and international scales in the marine environment.

10.5.4 Data limitations

10.5.4.1 The data sources used in this chapter are detailed in Table 10.3. The desktop data used are the most up to date publicly available information which can be obtained from the applicable data sources as cited. Data that has been collected is based on existing literature, consultation with stakeholders and identification of habitats to inform likely fish, shellfish and sea turtle species.

10.5.4.2 Coull *et al.* (1998) and Ellis *et al.* (2012) are considered the key references for providing broad scale overviews of the potential extent of fish spawning and nursery grounds. These publications provide an indication of the general location of spawning and nursery grounds from various sources and do not define precise spatial boundaries and may fail to account for recent spatio-temporal changes in spawning and nursery behaviour. Additionally, the spawning times given in these publications represent the maximum duration of spawning on a species/stock basis. In some cases, the duration of spawning may be much more contracted, on a site-specific basis, than reported in Coull *et al.* (1998) and Ellis *et al.* (2012).

10.5.4.3 No site-specific fish, shellfish and sea turtle surveys were carried out to inform the assessment, although some information was obtained from site-specific benthic subtidal ecology surveys, aerial surveys and observations carried out by the Marine Mammal Observers during site investigation surveys. It is possible that some species have not been identified as being locally important within the Fish, Shellfish and Sea Turtle Ecology Study Area, particularly with respect to pelagic species which would not have been sampled during site-specific benthic surveys. However, the comprehensive desktop study completed over the wider region of the western Irish Sea captured all reported fish, shellfish and sea turtle species and described these in the context

of the Fish, Shellfish and Sea Turtle Ecology Study Area. Thus, a conservative approach was adopted in terms of the suite of species considered within the baseline environment and the IEFs set out in Table 10.6 are considered to be robust for the purposes of the impact assessment.

10.6 Methodology for assessing the significance of effects

10.6.1 Key parameters for assessment

10.6.1.1 The assessment of significance of effects has been carried out on both of the two discrete project design options detailed in Volume II, Chapter 4, Description of Development. This approach has allowed for a robust and full assessment of the Proposed Development.

10.6.1.2 The two Project Design Options and parameters relevant to each potential impact are detailed in Table 10.7 and Table 10.8.

Table 10.7: Project design parameters and impacts assessed – Project Design Option 1

Potential impact	Phase			Project design option 1
	C	O	D	
Temporary habitat loss/disturbance	✓	✓	✓	**Construction phase** A maximum of 9,929,060 m^2 of temporary habitat loss/disturbance due to: <u>Confirmatory surveys</u> 431 cone Penetration tests, 131 boreholes, 240 grab samples and 300 Vibrocores along export cable and inter-array cabling. Seabed moorings associated with floating LiDAR, Acoustic Doppler Current Profiler and wave buoy. <u>Site preparation:</u> Site preparation activities prior to inter-array, interconnector, and offshore export cable installation to include sandwave clearance, 4,219,460 m^2 of habitat loss/disturbance: • For inter-array cables, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the inter-array cables length. Total seabed area of 2,562,000 m^2. • For export cables, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the export cables length. Total seabed area of 840,000 m^2. • For Offshore Substation Platforms (OSP) interconnector, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the OSP interconnector length. Total seabed area of 588,000 m^2. • For scour protection, sandwaves may be cleared along a diameter of 99m, to a depth of 10m, along 50%. Total seabed area of 215,540 m^2. • For OSP/ Wind Turbine Generator (WTG) installation, sandwaves may be cleared along a diameter of 100m, to a depth of 5m, at 20% of locations. Total seabed area of 13,920 m^2.

Site preparation activities also include boulder clearance, 2,850,000 m^2 of habitat loss/disturbance:

- For inter-array cable, boulder clearance may occur at a width of 15 m along 100% of the inter-array cables length. Total seabed area of 1,830,000 m^2.
- For export cable, boulder clearance may occur at a width of 15 m along 100% of the export cable length. Total seabed area of 600,000 m^2.
- For OSP interconnector, boulder clearance may occur at a width of 15 m along 100% of the interconnector length. Total seabed area of 420,000 m^2.

1,200 m^2 of habitat loss/disturbance during Unexploded Ordnance (UXO) clearance.

Cable installation:

Installation of cables, 2,850,000 m^2 habitat loss/disturbance:

- For inter-array cables, total length of 110 – 122 km with a seabed disturbance width of 15 m. Total seabed area of 1,830,000 m^2.
- For export cable, total length of 35-40 km with a seabed disturbance width of 15 m. Total seabed area of 600,000 m^2.
- For interconnector, total length of 25-28 km with a seabed disturbance width of 15 m. Tota seabed area of 420,000 m^2.

Jack-up Vessels:

- Disturbance of 278,400 m^2 of seabed from jack-up barge across construction period, with a total combined maximum leg area of 1200 m^2 per jack-up barge.

Operational and maintenance phase

Cable repair and maintenance:

Inter-array, export and interconnector cable repair/reburial activities:

				• For inter-array cables, repair and reburial of cables between 110 km and 122 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 1.5 m deep trench (cable repair and reburial once every 3 years). • For export cables, repair and reburial of cables between 35 km and 40 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 2.5 m deep trench (cable repair and re-burial once every 5 years). • Interconnector cables: repair and reburial of cables of between 25 km and 28 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 10 m deep trench (cable repair and reburial once every 3 years). • Operational dredging: 275,000 m^2 of seabed disturbance once every 5 years. <u>WTG/OSP repair and maintenance:</u> Maintenance activities of WTGs and OSPs to include: • WTG and OSP scour protection repair and maintenance (once every 5 years for WTGs and once every 5 years for OSPs). <u>Jack-up Vessels:</u> • Disturbance of 613,200 m^2 of seabed from jack-up barge across O&M period, with a total combined maximum leg area of 1200 m^2 per jack-up barge. **Decommissioning phase** All structures above the seabed would be removed via cutting monopiles 2m below seabed, scour protection, cables and cable protection would be left in situ. Decommissioning would be undertaken in the reverse of construction using similar plant and techniques.
Increased suspended sediment concentrations and associated deposition	✓	✓	✓	**Construction phase** <u>Confirmatory surveys</u>

431 Cone Penetration tests, 131 boreholes, 240 grab samples and 300 Vibrocores along export cable and inter-array cabling. Seabed moorings associated with floating LiDAR, Acoustic Doppler Current Profiler and wave buoy.

Site preparation:

Site preparation activities prior to inter-array, interconnector, and offshore export cable installation to include sandwave clearance:

- For inter-array cables, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the inter-array cables length. Total volume of 1,000,000 m^3.
- For export cables, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the export cables length. Total volume of 500,000 m^3.
- For OSP interconnector, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the OSP interconnector length. Total volume of 500,000 m^3.
- For scour protection, sandwaves may be cleared along a diameter of 99m, to a depth of 10m, along 50%. Total volume of 1,000,000 m^3.
- For OSP/WTG installation, sandwaves may be cleared along a diameter of 100m, to a depth of 5m, at 20% of locations. Total volume of 139,200 m^3.

Sandwave clearance has been modelled at representative locations across the Array Area and Cable Corridor and Working Area.

Site preparation activities also include boulder clearance:

- Site preparation activities also include boulder clearance ploughing and picking of 100% of inter-array, export and interconnector cables at a width of 15 m and depth of 500 mm. Total seabed area of 2,850,000 m^2.

Foundation installation:

WTGs and OSPs installed on monopile foundations:

- Drilled installation of 25 WTG piles 7-11 m in diameter at 0.2 – 1.0 m/h to full depth of 37 m. One concurrent drilling event with a drilling duration per pile of 88 hours.
- Drilled installation of 2 OSP piles 7-14 m in diameter at 0.2 – 1.0 m/h to full depth of 45 m. One concurrent drilling event with a drilling duration per pile of 88 hours.
- Jetting to remove refused monopiles. 4,474 m^3 of material per refusal with 5 refusals assumed (22, 370 m^3).

Modelled at representative locations across the Array Area.

Cable installation:

- For inter-array cables, total length of 110 – 122 km with a seabed disturbance width of 15 m. Total seabed area of 1,830,000 m^2.
- For export cable, total length of 35 – 40 km with a seabed disturbance width of 15 m. Total seabed area of 600,000 m^2.
- For interconnector, total length of 25-28 km with a seabed disturbance width of 15 m. Total seabed area of 420,000 m^2.

Modelled at representative locations.

Operational and maintenance phase

Cable repair and maintenance:

Inter-array, export and interconnector cable repair/reburial activities:

- For inter-array cables, repair and reburial of cables between 110 km and 122 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 1.5 m deep trench (cable repair once every 3 years and cable re-burial once every 3 years).
- For export cables, repair and reburial of cables between 30 km and 40 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 2.5 m deep trench (cable repair once every 5 years and cable re-burial once every 5 years).
- Interconnector cables: repair and reburial of cables of between 25 km and 28 km in length over the lifetime of the Proposed Development with

				disturbance of seabed material from 15 m wide and 10 m deep trench (cable repair once every 3 years and cable re-burial once every 3 years). • Operational dredging: 275,000 m^2 of seabed disturbance (volume 400,000 m^3) once every 5 years (300,000 m^3 for IAC and 100,000 m^3 for interconnector and Export cables). <u>Jack-up Vessels:</u> Disturbance of 613,200 m^2 of seabed from jack-up barge across construction period **Decommissioning phase** All structures above the seabed would be removed via cutting of monopiles 2m below seabed, scour protection, cables and cable protection would be left in situ; and Decommissioning would be undertaken in the reverse of construction using similar plant and techniques.
Injury and/or disturbance from underwater noise and vibration during pile driving and cable installation	✓	✓	×	**Construction phase** <u>Foundation installation:</u> WTGs installed on monopile foundations: • Installation of 56 WTGs with a pile diameter between 7 m and 11 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24-hour period); • Maximum hammer energy 6,600 kJ, average hammer energy 4,400 kJ and a strike rate of 30 strikes per minute; • Soft start at 825 kJ; • Anticipated maximum duration of piling at 5 hours and 10 minutes per day with an average duration of 4 hours per pile and; • Total of 75 days when piling may occur over construction period, which may last up to 5 years.

				Offshore Substations Platforms (OSP) installed on monopile foundations: • Installation of two OSPs with a pile diameter between 7 and 14 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy 6,600kJ and an average hammer energy 6,000 kJ; • Soft start at 825 kJ; • Average duration of 4 hours per pile and; • Total of 4 days when piling may occur over construction period. Detonation of UXO's. **Operational and maintenance phase** • 56 operational WTGs • Cable repair once every 3 years and cable re-burial once every 3 years for inter-array and interconnector cables. • For export cables, cable repair once every 5 years and cable re-burial once every 5 years. • Operational dredging once every 5 years. • Geophysical surveys every 6 months for first two years and annually thereafter.
Injury and/or disturbance to basking shark and sea turtles from increased vessel activities	✓	✓	✓	**Construction phase** 66 vessels on site at one time comprised of jack up barges, cargo, support, tug/anchor, cable installation, guard, survey, crew transfer, sandwave clearance and UXO clearance vessels. 4150 return trips across construction period and 1,797 return trips per year. Construction schedule of 24 hours a day, 7 days a week for a period of up to 5 years.

				Operational and maintenance phase 30 vessels on site at one time comprised of crew transfer, jack-up, cable repair, service operations, cable survey and excavator vessels. 1,359 return trips per year. **Decommissioning phase** As above for construction phase
Accidental pollution from vessels, vehicles, equipment and machinery	✓	✓	✓	**Construction phase** Accidental pollution within the Proposed Development construction phase from: • Installation of 56 WTGs and two OSPs within the Array Area. • Installation of inter-array cables between 110 – 122 km in length, OSP interconnector cables between 25 – 28 km in length, and offshore export cables between 35 – 40 km in length; • 66 vessels on site at one time comprised of jack up barges, cargo, support, tug/anchor, cable installation, guard, survey, crew transfer, sandwave clearance and UXO clearance vessels. • 4,150 return trips across construction period and 1,797 return trips per year. • Construction schedule of 24 hours a day, 7 days a week for a period of 5 years. • 294 helicopter return trips over the construction phase and 118 helicopter return trips per year. **Operational and maintenance phase** Accidental pollution within the Proposed Development during O&M from: • 30 vessels on site at one time comprised of crew transfer, jack-up, cable repair, service operations, cable survey and excavator vessels. • 1,359 return trips per year. • 485 helicopter return trips per year;

				• Presence of 56 WTGs and 2 OSPs and; • Maintenance activities of 56 WTGs and 2 OSPs **Decommissioning phase** Accidental pollution in the Array Area during decommissioning from: • Decommissioning of 56 WTGs and 2 OSPs
Long term habitat loss as a result of the presence of foundation structures, scour protection and cable protection.	×	✓	×	**Operational and maintenance phase** 662,800 m^2 of long-term habitat loss during operation and maintenance will occur as a result of: <u>Foundations:</u> • For the WTG foundations, 615 – 4,779 m^2 of scour protection (scour mattresses, rock dumping, artificial fronds and/or other novel techniques) per pile (Total of 267,624 m^2). Presence of 56 WTGs with base diameter of 7-11m (273,004 m^2 total seabed footprint including scour protection). • For OSPs, 615 – 7,543 m^2 of scour protection per pile (15,086 m^2 for the OWF). Presence of 2 OSPs with base diameter of 7-14m (Total seabed and scour protection footprint of 15,396 m^2). <u>Cables:</u> • For inter-array cables, 18,300 m of cables requiring protection (15%). Total area of 146,400 m^2. • For Export cables, 8,000 m of cable requiring protection (20%). Total area of 64,000 m^2. • For Export cable crossing, 750-24,000 m^2. • For interconnector, 14,000 m of cables requiring protection (50%). Total area of 140,000 m^2. Combination of rock installation, concrete mattresses, geotextie sand containers, rock bags, cast iron shells, sleeving and CPS system.
Alteration of seabed habitats arising from changes in physical processes as a result of the presence of foundation structures, scour protection and cable protection	×	✓	×	**Operational and maintenance phase** Presence of WTGs and OSPs installed on monopile foundations: • 56 WTG piles of 7 m to 11 m in diameter with a seabed footprint of 38-96 m^2 per pile and scour protection footprint of 615 – 4,779 m^2. Total seabed and scour protection footprint of 273,004 m^2.

				• Scour protection area of 615 – 4,779 m^2 per WTG foundation at a height of 0.5 - 3 m. Total scour protection volume of 307 – 14,429 m^3 per WTG foundation and total scour protection volume of 14,429 – 802,872 m^3 for OWF. 2 OSP piles of 7 m to 14 m in diameter with a seabed footprint of 38-154 m^2 per pile and scour protection footprint of 615 – 7,543 m^2. Total seabed and scour protection footprint of 15,396 m^2. • Scour protection area of 615 – 7,543 m^2 per OSP foundation at a height of 0.5 - 3 m. Total scour protection volume of 307 – 22,629 m^3 per OSP foundation and total scour protection volume of 614 – 45,258 m^3 for OWF. Presence of remedial protection and cable crossings (if applicable) for inter-array, export and interconnector cables: • Inter-array cables: Total cable protection footprint of 146,400 m^2 and volume of 219,600 m^3, with height of 0 -1.5 m. • Export cables: Total cable protection footprint of 64,000 m^2 and volume of 96,000 m^3, with height of 0 - 1.5 m. Total cable crossings area of 75 - 24,000 m^2 and volume of 375 - 60,000 m^3. • Interconnector cables: Total cable protection footprint of 140,000 m^2 and volume of 252,000 m^3, with height of 0 - 1.8 m. Wave climate and tidal currents modelled with and without presence of Proposed Development.
Changes in Electromagnetic Fields (EMF) from subsea electrical cabling	×	✓	×	**Operational and maintenance phase** Presence of inter-array, OSP interconnector, and offshore export cables: • 66 kV inter-array cables between 110 – 122 km in length, • 220 kV OSP interconnector cables between 25 – 28 km in length • 220 kV offshore export cables between 35 – 40 km in length • Burial depth between 0-1.5 m for inter-array cables and 0-2.5 m for OSP interconnector and offshore export cables • 15% of inter-array cable routes, 50% of OSP interconnector cable routes, and 20% of export cable routes requiring protection • Third party export cable crossings • Operational phase of 36.5 years.

	• Cable protection system (up to 1.5m in diameter) comprising of concrete, polyurethane, steel, cast iron shells, high density polyethylene and/or plastic ducts.

Table 10.8 Project design parameters and impacts assessed – Project Design Option 2

Potential impact	Phase			Project design option 2
	C	O	D	
Temporary habitat loss/disturbance	✓	✓	✓	**Construction phase** A maximum of 9,892,260 m^2 of temporary habitat loss/disturbance due to: <u>Confirmatory surveys</u> 431 Cone Penetration tests, 131 boreholes, 240 grab samples and 300 Vibrocores along export cable and inter-array cabling. Seabed moorings associated with floating LiDAR, Acoustic Doppler Current Profiler and wave buoy. <u>Site preparation:</u> Site preparation activities prior to inter-array, interconnector, and offshore export cable installation to include sandwave clearance, 4,182,660 m^2 of habitat loss/disturbance: • For inter-array cables, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the inter-array cables length. Total seabed area of 2,562,000 m^2. • For export cables, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the export cables length. Total seabed area of 840,000 m^2. • For OSP interconnector, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the OSP interconnector length. Total seabed area of 588,000 m^2. • For scour protection, sandwaves may be cleared along a diameter of 99m, to a depth of 10m, along 50%. Total seabed area of 180,900 m^2. • For OSP/WTG installation, sandwaves may be cleared along a diameter of 100m, to a depth of 5m, at 20% of locations. Total seabed area of 11,760 m^2.

Site preparation activities also include boulder clearance, 2,850,000 m^2 of habitat loss/disturbance:

- For inter-array cable, boulder clearance may occur at a width of 15 m along 100% of the inter-array cables length. Total seabed area of 1,830,000 m^2.
- For export cable, boulder clearance may occur at a width of 15 m along 100% of the export cable length. Total seabed area of 600,000 m^2.
- For OSP interconnector, boulder clearance may occur at a width of 15 m along 100% of the interconnector length. Total seabed area of 420,000 m^2.

1,200 m^2 of habitat loss/disturbance during UXO clearance.

Cable installation:

Installation of cables, 2, 850, 000 m^2 of habitat loss/disturbance:

- For inter-array cables, total length of 110-122 km with a seabed disturbance width of 15 m. Total seabed area of 1,830,000 m^2.
- For export cable, total length of 35- 40 km with a seabed disturbance width of 15 m. Total seabed area of 600,000 m^2.
- For interconnector, length of 25-28 km with a seabed disturbance width of 15 m. Total seabed area of 420,000 m^2.

Jack-up Vessels:

- Disturbance of 278,400 m^2 of seabed from jack-up barge across construction period, with a total combined maximum leg area of 1200 m^2 per jack-up barge.

Operational and maintenance phase

Cable repair and maintenance:

Inter-array, export and interconnector cable repair/reburial activities:

- For inter-array cables, repair and reburial of cables between 110 km and 122 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 1.5 m deep trench (cable repair once every 3 years and cable re-burial once every 3 years).

				• For export cables, repair and reburial of cables between 35 km and 40 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 2.5 m deep trench (cable repair once every 5 years and cable re-burial once every 5 years). • Interconnector cables: repair and reburial of cables of between 25 km and 28 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 10 m deep trench (cable repair once every 3 years and cable re-burial once every 3 years). • Operational dredging: 275,000 m^2 of seabed disturbance once every 5 years. <u>WTG/OSP repair and maintenance:</u> Maintenance activities of WTGs and OSPs to include: • WTG and OSP scour protection repair and maintenance (once every 5 years for WTGs and once every 5 years for OSPs). <u>Jack-up Vessels:</u> • Disturbance of 613,200 m^2 of seabed from jack-up barge across construction period, with a total combined maximum leg area of 1200 m^2 per jack-up barge. **Decommissioning phase** All structures above the seabed would be removed via cutting monopiles 2m below seabed, scour protection, cables and cable protection would be left in situ. Decommissioning would be undertaken in the reverse of construction using similar plant and techniques.
Increased suspended sediment concentrations and associated deposition	✓	✓	✓	**Construction phase** <u>Confirmatory surveys</u>

431 Cone Penetration tests, 131 boreholes, 240 grab samples and 300 Vibrocores along export cable and inter-array cabling. Seabed moorings associated with floating LiDAR, Acoustic Doppler Current Profiler and wave buoy.

Site preparation:

Site preparation activities prior to inter-array, interconnector, and offshore export cable installation to include sandwave clearance:

- For inter-array cables, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the inter-array cables length. Total volume of 1,000,000 m^3.
- For export cables, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the export cables length. Total volume of 500,000 m^3.
- For OSP interconnector, sandwaves may be cleared along a width of 70m, to a depth of 10m, along 30% of the OSP interconnector length. Total volume of 500,000 m^3.
- For scour protection, sandwaves may be cleared along a diameter of 99m, to a depth of 10m, along 50%. Total volume of 1,000,000 m^3.
- For OSP/WTG installation, sandwaves may be cleared along a diameter of 100m, to a depth of 5m, at 20% of locations. Total volume of 117,600 m^3.

Sandwave clearance modelled at representative locations across the Array Area and Cable Corridor and Working Area.

Site preparation activities also include boulder clearance:

- Site preparation activities also include boulder clearance ploughing and picking of 100% of inter-array, export and interconnector cables at a width of 15 m and depth of 500 mm. Total seabed area of 2,850,000 m^2.

Foundation installation:

WTGs and OSPs installed on monopile foundations:

- Drilled installation of 25 WTG piles 7-11 m in diameter at 0.2 – 1.0 m/h to full depth of 37 m. One concurrent drilling event with a drilling duration per pile of 88 hours.
- Drilled installation of 2 OSP piles 7-14 m in diameter at 0.2 – 1.0 m/h to full depth of 45 m. One concurrent drilling event with a drilling duration per pile of 88 hours.
- Jetting to remove refused monopiles. 4,474 m^3 of material per refusal with 5 refusals assumed (22, 370 m^3).

Modelled at representative locations across the Array Area.

Cable installation:

- For inter-array cables, total length of 110-122 km with a seabed disturbance width of 15 m. Total seabed area of 1,830,000 m^2.
- For export cable, total length of 35- 40 km with a seabed disturbance width of 15 m. Total seabed area of 600,000 m^2.
- For interconnector, total length of 25-28 km with a seabed disturbance width of 15 m. Total seabed area of 420,000 m^2.

Operational and maintenance phase

Cable repair and maintenance:

Inter-array, export and interconnector cable repair/reburial activities:

- For inter-array cables, repair and reburial of cables between 110 km and 122 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 1.5 m deep trench (cable repair once every 3 years and cable re-burial once every 3 years).
- For export cables, repair and reburial of cables between 30 km and 40 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 2.5 m deep trench (cable repair once every 5 years and cable re-burial once every 5 years).
- Interconnector cables: repair and reburial of cables of between 25 km and 28 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 10 m deep trench (cable repair once every 3 years and cable re-burial once every 3 years).
- Operational dredging: 275,000 m^2 of seabed disturbance (volume 400,000 m^3) once every 5 years (300,000 m^3 for IAC and 100,000 m^3 for interconnector and Export cables).

Jack-up Vessels:

Disturbance of 613,200 m^2 of seabed from jack-up barge across construction period

Decommissioning phase

All structures above the seabed would be removed via cutting of monopiles 2m below seabed, scour protection, cables and cable protection would be left in situ; and

				Decommissioning would be undertaken in the reverse of construction using similar plant and techniques.
Injury and/or disturbance from underwater noise and vibration during pile driving and cable installation	✓	✓	×	**Construction phase** <u>Foundation installation:</u> WTGs installed on monopile foundations: • Installation of 47 WTGs with a pile diameter between 7 m and 11 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy 6,600 kJ, average hammer energy 4,400 kJ and a strike rate of 30 strikes per minute; • Soft start energy at 825 kJ; • Anticipated maximum duration of piling at 5 hours and 10 minutes per day with an average duration of 4 hours per pile and; • Total of 63 days when piling may occur over construction period, which may last up to 5 years. OSPs installed on monopile foundations: • Installation of 2 OSPs with a pile diameter between 7 m and 14 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy 6,600kJ and an average hammer energy 6,000kJ; • Soft start at 825 kJ; • Average duration of 4 hours per pile and; • Total of 4 days when piling may occur over construction period. Detonation of UXO's. **Operational and maintenance phase** • 47 operational WTGs

				• Cable repair once every 3 years and cable re-burial once every 3 years for inter-array and interconnector cables. • For export cables, cable repair once every 5 years and cable re-burial once every 5 years. • Operational dredging once every 5 years. • Geophysical surveys every 6 months for first two years and annually thereafter.
Injury and/or disturbance to basking shark and sea turtles from increased vessel activities	✓	✓	✓	**Construction phase** 66 vessels on site at one time comprised of jack up barges, cargo, support, tug/anchor, cable installation, guard, survey, crew transfer, sandwave clearance and UXO clearance vessels. 4150 return trips across construction period and 1,797 return trips per year. Construction schedule of 24 hours a day, 7 days a week for a period of up to 5 years. **Operational and maintenance phase** 30 vessels on site at one time comprised of crew transfer, jack-up, cable repair, service operations, cable survey and excavator vessels. 1,359 return trips per year. **Decommissioning phase** As above for construction phase
Accidental pollution from vessels, vehicles, equipment and machinery	✓	✓	✓	**Construction phase** Accidental pollution within the Proposed Development construction phase from: • Installation of 47 WTGs and 2 OSPs within the Array Area. • Installation of inter-array cables between 110 – 122 km in length, OSP interconnector cables between 25 – 28 km in length, and offshore export cables between 35 – 40 km in length;

				• 66 vessels on site at one time comprised of jack up barges, cargo, support, tug/anchor, cable installation, guard, survey, crew transfer, sandwave clearance and UXO clearance vessels. • 4,150 return trips across construction period and 1,797 return trips per year. • Construction schedule of 24 hours a day, 7 days a week for a period of 5 years. • 294 helicopter return trips over the construction phase and 118 helicopter return trips per year. **Operational and maintenance phase** Accidental pollution within the Proposed Development during O&M from: • 30 vessels on site at one time comprised of crew transfer, jack-up, cable repair, service operations, cable survey and excavator vessels. • 1,359 return trips per year. • 485 helicopter return trips per year; • Presence of 47 WTGs and 2 OSPs and; • Maintenance activities of 47 WTGs and 2 OSPs **Decommissioning phase** Accidental pollution in the Array Area during decommissioning from: • Decommissioning of 47 WTGs and 2 OSPs
Long term habitat loss as a result of the presence of foundation structures, scour protection and cable protection.	×	✓	×	**Operational and maintenance phase** 618,921 m^2 of long-term habitat loss during operation and maintenance will occur as a result of: <u>Foundations:</u> • For the WTG foundations, 615 – 4,779 m^2 of scour protection (scour mattresses, rock dumping, artificial fronds and/or other novel techniques) per pile (total 224,613 m^2). Presence of 47 WTGs with base diameter of 7-11m (229,125 m^2 total seabed footprint including scour protection).

				• For OSPs, 615 – 7,543 m^2 of scour protection per pile (total 15,086 m^2) for the OWF. Presence of 2 OSPs with base diameter 7-14m (total seabed and scour protection footprint of 15,396 m^2). Cables: • For inter-array cables, 18,300 m of cables requiring protection (15%). Total of 146,400 m^2. • For Export cables, 8,000 m of cable requiring protection (20%). Total of 64,000 m^2. • For Export cable crossing, 750 - 24,000 m^2. • For interconnector, 14,000 m of cables requiring protection (50%). Total of 140,000 m^2. Combination of rock installation, concrete mattresses, geotextie sand containers, rock bags, cast iron shells, sleeving and CPS system.
Alteration of seabed habitats arising from changes in physical processes as a result of the presence of foundation structures, scour protection and cable protection	×	✓	×	**Operational and maintenance phase** Presence of WTGs and OSPs installed on monopile foundations: • 47 WTG piles of 7 m to 11 m in diameter with a seabed footprint of 38-96 m^2 per pile and scour protection footprint of 615 – 4,779 m^2. Total seabed and scour protection footprint of 229,133 m^2. • Scour protection area of 615 – 4,779 m^2 per WTG foundation at a height of 0.5 - 3 m. Total scour protection volume of 307 – 14,429 m^3 per WTG foundation and total scour protection volume of 14,429 – 802,872 m^3 for OWF. 2 OSP piles of 7 m to 14 m in diameter with a seabed footprint of 38-154 m^2 per pile and scour protection footprint of 615 – 7,543 m^2. Total seabed and scour protection footprint of 15,396 m^2. • Scour protection area of 615 – 7,543 m^2 per OSP foundation at a height of 0.5 - 3 m. Total scour protection volume of 11,550 m3 per OSP foundation and total scour protection volume of 614 – 45,258 m^3 for OWF. Presence of remedial protection and cable crossings (if applicable) for inter-array, export and interconnector cables: • Inter-array cables: Total cable protection footprint of 146,400 m^2 and volume of 219,600 m^3, with height of 0 -1.5 m. • Export cables: Total cable protection footprint of 64,000 m2 and volume of 96,000 m^3, with height of 0 -1.5 m. Total cable crossings area of 750 – 24,000 m^2 and volume of 375 - 60,000 m^3.

				• Interconnector cables: Total cable protection footprint of 140,000 m^2 and volume of 252,000 m^3, with height of 0 - 1.8 m. Wave climate and tidal currents modelled with and without presence of Proposed Development.
Changes in Electromagnetic Fields (EMF) from subsea electrical cabling	×	✓	×	**Operational and maintenance phase** Presence of inter-array, OSP interconnector, and offshore export cables: • 66 kV inter-array cables between 110 – 122 km in length. • 220 kV OSP interconnector cables between 25 – 28 km in length. • 220 kV offshore export cables between 35 – 40 km in length. • Burial depth between 0-1.5 m for inter-array cables and 0-2.5 m for OSP interconnector and offshore export cables. • 15% of inter-array cable routes, 50% of OSP interconnector cable routes, and 20% of export cable routes requiring protection. • Third party export cable crossings. • Operational phase of 36.5 years. • Cable protection system (up to 1.5m in diameter) comprising of concrete, polyurethane, steel, cast iron shells, high density polyethylene and/or plastic ducts.

10.6.2 Impacts scoped out of the assessment

10.6.2.1 On the basis of the baseline environment and the description of development outlined in Volume II, Chapter 4: Description of Development, a number of impacts were scoped out of the assessment for fish, shellfish and sea turtle ecology. These impacts are outlined, together with a justification for scoping them out, in Table 10.9.

Table 10.9: Impacts scoped out of the assessment for fish, shellfish and sea turtle ecology

Potential impact	Justification
Temporary intertidal habitat loss / disturbance	At the Landfall, offshore export cables are to be installed via trenchless technologies (such as Horizontal Directional Drilling (HDD)), thereby avoiding any direct impacts on intertidal habitats. As such, there will be no direct impact on intertidal habitats, with any direct effects of trenchless operations limited to either the terrestrial or subtidal environments.
Remobilisation of contaminated sediments	Seabed disturbance associated with construction, maintenance and decommissioning activities (e.g. foundation and cable installation) could lead to the remobilisation of sediment-bound contaminants that may result in harmful and adverse effects on fish, shellfish and sea turtle receptors. Sampling undertaken in support of a permit application to undertake dredging and disposal works for ABWP1 (Ramboll, 2016) has demonstrated that contamination in the offshore sediments is low and at levels which are unlikely to result in adverse effects on fish and shellfish receptors.
Injury and/or disturbance to fish and shellfish from vessel activities	Underwater noise generated from vessels is likely to be low and effects would only occur if fish species remained within immediate vicinity of the vessel (i.e. within metres) for a number of hours which is highly unlikely as fish will move away from any noise. Collision risk is only likely to be a risk to large species which spend extended periods on the surface. This impact has therefore been scoped out of the assessment for all fish species, other than basking shark and sea turtles.
Drop Down Video (DDV) and Remotely Operated Vehicle (ROV) operations as part of confirmatory surveys	DDV and ROV are non-intrusive survey methods. Although the DDV is landed on the seabed, the footprint is small and any associated damage to subtidal habitats is minimal.

Disturbance to fish and shellfish from underwater noise and vibration generated by trenchless activities during construction	There is potential for elevations in subsea noise during landfall operations at the seaward exit point(s) but this is considered to result in very localised, short-term effects on fish, shellfish and sea turtles.
Removal of hard substrates resulting in loss of colonising communities	Foundations and scour protection would be left *in-situ* and would not be removed.

10.7 Impact assessment methodology

10.7.1 Overview

10.7.1.1 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of receptors and the magnitude of the impacts. This section describes the criteria applied in this chapter to assign values to the sensitivity of the receptors and the magnitude of potential impacts. The terms used to define sensitivity and magnitude are based on those which are described in further detail in Volume II, Chapter 5: EIA Methodology.

10.7.1.2 Both sensitivity and magnitude are assessed on a four-level scale to align with the EPA (2022) guidance: High, Medium, Low and Negligible.

10.7.2 Impact assessment criteria

SENSITIVITY

10.7.2.1 As set out in Volume II, Chapter 5: EIA Methodology, the sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected. Sensitivity is quantified via a consideration of its context (its adaptability, tolerance and recoverability) and value. Table 10.10 sets out the criteria used in defining the sensitivity of the identified fish, shellfish and sea turtle ecological receptors. All definitions of time periods have been defined from the EPA Guidelines (EPA, 2022). Four defined levels of sensitivity have been determined (High, Medium, Low or Negligible) and where one of the definitions, for a given level, is met then this will determine the level of sensitivity assigned. Where a receptor could reasonably be assigned more than one level of sensitivity, professional judgement has been used to determine which level is applicable.

Table 10.10: Definitions of sensitivity for fish, shellfish and sea turtle receptors

Receptor sensitivity	Definition
High	**Adaptability:** The receptor cannot avoid or adapt to an impact. **Tolerance:** The receptor has no or very low capacity to accommodate the proposed form of change. **Recoverability:** The effect on the receptor is anticipated to be permanent (i.e., over 60 years) and recovery is not anticipated. **Value:** The receptor is of international importance.

Medium	**Adaptability:** The receptor has a limited ability to avoid or adapt to an impact. **Tolerance:** The receptor has a moderate to low capacity to accommodate the proposed form of change. **Recoverability:** The receptor is anticipated to recover fully within the medium-term (i.e., seven to 15 years) to long-term (15 – 60 years). **Value:** The receptor is of national or international importance.
Low	**Adaptability:** The receptor has a reasonable capacity to avoid or adapt to an impact. **Tolerance:** The receptor has a high capacity to accommodate the proposed form of change. **Recoverability:** The receptor is anticipated to recover fully within the short-term (i.e., one to seven years). **Value:** The receptor is of national importance.
Negligible	**Adaptability:** The receptor has a high capacity to avoid or adapt to an impact. **Tolerance:** The receptor has a high capacity to accommodate the proposed form of change. **Recoverability:** The receptor is anticipated to recover fully and will be temporary (i.e., lasting less than one year). **Value:** The receptor is of local importance.

MAGNITUDE

10.7.2.2 The definitions of magnitude are given in Table 10.11. Where an impact could reasonably be assigned more than one level of magnitude, professional judgement has been used to determine which level is most appropriate for the impact. The magnitude has been assigned based on the most appropriate potential consequences of the impact. For example, whilst an impact may occur constantly throughout the O&M period, it may be indiscernible and immeasurable in practice. Therefore, it would be concluded to be of a Negligible magnitude despite the frequency of the impact.

10.7.2.3 For the purposes of the definitions below, near-field has been defined as within the Array Area and Cable Corridor and Working Area. Far-field has been defined as extending beyond these boundaries.

Table 10.11: Definition of terms relating to the magnitude of an impact

Magnitude	Definition
High	**Extent:** Impact across the near-field and far-field areas beyond the study area. **Duration:** The impact is anticipated to be permanent (i.e., over 60 years). **Frequency:** The impact will occur constantly throughout the relevant project phase. **Consequences:** Permanent changes to key characteristics or features of the particular environmental aspect's character or distinctiveness

Medium	**Extent:** The maximum extent of the impact is restricted to the far-field (i.e., the defined study area). **Duration:** The impact is anticipated to medium-term (i.e., seven to 15 years) to long-term (15 – 60 years). **Frequency:** The impact will occur constantly throughout a relevant project phase. **Consequences:** Noticeable change to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Low	**Extent:** The maximum extent of the impact is restricted to the near-field and adjacent far-field areas. **Duration:** The impact is anticipated to be temporary (i.e., lasting less than one year) to short-term (i.e., one to seven years). **Frequency:** The impact will occur frequently throughout a relevant project phase. **Consequences:** Barely discernible to noticeable change to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Negligible	**Extent:** The maximum extent of the impact is restricted to the near-field and immediately adjacent far-field areas. **Duration:** The impact is anticipated to be momentary (seconds to minutes) to brief (lasting less than one day). **Frequency:** The impact will occur once or infrequently throughout a relevant project phase. **Consequences:** No discernible to barely discernible change to key characteristics or features of the particular environmental aspect's character or distinctiveness.

SIGNIFICANCE OF EFFECT

10.7.2.4 The significance of the effect upon fish, shellfish and sea turtle ecology is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The particular method employed for this assessment is presented in Table 10.12. Where a range of significance of effect is presented in Table 10.12, the final assessment for each effect is based upon expert judgement.

Table 10.12: Significance of effect matrix

			Baseline Environment - Sensitivity			
			High	Medium	Low	Negligible
Description of Impact - Magnitude	Adverse Impact	High	Profound or Very Significant (significant)	Significant	Moderate*	Imperceptible
		Medium	Significant	Moderate*	Slight	Imperceptible
		Low	Moderate*	Slight	Slight	Imperceptible
	Neutral Impact	Negligible	Not Significant	Not Significant	Not Significant	Imperceptible
	Positive Impact	Low	Moderate*	Slight	Slight	Imperceptible
		Medium	Significant	Moderate*	Slight	Imperceptible
		High	Profound or Very Significant (significant)	Significant	Moderate*	Imperceptible

*Moderate levels of effect have the potential, subject to the assessor's professional judgement to be significant or not significant. Moderate will be considered as significant or not significant in EIA terms, depending on the sensitivity and magnitude of change factors evaluated. These evaluations are explained as part of the assessment, where they occur.

10.7.3 Factored in measures

10.7.3.1 The Project Design Options set out in Volume II, Chapter 4: Description of Development includes a number of designed-in measures and management measures (or controls) which have been factored into the Proposed Development and are committed to be delivered by the Developer as part of the Proposed Development.

10.7.3.2 These factored-in measures are standard measures applied to offshore wind development, including lighting and marking of the Proposed Development, use of 'soft-starts' for piling operations etc, to reduce the potential for impacts. Factored-in measures relevant to the assessment on fish, shellfish and sea turtle ecology are presented in Table 10.13. These measures are integrated into the description of development and have therefore been considered in the impact assessment (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development. This approach is in line with EPA guidance which states that 'in an EIAR it may be useful to describe avoidance measures that have been integrated into the proposed proposal' (EPA, 2022).

Table 10.13: Factored in measures

Factored in measures	Justification
Scour protection	In the absence of scour protection, there is potential for scour pits to develop around foundations. This may result in the release of sediment into the water column and a change to seabed habitat in the vicinity of the foundation. Scour protection will be installed as described in Volume II, Chapter 4: Description of Development.
Cable Burial Risk Assessment (CBRA)	The aim of the CBRA is to undertake a risk assessment in order to determine suitable burial depths for a cable along the entire route to protect the cable from third party and natural hazards. This includes identifying all hazards to the cable and carrying out a risk assessment to make recommendations on the burial depth required along the length of the cable to ensure that the risk to the cable is within acceptable limits. The CBRA includes an assessment of seabed conditions (based on available survey data) and an assessment of shipping, fishing, dredging, military activities etc. Burial requirements are normally driven by the risk from fishing gear and vessel anchors, as well as the seabed conditions along the cable route (which affects the anchor and fishing gear penetration depths). This process will be informed by a Burial Assessment Study (BAS) which looks at the different installation methodologies available (Volume II, Chapter 4: Description of Development) and provides recommendations as to the suitability of each option based on the seabed conditions. The BAS also identifies areas where burial may not be feasible and additional protection (e.g. rock placement) may be required. This will feed into the CBRA to provide cable protection requirements (burial and external protection).
Development of and adherence to the Rehabilitation Schedule (Volume III, Appendix 4.1)	The Rehabilitation Schedule describes measures for the decommissioning of the Proposed Development. Measures which will be implemented that will mitigate against effects on fish, shellfish and sea turtle include leaving scour protection *in-situ*.
Development of and implementation of an Environmental Management Plan (EMP) and	This includes mitigation/monitoring measures and commitments made within the EIAR, including but

associated annexes (Volume III, Appendix 25.1)	not limited to chemical usage, invasive and non-native species, pollution prevention and waste management.
A Marine Pollution Contingency Plan will be included in the EMP (Volume III, Appendix 25.1, Annex 2).	Ensures plans are in place to manage any marine pollution spills including key emergency contact details.
A confirmatory survey to be undertaken within the Array Area and Cable Corridor and Working Area to verify the presence/ absence of any areas of reef habitat and blue mussel beds.	Confirmatory surveys to verify the presence or absence of Annex I features (blue mussel beds, reefs) and to confirm predicted benthic habitats present. Measures to avoid and minimise direct and indirect impacts on these features will be implemented via micro-routing and micro-sitting.
An Invasive Non-Indigenous Species Management Plan will be implemented (Volume III, Appendix 25.4)	The plan outlines measures that will ensure vessels comply with the International Maritime Organisation (IMO) ballast water management guidelines and the Sea Pollution (Ballast Water Management Convention) Regulations 2023., it will consider the origin of vessels and contain standard housekeeping measures for such vessels, as well as measures to be adopted in the event that a high alert species is recorded.
Implementation of and adherence to Marine Mammal Mitigation Plan (MMMP) (Volume III, Appendix 25.2)	This identifies appropriate mitigation measures during offshore activities that are likely to produce underwater noise and vibration levels capable of potentially causing injury or disturbance to marine mammals. Factored-in measures adopted to reduce the risk of injury to marine mammal receptors as described in the plan will also be employed to reduce the risks to other marine megafauna that can be visually detected on the surface of the sea. Therefore, both sea turtles and basking shark are included as part of the MMMP.
Environmental Vessel Management Plan (VMP) drawing upon best practice guidance to minimise the risk to marine mammals from vessel activities (Volume III, Appendix 25.10.	The implementation of an Environmental VMP which includes best practice guidance measures to minimise the potential for collision risk, potential injury to, and disturbance of marine megafauna from vessel activities.
Development of and adherence to Environmental Monitoring	Volume II, Chapter 25: Summary of Factored in Measures, Mitigation and Monitoring sets out commitments to environmental monitoring throughout all phases of development.

Cables will be buried where possible and protected where not possible.	Reduces the effect of Electromagnetic Fields (EMF).
Management of bentonite spills via good working practises	Monitoring of mud volumes and pressure, detection of break outs and pausing drilling, plugging fissures and ongoing monitoring.
Operational and Maintenance asset monitoring.	Operational and Maintenance asset monitoring commitments include survey of seabed and assets every 6 months for the first two years and annually thereafter (Volume II: Chapter 4: Description of Development).
Maximum vessel numbers	Commitment to the maximum vessel numbers as set out in Volume II, Chapter 4 Description of Development.
Use of soft starts	Adherence to soft starts and maximum piling energies as set out in Volume II, Chapter 4 Description of Development.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339).	The Developer was granted a Foreshore Licence (FS007339) for Site Investigations (associated with the Proposed Development) from the Minister for Housing, Local Government and Heritage in May 2022. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339) being carried out. As such there is no temporal overlap between the activities consented in this Foreshore Licence and the Proposed Development and there will be no potential for cumulative effects.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried out.	The Developer submitted a Foreshore Licence Application for Site Surveys to the Minister for Housing, Local Government and Heritage in April 2023 (FS007555) and this application is pending determination. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site

	Surveys FS007555 (should a licence be granted) are being carried out. As such there is no temporal overlap between the activities proposed in the Foreshore Licence Application and the Proposed Development.

10.8 Assessment of the significance of effects

10.8.1.1 The impacts of the construction, operational and maintenance and decommissioning phases of both Project Design Options forming the Proposed Development have been assessed on fish, shellfish, and sea turtle ecology. The potential impacts arising from the construction, operational and maintenance and decommissioning phases of the Proposed Development are listed in Table 10.7 and Table 10.8, along with the project parameters against which each impact has been assessed.

10.8.1.2 A description of the potential effect on fish, shellfish and sea turtle ecology caused by each identified impact is provided in Section 10.9 and Section 10.10.

10.9 Assessment of Project Design Option 1

10.9.1 Impact 1 – Temporary habitat loss/disturbance

10.9.1.1 Direct temporary habitat loss/disturbance within the Proposed Development may occur during the construction, operational and maintenance, and decommissioning phases as a result of a range of activities including use of jack-up vessels during installation/maintenance activities, installation and maintenance of inter-array, interconnector and offshore export cables and associated seabed preparation.

SENSITIVITY OF THE RECEPTOR

10.9.1.2 Sessile or low mobility species may be particularly vulnerable to habitat loss/disturbance and therefore shellfish species are likely to be the most sensitive receptor group, with local mortality likely to occur within the impacted area. Most fish species are highly mobile and are expected to be able to avoid the impact.

10.9.1.3 The rate of recovery of an area after large-scale seabed disturbance (e.g. dredging activities) is linked to the substrate type and the environmental features that determine the community composition (Newell *et al.*, 1998; Desprez, 2000; Bruns *et al.*, 2020). For example, high rates of recovery have been recorded for sand and mud substrates that are dominated by mobile, opportunistic species with high reproductive and growth rates (Newell *et al.*, 1998). In contrast, for stable rocky substrates colonised by slow-growing species, the process of recovery to pre-disturbed conditions will be slower (Newell *et al.*, 1998). The Array Area and Cable Corridor and Working Area are characterised by mobile sand over the Arklow Bank, and a mixture of coarse sediments and fine sands in inshore areas. Species in this area are expected to have some tolerance of natural variation in environmental conditions particularly with respect to the dynamic nature of the Arklow Bank, which has strong currents, sediment transport and breaking waves (chapter 6: Coastal Processes). Therefore, subject to localised losses of individuals within the immediate vicinity of the activities and the ability of species to recover, the communities are expected to show at least some tolerance to habitat disturbance.

10.9.1.4 The Marine Evidence based Sensitivity Assessment (MarESA), database was reviewed to determine the potential sensitivity of key species in the Fish, Shellfish and Sea Turtle Study Area. The MarESA assessment suggests that *Nephrops* has a moderate sensitivity to substratum loss,

as this species takes three to four and a half years to reach sexual maturity and could take between one to ten years to recover (Sabatini and Hill, 2008). However, as set out above, this species is likely to occur in deeper waters on a substrate of mud, outside the Array Area. Therefore, *Nephrops* are unlikely to be impacted by temporary habitat loss/disturbance and are considered to be of Negligible sensitivity.

10.9.1.5 Sessile molluscs are also likely to be sensitive to substratum loss and physical disturbance given their lack of mobility. For blue mussel, recoverability can occur across the short term (1-5 years) due to fast colonisation rates (Toschko *et al.*, 2008; Kerckhof *et al.*, 2019). MarESA has assessed blue mussels as having a high intolerance but a high recoverability to substratum loss (Tyler-Walters, 2008). Recovery will however depend on sufficient levels of fecundity, annual recruitment and settlement of juvenile spat on new substratum. The presence of mussel seed beds in the Fish, Shellfish and Sea Turtle Study Area will aid recruitment and as such recoverability is likely to be high within the Proposed Development. Consequently, blue mussels are deemed to be unable to adapt or avoid the impact, with high recoverability and regional importance. Therefore, blue mussels are considered to be of Low sensitivity to temporary habitat loss and disturbance.

10.9.1.6 There was no MarESA assessment for common whelk, however an assessment for dog whelk *Nucella lapillus*, which has similar ecology to common whelk (i.e. lays eggs in protective egg capsules), suggests that sensitivity to substratum loss will be high given their low dispersal ability and potentially slow recruitment from other populations (Tyler-Walters, 2007). It should be noted, however, that the larger common whelk is likely to have greater mobility than dog whelk, allowing for greater recovery of individuals into affected areas following cessation of activities. Therefore, common whelk are deemed to have a limited ability to avoid or adapt to the impact, high recoverability and regional value, and are considered to be of Low sensitivity to temporary habitat loss and disturbance.

10.9.1.7 Most fish species are mobile and are unlikely to be directly affected by temporary habitat loss. However, temporary habitat loss/disturbance could lead to adverse effects on fish and shellfish species that either spawn within the Fish, Shellfish and Sea Turtle Study Area or use the habitats within the area as nursery grounds for juveniles (which have limited mobility than adult counterparts). The baseline assessment suggests that the main spawning areas for the majority of key fish and shellfish species do not overlap with the Array Area and therefore significant impacts on spawning stocks are not anticipated. The exception to this is lemon sole and sprat, for which the spawning habitat overlaps the Array Area and Cable Corridor and Working Area. Lemon sole and sprat both have pelagic eggs (Geffen *et al.*, 2021), and as such recruitment is unlikely to be greatly affected by temporary habitat loss / disturbance due to a lack of impact pathway to their eggs. Sprat have a pelagic life history and therefore habitat loss / disturbance to the benthic environment is unlikely to impede recruitment. Sprat are deemed to have a high ability to avoid temporary habitat loss, high recoverability and are of regional importance therefore this receptor is assessed as Negligible sensitivity.

10.9.1.8 Lemon sole, unlike sprat, have a mostly benthic life history, despite eggs being pelagic. Therefore, habitat loss and disturbance may interfere/disrupt adult spawning events and metamorphoses into young individuals. Lemon sole spawn throughout much of their Irish and UK distribution and as such temporary habitat loss is unlikely to have a great impact on recruitment at a whole stock level. However, Lemon sole is more restricted in their habitat preference when compared to other flatfish species (Hinz *et al.*, 2003; Hinz *et al.*, 2006), with Hinz *et al.*, (2003) hypothesising that this may be caused by the requirement for sufficient amounts of small prey items as a result of their small mouth size. Lemon sole are considered to have medium tolerance and adaptability, medium recoverability and are of regional importance. This receptor is therefore assessed as Medium sensitivity.

10.9.1.9 The Array Area and Cable Corridor and Working Area overlap with nursery grounds for herring, sandeel, lemon sole, whiting, cod, anglerfish, spotted ray, thornback ray and tope. Juvenile fish are expected to have some ability to avoid the impact, albeit less so than their more mobile adult counterparts. All these species are either benthic or demersal during at least part of their life history and as such have a high dependency upon the benthic environment / habitats. Temporary habitat loss will only affect a small proportion of their wider nursery grounds. Therefore, these receptors are deemed to have medium adaptability and tolerance, medium recoverability and are of local to regional importance. These IEFs are considered to be of Medium sensitivity.

10.9.1.10 All other mobile fish and shellfish IEFs are considered to be highly adaptable, with a high recoverability and local to international importance and are therefore assessed as being of Low sensitivity.

10.9.1.11 As highly mobile species, both leatherback turtle and basking shark are unlikely to be affected directly by temporary habitat loss/disturbance. In addition, key prey items for basking shark (zooplankton) and leatherback turtle (jellyfish) are unlikely to be affected by temporary habitat loss/disturbance and therefore the sensitivity of both species is assessed as Negligible.

10.9.1.12 Temporary habitat loss/disturbance is likely to be very localised and would occur in the immediate vicinity of the activities and within the boundaries of the Proposed Development. Following completion of the activities it is anticipated that the habitats would recover, and fish and shellfish species are likely to recolonise the recovered areas. The sensitivity of fish, shellfish and sea turtle IEFs to temporary habitat loss/disturbance has been assessed as Negligible to Medium.

Construction phase

MAGNITUDE OF THE IMPACT

10.9.1.13 During construction, habitat will be temporarily lost/disturbed during the installation of 110-122 km of inter-array cable, 25-28 km of interconnector cables and 35-40 km of offshore export cable, and during the temporary placement of spud legs from jack up vessels, anchors associated with construction vessels and site preparation activities including sandwave and boulder clearance.

10.9.1.14 Seabed preparation activities will occur in advance of installation of the inter-array, inter-connector and offshore export cables, with sandwave clearance required for 30% of inter-array, interconnector and offshore export cables. Boulder clearance would be required for 100% of inter-array, interconnector and offshore export cables. Cable burial will occur within the same area where sandwave clearance and boulder clearance has previously been completed, therefore cable burial will represent a repeat disturbance of some of the area affected by pre-construction clearance. The design scenario is for a temporary habitat loss of a maximum of 9,929,060 m^2: 4,219,460 m^2 as a result of sandwave clearance, 2,850,000 m^2 as a result of boulder clearance, 2,850,000 m^2 of disturbance for cable installation and 1,200 m^2 as a result of UXO clearance. Additionally, the design scenario factors in 278,400 m^2 of temporary habitat loss as a result of the use of jack-up barges/vessels. It should be noted that the 9,929,060 m^2 area of disturbance is conservatively high due to a proportion of this area representing repeat disturbance.

10.9.1.15 This accounts for a very small proportion (<0.1%) of the habitats present within the 13,748,211,512 m^2 Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and <1% of the habitats present in the 1,108,846,004 m^2 Fish, Shellfish and Sea Turtle Ecology Study Area. It should also be noted that habitat disturbance will occur throughout the five-year construction phase, with only a small proportion of the overall footprint presented above affected at any one time, and recovery occurring quickly following installation of infrastructure.

10.9.1.16 The exact number of anchors or anchor repositions required is not known. However, the disturbance area will be very small, particularly in the context of activities such as cable burial and sandwave clearance, and therefore will not add significant areas to the design scenario for temporary habitat loss/disturbance.

10.9.1.17 The impact will affect the IEFs directly through direct damage and disturbance and indirectly due to loss of important habitats, such as foraging, nursery or spawning habitats. The impact will occur as a series of discrete events associated with each of the activities over the construction phase of the Proposed Development, which will take place over a period of five years. Habitat loss is expected to be localised to within the immediate vicinity of the activity and therefore will occur within the Array Area and Cable Corridor and Working Area.

10.9.1.18 A recent review commissioned by the Crown Estate reviewed the effects of cable installation on subtidal sediments and habitats (RPS, 2019), drawing on monitoring reports from over 20 UK offshore windfarms. This review showed that sandy sediments recover quickly following cable installation, with trenches infilling quickly following cable installation and little or no evidence of disturbance in the years following cable installation. It also presented evidence that remnant cable trenches in coarse and mixed sediments and muddy sediments were conspicuous for several years after installation. However, these shallow depressions were of limited depth (i.e. tens of cm) relative to the surrounding seabed, over a horizontal distance of several metres and therefore did not represent a large shift from the baseline environment (RPS, 2019).

10.9.1.19 Jack-up footprints associated with foundation and wind turbine installation will result in compression of seabed sediments beneath spud cans or tubular legs where these are placed on the seabed. These will infill over time, although may remain on the seabed for a number of years, as demonstrated by monitoring studies of UK offshore windfarms (BOWind, 2008). Monitoring at the Barrow offshore windfarm showed depressions were almost entirely infilled approximately one year after construction (BOWind, 2008). In areas where mobile sands and coarse sediments are present such as in the majority of the Array Area (see chapter 9: Benthic Subtidal and Intertidal Ecology), jack-up depressions are likely to be temporary features which will only persist for a period of months to a small number of years.

10.9.1.20 The impact is predicted to be restricted to the near-field, short term duration, frequent and of low consequence. Habitats are expected to recover following cessation of the construction activities. It is predicted that the impact will affect the receptor both directly and indirectly. The magnitude is therefore, considered to be Low.

SIGNIFICANCE OF THE EFFECT

10.9.1.21 The magnitude of the impact has been assessed as **Low.**

10.9.1.22 The sensitivity of Nephrops, sprat, leatherback turtle and basking shark is **Negligible**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Imperceptible**, which is **not significant** in EIA terms.

10.9.1.23 The sensitivity of fish species with overlapping nursery grounds is **Medium**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Slight** adverse, which is **not significant** in EIA terms.

10.9.1.24 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from temporary habitat loss to all other IEFs is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.1.25 The effect of temporary habitat loss/disturbance is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.1.26 The significance of effect from temporary habitat loss/disturbance is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 10.13 is considered

necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of temporary habitat loss/disturbance.

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.9.1.27 Operational and maintenance activities within the Array Area and along the Cable Corridor and Working Area may lead to temporary subtidal habitat loss/disturbance. The design scenario covers the repair and reburial of sections of inter-array cables, export cables and interconnector cables once every five years and disturbance of 613,200 m^2 of seabed from jack-up barges across operational and maintenance phase and 275,000 m2 from operational dredging once every 5 years.

10.9.1.28 Recovery to seabed habitats would be expected to occur quickly following removal of spud cans from jack-up vessels. Cable repair or reburial activities will affect seabed habitats in the immediate vicinity of these operations, with effects on seabed habitats also expected to be similar to the construction phase. The spatial extent of this impact is very small in relation to the Array Area and Cable Corridor and Working Area, although there is the potential for repeat disturbance to the habitats because of these activities (e.g. placement of spud cans on or in close proximity to where these were placed during construction; remedial burial of a length of cable installed during the construction phase, affecting the same area of seabed). Activities resulting in the temporary subtidal habitat loss/disturbance will occur intermittently throughout the operational and maintenance phase.

10.9.1.29 The impact is predicted to be restricted to the near-field, short term duration, infrequent and of low consequence. Habitats are expected to recover following cessation of repair activities. The magnitude is therefore, considered to be Negligible.

SIGNIFICANCE OF EFFECT

10.9.1.30 The magnitude of the impact has been assessed as **Negligible.**

10.9.1.31 The sensitivity of Nephrops, sprat, leatherback turtle and basking shark is **Negligible**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Imperceptible**, which is **not significant** in EIA terms.

10.9.1.32 The sensitivity of fish species with overlapping nursery grounds is **Medium**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Not Significant**, which is **not significant** in EIA terms.

10.9.1.33 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from temporary habitat loss to all other IEFs is **Not Significant**, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.1.34 The effect of temporary habitat loss/disturbance is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.1.35 The significance of effect from temporary habitat loss/disturbance is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 10.13 is considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of temporary habitat loss/disturbance.

Decommissioning phase

MAGNITUDE OF IMPACT

10.9.1.36 For the purposes of this assessment, the impacts of decommissioning are predicted to be similar to those for the construction phase, as set out above, although the area of temporary habitat loss/disturbance will be lower as cables, cable protection and WTG and OSP foundation scour protection will be left *in situ*.

10.9.1.37 The impact is predicted to be restricted to the near-field, short term duration, frequent and of low consequence. Habitats are expected to recover following cessation of the construction activities. It is predicted that the impact will affect the receptor both directly and indirectly. The magnitude is therefore, considered to be Low.

SIGNIFICANCE OF THE EFFECT

10.9.1.38 The magnitude of the impact has been assessed as **Low.**

10.9.1.39 The sensitivity of Nephrops, sprat, leatherback turtle and basking shark is **Negligible**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Imperceptible**, which is **not significant** in EIA terms.

10.9.1.40 The sensitivity of fish species with overlapping nursery grounds is **Medium**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Slight** adverse, which is **not significant** in EIA terms.

10.9.1.41 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from temporary habitat loss to all other IEFs is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.1.42 The effect of temporary habitat loss/disturbance is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.1.43 The significance of effect from temporary habitat loss/disturbance is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of temporary habitat loss/disturbance.

10.9.2 Impact 2 – Increased suspended sediment concentrations and associated deposition

10.9.2.1 Increases in suspended sediment concentrations and associated sediment deposition are predicted to occur during the construction, operational and maintenance and decommissioning phases as a result of the installation and removal of foundations and the installation and maintenance (repair and reburial) of inter-array, interconnector and offshore export cables. Volume II, Chapter 6: Coastal Processes provides a full description of the physical assessment, including numerical modelling used to inform the predictions made with respect to increases in suspended sediment and subsequent deposition.

SENSITIVITY OF RECEPTOR

10.9.2.2 Adult fish have high mobility and can actively avoid areas where there is high sedimentation making them less susceptible to physiological effects compared to juvenile fish or shellfish species. Juvenile fish are likely to be present throughout the Array Area and Cable Corridor and

Working Area and nursery areas have been mapped for several species as overlapping the Fish, Shellfish and Sea Turtle Study Area. However, juvenile fish typically inhabit coastal and estuarine areas which are subject to high natural variations in suspended sediments and deposition (Rijnsdorp and Stralen, 1985) and therefore it is unlikely that a temporary increase in suspended sediment concentrations will lead to adverse effects on individuals occurring within the Fish, Shellfish and Sea Turtle Study Area.

10.9.2.3 Migratory fish species known to occur in the area are also expected to have some tolerance to high suspended sediment concentrations, given their migration routes typically pass through estuarine habitats which have background suspended sediment concentrations which are considerably higher than those expected within the Fish, Shellfish and Sea Turtle Study Area (Wass and Leeks, 1999). For example, the Severn Estuary, a key river system for diadromous fish species, can regularly be exposed to suspended sediment concentrations of >1,000 mg l (Bull, 1997), with concentrations varying by five-fold over a 24-hour period (Rijnsdorp and Stralen, 1985). As it is predicted that construction activities associated with the Proposed Development will produce temporary and short-lived increases in suspended sediment concentrations, with levels below those experienced in estuarine environments, it would be expected that any migratory species should only be temporarily affected (if they are affected at all). Any adverse effects on these species are likely to be short-term behavioural effects (i.e. avoidance) and are not expected to create a barrier to migration to rivers or estuaries used by these species in the Western Irish Sea Fish, Shellfish and Sea Turtle Ecology Study Area.

10.9.2.4 Hatching success of fish and shellfish larvae has the potential to be affected by increased suspended sediment concentrations, with interspecific variation depending on the sediment concentration and composition (Kjelland *et al.*, 2015). For example, Kiorboe *et al.* (1981) found no effect on development or hatching of herring eggs exposed to 5-500 mg / l of suspended sediments, whereas Griffin *et al.* (2009) found sub lethal and lethal effects on Pacific herring *Clupea Pallasi* eggs exposed to 250 and 500 mg / l of suspended sediment.

10.9.2.5 Sedimentation can reduce egg survival (Kjelland *et al.*, 2015), and therefore increased sediment doses near spawning habitats may affect the viability of spawning stocks. Spawning grounds for lemon sole, plaice, sprat, whiting, sole, sandeel, mackerel, ling and cod overlap the Fish, Shellfish and Sea Turtle Ecology Study Area, and eggs and larvae for these species are pelagic (other than sandeel). Increased suspended sediment concentrations can reduce the buoyancy of pelagic fish eggs leading to fatality (Westerberg *et al.*, 1996). However, these species can spawn in areas with naturally high baseline suspended sediment levels.

10.9.2.6 Sandeel have benthic eggs which are attached to grains of sand. Effects of increased Suspended Sediment Concentration (SSC) in the water column and associated smothering, have been shown to be inconsequential to sandeel species (MarineSpace Ltd *et al.*, 2013). Sandeel eggs are likely to be tolerant to increases in SSC and deposition due to the nature of resuspension and deposition within their natural high energy environment.

10.9.2.7 All fish IEFs (including diadromous species) are considered to be highly adaptable and tolerant to suspended sediments, with high recoverability and regional importance, therefore they are assessed as Low sensitivity.

10.9.2.8 Mobile shellfish species, such as crabs and lobsters, are insensitive to increases in turbidity and are likely to actively avoid such areas as they rely on visual acuity during predation (Neal and Wilson, 2008). *Nephrops* are not considered to be sensitive to increases in suspended sediment concentrations or sediment deposition, since they are a burrowing species with the ability to excavate any sediment deposited within their burrows (Sabatini and Hill, 2008). Mobile shellfish species are therefore considered to be highly adaptable and tolerant to suspended sediments and smothering, have high recoverability and local to regional importance. These IEFs are therefore assessed as Low sensitivity.

10.9.2.9 Sessile/low mobility shellfish, such as whelk, mussel, razor clam, scallops and cockle, may be vulnerable to increased suspended sediment concentrations and to sediment deposition as this can lead to clogged feeding apparatus and smothering. Cockles, scallops, whelks and clams are adapted to environments where there is a high natural flux in sediment levels (e.g. estuaries) and therefore they are of low sensitivity or not sensitive to increased suspended sediment concentrations and sediment deposition (Tyler-Walters, 2007; Marshall and Wilson, 2008). Sessile/low mobility shellfish species are therefore considered to be highly adaptable and tolerant to suspended sediments and smothering, have high recoverability and local to regional importance. These IEFs are therefore assessed as Low sensitivity.

10.9.2.10 Mussels are relatively tolerant to high levels of suspended sediments and thrive in areas that would be harmful to other suspension feeders. Mussels have limited ability to move short distances to avoid burial from sediment deposition, however mortalities from sand burial have been reported (Tyler-Walters, 2008). As mentioned above recoverability can occur across the short term (1-5 years) due to the fast colonisation rates of blue mussel (Toschko *et al.*, 2008; Kerckhof *et al.*, 2019). MarESA has assessed blue mussels as having an intermediate intolerance but a high recoverability to smothering (Tyler-Walters, 2008). Therefore, blue mussels are considered to be of medium adaptability and tolerance to suspended sediments and smothering, have high recoverability and local to regional importance. These IEFs are therefore assessed as Low sensitivity.

10.9.2.11 As highly mobile species, both leatherback turtle and basking shark are unlikely to be affected directly by increases in suspended sediment concentrations and sediment deposition. In addition, there are unlikely to be any indirect effects through changes to prey communities as zooplankton, including jellyfish, are unlikely to be affected by increases in suspended sediment concentrations and sediment deposition. Therefore, the sensitivity of both species is assessed as Negligible.

10.9.2.12 In summary, temporary increases in suspended sediment concentrations and sediment deposition are likely to be very localised and would occur within one tidal excursion of the construction activities, with the majority of any effects occurring within the boundaries of the Proposed Development. Following completion of activities, it is anticipated that fish, shellfish and sea turtle populations would repopulate and rapidly recover (where displacement has occurred at all). Fish, shellfish and sea turtle IEFs have therefore been assessed as Negligible to Low sensitivity to increased suspended sediments and associated deposition.

Construction phase

MAGNITUDE OF THE IMPACT

10.9.2.13 The installation of Proposed Development infrastructure within the Array Area and Cable Corridor and Working Area will lead to increases in SSC, above baseline levels of 2.5 mg/l, and associated sediment deposition. Full details of the modelling undertaken to inform this assessment is presented in Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling, including the individual scenarios considered and assumptions within these and full modelling outputs for SSC and associated sediment deposition. A baseline for sedimentological conditions is presented in Volume II, Chapter 6: Coastal Processes. For the purposes of this assessment, site preparation activities, drilling for foundation installation and cable installation have been considered.

10.9.2.14 Sandwave clearance may involve disturbance of seabed material along a corridor of 70 m wide and to a depth of 10 m for inter-array, export and OSP interconnector cables. Sandwave clearance will also occur at 20% of OSP and WTG installations along a maximum diameter of 100m. Modelling of suspended sediment associated with sandwave clearance in the Array Area show SSC at a maximum of 2,000 mg/l within the first hour. However, after five hours the SSC is less than 2.5 mg/l. Disposal south of the Array Area initially results in a plume with SSC at a maximum of 2,000 mg/l, which after five hours is reduced down to less than 2.5 mg/l. Suspended sediments will largely be limited to the Array Area and to the area to the north and south of this

(i.e. along the dominant tidal axis), with the resultant plume not extending beyond 8 km from the Array Area and Cable Corridor and Working Area under all tidal flow simulations (speeds and direction). For sediment deposition thicknesses between 100 mm and 500 mm are predicted to occur within 1 km of the disturbance event. At 10 km from the disturbance event sediment deposition is predicted to be 2.5 mm and beyond this sediment deposition becomes immeasurable.

10.9.2.15 Modelling of suspended sediment associated with sandwave clearance along the export cables show SSC at a maximum of 2,000 mg/l within the first hour. However, after four hours the SSC are less than 2.5 mg/l. Disposal south of the Array Area initially results in a plume with SSC at a maximum of 2,000 mg/l, which after five hours is reduced down to less than 5 mg/l. Suspended sediments will largely be limited to the Array Area and to the area to the north and south of this (i.e. along the dominant tidal axis), with the resultant plume not extending beyond 8 km from the Array Area and Cable Corridor and Working Area under all tidal flow simulations (speeds and direction). For sediment deposition, thicknesses up to 250 mm are predicted to occur within 1 km of the disturbance event. At 10 km from the disturbance event sediment deposition is predicted to be 2.5 mm and beyond this sediment deposition becomes immeasurable.

10.9.2.16 The design scenario for foundation installation assumes the drilled installation of 25 WTG piles 7-11 m in diameter and 2 OSP piles 7-14 m in diameter. Numerical modelling has simulated drilling at WTG for 88 hours, followed by a 12 hour pause and then another 88-hour drilling event at the Southern OSP. Suspended sediment concentrations and extent progressively increase across the drilling event. After completion of WTG drilling the greatest SSC is within the centre of the plume (approximately 25 mg/l). During OSP drilling SSC of over 100 mg/l are expected at the point of activity, reducing to <25 mg/l 18 km North of point of activity. Two days following cessation of drilling activities SSCs are undiscernible from background levels. Sediment deposition is expected to be approximately 15 mm following completion of drilling.

10.9.2.17 At the landfall the use of trenchless techniques (i.e. HDD or Direct Pipe) could also result in an increase in suspended sediments and sediment deposition at the exit point(s), including release of bentonite (drilling mud). Modelling of SSC at the HDD shows maximum concentrations of 50 mg/l with concentrations no greater than 2.5 mg/l outside the Cable Corridor and Working Area. For sediment deposition, 6.5 days after cessation of instillation works a maximum deposition of 7.5 mm is predicted within 0.3 km. Bentonite release has also been assessed within accidental pollution Section 10.9.5.

10.9.2.18 The design scenario proposes the installation of 110-122 km of inter array cables, 25-40 km of export cables and 25-28 km of interconnector cables. Cable trenching using jetting tools has been modelled. Numerical modelling show that the greatest increase in SSC is observed immediately adjacent to the works (approx. 500 mg/l), with levels above background (2.5 mg/l) being observed 8 km away from the disturbance event. Sediment deposition of 25 mm occur within 1 km and <2.5 mm at 10 km.

10.9.2.19 The impact is predicted to be restricted to the near-field, short term duration, frequent and of low consequence. Baseline conditions are expected to resume following cessation of the construction activities. It is predicted that the impact will affect the receptor both directly and indirectly. The magnitude is therefore, considered to be Low.

SIGNIFICANCE OF THE EFFECT

10.9.2.20 The magnitude of the impact has been assessed as **Low.**

10.9.2.21 The sensitivity of basking shark and sea turtle is **Negligible**. Therefore, the significance of effect from increased suspended sediment and deposition is **Imperceptible**, which is **not significant** in EIA terms.

10.9.2.22 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from increased suspended sediment and deposition is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.2.23 The effect of increased suspended sediments and associated deposition is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.2.24 The significance of effect from increased suspended sediments and associated deposition is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 is considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of increased suspended sediments and associated deposition.

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.9.2.25 Operation and maintenance activities, such as the repair and re-burial of cables, will result in seabed sediment disturbance. The volumes of sediment disturbance are expected to be far less than that disturbed during construction. The design scenario considers the repair and re-burial, once every 5 years (once every 3 for inter-array), of 110-122 km of inter-array cables, 30-40 km of export cables and 25-28 km of interconnector cables. The design scenario also considers 400,000 m^3 of sediment during operational dredging once every 5 years.

10.9.2.26 The impact is predicted to be restricted to the near-field, short term duration (occurs across operation and maintenance period, however individual events will be short term), frequent and of low consequence. The magnitude is therefore, considered to be Low.

SIGNIFICANCE OF EFFECT

10.9.2.27 The magnitude of the impact has been assessed as **Low.**

10.9.2.28 The sensitivity of basking shark and sea turtle is **Negligible**. Therefore, the significance of effect from increased suspended sediment and deposition is **Imperceptible**, which is **not significant** in EIA terms.

10.9.2.29 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from increased suspended sediment and deposition is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.2.30 The effect of increased suspended sediments and associated deposition is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.2.31 The significance of effect from increased suspended sediments and associated deposition is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 is considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of increased suspended sediments and associated deposition.

Decommissioning phase

MAGNITUDE OF IMPACT

10.9.2.32 Decommissioning would be undertaken in reverse of construction using similar plants and materials. However, the volumes of sediment disturbance are expected to be far less than that disturbed during construction due to scour protection, cables and cable protection being left *in-situ*.

10.9.2.33 The impact is predicted to be restricted to the near-field, short term duration, frequent and of low consequence. The magnitude is therefore, considered to be Low.

SIGNIFICANCE OF EFFECT

10.9.2.34 The magnitude of the impact has been assessed as **Low.**

10.9.2.35 The sensitivity of basking shark and sea turtle is **Negligible**. Therefore, the significance of effect from increased suspended sediment and deposition is **Imperceptible**, which is **not significant** in EIA terms.

10.9.2.36 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from increased suspended sediment and deposition is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.2.37 The effect of increased suspended sediments and associated deposition is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.2.38 The significance of effect from increased suspended sediments and associated deposition is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 is considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of increased suspended sediments and associated deposition.

10.9.3 Impact 3 – Injury and/or disturbance to fish and shellfish from underwater noise and vibration

10.9.3.1 Underwater noise and vibration within the Array Area and Cable Corridor and Working Area will occur during the construction, operational and maintenance, and decommissioning phases as a result of a range of activities including impact piling, cable laying, dredging, drilling, rock placement, operational WTG noise, and unexploded ordnance (UXO) clearance. This can cause injury and/or disturbance to fish and shellfish.

10.9.3.2 The assessment has been informed by the Underwater Noise Assessment by Subacoustech (Volume III, Appendix 11.1: Underwater Noise Assessment) which includes the results of numerical modelling using the INSPIRE underwater noise model.

CRITERIA FOR DETERMINING SENSITIVITY AND MAGNITUDE

10.9.3.3 Underwater noise and vibration may cause the following effects on fish receptors:

- Behavioural effects (e.g. reduced detection of predators/prey, inhibited communication between conspecifics, alteration in swimming behaviour);
- Masking effects (i.e. the reduced detectability of a given sound owing to the simultaneous occurrence of another sound);

- Temporary threshold shift (TTS) in hearing (short or long-term changes in hearing sensitivity that may or may not reduce fitness);
- Recoverable tissue injury (not resulting in mortality e.g. hair cell damage, minor internal or external hematoma etc.); and
- Mortality or potential mortal injury (immediate or delayed death).

10.9.3.4 There can also be vibration effects within the immediate vicinity of piling or other sources of noise that can cause slight movement of sediment that in turn may have an effect on the behaviour of benthic fish species or could potentially affect the viability of fish eggs near the source (Popper and Hawkins 2018). Vibration can also refer to the effects of particle motion (separate from sound pressure) in the water column. However, very little research has been conducted on the effects of vibration on fish. Noise and vibration are produced at the same time and so for the purposes of this assessment we have referred to them together as appropriate.

10.9.3.5 For the purposes of this assessment the sound exposure guidelines for fish and sea turtles (Popper *et al.*, 2014) were considered to be the most relevant for impacts of underwater noise upon fish and sea turtles. Hearing abilities of fish are related to the morphological adaptations of the acoustic-lateralis apparatus, in particular the distance of the swim bladder to the inner ear (Hastings and Popper, 2005). Considering Popper *et al.* (2014), the fish and sea turtle IEFs can broadly be characterised into four groupings based on their hearing abilities:

- Type 1 – Species with no swim bladder and rely on the detection of particle motion. They have a lower hearing ability than other groups.
- Type 2 – Species with a swim bladder that is not connected to the inner ear. They have a better level of hearing than Type 1 but also rely on the detection of particle motion.
- Type 3 – Species with a swim bladder that is involved in hearing (connected to the inner ear). They can detect both particle motion and sound pressure and can hear sounds over a far greater distance than other hearing groups.
- Type 4 – Fish eggs and larvae.
- Type 5 – Sea turtles

Table 10.14: Hearing categories of the fish and sea turtle IEFs (adapted from Popper *et al.*, 2014)

Hearing Type	IEF
1	Flatfish (lemon sole, Plaice, turbot, dab, common sole, thickback sole), sand goby, pogge, dragonet, black goby, Atlantic mackerel, sandeel, sea lamprey, river lamprey, elasmobranchs
2	Ling*, blue whiting, Atlantic salmon, sea trout
3	Cod, whiting, Atlantic herring, sprat, twaite shad, European eel*, haddock, anglerfish*
4	Fish eggs
5	Leatherback turtle

*Denotes uncertainty in hearing group

10.9.3.6 Popper *et al.* (2014) provides criteria that can be applied to assess the potential effects of noise and vibration on fish from different marine activities such as piling, dredging and vessel movements based on the species groups described above. The noise levels are based on consideration of peak noise (the maximum absolute value of the instantaneous sound pressure (or motion) during a specified time interval), and cumulative Sound Exposure Level (SEL_{cum})

which is the linear summation of the individual sound events over the time period of interest (see Volume III, Appendix 11.1: Underwater Noise Assessment for further details).

SENSITIVTY OF RECEPTOR

10.9.3.7 Insufficient data exists to make a recommendation for guidelines in relation to masking effects or behavioural effects from pile driving and therefore a qualitative approach has been adopted in which relative risk of an effect is placed in order of rank at three distances from the source – near (tens of metres from the source), intermediate (hundreds of metres from the source) and far (thousands of metres from the source) (Table 10.15). Additionally, insufficient data exists for recoverable injury and TTS from pile driving on eggs and larvae and sea turtles, and as such the same ranking system has been applied for these receptors.

Table 10.15: Mortality, potential injury, temporary threshold shift, masking and behaviour criteria for fish, shellfish and turtles in relation to pile driving noise (Popper *et al*. 2014)

Fish grouping	Mortality and potential mortal injury	Impairment			
		Recoverable injury	Temporary Threshold Shift	Masking	Behaviour
Type 1: No swim bladder (particle motion detection)	>219 dB SEL_{cum} or >213 dB peak	>216 dB SEL_{cum} or >213 dB peak	>186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Type 2: Swim bladder is not involved in hearing (particle motion detection)	>210 dB SEL_{cum} or >207 dB peak	>203 dB SEL_{cum} or >207 dB peak	>186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Type 3: Swim bladder is involved in hearing (primarily pressure detection)	>207 dB SEL_{cum} or >207 dB peak	>203 dB SEL_{cum} or >207 dB peak	>186 dB SEL_{cum}	(N) High (I) High (F) Moderate	(N) High (I) High (F) Moderate
Sea turtles	>210 dB SEL_{cum} or >207 dB peak	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) High (I) Moderate (F) Low

Eggs and larvae	>210 dB SEL_{cum} or >207 dB peak	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Notes: peak and rms sound pressure levels dB re 1 µPa; SEL dB re 1 µPa2·s. All criteria are presented as sound pressure even for fish without swim bladders since no data for particle motion exist. Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N; tens of metres from source), intermediate (I; hundreds of metres from source), and far (F; thousands of metres from source).

10.9.3.8 For continuous noise sources such as vibropiling and dredging, quantitative criteria for assessment are only available for recoverable injury and TTS for Type 3 fish. For other potential effects (i.e. masking and behaviour changes) the qualitative approach described above is applicable (Table 10.16)

Table 10.16: Mortality, potential injury, temporary threshold shift, masking and behaviour criteria for fish, shellfish and turtles in relation to vessel noise and other continuous sounds (Popper *et al.* 2014)

Fish grouping	Mortality and potential mortal injury	Impairment			
		Recoverable injury	Temporary Threshold Shift	Masking	Behaviour
Type 1: No swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Type 2: Swim bladder is not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Type 3: Swim bladder is involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB rms for 48 hrs	158 dB rms for 12 hours	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Sea turtles	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Low

Eggs and larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

Notes: peak and rms sound pressure levels dB re 1 µPa; SEL dB re 1 µPa2·s. All criteria are presented as sound pressure even for fish without swim bladders since no data for particle motion exist. Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N; tens of metres from source), intermediate (I; hundreds of metres from source), and far (F; thousands of metres from source).

10.9.3.9 For explosive noise sources such as UXO detonation, quantitative criteria for assessment are only available for mortality and potential mortal injury. For other potential effects the qualitative approach described above is applicable (Table 10.17).

Table 10.17: Mortality, potential injury, temporary threshold shift, masking and behaviour criteria for fish, shellfish and turtles in relation to explosions (Popper *et al*. 2014)

Fish grouping	Mortality and potential mortal injury	Impairment			
		Recoverable injury	Temporary Threshold Shift	Masking	Behaviour
Type 1: No swim bladder (particle motion detection)	229-234 dB peak	(N) High (I) Low (F) Low	(N) High (I) Moderate (F) Low	NA	(N) High (I) Moderate (F) Low
Type 2: Swim bladder is not involved in hearing (particle motion detection)	229-234 dB peak	(N) High (I) High (F) Low	(N) High (I) Moderate (F) Low	NA	(N) High (I) High (F) Low
Type 3: Swim bladder is involved in hearing (primarily pressure detection)	229-234 dB peak	(N) High (I) High (F) Low	(N) High (I) High (F) Low	NA	(N) High (I) High (F) Low
Sea turtles	229-234 dB peak	(N) High (I) High (F) Low	(N) High (I) High (F) Low	NA	(N) High (I) High (F) Low

Eggs and larvae	>13 mm.s^{-1} peak velocity	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	NA	(N) High (I) Low (F) Low

Notes: peak and rms sound pressure levels dB re 1 µPa; SEL dB re 1 µPa2·s. All criteria are presented as sound pressure even for fish without swim bladders since no data for particle motion exist. Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N; tens of metres from source), intermediate (I; hundreds of metres from source), and far (F; thousands of metres from source).

TYPE 1

10.9.3.10 Type 1 species, those with no swim bladder, are reported to be insensitive to sound pressure and are most likely to detect the particle motion element of sound (Popper *et al.*, 2014). Type 1 species, likely to be present within the ZoI include flatfish, gobies, Atlantic mackerel, sand eel and elasmobranchs.

10.9.3.11 The Popper *et al.* (2014) criteria for fish with no swim bladder (Type 1) indicates that piling is likely to have a Moderate effect on masking for fish within tens of metres from the noise source and a Low effect beyond this. Behavioural effects are likely to be High within tens of metres, Moderate within hundreds of metres and Low at greater distances (Table 10.15).

10.9.3.12 The Popper *et al.* (2014) criteria for fish with no swim bladder (Type 1) indicates for continuous noise sources, mortality and recoverable injuries are likely to be Low at all distances. Moderate TTS effects may be observed within tens of metres and Low beyond this distance. High effects on masking are likely within tens and hundreds of metres from the noise source with Moderate effects within thousands of metres. Moderate behavioural effects are likely within tens and hundreds of metres and Low behavioural effects are likely at thousands of metres (Table 10.16).

10.9.3.13 Sandeel are considered as partially stationary receptors, due to their burrowing nature, substrate dependence, and benthic spawning behaviour. The Fish, Shellfish and Sea Turtle Ecology Study Area overlaps with nursery grounds for sandeel and a small stretch of sandeel spawning grounds in the Northern extent. Sandeel are thought to be affected by vibration through the seabed, particularly when buried in the seabed during hibernation. Therefore, they may experience some mortality or recoverable injury in addition to TTS and behavioural responses. Taking into account their stationary nature, sandeel are deemed to be of medium adaptability, tolerance and recoverability and are of regional value. They have been assessed as Medium sensitivity.

10.9.3.14 All other Type 1 IEFs, including those with known spawning and nursery grounds in the Fish, Shellfish and Sea Turtle Ecology Study Area, are expected to be able to avoid noise sources before potential mortal injuries could occur, though there might be some temporary physiological effects in addition to behavioural responses. They are deemed to be of high adaptability, tolerance and recoverability and are of local to international value. They have been assessed as Low sensitivity.

TYPE 2

10.9.3.15 Type 2 species, those with a swim bladder not involved in hearing, are reported to be insensitive to sound pressure and are most likely to detect the particle motion element of sound (Popper *et al.*, 2014). Type 2 species, likely to be present within The Fish, Shellfish and Sea Turtle Ecology Study Area, include ling, blue whiting, Atlantic salmon and sea trout.

10.9.3.16 The Popper *et al.* (2014) criteria for fish with a swim bladder that is not involved in hearing (Type 2) indicates that piling is likely to have a Moderate effect on masking for fish within tens of metres from the noise source and a Low effect beyond this. Behavioural effects are likely to be High

within tens of metres, Moderate within hundreds of metres and Low at greater distances (Table 10.15).

10.9.3.17 The Popper *et al.* (2014) criteria for fish with a swim bladder that is not involved in hearing (Type 2) indicates for continuous noise sources, mortality and recoverable injuries are likely to be Low at all distances. Moderate TTS effects may be observed within tens of metres and Low beyond this distance. High effects on masking are likely within tens and hundreds of metres from the noise source with Moderate effects within thousands of metres. Moderate behavioural effects are likely within tens and hundreds of metres and low behavioural effects are likely at thousands of metres (Table 10.16).

10.9.3.18 Ling and blue whiting are highly mobile with pelagic eggs and are expected to be able to avoid noise sources before potential mortal injuries could occur. TTS and behavioural responses might occur, but these would be temporary (high recoverability), with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling has ceased. They are deemed to be of high adaptability, tolerance and recoverability and are of local importance. They have been assessed as Low sensitivity.

10.9.3.19 Atlantic salmon and sea trout occur within the Slaney River Valley SAC, and while their migration patterns out of this SAC are not fully understood, they are assumed to migrate northerly through the Fish, Shellfish and Sea Turtle Ecology Study Area, similar to the migration patterns observed for Atlantic salmon along other East Ireland rivers (Barry *et al.*, 2020). While these species are expected to be able to avoid noise sources before potential mortal injuries could occur, this may impede upon or delay their migration. They have been deemed to be of medium adaptability, tolerance and recoverability and are of international value. They have been assessed as Medium sensitivity.

TYPE 3

10.9.3.20 Type 3 species, those with a swim bladder that is involved in hearing (connected to the inner ear), can detect both particle motion and sound pressure and can hear sounds over a far greater distance than other hearing groups. They are more sensitive to sound than Type 1 and 2 species. Type 3 species likely to be present within the ZoI include cod, whiting, Atlantic herring, sprat, European eel and twaite shad.

10.9.3.21 The Popper *et al.* (2014) criteria for fish with a swim bladder that is involved in hearing (Type 3) indicates that piling in likely to have a High effect on both masking and behaviour on fish within tens and hundreds of metres from the noise source and a Moderate effect beyond this. The Popper *et al.* (2014) criteria for fish with a swim bladder that is not involved in hearing indicates for vessels and other continuous noise sources, mortality is likely to be Low at all distances (Table 10.15).

10.9.3.22 Moderate TTS effects may be observed within tens of metres and Low beyond this distance. High effects on masking are likely within tens and hundreds of metres from the noise source with Moderate effects within thousands of metres. Moderate behavioural effects are likely within tens and hundreds of metres and Low significance effects are likely at thousands of metres.

10.9.3.23 For continuous noise sources, it is likely there will be a High masking effect at all distances. For behavioural effects, Popper *et al.* (2014) suggests the effects are likely to be of High behavioural effects within tens of metres, Moderate within hundreds of metres and Low within thousands of metres (Table 10.16).

10.9.3.24 Atlantic herring have a high substrate dependency during spawning and lay benthic eggs, however no known spawning grounds overlap with the ZoI. Juvenile and adult Atlantic herring are expected to be able to avoid noise sources before potential mortal injuries could occur unless they are engaged in spawning behaviour. They are deemed to be of medium adaptability,

tolerance and recoverability and are of regional importance. They have been assessed as Medium sensitivity.

10.9.3.25 Twaite shad and European eel are known to occur with the Slaney River Valley SAC, with little known about their seaward migration out of this SAC. They are expected to be able to avoid noise sources before potential mortal injuries could occur, however this may delay their migration. They are deemed to be of medium adaptability, tolerance and recoverability and are of international value. They have been assessed as Medium sensitivity.

EGGS AND LARVAE

10.9.3.26 The Fish, Shellfish and Sea Turtle Ecology Study Area overlaps with spawning grounds for a number of species. There is limited information on auditory criteria for fish eggs and larvae, however Popper *et al.* (2014) suggest that fish eggs and larvae have a low sensitivity to underwater noise and vibration. The Popper *et al.* (2014) criteria for fish eggs indicates that piling is likely to have a Moderate effect in relation to all other criteria: recoverable injuries; TTS; masking and behaviour within tens of metres and a Low effect beyond this (Table 10.15). They have therefore been assessed as Low sensitivity.

SHELLFISH

10.9.3.27 Anthropogenic sources of underwater noise and vibration have been shown to have potential effects on benthic invertebrates including shellfish that do not rely on acoustics for communication. Studies of invertebrates have indicated that increased noise and vibration levels can result in increased mortality, injury to tissues, growth and reproductive rates, and food uptake in invertebrates (Popper and Hawkins, 2018; Hawkins and Popper, 2016; Spiga *et al.*, 2012).

10.9.3.28 Invertebrate species are unable to detect sound pressure but are likely to be able to detect particle motion through a variety of organs such as hairs on the body that respond to mechanical stimulation, chordotonal organs associated with joints or vibrations transmitted through the exoskeleton from the substrate (Popper and Hawkins, 2018). The effects of pile driving on a bivalve mollusc has been studied by Spiga *et al.* (2016) with individuals subjected to pile driving exhibiting increased feeding (filtering) rate than those in ambient conditions. It is currently assumed that shellfish are sensitive to the particle motion and are not sensitive to the sound pressure component of underwater noise and vibration. Shellfish are assessed to have a Low sensitivity to underwater noise and vibration effects.

SEA TURTLE

10.9.3.29 There is limited information on auditory criteria for sea turtles and the effect of impulsive noise is therefore inferred from documented effects to other vertebrates. The Popper *et al.* (2014) criteria for sea turtles indicates that piling is likely to have a High effect in relation to all other criteria: recoverable injuries; TTS; masking and behaviour within tens of metres. For recoverable injuries and TTS the effect is likely to be Low beyond this distance. However, for masking and behaviour the effects may be Moderate within hundreds of metres and Low beyond this (Table 10.15).

10.9.3.30 They are considered to have a Low sensitivity to underwater noise and vibration effects.

MAGNITUDE OF THE IMPACT – PILE DRIVING

10.9.3.31 The design scenario considers the installation of 56 WTGs (pile diameter between 7 m and 11 m) and two OSPs (pile diameter between 7 m and 14 m), with a maximum hammer energy of 6,600 kJ. A soft start at 825 kJ will be performed and the total number of days whereby piling will occur will be 4 days for OSPs and 75 days for WTGs. Piling may occur for up to 5 hours 10 minutes a day.

10.9.3.32 Impact piling for the WTG and OSP foundations was modelled at a total of five representative locations covering the extents of the Array Area. The locations were chosen to give the greatest geographical spread to maximise the potential impact ranges to the north and the south of the site. The monopile foundations may be 7-11 m in diameter for Project Design Option 1 and so installation of both 7 m and the 11 m diameter foundations has been modelled. The OSP foundations will have a diameter of 7 m or 14 m and were also modelled. A soft start and ramp up scenarios were modelled for all foundation types. The soft start approach to piling that is proposed will give mobile fish species and turtles an opportunity to move away from the noise source before underwater noise and vibration levels increase to a level that may cause damage to the individual.

10.9.3.33 The model was run for both stationary and fleeing individuals (travelling at a constant speed of 1.5 m/s). For further details of the modelled locations and foundation design details modelled see Volume III, Appendix 11.1: Underwater Noise Assessment. One pile will be installed at any one time. Piling may occur for up to 5 hours 10 minutes per a day and the total duration of piling for the project will be up to 75 days.

10.9.3.34 The biggest modelled ranges are predicted for the larger monopile scenarios at the SW WTG monopile and South OSP locations due to the combination of larger blow energies used and the proximity to deep water out to the south and east of the site.

10.9.3.35 The largest recoverable injury ranges for fish (>203 dB SEL_{cum} threshold) are predicted to be 7.9 km assuming a stationary receptor; if a fleeing animal is assumed, these ranges reduce to less than 100 m. Maximum TTS ranges (>186 dB SEL_{cum} threshold) are predicted up to 50 km for a stationary animal, reducing to 36 km for a fleeing animal. These are shown in Table 10.18.

Table 10.18: Noise modelling results for injury ranges for fleeing and stationary receptors (single piling at SW location)

Receptor	Criteria	Noise level (dB re 1 µPa Sound Pressure Level (SPL)/ dB re 1 µPa2 s Sound Exposure Level (SEL))	Impact range (m) at SW WTG site
Mortality and potentially mortal injury			
Type 1 fish	SPLpeak	213	130
	SELcum (fleeing)	219	<100
	SELcum (static)	219	800
Type 2 fish	SPLpeak	207	340
	SELcum (fleeing)	210	<100
	SELcum (static)	210	3,100
Type 3 fish	SPLpeak	207	340
	SELcum (fleeing)	207	<100
	SELcum (static)	207	3,100
Eggs and Larvae	SPLpeak	207	340
	SELcum (static)	210	3,100
Turtles	SPLpeak	207	340
	SELcum (fleeing)	210	<100
	SELcum (static)	210	3,100
Recoverable Injury			
Type 1 fish	SPLpeak	213	130
	SELcum (fleeing)	216	<100
	SELcum (static)	216	1,300

Type 2 fish	SPLpeak	207	340
	SELcum (fleeing)	203	<100
	SELcum (static)	203	7,900
Type 3 fish	SPLpeak	207	340
	SELcum (fleeing)	203	<100
	SELcum (static)	203	7,900
Temporary Threshold Shift			
Type 1 fish	SELcum (fleeing)	186	36,000
	SELcum (static)	186	50,000
Type 2 fish	SELcum (fleeing)	186	36,000
	SELcum (static)	186	50,000
Type 3 fish	SELcum (fleeing)	186	36,000
	SELcum (static)	186	50,000

TYPE 1

10.9.3.36 For fish with no swim bladder, the >213 dB peak thresholds for mortality and recoverable injury, may be exceeded up to 130 m away from the noise source at the SW site 11 m diameter monopiles (Table 10.18), covering an area of up to 0.05 km^2. At the other WTG foundation sites modelled, the maximum distance range was 90-120 m (0.03-0.04 km^2). For the two OSP foundation sites modelled, the maximum distance range was 110-120 m (0.03-0.04 km^2) for both the 7m and 14 m monopiles.

10.9.3.37 The >219 dB SEL_{cum} threshold for mortality and recoverable injury criteria was modelled to be exceeded less than 100 m from the noise source for all WTG foundation and OSP foundation locations for fleeing animals. In the case of stationary fish, the mortality and recoverable injury threshold was exceeded up to 800 m from the noise source for the SW WTG site for 14 m diameter foundations, covering an area of up to 2 km^2. At the NW WTG site the threshold was exceeded up to 500 m from the noise source, covering an area of up to 0.6 km^2 for stationary fish. At the S OSP site with 14 m diameter foundations, the mortality and recoverable injury threshold was exceeded up to 800 m from the noise source, covering an area of up to 1.7 km^2. Using the 7 m diameter foundations, the thresholds were exceeded at up to 800 m with an area of up to 1.6 m^2.

10.9.3.38 The >186 dB SEL_{cum} threshold for TTS was modelled to be exceeded up to 36 km from the noise source (maximum range) at the SW WTG site, covering an area of up to 1,900 km^2 for fleeing animals (Figure 10.8). At the NW WTG site the model predicts that the TTS threshold could be exceeded up to 19 km from the noise source, covering an area of 440 km^2 for fleeing animals. At the S OSP site the model predicted the TTS threshold could be exceeded up to 35 km from the noise source, covering an area of up to 1,800 km^2 for both the 7 m and 14 m diameter foundations.

10.9.3.39 For stationary animals, the >186 dB SEL_{cum} threshold for TTS was modelled to be exceeded up to 50 km from the noise source (maximum range) at the SW WTG, covering an area of up to 4,000 km^2. The same was modelled for the S OSP site. Using the 7 m diameter foundations at the S OSP site, the thresholds were exceeded at up to 49 km with an area of up to 3,900 m^2. At the NW WTG site the model predicts that the TTS threshold could be exceeded up to 29 km from the noise source, covering an area of 1,200 km^2 for stationary animals.

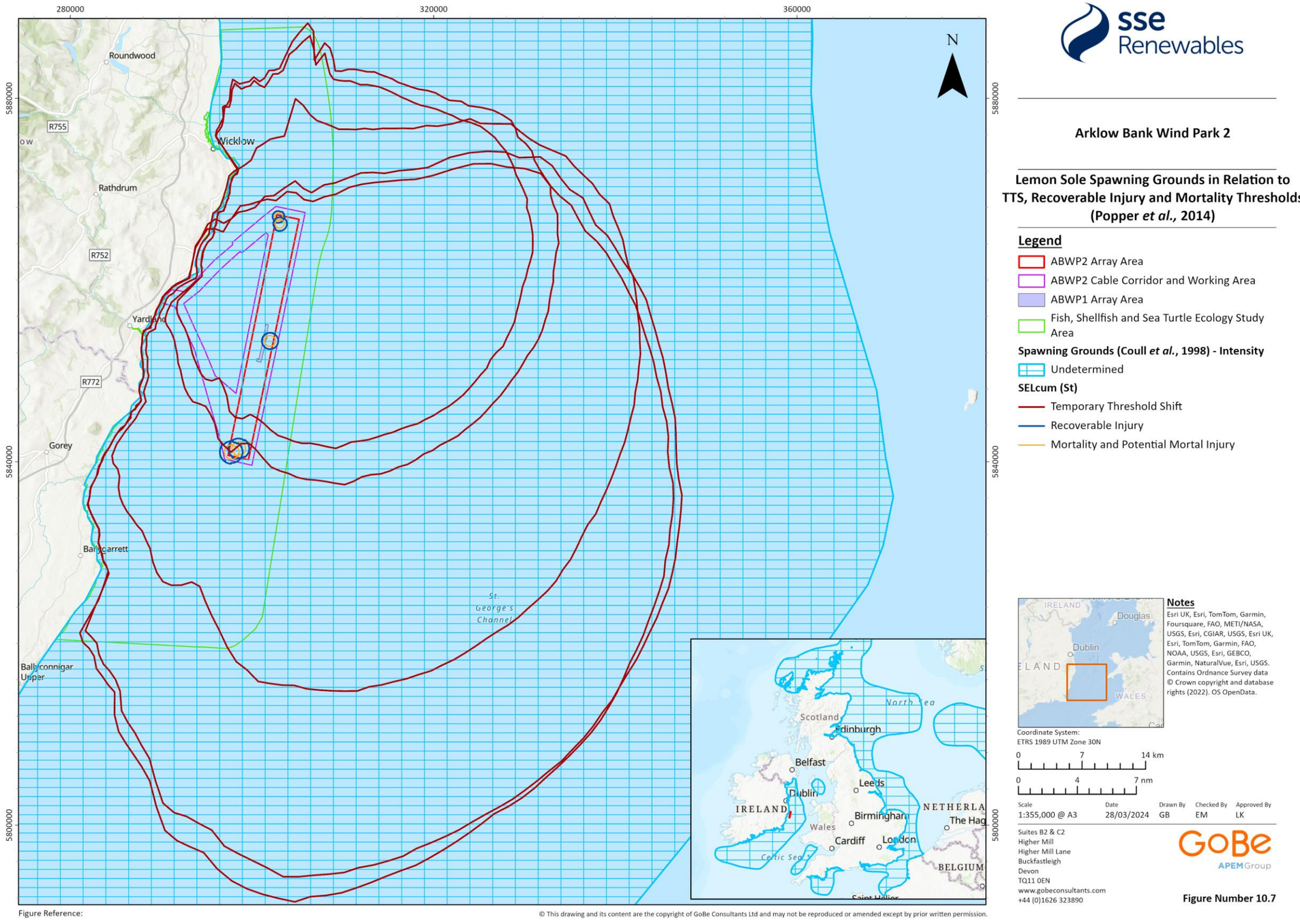
10.9.3.40 Given the low extent of the mortality and mortal injuries threshold (<100 m for fleeing and 800 m for stationary) and recoverable injury threshold (<100 m for fleeing and 1,300 m for stationary), injuries (mortal and recoverable) are only expected to affect a small number of Type 1 individuals out of a much larger population size. However, TTS, masking effects and behavioural responses

are likely to affect a greater number of individuals than mortality and recoverable injuries, with TTS threshold being met at 26 km for fleeing and 50 km for stationary.

10.9.3.41 Spawning and/or nursery grounds for Atlantic mackerel, lemon sole, sandeel, spotted ray, thornback ray, tope and plaice occur within the Fish, Shellfish and Sea Turtle Ecology Study Area. Mortal injury and recoverable injury is unlikely to occur within known spawning and nursery grounds for Atlantic mackerel and plaice, and within known spawning grounds for sandeel. However, mortal injury and recoverable injury will overlap with spawning grounds for lemon sole (Figure 10.7) and nursery grounds for sandeel, spotted ray, thornback ray and tope. TTS is expected to overlap with spawning grounds for sandeel, lemon sole, mackerel and plaice and nursery grounds for plaice, sandeel, spotted ray, thornback ray, tope and lemon sole. Spawning and nursery grounds for all these IEFs are widespread across British waters.

10.9.3.42 As partially stationary receptors sandeel are unlikely to be able to avoid the impact. However, all other Type 1 IEFs are expected to be able to move outside of the impact range during soft-start procedures before sound levels reach a level likely to cause injury and therefore impacts are likely to be largely restricted to temporary effects (TTS, masking and behavioural effects).

10.9.3.43 Given the broadscale distribution of potential spawning and nursery grounds and appropriate habitats for Type 1 IEFs and/or their ability to avoid the impact, together with the low duration, low frequency and small extent (for mortal and recoverable injury), the impact has been assessed as Low.



Arklow Bank Wind Park 2

Lemon Sole Spawning Grounds in Relation to TTS, Recoverable Injury and Mortality Thresholds (Popper *et al.*, 2014)

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 Array Area
- Fish, Shellfish and Sea Turtle Ecology Study Area

Spawning Grounds (Coull *et al.*, 1998) - Intensity

- Undetermined

SELcum (St)

- Temporary Threshold Shift
- Recoverable Injury
- Mortality and Potential Mortal Injury

Notes

Esri UK, Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS, Esri, CGIAR, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, GEBCO, Garmin, NaturalVue, Esri, USGS. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 7 14 km

0 4 7 nm

Scale	Date	Drawn By	Checked By	Approved By
1:355,000 @ A3	28/03/2024	GB	EM	LK

Suites B2 & C2
Higher Mill
Higher Mill Lane
Buckfastleigh
Devon
TQ11 0EN
www.gobeconsultants.com
+44 (0)1626 323890

Figure Number 10.7

Figure 10.7: Spawning grounds for lemon sole (Coull *et al.*, 1998) in relation to TTS, recoverable injury and mortality thresholds (Popper *et al.*, 2014)

TYPE 2

10.9.3.44 For the >207 dB peak thresholds indicated in Table 10.18 for Type 2 fish, modelling for the 11 m diameter monopiles indicates this threshold may be exceeded up to 340 m away from the sound source at the SW site, covering an area of up to 0.33 km^2. At the other WTG foundation sites modelled, the maximum distance range was 230-310 m (0.16-0.3 km^2). For the two OSP foundation sites modelled, the maximum distance range was 207-310 m (0.22-0.3 km^2) for the 7 m and 14 m diameter foundations. This is the distance at which underwater noise and vibration may cause mortality or a recoverable injury to fish that have a swim bladder that is not involved in hearing.

10.9.3.45 The >210 dB SEL_{cum} threshold for mortality criteria was modelled to be exceeded less than 100 m from the noise source for all WTG foundation and OSP foundation locations for fleeing animals. In the case of stationary fish, the mortality threshold was exceeded up to 3,100 m from the noise source for the SW WTG site, covering an area of up to 26 km^2. At the NW WTG site the threshold was exceeded up to 1,600 m from the noise source, covering an area of up to 6.8 km^2 for stationary fish. At the S OSP site (both 7 m and 14 m diameter foundations) the threshold was exceeded up to 2,800 m from the noise source, covering an area of up to 23 km^2 for stationary fish. The >203 dB SEL_{cum} threshold for recoverable injury criteria was modelled to be exceeded less than 100 m from the noise source for all WTG foundation and OSP foundation locations for fleeing animals.

10.9.3.46 The >186 dB SEL_{cum} threshold for TTS was modelled to be exceeded up to 36 km from the noise source (maximum range) at the SW WTG site, covering an area of up to 1,900 km^2 for fleeing animals (Figure 10.8). At the NW WTG site the model predicts that the TTS threshold could be exceeded up to 19 km from the noise source, covering an area of 440 km^2 for fleeing animals. At the S OSP site the model predicts that the TTS threshold could be exceeded up to 35 km from the noise source, covering an area of 1,800 km^2 for fleeing animals.

10.9.3.47 For stationary animals, the >186 dB SEL_{cum} threshold for TTS was modelled to be exceeded up to 50 km from the noise source (maximum range) at the SW WTG and the S OSP sites, covering an area of up to 4,000 km^2. Using the 7 m diameter foundations at the S OSP site, the thresholds were exceeded at up to 49 km with an area of up to 3,900 m^2. At the NW WTG site the model predicts that the TTS threshold could be exceeded up to 29 km from the noise source, covering an area of 1,200 km^2 for stationary animals.

10.9.3.48 Given the low extent of the mortality and mortal injuries threshold (<100 m for fleeing and 3,100 m for stationary) and recoverable injury threshold (<100 m for fleeing and 7,900 m for stationary), injuries (mortal and recoverable) are only expected to affect a small number of Type 2 individuals out of a much larger population size. However, TTS, masking effects and behavioural responses are likely to affect a greater number of individuals than mortality and recoverable injuries, with TTS threshold being met at 26 km for fleeing and 50 km for stationary.

10.9.3.49 Ling spawn throughout much of the Northern Irish Sea and Eastern Celtic Sea, with their spawning grounds not overlapping the mortal and recoverable injury thresholds but overlapping the TTS threshold. Furthermore, their nursery grounds are widespread across much of Western Ireland, Scotland and North Sea and do not overlap with the Proposed Development. Therefore, in the context of their wider spawning and nursery grounds, the impacts associated with the underwater noise and vibration from piling are considered to be of local to regional context.

10.9.3.50 Blue whiting spawning and nursery grounds do not overlap with the thresholds and are mostly located in offshore waters off Western Ireland and the Scottish coast. Blue whiting mainly inhabit offshore waters and therefore any impacts associated with underwater noise is only likely to impact a very small number of individuals.

10.9.3.51 Ling and blue whiting are expected to be able to move outside of the impact range during soft-start procedures before sound levels reach a level likely to cause injury and therefore impacts are likely to be largely restricted to temporary effects (TTS, masking and behavioural effects). Given the broadscale distribution of potential spawning and nursery grounds for ling and the likely lack of abundance of blue whiting within the ZoI, together with the low duration, low frequency and small extent (for mortal and recoverable injury), the impact has been assessed as Low.

10.9.3.52 Atlantic salmon and sea trout occur within the Slaney River Valley SAC, and while their migration patterns out of this SAC are not fully understood, they are assumed to migrate northerly past the Proposed Development, similar to the migration patterns observed for Atlantic salmon along other East Ireland rivers (Barry *et al.*, 2020). As stated above, piling may occur for up to 5 hours 10 minutes per a day and the total duration of piling for the project will be up to 75 days. Noise from piling may occur during migration periods for Atlantic salmon and sea trout. The thresholds for mortal and recoverable injury are low in extent (<100 m) (Figure 10.8), with both species being highly mobile and able to move outside of the impact range during soft-start procedures. However, avoidance behaviour could impede upon their migration. Considering the low duration of pilling, the magnitude has been assessed as Low.

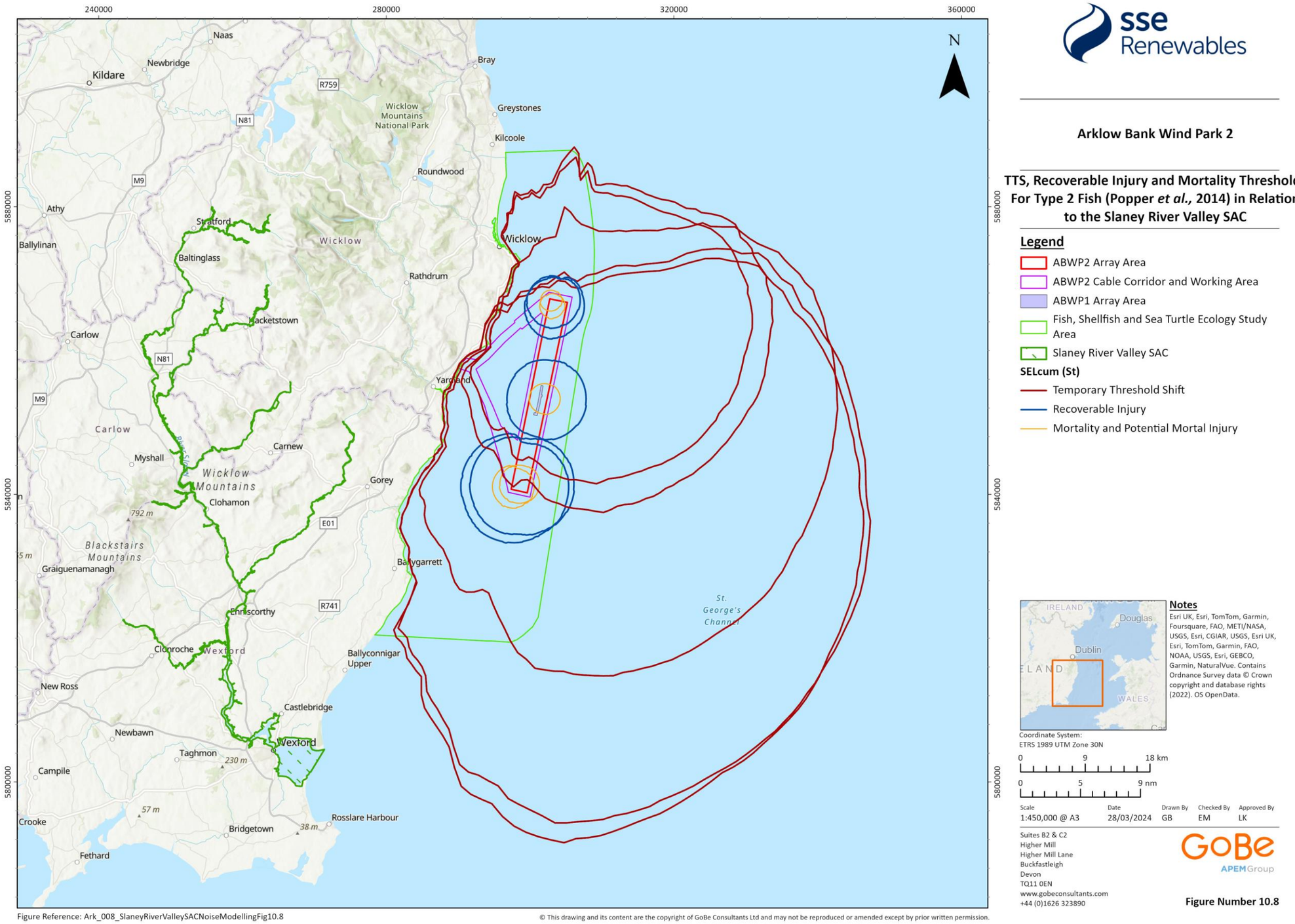


Figure Reference: Ark_008_SlaneyRiverValleySACNoiseModellingFig10.8

Arklow Bank Wind Park 2

TTS, Recoverable Injury and Mortality Thresholds For Type 2 Fish (Popper *et al.*, 2014) in Relation to the Slaney River Valley SAC

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 Array Area
- Fish, Shellfish and Sea Turtle Ecology Study Area
- Slaney River Valley SAC

SELcum (St)

- Temporary Threshold Shift
- Recoverable Injury
- Mortality and Potential Mortal Injury

Notes

Esri UK, Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS, Esri, CGIAR, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, GEBCO, Garmin, NaturalVue. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 9 18 km

0 5 9 nm

Scale	Date	Drawn By	Checked By	Approved By
1:450,000 @ A3	28/03/2024	GB	EM	LK

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Figure Number 10.8

Figure 10.8: TTS, recoverable injury and mortality thresholds for Type 2 fish (Popper *et al.*, 2014) in relation to the Slaney River Valley SAC

TYPE 3

10.9.3.53 For the >207 dB peak thresholds indicated in Table 10.18 above, modelling for the 11 m diameter monopiles indicates this threshold may be exceeded up to 340 m away from the sound source at the SW site, covering an area of up to 0.33 km^2. At the other WTG foundation sites modelled, the maximum distance range was 230-310 m (0.16-0.3 km^2). For the two OSP foundation sites modelled, the maximum distance range was 207-310 m (0.22-0.29 km^2). This is the distance at which underwater noise and vibration may cause mortality or a recoverable injury to fish that have a swim bladder that is involved in hearing.

10.9.3.54 The >207 dB SEL_{cum} threshold for mortality criteria was modelled to be exceeded less than 100 m from the noise source for all WTG foundation and OSP foundation locations for fleeing fish. The >203 dB SEL_{cum} threshold for recoverable injury criteria was modelled to be exceeded less than 100 m from the noise source for all WTG foundation and OSP foundation locations for fleeing fish.

10.9.3.55 The >186 dB SEL_{cum} threshold for TTS was modelled to be exceeded up to 36 km from the noise source (maximum range) at the SW WTG site, covering an area of up to 1,900 km^2 for fleeing animals. At the NW WTG site the model predicts that the TTS threshold could be exceeded up to 19 km from the noise source, covering an area of 440 km^2 for fleeing animals. At the S OSP site, the TTS threshold was exceeded up to 37 km from the noise source, covering an area of up to 1,800 km^2.

10.9.3.56 For stationary animals, the >186 dB SEL_{cum} threshold for TTS was modelled to be exceeded up to 50 km from the noise source (maximum range) at the SW WTG and S OSP sites, covering an area of up to 4,000 km^2. Using the 7 m diameter foundations at the S OSP site, the thresholds were exceeded at up to 49 km with an area of up to 3,900 m^2. At the NW WTG site the model predicts that the TTS threshold could be exceeded up to 29 km from the noise source, covering an area of 1,200 km^2 for stationary animals. At the S OSP site, the TTS threshold could be exceeded up to 51 km from the noise source, covering an area of up to 4,100 km^2.

10.9.3.57 Cod and whiting nursery grounds overlap with the Proposed Development, with spawning grounds overlapping by a small distance with the Fish, Shellfish and Sea Turtle Ecology Study Area in the North. Both species have spawning and nursery grounds that are widespread across the UK. Spawning grounds for sprat and nursery grounds for herring occur across much of the UK including within the Proposed Development (Figure 10.9). As stated above, piling may occur for up to 5 hours 10 minutes per a day and the total duration of piling for the project will be up to 75 days. Noise from piling may occur during spawning and/or nursing periods for these IEFs. In the context of their wider spawning and nursery grounds, the impacts associated with the underwater noise and vibration from piling are considered to be of local to regional context. Therefore, the magnitude has been assessed as Low.

10.9.3.58 European eel and twaite shad occur within the Slaney River Valley SAC and other rivers along the East coast of Ireland. As stated above, piling may occur for up to 5 hours 10 minutes per a day and the total duration of piling for the project will be up to 75 days. Noise from piling may occur during migration periods for these species. The thresholds for mortal and recoverable injury are low in extent (<100 m), with both species being highly mobile. However, should these IEFs migrate past the Proposed Development during pilling events TTS are likely to occur and any avoidance behaviour could impede upon their migration. Therefore, the magnitude has been assessed as Low.

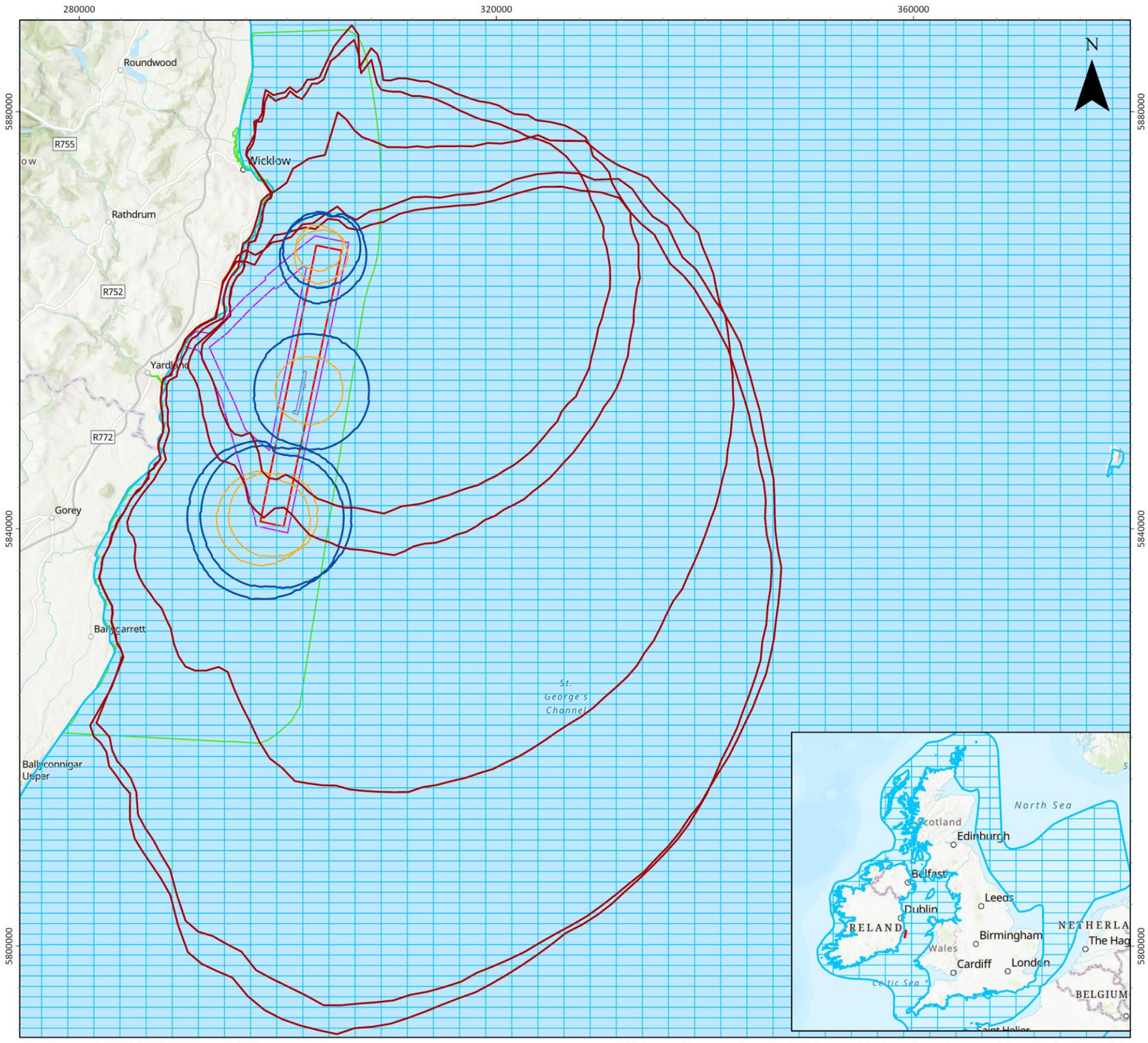

Figure Reference: Ark_009_SpratNoiseModellingFig10.9

sse Renewables

Arklow Bank Wind Park 2

Sprat Spawning Grounds in Relation to TTS, Recoverable Injury and Mortality Thresholds (Popper *et al.*, 2014)

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 Array Area
- Fish, Shellfish and Sea Turtle Ecology Study Area

Spawning Grounds (Coull *et al.*, 1998) - Intensity

- Undetermined

SELcum (St)

- Temporary Threshold Shift
- Recoverable Injury
- Mortality and Potential Mortal Injury

Notes

Esri UK, Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, Ordnance Survey, NASA, NGA, USGS, Esri, GEBCO, Garmin, NaturalVue, Esri, USGS. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 7 14 km

0 4 7 nm

Scale	Date	Drawn By	Checked By	Approved By
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Figure Number 10.9

Figure 10.9: Spawning grounds for sprat (Coull *et al.*, 1998) in relation to TTS, recoverable injury and mortality thresholds (Popper *et al.*, 2014)

FISH LARVAE AND EGGS

10.9.3.59 For the >207 dB peak thresholds indicated in Table 10.18 above, modelling for the 11 m diameter monopiles indicates this threshold may be exceeded up to 340 m away from the sound source at the SW site, covering an area of up to 0.33 km^2. At the other WTG foundation sites modelled, the maximum distance range was 230-310 m (0.16-0.3 km^2). For the two OSP foundation sites modelled, the maximum distance range was 207-310 m (0.22-0.29 km^2). This is the distance at which underwater noise and vibration may cause mortality or a recoverable injury to fish eggs.

10.9.3.60 For the >210 dB SEL_{cum} mortality threshold, the model predicted this would be exceeded up to 3,100 m from the noise source for the SW WTG site, covering an area of up to 26 km^2. At the NW WTG site the threshold was exceeded up to 1,600 m from the noise source, covering an area of up to 6.8 km^2 for fish eggs. At the S OSP site, the mortality threshold was exceeded up to 2,800 m from the noise source, covering an area of up to 23 km^2 for both the 7 m and 14 m foundations.

10.9.3.61 Spawning grounds for all spawning IEFs are widespread across the British and/or Irish coasts. Underwater noise and vibration effects are expected to have a very localised effect on fish eggs and larvae. As such, the magnitude of the effect has been assessed to be Low.

SEA TURTLES

10.9.3.62 For the >207 dB peak thresholds indicated in Table 10.18 above, modelling for the 11 m diameter monopiles indicates this threshold may be exceeded up to 330 m away from the sound source at the SW site, covering an area of up to 0.33 km^2. At the other WTG foundation sites modelled, the maximum distance range was 230-310 m (0.16-0.3 km^2). For the two OSP foundation sites modelled, the maximum distance range was 207-310 m (0.22-0.29 km^2). This is the distance at which underwater noise and vibration may cause mortality or a recoverable injury to turtles.

10.9.3.63 The >210 dB SEL_{cum} threshold for mortality criteria was modelled to be exceeded less than 100 m from the noise source for all WTG foundation and OSP foundation locations for fleeing animals.

10.9.3.64 In the case of stationary sea turtles, the mortality threshold was exceeded up to 3,100 m from the noise source for the SW WTG site, covering an area of up to 26 km^2. At the NW WTG site the threshold was exceeded up to 1,600 m from the noise source, covering an area of up to 6.8 km^2 for stationary sea turtles. At the S OSP site, the mortality threshold was exceeded up to 2,800 m from the noise source, covering an area of up to 23 km^2 for both the 7 m and 14 m foundations.

10.9.3.65 The desktop study to inform the baseline suggests that while leatherback sea turtle may be present within the ZoI, they are unlikely to occur at any great number. Given the small spatial extent of the effect and the wide distribution of the species, the magnitude of the effect is assessed to be Low.

SHELLFISH

10.9.3.66 Shellfish species such as mussels and whelk have much less sensitivity to underwater noise and vibration than many fish species. Any effects from underwater noise and vibration from the Proposed Development are expected to be localised. These species are widespread with a range that extends up to Iceland and so only a very small proportion of the population will be affected. Taking the widespread presence across Irish waters into account, and the proportionately small numbers of individuals that would be affected (relative to the wider population), the magnitude of effect on shellfish receptors is assessed as Low.

SIGNIFICANCE OF THE EFFECT – PILE DRIVING

TYPE 1

10.9.3.67 The sensitivity of sandeel to noise produced during piledriving has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.9.3.68 The sensitivity of all other Type 1 IEFs to noise produced during piledriving has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

TYPE 2

10.9.3.69 The sensitivity of ling and blue whiting to noise produced during piledriving has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.9.3.70 The sensitivity of Atlantic salmon and sea trout to noise produced during piledriving has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

TYPE 3

10.9.3.71 The sensitivity of twaite shad and European eel to noise produced during piledriving has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.9.3.72 The sensitivity of all other Type 3 IEFs to noise produced during piledriving has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

EGGS AND LARVAE

10.9.3.73 The sensitivity of all egg IEFs to noise produced during piledriving has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

SHELLFISH

10.9.3.74 The sensitivity of all shellfish IEFs to noise produced during piledriving has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

SEA TURTLE

10.9.3.75 The sensitivity of leatherback turtle to noise produced during piledriving has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

MAGNITUDE OF THE IMPACT – CONTINIOUS NOISE SOURCES

10.9.3.76 Continuous sound sources associated with the construction phase of the Proposed Development include sandwave clearance and geophysical surveys. Recoverable injury has a numerical criterion of 170 dB rms for 48 hrs for continuous noise sources on Type 3. Of the continuous noise sources for the project, four have source noise levels below this criterion. There are four noise

activities with a source noise level of more than 170 dB rms: cable laying; suction dredging; rock placement; and trenching. For these activities the modelling indicates the criterion may be exceeded up to 50 m away from the noise source if continuous for 48 hours or more. The TTS criterion for continuous noise sources is 158 dB rms for 12 hours. Modelling indicates the criterion may be exceeded up to 50 m away from the noise source if continuous for 12 hours or more.

10.9.3.77 The magnitude has therefore been deemed to be restricted to the near field and adjacent far-field areas, short term duration, frequent and of low consequence. The magnitude has been assessed as Negligible for all hearing groups other than Type 3. Considering the effects of recoverable injury and TTS within 50 m of the noise source, the magnitude for Type 3 IEFs has been assessed as Low.

SIGNIFICANCE OF THE EFFECT – CONTINIOUS NOISE SOURCES

TYPE 1

10.9.3.78 The sensitivity of sandeel to continuous noise sources has been assessed as **Medium**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

10.9.3.79 The sensitivity of all other Type 1 IEFs to continuous noise sources has been assessed as **Low,** with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

TYPE 2

10.9.3.80 The sensitivity of ling and blue whiting to continuous noise sources has been assessed as **Low,** with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

10.9.3.81 The sensitivity of Atlantic salmon and sea trout to continuous noise sources has been assessed as **Medium**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

TYPE 3

10.9.3.82 The sensitivity of twaite shad and European eel to continuous noise sources has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.9.3.83 The sensitivity of all other Type 3 IEFs to continuous noise sources has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

EGGS AND LARVAE

10.9.3.84 The sensitivity of all egg IEFs to continuous noise sources has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SHELLFISH

10.9.3.85 The sensitivity of all shellfish IEFs to continuous noise sources has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SEA TURTLE

10.9.3.86 The sensitivity of leatherback turtle to continuous noise sources has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

MAGNITUDE OF THE IMPACT – UXO

10.9.3.87 It is possible that UXO devices with a range of charge weights (or quantity of contained explosive) are present within the boundaries of the proposed development. These would need to be cleared before any construction can begin. When modelling potential noise from UXO clearance, a variety of explosive types needed to be considered, with the potential that many have been subject to degradation and burying over time. Two otherwise identical explosive devices are likely to produce different blasts in the case where one has spent an extended period on the seabed. A selection of explosive sizes were modelled based on what might be present, and in each case, it was assumed that the maximum explosive charge in each device is present and detonates with the clearance. For UXO explosions, the following criteria are used (Table 10.19).

10.9.3.88 The noise produced by the detonation of explosives is affected by several different elements, only one of which can easily be factored into a calculation: the charge weight. In this case the charge weight is based on the equivalent weight of Trinitrotoluene (TNT). A worst-case scenario has been used which means that the modelling is an over-estimate of the noise levels produced. The maximum equivalent charge weight for the potential UXO devices that could be present within the proposed development has been estimated as 800 kg. This has been modelled alongside a range of smaller devices, at charge weights of 25, 55, 120, 240, 525 and 700 kg. In each case, an additional donor weight of 0.5 kg has been included to initiate detonation. Low-order deflagration has also been assessed, which assumes that the donor or shaped charge (charge weight of 0.5 kg) detonates fully to initiate a burnout of the explosive but without the follow-up detonation of the UXO. The modelling does not consider variable bathymetry or seabed type, and thus calculation results will be the same regardless of where it is used. Full details on this modelling are provided in Volume III, Appendix 11.1: Underwater Noise Assessment. The distances at which the criteria for explosions could be exceeded for different charge weights is provided in Table 10.19.

Table 10.19: impact ranges for UXO detonation using the unweighted SPL_{peak} explosion noise criteria from Popper *et al.* (2014) for fish.

Popper *et al.* (2014) Unweighted SPL_{RMS}	Mortality and potential mortal injury	
	234 dB	229 dB
0.5 kg	< 50 m	80 m
25 kg + donor	170 m	290 m
55 kg + donor	230 m	380 m
120 kg + donor	300 m	490 m
240 kg + donor	370 m	620 m
525 kg + donor	490 m	810 m
700 kg + donor	530 m	890 m
800 kg + donor	560 m	930 m

TYPE 1, 2 AND 3

10.9.3.89 The results of modelling of UXO clearance indicates that if the maximum charge (800 kg + donor) was detonated it could result in mortality or mortal injury in 560-930 m from the explosion. If Low-order deflagration (charge weight of 0.5 kg) is used to initiate a burnout of the explosive any fish within 80 m of the explosion would be at risk of mortality or mortal injury. Low-order deflagration is not always possible and if the original charge is not fully detonated then a High-order detonation would be required to remove the remaining charge. If High-order detonation is required of an

800 kg UXO it has the potential to kill Type 1 fish occurring in the area. Recoverable injury, TTS and behavioural effects are also likely within tens of metres of the noise source and may be observed within hundreds of metres.

10.9.3.90 Considering the small extent, the momentary duration and infrequency of UXO detonation, the magnitude has been considered as Low for Type 1, 2 and 3 IEFs.

EGGS AND LARVAE

10.9.3.91 In terms of underwater noise and vibration from detonation of UXO, the Popper *et al.* (2014) criteria indicate that recoverable injury, TTS and behavioural effects are likely within tens of metres of the explosion. It is also possible that mortality of fish eggs and larvae will occur within tens of metres of the explosion.

10.9.3.92 Considering the very small extent, the momentary duration and infrequency of UXO detonation, the magnitude has been considered as Negligible for fish eggs and larvae.

SEA TURTLES

10.9.3.93 The results of modelling of UXO clearance indicates that if the maximum charge (800 kg + donor) was detonated it could result in mortality or mortal injury in 560-930 m from the explosion. If Low-order deflagration (charge weight of 0.5 kg) is used to initiate a burnout of the explosive any fish within 80 m of the explosion would be at risk of mortality or mortal injury. Low-order deflagration is not always possible and if the original charge is not fully detonated then a High-order detonation would be required to remove the remaining charge. If High-order detonation is required of an 800 kg UXO it has the potential to kill any sea turtles in the area. However, given the low numbers previously recorded there is a low likelihood of this occurring. Recoverable injury, TTS and behavioural effects are also possible within hundreds of metres of the noise source.

10.9.3.94 Considering the low likelihood of a leatherback turtle occurring in the area during a UXO detonation, the magnitude of the effect is assessed to be Negligible.

SIGNIFICANCE OF THE EFFECT – UXO

TYPE 1

10.9.3.95 The sensitivity of sandeel to noise produced during UXO detonation has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.9.3.96 The sensitivity of all other Type 1 IEFs to noise produced during UXO detonation has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

TYPE 2

10.9.3.97 The sensitivity of ling and blue whiting to noise produced during UXO detonation has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.9.3.98 The sensitivity of Atlantic salmon and sea trout to noise produced during UXO detonation has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

TYPE 3

10.9.3.99 The sensitivity of twaite shad and European eel to noise produced during UXO detonation has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.9.3.100 The sensitivity of all other Type 3 IEFs to noise produced during UXO detonation has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

EGGS AND LARVAE

10.9.3.101 The sensitivity of all egg IEFs to noise produced during UXO detonation has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be **Negligible Significance**, which is not significant in EIA terms.

SHELLFISH

10.9.3.102 The sensitivity of all shellfish IEFs to noise produced during UXO detonation has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be **Negligible Significance**, which is not significant in EIA terms.

SEA TURTLE

10.9.3.103 The sensitivity of leatherback turtle to noise produced during UXO detonation has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be **Negligible Significance**, which is not significant in EIA terms.

PROPOSED MITIGATION

10.9.3.104 No further mitigation has been proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.3.105 The significance of effect from underwater noise and vibration during piling, and other construction activities is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of underwater noise and vibration.

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.9.3.106 The main source of underwater noise and vibration during operation of the Proposed Development will be from the rotating machinery in the WTGs, which will be transmitted into the sea through the structure of the WTG tower and foundations (Nedwell *et al.*, 2003; Tougaard *et al.*, 2020). This has been modelled as described in Volume III, Appendix 11.1: Underwater Noise Assessment.

10.9.3.107 The results of this modelling showed that for fish with a swim bladder that is involved in hearing recoverable injury and TTS effects would be limited to within 50 m of the noise source. Effects on other hearing groups including fish eggs and turtles are considered to be negligible.

10.9.3.108 Other sources of operational noise include repair and re-burial of cables, operational dredging and geophysical surveys. All are expected to produce low noise levels when compared to pilling during construction and will be infrequent (cable repair and re-burial once every 3 years for inter-array and interconnector cables and once every 5 years for export cables, operational

dredging once every 5 years and geophysical surveys every 6 months for first two years and annually thereafter).

10.9.3.109 The impact during the operational and maintenance phase is assessed as low in extent, long term and continuous (in the case of WTGs). The magnitude for all hearing groups has therefore been assessed as Negligible.

SIGNIFICANCE OF EFFECT

TYPE 1

10.9.3.110 The sensitivity of sandeel has been assessed as **Medium**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

10.9.3.111 The sensitivity of all other Type 1 IEFs has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

TYPE 2

10.9.3.112 The sensitivity of ling and blue whiting has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

10.9.3.113 The sensitivity of Atlantic salmon and sea trout has been assessed as **Medium**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

TYPE 3

10.9.3.114 The sensitivity of twaite shad and European eel has been assessed as **Medium**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not significant**, which is not significant in EIA terms.

10.9.3.115 The sensitivity of all other Type 3 IEFs has been assessed as **Medium**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not significant**, which is not significant in EIA terms.

EGGS AND LARVAE

10.9.3.116 The sensitivity of all egg IEFs has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SHELLFISH

10.9.3.117 The sensitivity of all shellfish IEFs has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SEA TURTLE

10.9.3.118 The sensitivity of leatherback turtle has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

PROPOSED MITIGATION

10.9.3.119 No additional mitigation is proposed for this effect.

RESIDUAL EFFECT ASSESSMENT

10.9.3.120 The significance of effect from underwater noise and vibration from the operation and maintenance of the WTGs is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. As such, no ecologically significant adverse residual effects have been predicted in respect of underwater noise and vibration.

10.9.4 Impact 4 – Injury and/or disturbance to basking shark and sea turtles from increased vessel activities.

10.9.4.1 Increased vessel movement during the construction, operational and maintenance and decommissioning phases has the potential to lead to an increased risk of collision on basking shark and leatherback turtle as these species may occur near the surface and therefore within the potential zone of impact.

SENSITIVITY OF RECEPTOR

10.9.4.2 There are different potential outcomes of vessel collision; both fatal and non-fatal injuries have been documented (Laist *et al.*, 2001; Vanderlaan and Taggart, 2007; Cates *et al.*, 2017). Fatal collisions can be seen via carcasses washing up on beaches (Laist *et al.*, 2001; Peltier *et al.*, 2019), carcasses caught on vessel bows (Laist *et al.*, 2001; Peltier *et al.*, 2019) and floating carcasses which have strong evidence of ship strike, such as propeller cuts, significant bruising, oedema, internal bleeding radiating from a specific impact site, fractures and ship paint marks (Jensen and Silber, 2004; Douglas *et al.*, 2008). Fatalities from ship strikes, however, often go unreported (Authier *et al.*, 2014). For non-fatal injuries, there is evidence of animals which have survived ship strikes with no discernible injury, with animals which survive with non-fatal injuries from propellers being widely documented (Wells *et al.*, 2008; Luksenburg, 2014).

10.9.4.3 For basking shark, propeller and boat strikes may result in serious injury, particularly in summer months when animals are feeding at the surface. However, there are few reported incidents of injury from collision; anecdotal evidence of collisions with basking shark were reported on two occasions by marine tourism boats in the Clyde Sea but the extent of any injuries suffered were unknown (Speedie *et al.*, 2009).

10.9.4.4 Leatherback turtles are also vulnerable to vessel strike when surfacing to breathe. Boat strikes account for a notable proportion of sea turtle mortalities in nearshore turtle habitats worldwide. For example, 2.5% of green turtles found dead on beaches in Hawaii between 1982 and 2003 were attributed to boat strike (Chaloupka *et al.*, 2008). Boat strikes were also identified as the cause of mortality for leatherback turtles off the coast of Gabon (Deem *et al.*, 2006). Denkinger *et al.* (2013) looked at records of live green sea turtles surveyed in the Galapagos and found that up that 20% of injuries were likely to be from collisions with boats.

10.9.4.5 The baseline environment section presented in section 10.5.2 suggests that the Fish, Shellfish and Sea Turtle Study Area does not support high numbers of basking shark or leatherback turtle, although they may occasionally occur within this area. If a vessel were to collide with a basking shark or leatherback turtle it is expected that the animal would be injured. On this basis, basking shark and leatherback turtle are deemed to be of medium adaptability, low tolerance, low recoverability, and international value. The sensitivity of these IEFs to injury and/or disturbance from increased vessel activities is considered to be High.

Construction phase

MAGNITUDE OF THE IMPACT

10.9.4.6 The design scenario for an increase in vessel activity during the construction phase is for 66 vessels within the Proposed Development at any one time, with 4,150 return trips over the entire construction phase. Vessel types used during construction typically include jack-up barges, tug/anchor handlers, cable installation vessels, scour/cable protection installation vessels, guard vessels, survey vessels and crew transfer vessels. Whilst this will lead to an uplift in vessel activity, the movements will primarily be within the Array Area, Cable Corridor and Working Area and existing shipping routes to/from port.

10.9.4.7 The baseline environment presented in Volume II, Chapter 15: Shipping and Navigation, suggests that vessel activity is numerous within 10 nautical miles of the Array Area, with an average of 36-37 vessels recorded per day and a maximum of 59 per day. Vessel traffic associated with the Proposed Development will lead to an increase in vessel movements within the Fish, Shellfish and Sea Turtle Study Area, albeit to a small degree. This increase in vessel movement could lead to an increase in interactions between basking sharks and sea turtles with vessels during offshore construction. Vessels travelling at 7 m/s or faster are those most likely to cause death or serious injury to basking sharks and turtles (Laist *et al.*, 2001; Wilson *et al.*, 2007). With the exception of crew transport vessels (CTVs) and Service Operation Vessels (SOVs), vessels involved in the construction phase are likely to be travelling at low speeds, and all vessels will be expected to follow a Environmental Vessel Management Plan (EVMP) (Volume III, Appendix 25.10) to minimise interaction with marine megafauna (Table 10.13).

10.9.4.8 As such, injury and/or disturbance to basking shark and sea turtles from increased vessel activities involved in the construction phase is deemed to be restricted to the near field and adjacent far-field areas, short term duration, in-frequent and of low consequence. Considering the low probability of vessel collision with basking sharks and sea turtles (as a result of low baseline numbers of basking shark and sea turtle and low vessel speeds for vessels other than CTVs and SOVs), the magnitude has been considered as Negligible.

SIGNIFICANCE OF THE EFFECT

10.9.4.9 The magnitude of the impact has been assessed as **Negligible**, with the sensitivity of basking sharks and sea turtles as **High**. Therefore, the significance of effect from collision risk will be **Not Significant**, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.4.10 The effects of injury and/or disturbance to basking shark and sea turtles from increased vessel activities is not significant in EIA terms, Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.4.11 The significance of effect from injury and/or disturbance to basking shark and sea turtles from increased vessel activities is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of injury and/or disturbance to basking shark and sea turtles from increased vessel activities.

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.9.4.12 An increase in vessel activity during the operational and maintenance phase may lead to an increased risk of injury due to collisions with vessels. The design scenario is for 30 vessels on site at any one time and 1,359 vessel round trips per year over the lifetime of the Proposed Development, with vessel types similar to those used for construction. The baseline environment presented in Volume II, Chapter 15: Shipping and Navigation, suggests that vessel activity is numerous within 10 nautical miles of the Array Area, with an average of 36-37 vessels recorded per day and a maximum of 59 per day.

10.9.4.13 The magnitude of the impact of the operational and maintenance phase for collision risk injury, for all marine megafauna receptors is lower than that described for the construction phase with fewer vessels at any one time within the Array Area and fewer vessel movements per year. However, the duration of effect would occur over the 36.5-year operating lifetime of the Proposed Development. Vessel movements will be confined to the Array Area, Cable Corridor and Working Area and existing shipping routes to/from port.

10.9.4.14 With the EVMP in place (Volume III, Appendix 25.10) (Table 10.13), the impact is predicted to be confined to the near field and adjacent far field areas, long term duration, infrequent and of low consequence. The magnitude is therefore, considered to be Negligible for both basking shark and leatherback turtle.

SIGNIFICANCE OF EFFECT

10.9.4.15 The magnitude of the impact has been assessed as **Negligible**, with the sensitivity of basking sharks and sea turtles as **High**. Therefore, the significance of effect of injury and/or disturbance to basking shark and sea turtles from increased vessel activities will be **Not significant**, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.4.16 The effects of collision risk on basking sharks and sea turtles is not significant in EIA terms, Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.4.17 The significance of effect of injury and/or disturbance to basking shark and sea turtles from increased vessel activities is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of injury and/or disturbance to basking shark and sea turtles from increased vessel activities.

Decommissioning phase

MAGNITUDE OF IMPACT

10.9.4.18 The Design Scenario for the decommissioning phase of the project is anticipated to be similar in nature to that of the construction phase, with the design scenario considering 66 vessels on site at any one time and 1,797 return trips per year. The baseline environment presented in Volume II, Chapter 15: Shipping and Navigation, suggests that vessel activity is numerous within 10 nautical miles of the Array Area, with an average of 36-37 vessels recorded per day and a maximum of 59 per day. As such, the magnitude of injury and/or disturbance to basking shark and sea turtles from increased vessel activities is deemed to be restricted to the near field and adjacent far-field areas, short term duration, frequent and of low consequence. It is predicted that

the impact will affect the receptor directly. The magnitude is therefore, considered to be Negligible.

SIGNIFICANCE OF EFFECT

10.9.4.19 The magnitude of the impact has been assessed as **Negligible**, with the sensitivity of basking sharks and sea turtles as **High**. Therefore, the significance of effect from collision risk will be **Not Significant**, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.4.20 The effects of injury and/or disturbance to basking shark and sea turtles from increased vessel activities is not significant in EIA terms, Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.4.21 The significance of effect injury and/or disturbance to basking shark and sea turtles from increased vessel activities is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of injury and/or disturbance to basking shark and sea turtles from increased vessel activities.

10.9.5 Impact 5 – Accidental pollution from vessels, vehicles, equipment and machinery

10.9.5.1 Accidental release of pollutants (such as fuel, lubricants, and anti-fouling biocides) from vessels or equipment associated with the Proposed Development has the potential to occur during the construction, operational and maintenance and decommissioning phases as a result of the installation/removal of foundations, presence of operational equipment, maintenance activities, and the installation of inter-array cables, interconnector cables and offshore export cables.

SENSITIVITY OF RECEPTOR

10.9.5.2 The most sensitive IEFs are sessile or low mobility site-attached species (primarily shellfish) that are unable to avoid pollution events. For example, blue mussels are suspension feeders and may absorb contaminants directly from the water via suspended particulate matter. Bivalves are able to accumulate heavy metals into their tissues to levels much higher than environmental levels and therefore show a degree of tolerance (Widdows and Donkin, 1992), however, sub-lethally the contaminants could reduce the growth rate of individuals (Tyler-Walters, 2008). Similarly, synthetic compounds can accumulate in tissues of bivalves and cause a reduction in growth rates and fecundity, and potentially mortality of individuals (Tyler-Walters, 2008).

10.9.5.3 Decapod crustaceans, such as *Nephrops*, are able to tolerate small increases in heavy metal contamination but as with bivalves, sublethal physiological effects would be expected to occur as concentrations can build up in their gill tissues, carapace, tail mussels and ovaries (Sabatini and Hill, 2008).

10.9.5.4 Hydrocarbon and Polycyclic Aromatic Hydrocarbon (PAH) contamination normally occurs as a result of oil spills and high swell and winds can cause oil pollutants to mix with the seawater and potentially negatively affect sublittoral habitats (Castège *et al.*, 2014). Filter feeders are highly sensitive to oil pollution, particularly bottom dwelling organisms in areas where oil components are deposited by sedimentation. Bivalve contact with oil causes an increase in energy expenditure and a decrease in feeding rate, resulting in less energy available for growth and reproduction (Suchanek, 1993). Crustaceans are widely reported to be intolerant of synthetic chemicals (Cole *et al.*, 1999).

10.9.5.5 The recoverability of shellfish receptors will vary considerably between species. For example, both bivalves and crustaceans, which typically have high fecundity, may recover fully although noting that even with good annual recruitment/reproduction this may take several years (Tyler-Walters, 2008; Sabatini and Hill, 2008). It is anticipated that, following cessation of any potential impact, re-colonisation of affected areas would occur via adult migration and larval settlement thereby allowing a return to ecological baseline conditions and baseline levels of contaminants. Therefore, shellfish assemblages (including blue mussels and whelks) are deemed to have some degree of adaptability and tolerance, are expected to recover within the short term and are of local to regional importance. These IEFs are assessed as Medium sensitivity.

10.9.5.6 Accidental pollution can impact upon the hatching success of fish eggs via delaying the hatching process, causing premature hatching and fatalities of newly hatched larvae (Jezierska *et al.*, 2008; Sorensen *et al.*, 2019). This could reduce recruitment of those species that spawn within the Proposed Development and adjacent areas (Fish, Shellfish and Sea Turtle Ecology Study Area) and include lemon sole, plaice and sprat. However, given the large area of available spawning habitat, any impacts are expected to be small. These IEFs are deemed to have some level of adaptability and tolerance, are expected to recover within the short term and are of local to regional importance. These IEFs are assessed as Medium sensitivity.

10.9.5.7 Most fish species, basking sharks and sea turtles are highly mobile and consequently have the ability to avoid polluted areas. These IEFs are deemed to be able to avoid the impact, are expected to recover within the short term and are of local to international importance. These IEFs are assessed as Low to Medium sensitivity.

Construction phase

MAGNITUDE OF THE IMPACT

10.9.5.8 The installation of the Proposed Development may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The project design parameters include the release of synthetic compounds, for example from antifouling biocides, heavy metal, and hydrocarbon contamination as a result of the installation of 56 WTGs, two OSPs, inter-array, interconnector and offshore export cables. The project design parameters also include 66 vessels within the Proposed Development at any one time, 1,797 vessel return trips per year and 118 helicopter return trips per year. The magnitude of the impact will be dependent on the quantities of potential pollutants carried by vessels, helicopters and equipment. Although many of the large vessels (e.g. installation vessels) may contain large quantities of diesel oil, any accidental spill from vessels, vehicles, machinery from construction activities would be subject to immediate dilution and rapid dispersal (Fingas and Banta, 2008).

10.9.5.9 The factored in measures include an Environmental Management Plan (EMP) and Marine Pollution Contingency Plan (MPCP). Adherence to the factored-in measures outlined in Table 10.13 will significantly reduce the likelihood of an accidental pollution incident occurring and the magnitude of its impact. Given the factored-in measures, the likelihood of accidental release is considered to be extremely low.

10.9.5.10 There is also a risk to fish, shellfish and sea turtle IEFs from water based drilling mud, including bentonite, which is used as a lubricant during the HDD process. HDD will be undertaken to install the offshore export cables at the landfall and potentially across the sandbank for inter-array cable installation. Drilling muds are used in a closed system to minimise loss to the environment, however it is possible that muds (including bentonite) can break out during drilling operations, which may occur in intertidal or subtidal areas. Bentonite is low toxicity drilling mud and therefore the risk to fish, shellfish and sea turtle IEFs is minimal, particularly when considering that any break outs will be quickly diluted with seawater aiding in the quick settlement of bentonite particles (Liu *et al.*, 2018). However, any potential break outs or accidental spills of bentonite will be managed via good working practices (e.g. monitoring of mud volumes and pressure, detection of

break outs and pausing drilling, plugging fissures and ongoing monitoring) such that any loss of bentonite to the environment will be minimal. Suspended sediment and deposition associated with bentonite from the HDD have been assessed within section 10.9.2.

10.9.5.11 Accidental release of pollutants during all construction phase is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed), infrequent and of low consequence. The magnitude is therefore, considered to be Low.

SIGNIFICANCE OF THE EFFECT

10.9.5.12 The magnitude of the impact has been assessed as **Low.**

10.9.5.13 The sensitivity of shellfish IEFs and fish species which spawn within the Proposed Development is **Medium**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

10.9.5.14 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.5.15 The effect of accidental pollution is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.5.16 The significance of effect from accidental pollution is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of accidental pollution.

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.9.5.17 Operational and maintenance tasks within the Proposed Development may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The project design parameters include the release of synthetic compounds, for example from antifouling biocides, heavy metal, and hydrocarbon contamination as a result of the presence of 56 WTGs and two OSPs as well as from maintenance activities. The project design parameters also includes 30 vessels within the Proposed Development at any one time, 1,359 vessel return trips per year and 485 helicopter return trips per year.

10.9.5.18 The magnitude of the impact will be dependent on the quantities of potential pollutants carried by vessels, helicopters and equipment. Although many of the large vessels (e.g. installation vessels) may contain large quantities of diesel oil, any accidental spill from vessels, vehicles, machinery or from construction, operational and maintenance and decommissioning activities will be subject to immediate dilution and rapid dispersal (Fingas and Banta, 2008).

10.9.5.19 Given the factored-in measures, the likelihood of accidental release is considered to be extremely low. Adherence to the factored-in measures outlined in Table 10.13 will significantly reduce the likelihood of an accidental pollution incident occurring and the magnitude of its impact.

10.9.5.20 Accidental release of pollutants during the operational and maintenance phase is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed), infrequent and of low consequence. The magnitude is therefore, considered to be Negligible.

SIGNIFICANCE OF EFFECT

10.9.5.21 The magnitude of the impact has been assessed as **Negligible.**

10.9.5.22 The sensitivity of shellfish IEFs and fish species which spawn within the Proposed Development is **Medium**. Therefore, the significance of effect will be **Not Significant**, which is **not significant** in EIA terms.

10.9.5.23 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Not Significant**, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.5.24 The effect of accidental pollution is not significant in EIA terms, Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.5.25 The significance of effect from accidental pollution is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of accidental pollution.

Decommissioning phase

MAGNITUDE OF IMPACT

10.9.5.26 The Design Scenario for the decommissioning phase of the project is anticipated to be similar in nature to that of the construction phase. The project design parameters include the release of synthetic compounds, for example from antifouling biocides, heavy metal, and hydrocarbon contamination as a result of the installation of 56 WTGs, two OSPs, inter-array, interconnector and offshore export cables. The project design parameters also includes 66 vessels within the Proposed Development at any one time, 1,797 vessel return trips per year and 118 helicopter return trips per year.

10.9.5.27 Accidental release of pollutants during the decommissioning phase is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed), infrequent and of low consequence. The magnitude is therefore, considered to be Low.

SIGNIFICANCE OF EFFECT

10.9.5.28 The magnitude of the impact has been assessed as **Low.**

10.9.5.29 The sensitivity of shellfish IEFs and fish species which spawn within the Proposed Development is **Medium**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

10.9.5.30 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.5.31 The effect of accidental pollution is not significant in EIA terms, therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.5.32 The significance of effect from accidental pollution is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore,

no ecologically significant adverse residual effects have been predicted in respect of accidental pollution.

10.9.6 Impact 6 – Long term habitat loss

10.9.6.1 Long-term habitat loss will occur directly under all foundation structures, associated scour protection and cable protection (including at crossings) where this is required. This impact considers the habitat loss occurring during the operational and maintenance phases.

SENSITIVITY OF RECEPTOR

10.9.6.2 Fish and shellfish species that are reliant upon the presence of suitable sediment/habitat for their survival are considered to be more vulnerable to habitat change. Long term habitat loss could lead to long term loss of spawning/nursery grounds for fish and shellfish species where these overlap the Array Area and Cable Corridor and Working Area. Spawning grounds for lemon sole and sprat occur throughout the Irish Sea and coincide with the Proposed Development. Unlike other species, lemon sole does not have well-defined spawning grounds but spawn widely through its range, gathering in small concentrations where the fish aggregate. Sprat also spawns widely across its range from coastal waters out to deeper waters offshore. For both species the proportion of long-term habitat loss associated with the foundation structures, scour protection and cable protection is negligible in the context of their wider spawning area. Furthermore, sprat is a pelagic species and has little association with the benthic environment. Therefore, the sensitivity of sprat has been assessed as Negligible.

10.9.6.3 The Proposed Development overlaps with mapped nursery grounds for a number of species including; cod, whiting, lemon sole, mackerel, spotted ray and tope shark. Long term habitat loss reduces the amount of habitat available to these species, and associated loss of prey resources (indirect effect) for juveniles inhabiting the nursery grounds. For all species, the total area of nursery habitat loss will be small in the context of the wider nursery areas for key species and therefore, there is unlikely to be a population-level effect on juveniles within the Fish, Shellfish and Sea Turtle Study Area. These IEFs are of high adaptability and tolerance, high recoverability and of local to international importance. Therefore, they have been assessed as Low sensitivity.

10.9.6.4 The presence of infrastructure has the potential to benefit a number of IEF groups, with the foundations and scour protection offering a habitat for a range of species that naturally utilise hard substratum environments including brown crab, wrasse *Ctenolabrus rupestris*, European lobster, small spotted catshark *Scyliorhinus canicula*, nursehound and blue mussel (De Mesel *et al.*, 2015; Griffin *et al.*, 2016; Krone *et al.*, 2017; Thatcher *et al.*, 2023). Furthermore, the presence of scour protection may positively benefit some species, such as plaice and lemon sole, that utilise the nearby soft sediment environment by increasing food availability (Buyse *et al.*, 2021; 2023a; 2023b).

10.9.6.5 Blue mussels depend upon a hard substratum to settle on for recruitment, including artificial structures, bedrock, boulders and pre-existing mussel shells/byssal threads. They can colonise OWF concreate foundations within a year and can become abundant within 2 years (De Mesel *et al.*, 2015). Therefore, blue mussels are expected to have a high level of adaptability, tolerance and recoverability to the impact, with the increase availability of hard substrata having the potential to positively impact the population. Therefore, blue mussels have been assessed as Negligible sensitivity.

10.9.6.6 Common whelk occurs on a range of sediment types including soft sediments (sand, mud) and hard substratum (Magnúsdóttir 2010). Therefore, common whelk are expected to have a high level of adaptability, tolerance and recoverability to the impact, and have been assessed as Negligible sensitivity.

10.9.6.7 The breeding and feeding strategies of leatherback turtle and basking shark are unlikely to be affected directly or indirectly by long term habitat loss resulting from the Proposed Development. They are assessed as Negligible.

10.9.6.8 *Nephrops* are unlikely to occur within the Array Area and Cable Corridor and Working Area and as such have been assessed as Negligible.

Operational and maintenance phase

MAGNITUDE OF THE IMPACT

10.9.6.9 The design scenario assumes the presence of 56 WTG, two OSPs, inter-array cabling, export cables and interconnector cables with associated scour protection, equating to 662,800 m^2 of long-term habitat loss. The impact of long-term subtidal habitat loss will be continuous through the 36.5-year operational phase of the Proposed Development. However, will only represent <0.1 % of the total 1,108,846,004 m^2 Fish, Shellfish and Sea Turtle Ecology Study Area and <0.01 % of the 13,748,211,512 m^2 Western Irish Sea Fish, Shellfish and Sea Turtle Study Area.

10.9.6.10 The Fish, Shellfish and Sea Turtle Ecology Study Area is predominantly sand and coarse sediment-based habitat types with small areas of rocky habitat. The introduction of hard substratum via rock protection and foundations will therefore represent a degree of change from that of the baseline. The impact will affect the IEFs directly through removal of individuals and indirectly due to loss of important habitats, such as foraging, nursery or spawning habitats. Habitat loss will be localised to discrete locations within the boundaries of the Array Area and Cable Corridor and Working Area only.

10.9.6.11 Long-term habitat loss is predicted to be of highly localised spatial extent (restricted to discrete areas within the Array Area and Cable Corridor and Working Area), long-term duration and continuous throughout the 36.5-year operational and maintenance phase. It is predicted that the impact will affect fish, shellfish and sea turtle receptors directly or indirectly depending on species' life strategy. The magnitude is therefore, considered to be Low.

SIGNIFICANCE OF THE EFFECT

10.9.6.12 The magnitude of the impact has been assessed as **Low.**

10.9.6.13 The sensitivity of sprat, blue mussel, common whelk, *Nephrops*, leatherback turtle and basking shark is **Negligible**. Therefore, the significance of effect will be **Imperceptible** significance, which is **not significant** in EIA terms.

10.9.6.14 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.6.15 The effects of long-term habitat loss is not significant in EIA terms. Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.6.16 The significance of effect from long term habitat loss is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of collision risk to basking sharks and sea turtles.

10.9.7 Impact 7 – Alteration of seabed habitats arising from changes in physical processes

10.9.7.1 The presence of the WTG and OSP foundations and associated scour protection may lead to changes in the physical processes within the Array Area and potentially further afield and subsequently alteration of seabed habitats. Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling, describes in detail the changes that could occur as a result of the presence of foundation structures and associated scour protection.

SENSITIVITY OF THE RECEPTOR

10.9.7.2 Decreases in flow rate (around the foundations) could lead to sediments becoming muddier owing to increased settlement of particulate matter. Some fish and shellfish species and communities may be more vulnerable to reductions in water flow if the decrease is sufficient to reduce the availability of suspended food particles, and consequently inhibit feeding and growth. Scour and increases in flow rates in the wider Array Area could change the characteristics of the sediment potentially making the habitat less suitable for other species. Settlement of planktonic larvae for species with nursery grounds over the bank (e.g. cod, whiting and elasmobranchs) may also be inhibited by re-suspension of particulate matter.

10.9.7.3 Many fish and shellfish have a larval planktonic phase, with dispersal being dictated by local hydrographic conditions. In the Irish Sea a gyre (circulating mass of water) forms during the spring and summer and this retains larvae in the vicinity of the parent populations where there is suitable substrate (i.e. rather than being carried off by currents into areas of unsuitable substrate; Hill *et al.*, 1996; 1997). Thus, changes to hydrographic conditions could potentially affect local recruitment, reducing larval settlement and subsequently causing declines in local abundance of affected species.

10.9.7.4 However, the physical processes modelling suggested that such changes to hydrography would be minimal and largely localised around the structures. Therefore, it is considered that there are unlikely to be any detectable changes in the fish and shellfish community as a result of this impact.

10.9.7.5 As highly mobile species, both leatherback turtle and basking shark are unlikely to be affected directly by changes in physical processes. In addition, there are unlikely to be any indirect effects through changes to prey communities as zooplankton, including jellyfish, are unlikely to be affected by localised changes in flow rates. The sensitivity of these IEFs is therefore considered to be Negligible.

10.9.7.6 All other fish and shellfish receptors within the Fish and Shellfish Ecology Study Area are deemed to be of high tolerance and adaptability, high recoverability and of local to international importance. The sensitivity of these IEFs is therefore, considered to be Low.

Operational and maintenance phase

MAGNITUDE OF THE IMPACT

10.9.7.7 The design scenario assumes the presence of 56 WTGs and two OSPs installed on monopile foundations of 7-11 m or 7-14 m diameter at the base, and associated scour protection around each foundation.

10.9.7.8 Modelling was undertaken for changes in hydrodynamic flow during peak Spring and Neap, flood and ebb tidal conditions. Changes to tidal flow are expected to be low with the largest changes of between 0.05 and 0.1 m/s within the Array Area and immediately downstream of foundations. For waves, modelling was undertaken for several scenarios, with a slight reduction in wave conditions predicted (up to 0.5 m in significant wave height immediately adjacent to structures). The greatest spatial extent of change is predicted for the 105° N direction scenario, with a change in wave characteristics up to 6 km from the Array Area.

10.9.7.9 The potential alteration to seabed habitats due to changes in physical processes is predicted to be of near field (very localised) spatial extent, long term duration, continuous and of low consequence. The magnitude is therefore, considered to be Low.

SIGNIFICANCE OF THE EFFECT

10.9.7.10 The magnitude of the impact has been assessed as **Low.**

10.9.7.11 The sensitivity of basking shark and leatherback turtle is **Negligible**. Therefore, the significance of effect from alterations of seabed habitats arising from changes in physical processes is **Imperceptible**, which is **not significant** in EIA terms.

10.9.7.12 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from alterations of seabed habitats arising from changes in physical processes is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.7.13 The effect of alteration of seabed habitats arising from changes in physical processes is not significant in EIA terms, Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.7.14 The significance of effect from alteration of seabed habitats arising from changes in physical processes is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of alteration of seabed habitats arising from changes in physical processes.

10.9.8 Impact 8 – Temporary Changes in Electromagnetic Fields (EMF) from subsea electrical cabling

10.9.8.1 The conduction of electricity through subsea power cables has the potential to emit a localised EMF which could potentially affect the sensory mechanisms of some species of fish and shellfish, particularly electrosensitive species including elasmobranchs and migratory fish species. EMF comprises both the electrical (E) fields, measured in volts per metre (V/m), and the magnetic (B) fields, measured in microtesla (μT) or milligauss (mG) (1 μT = 10 mG). Direct E-field are typically blocked using conductive sheathing, meaning that the EMFs that are emitted into the marine environment are the B-field and the resultant induced electrical field (iE).

SENSITIVITY OF THE RECEPTOR

10.9.8.2 Electro-magnetic sensitivities vary significantly by species according to their physiology and life-functions. Life functions supported by an electric sense may include detection of prey, predators or conspecifics to assist with feeding, predator avoidance, and social or reproductive behaviours; whilst life functions supported by a magnetic sense may include orientation, homing, and navigation to assist with long or short-range migrations or movements (Gill *et al.*, 2005; Normandeau *et al.*, 2011).

10.9.8.3 Elasmobranchs (sharks, rays and skates) are the major group of animals that are widely known to be sensitive to electric fields due to the presence of electroreceptive pores on the surface of their skin, known as Ampullae of Lorenzini. Both attraction and repulsion reactions to E-fields have been observed in elasmobranch species. Small spotted catshark, one of the elasmobranch species known to occur within the Fish, Shellfish and Sea Turtle Ecology Study Area, has been found to avoid electrical fields at 1,000 μV/cm (Gill and Taylor, 2001). A recent study by Hutchison *et al.* (2020) observed an increase in exploratory/foraging behaviour in little skate (*Leucoraja*

erinacea) in response to EMFs. A study commissioned by the Marine Management Organisation (MMO) (2014) found no evidence to suggest that EMF posed a significant risk to elasmobranchs at the site or population level, from the results of post-consent monitoring.

10.9.8.4 Other species, whilst not possessing specialised electroreceptors, are likely to be able to detect induced voltage gradients and include river lamprey, sea lamprey, European eel, cod, plaice and Atlantic salmon (Gill *et al.*, 2005). Lampreys possess specialised ampullary electroreceptors that are sensitive to weak, low frequency electric fields (Bodznick and Preston, 1983), but information regarding what use they make of the electric sense is limited. Chung-Davidson *et al.*, (2008) showed that the migratory behaviour of sea lamprey was affected (i.e. adults did not move) when stimulated with electrical fields of intensities of between 2.5 and 100 mV/m, with normal behaviour observed at electrical field intensities higher and lower than this range.

10.9.8.5 Atlantic salmon and European eel have both been found to possess magnetic material of a size suitable for magnetoreception, and these species can use the earth's magnetic field for orientation and direction-finding during migration (Gill and Bartlett, 2010; CSA, 2019). Mark and recapture experiments undertaken at the Nysted operational offshore windfarm showed that a high proportion of the tagged European eel crossed the 132 kV export cable (Hvidt *et al.*, 2003). A study of tagged European eel in the Baltic Sea found swimming speed to significantly reduce around a 130 kV sub-sea Alternating Current (AC) power cable, with the authors concluding that any delaying effect (i.e. on average 40 minutes) would not be likely to influence fitness in a 7,000 km migration. (Westerberg and Langenfelt, 2008). Research in Sweden on the effects of a High Voltage Direct Current (HVDC) cable on the migration patterns of a range of fish species, including salmonids, failed to find any effect (Westerberg *et al.*, 2007 as referenced in Wilhelmsson *et al.*, 2010). Research conducted at the Trans Bay cable, a direct current (DC) undersea cable near San Francisco, California, found that migration success and survival of chinook salmon *Oncorhynchus tshawytscha* was not impacted by the cable. However, behavioural changes were noted when these fish were near the cable (Kavet *et al.*, 2016) with salmon appearing to remain around the cable for longer periods. These studies demonstrate that while undersea power cables can result in altered patterns of fish behaviour, these changes are temporary and do not interfere with migration success or population health.

10.9.8.6 Potentially magneto-sensitive species are those that respond directly to geomagnetic and/or magnetic fields and typically species that undergo migration. Sea turtles (Chelonia), including leatherback turtle, are considered to be magneto-sensitive (Gill *et al.*, 2005), however, current understanding of their use of 'magnetic maps' is limited (Irwin and Lohmann, 2005; Johnsen and Lohmann, 2005). Lohmann and Lohmann (1996) suggested that whilst several species of turtle (Kemps Ridley's *Lepidochelys kempi*, green *Chelonia mydas*, and loggerheads *Caretta caretta*) utilise the Earth's B-fields, the use of these fields is not thought to be essential. As mentioned previously the Fish, Shellfish and Sea Turtle Ecology Study Area is unlikely to contain high numbers of leatherback turtles, however they may occasionally occur. Furthermore, leatherback turtles are unlikely to interact with the cables (and associated EMFs) to any great extent due to their pelagic nature.

10.9.8.7 Some benthic shellfish species may be affected to some extent by magnetic fields, for example spiny lobster *Panulirus argus* is thought to use the earth's magnetic field to orientate (Boles and Lohmann, 2003). However, it is unknown if other decapod crustaceans, including commercially important European lobster and *Nephrops*, are able to respond to magnetic fields in this way. In a field study Hutchison *et al.* (2018) observed the behaviour of American lobster *Homarus americanus* (a magneto-sensitive species) to Direct Current (DC) and AC fields from a buried cable and found that it did not cause a barrier to movement or migration. However, lobsters were observed to make more turns when near the energized cable. A separate study reported that crab movement and positioning inside large cages was unaffected by proximity to energised AC undersea power cables off southern California and in Puget Sound. The study indicated that crabs were also not attracted to or repelled by energised AC undersea power cables that were either

buried or unburied (Love *et al.*, 2016). Blue mussel, brown shrimp *Crangon crangon*, round crab *Rhithropanopeus harrisii* and flounder *Plathichthys flesus* exposed to static magnetic fields (B-field) of 3.7 mT for several weeks showed no differences in survival between exposed and control animals (Bochert and Zettler, 2004).

10.9.8.8 In summary, the range over which these species can detect electric fields from offshore windfarm subsea cables is very localised and likely to be limited to metres, from the cable (CSA, 2019). EMFs may alter animal behaviour (e.g. via avoidance of EMF, increases in foraging behaviour, reductions in swimming speeds) but there is little evidence to suggest a reduction in survival. Pelagic species are considered unlikely to be exposed to EMF as they generally swim well above the seafloor and consequently would rarely be exposed even at low levels from subsea power cables (CSA, 2019). All IEFs are therefore deemed to be of high tolerance and adaptability, high recoverability and of local to international importance. The sensitivity of all IEFs to temporary changes in electromagnetic fields is therefore, considered to be Low.

Operational and maintenance phase

MAGNITUDE OF THE IMPACT

10.9.8.9 A variety of design and installation factors affect EMF levels in the vicinity of the cables. These include current flow, distance between cables, cable insulation, number of conductors, configuration of cable and burial depth. The strength of the magnetic field (and consequently, iEs) decreases rapidly horizontally and vertically with distance from source (Normandeau *et al.*, 2011). Burial of cables, in particular, can therefore reduce the strength of the B- and iE-fields, however, it is unlikely that cables can be buried at sufficient depths that will reduce the magnitude of the B field, and hence the sediment-sea water interface iE field, to below that at which these fields could be detected by certain marine organisms on or close to the seabed (Gill *et al.*, 2005). By burying a cable, the magnetic field at the seabed is reduced as a result of field decay with distance from the cable (CSA, 2019). A recent study conducted by CSA (2019) found that inter-array and export cables buried between depths of 1 m to 2 m reduces the magnetic field at the seabed surface four-fold. For cables that are unburied and instead protected by thick concrete mattresses or rock berms, the field levels were found to be similar to buried cables.

10.9.8.10 EMF occurs naturally in the marine environment. The Earth's static magnetic field (geomagnetic field) is present in all environments, terrestrial and aquatic, and lies in the range 25 to 65 μT (Hutchison *et al.*, 2018; in the Irish Sea this is typically 45 to 50 μT; Normandeau *et al.*, 2011). Movement of seawater through the Earth's magnetic field (geomagnetic field) creates localised E-fields, which are typically very small, in the order of 10s of μV m-1, e.g. 25 μV m-1 is regarded as a natural ambient level in the North Sea and 30 μV m-1 has been reported for the English Channel (Tasker *et al.*, 2010; Normandeau *et al.*, 2011). Small electric fields are also directly produced by marine organisms.

10.9.8.11 Potential anthropogenic sources for EMF are primarily subsea cables used for power generation and telecommunications or submarine communications (Normandeau *et al.*, 2011; Tasker *et al.*, 2010). CSA (2019) compared offshore subsea cables from windfarms and found EMF magnetic field levels directly over AC power cables to range between 20 to 65 mG for 34.5 to 161 kV inter-array cables and 30 to 165 mG for 138 to 400 kV export cables at the seafloor. A reduction in magnetic field levels was seen 1 m above the seafloor, with 5 to 15 mG for inter-array cables and 10 to 40 mG for export cables. Induced electric field levels were 0.1 to 1.2 mV/m for inter-array and 0.2 to 2.0 mV/m for export cables, 1 m above the seafloor.

10.9.8.12 The design scenario proposes to install 110-122 km of 66 kV inter-array cables, 25-28 km of 220 kV interconnector cables and 35-40 km of 220 kV export cables. Cables would be buried at a depth of 0-1.5 m for inter-array cables and 0-2.5 m for interconnector and export cables. Furthermore, 15% of inter-array cable routes, 50% of OSP interconnector cable routes, and 20% of export cable require rock protection. Therefore, the values stated by CSA (2019) for magnetic

field levels and induced electric field levels 1 m above seafloor are expected to be directly comparable to that of the Proposed Development.

10.9.8.13 While there is some change to EMFs in the vicinity of inter-array and offshore export cables, these studies indicate that these are limited in extent, with the strength of EMF dissipating quickly with distance (within metres) from the buried cables. For example, magnetic field levels for export cables was 20 to 165 mG at seafloor by cable, 10 to 40 mG 1 m above cable and <0.1 to 12 mG 3 to 7.5 m away (lateral distance) and 1 m above the seafloor (CSA, 2019). The impact therefore is predicted to be of near-field extent (i.e. restricted to within the Array Area and Cable Corridor and Working Area), long term duration (i.e. the lifetime of the Proposed Development), continuous and of low consequence. The magnitude is therefore, considered to be Low.

SIGNIFICANCE OF THE EFFECT

10.9.8.14 The magnitude of the impact has been assessed as **Low**, with the sensitivity of IEFs as **Low.** Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.9.8.15 The effect of changes in EMFs is not significant in EIA terms. Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.9.8.16 The significance of effect from changes in EMFs is not significant in EIA terms. As such,, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of changes in EMFs.

10.10 Assessment of Project Design Option 2

10.10.1 Impact 1 – Temporary habitat loss/disturbance

10.10.1.1 Direct temporary habitat loss/disturbance within the Proposed Development will occur during the construction, operational and maintenance, and decommissioning phases as a result of a range of activities including use of jack-up vessels during installation/maintenance activities, installation and maintenance of inter-array, interconnector and offshore export cables and associated seabed preparation.

SENSITIVITY OF THE RECEPTOR

10.10.1.2 The sensitivity of the receptors is the same as that given in Project Design Option 1 (section 10.9.1).

Construction phase

MAGNITUDE OF THE IMPACT

10.10.1.3 Project design option 1 factored in a maximum of 9,929,060 m^2 of temporary habitat loss (section 10.9.1). For Project Design option 2, sandwave clearance for scour protection and OSP/WTG installation is less than that for Project Design option 1, equating to a maximum temporary habitat loss/disturbance (across all construction activities) of 9,892,260 m^2. Given the small degree of change, the magnitude is the same as that for Project Design option 1.

10.10.1.4 The impact is predicted to be restricted to the near-field, short term duration, frequent and of low consequence. Habitats are expected to recover following cessation of the construction activities. It is predicted that the impact will affect the receptor both directly and indirectly. The magnitude is therefore, considered to be **Low.**

SIGNIFICANCE OF THE EFFECT

10.10.1.5 The magnitude of the impact has been assessed as **Low.**

10.10.1.6 The sensitivity of *Nephrops*, sprat, leatherback turtle and basking shark is **Negligible**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Imperceptible**, which is **not significant** in EIA terms.

10.10.1.7 The sensitivity of fish species with overlapping nursery grounds is **Medium**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Slight** adverse, which is **not significant** in EIA terms.

10.10.1.8 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from temporary habitat loss to all other IEFs is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.1.9 The effect of temporary habitat loss/disturbance is not significant in EIA terms. Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.1.10 The significance of effect from temporary habitat loss/disturbance is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of temporary habitat loss/disturbance.

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.10.1.11 The design scenario is the same for both Project Design options and therefore the magnitude of temporary habitat loss/disturbance for Project Design Option 1 (given in section 10.9.1) is the same as that for Project Design option 2.

10.10.1.12 The impact is predicted to be restricted to the near-field, short term duration, infrequent and of low consequence. Habitats are expected to recover following cessation of repair activities. The magnitude is therefore, considered to be **Negligible.**

SIGNIFICANCE OF EFFECT

10.10.1.13 The magnitude of the impact has been assessed as **Negligible.**

10.10.1.14 The sensitivity of *Nephrops*, sprat, leatherback turtle and basking shark is **Negligible.** Therefore, the significance of effect from temporary habitat loss to these IEFs is **Imperceptible,** which is **not significant** in EIA terms.

10.10.1.15 The sensitivity of fish species with overlapping nursery grounds is **Medium**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Not Significant**, which is **not significant** in EIA terms.

10.10.1.16 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from temporary habitat loss to all other IEFs is **Not Significant**, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.1.17 The effect of temporary habitat loss/disturbance is not significant in EIA terms. Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.1.18 The significance of effect from temporary habitat loss/disturbance is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of temporary habitat loss/disturbance.

Decommissioning phase

MAGNITUDE OF IMPACT

10.10.1.19 The design scenario is the same for both Project Design options and therefore the magnitude of temporary habitat loss/disturbance for Project Design Option 1 (given in section 10.9.1) is the same as that for Project Design option 2.

10.10.1.20 The impact is predicted to be restricted to the near-field, short term duration, frequent and of low consequence. Habitats are expected to recover following cessation of the construction activities. It is predicted that the impact will affect the receptor both directly and indirectly. The magnitude is therefore, considered to be **Low.**

SIGNIFICANCE OF THE EFFECT

10.10.1.21 The magnitude of the impact has been assessed as **Low.**

10.10.1.22 The sensitivity of *Nephrops*, sprat, leatherback turtle and basking shark is **Negligible.** Therefore, the significance of effect from temporary habitat loss to these IEFs is **Imperceptible,** which is **not significant** in EIA terms.

10.10.1.23 The sensitivity of fish species with overlapping nursery grounds is **Medium**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Slight** adverse, which is **not significant** in EIA terms.

10.10.1.24 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from temporary habitat loss to all other IEFs is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.1.25 The effect of temporary habitat loss/disturbance is not significant in EIA terms. Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.1.26 The significance of effect from temporary habitat loss/disturbance is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of temporary habitat loss/disturbance.

10.10.2 Impact 2 – Increased suspended sediment concentrations and associated deposition

10.10.2.1 Increases in suspended sediment concentrations and associated sediment deposition are predicted to occur during the construction, operational and maintenance and decommissioning phases as a result of the installation and removal of foundations and the installation and

maintenance (repair and reburial) of inter-array, interconnector and offshore export cables. Volume II, Chapter 6: Coastal Processes provides a full description of the physical assessment, including numerical modelling used to inform the predictions made with respect to increases in suspended sediment and subsequent deposition.

SENSITIVITY OF THE RECEPTOR

10.10.2.2 The sensitivity of the receptors is the same as that given in Project Design Option 1 (section 10.9.2).

Construction phase

MAGNITUDE OF THE IMPACT

10.10.2.3 The design scenarios for Project Design option 1 and 2 are similar in nature with only small degrees of change (e.g. 139,200 m^3 of sandwave clearance for OSP/WTG installation for Project Design Option 1 and 117,600 m^3 for Project Design Option 2). Therefore, the magnitude of increased suspended sediment concentrations and associated deposition for Project Design Option 2 is the same as that described for Project Design Option 1 (section 10.9.2).

10.10.2.4 The impact is predicted to be restricted to the near-field, short term duration, frequent and of low consequence. Baseline conditions are expected to resume following cessation of the construction activities. It is predicted that the impact will affect the receptor both directly and indirectly. The magnitude is therefore, considered to be **Low.**

SIGNIFICANCE OF THE EFFECT

10.10.2.5 The magnitude of the impact has been assessed as **Low.**

10.10.2.6 The sensitivity of basking shark and sea turtle is **Negligible**. Therefore, the significance of effect from increased suspended sediment and deposition is **Imperceptible**, which is **not significant** in EIA terms.

10.10.2.7 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from increased suspended sediment and deposition is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.2.8 The effect of increased suspended sediments and associated deposition is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.2.9 The significance of effect from increased suspended sediments and associated deposition is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 is considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of increased suspended sediments and associated deposition.

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.10.2.10 The design scenario is the same for both Project Design Options and therefore the magnitude of temporary habitat loss/disturbance for Project Design Option 2 is the same as that for Project Design Option 1 (section 10.9.2).

10.10.2.11 The impact is predicted to be restricted to the near-field, short term duration (occurs across operation and maintenance period, however individual events will be short term), frequent and of low consequence. The magnitude is therefore, considered to be **Low.**

SIGNIFICANCE OF EFFECT

10.10.2.12 The magnitude of the impact has been assessed as **Low.**

10.10.2.13 The sensitivity of basking shark and sea turtle is **Negligible**. Therefore, the significance of effect from increased suspended sediment and deposition is **Imperceptible**, which is **not significant** in EIA terms.

10.10.2.14 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from increased suspended sediment and deposition is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.2.15 The effect of increased suspended sediments and associated deposition is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.2.16 The significance of effect from increased suspended sediments and associated deposition is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 is considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of increased suspended sediments and associated deposition.

Decommissioning phase

MAGNITUDE OF IMPACT

10.10.2.17 The design scenario is the same for both Project Design Options and therefore the magnitude of temporary habitat loss/disturbance for Project Design Option 2 is the same as that for Project Design Option 1 (section 10.9.2).

SIGNIFICANCE OF EFFECT

10.10.2.18 The magnitude of the impact has been assessed as **Low.**

10.10.2.19 The sensitivity of basking shark and sea turtle is **Negligible**. Therefore, the significance of effect from increased suspended sediment and deposition is **Imperceptible**, which is **not significant** in EIA terms.

10.10.2.20 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from increased suspended sediment and deposition is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.2.21 The effect of increased suspended sediments and associated deposition is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.2.22 The significance of effect from increased suspended sediments and associated deposition is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 is considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of increased suspended sediments and associated deposition.

10.10.3 Impact 3 - Injury and/or disturbance to fish and shellfish from underwater noise and vibration

10.10.3.1 Underwater noise and vibration within the Array Area and Cable Corridor and Working Area will occur during the construction, operational and maintenance, and decommissioning phases as a result of a range of activities including impact piling, cable laying, dredging, drilling, rock placement, vessel movements, operational WTG noise, and unexploded ordnance (UXO) clearance. This can cause injury and/or disturbance to fish and shellfish.

10.10.3.2 The assessment has been informed by the Underwater Noise Assessment by Subacoustech (Volume III, Appendix 11.1: Underwater Noise Assessment) which includes the results of numerical modelling using the INSPIRE underwater noise model.

SENSITIVITY OF THE RECEPTOR

10.10.3.3 The sensitivity of the receptors is the same as that given in section 10.9.3 for Project Design Option 1.

Construction phase

MAGNITUDE OF THE IMPACT – PILE DRIVING

10.10.3.4 Project Design Option 1 factored in noise produced during the installation of 56 WTGs with duration of pilling of 75 days. Project Design Option 2 considers the noise produced during the installation of 47 WTGs with duration of pilling of 63 days. Given the small degree of change, the magnitude of underwater noise produced during pilling is the same as that for Project Design Option 1.

SIGNIFICANCE OF THE EFFECT – PILE DRIVING

TYPE 1

10.10.3.5 The sensitivity of sandeel to noise produced during piledriving has been assessed as **Medium,** with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.10.3.6 The sensitivity of all other Type 1 IEFs to noise produced during piledriving has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

TYPE 2

10.10.3.7 The sensitivity of ling and blue whiting to noise produced during piledriving has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.10.3.8 The sensitivity of Atlantic salmon and sea trout to noise produced during piledriving has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

TYPE 3

10.10.3.9 The sensitivity of twaite shad and European eel to noise produced during piledriving has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.10.3.10 The sensitivity of all other Type 3 IEFs to noise produced during piledriving has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

EGGS AND LARVAE

10.10.3.11 The sensitivity of all egg IEFs to noise produced during piledriving has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

SHELLFISH

10.10.3.12 The sensitivity of all shellfish IEFs to noise produced during piledriving has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

SEA TURTLE

10.10.3.13 The sensitivity of leatherback turtle to noise produced during piledriving has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

MAGNITUDE OF THE IMPACT – VESSEL NOISE

10.10.3.14 The design scenario is the same for both Project Design Options and therefore the magnitude for Project Design Option 2 is the same as that for Project Design Option 1 (described in section 10.9.3).

SIGNIFICANCE OF THE EFFECT – PILE DRIVING

TYPE 1

10.10.3.15 The sensitivity of sandeel to continuous noise sources has been assessed as **Medium,** with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

10.10.3.16 The sensitivity of all other Type 1 IEFs to continuous noise sources has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

TYPE 2

10.10.3.17 The sensitivity of ling and blue whiting to continuous noise sources has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

10.10.3.18 The sensitivity of Atlantic salmon and sea trout to continuous noise sources has been assessed as **Medium**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

TYPE 3

10.10.3.19 The sensitivity of twaite shad and European eel to continuous noise sources has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.10.3.20 The sensitivity of all other Type 3 IEFs to continuous noise sources has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

EGGS AND LARVAE

10.10.3.21 The sensitivity of all egg IEFs to continuous noise sources has been assessed as **Low,** with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SHELLFISH

10.10.3.22 The sensitivity of all shellfish IEFs to continuous noise sources has been assessed as **Low,** with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SEA TURTLE

10.10.3.23 The sensitivity of leatherback turtle to continuous noise sources has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

MAGNITUDE OF THE IMPACT – UXO

10.10.3.24 The design scenario is the same for both Project Design Options and therefore the magnitude for Project Design Option 2 is the same as that for Project Design Option 1 (described in section 10.9.3).

SIGNIFICANCE OF THE EFFECT – UXO

TYPE 1

10.10.3.25 The sensitivity of sandeel to noise produced during UXO detonation has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.10.3.26 The sensitivity of all other Type 1 IEFs to noise produced during UXO detonation has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

TYPE 2

10.10.3.27 The sensitivity of ling and blue whiting to noise produced during UXO detonation has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.10.3.28 The sensitivity of Atlantic salmon and sea trout to noise produced during UXO detonation has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low,** therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

TYPE 3

10.10.3.29 The sensitivity of twaite shad and European eel to noise produced during UXO detonation has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low,** therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.10.3.30 The sensitivity of all other Type 3 IEFs to noise produced during UXO detonation has been assessed as **Medium**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

EGGS AND LARVAE

10.10.3.31 The sensitivity of all egg IEFs to noise produced during UXO detonation has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be **Negligible Significance**, which is not significant in EIA terms.

SHELLFISH

10.10.3.32 The sensitivity of all shellfish IEFs to noise produced during UXO detonation has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be **Negligible Significance**, which is not significant in EIA terms.

SEA TURTLE

10.10.3.33 The sensitivity of leatherback turtle to noise produced during UXO detonation has been assessed as **Low**, with the magnitude of the effect being assessed as **Low**, therefore the impact will be **Negligible Significance**, which is not significant in EIA terms.

PROPOSED MITIGATION

10.10.3.34 No further mitigation has been proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.3.35 The significance of effect from underwater noise and vibration during piling, and other construction activities is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of underwater noise and vibration.

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.10.3.36 Project Design Option 1 factored in noise produced during the operation of 56 WTGs. Project Design Option 2 considers the noise produced during the operation of 47 WTGs. The project design scenario for number of vessels and return trips is the same between Project Design Options 1 and 2. Given the small degree of change, the magnitude of underwater noise produced during pilling is the same as that for Project Design Option 1.

SIGNIFICANCE OF EFFECT

TYPE 1

10.10.3.37 The sensitivity of sandeel has been assessed as **Medium**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

10.10.3.38 The sensitivity of all other Type 1 IEFs has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

TYPE 2

10.10.3.39 The sensitivity of ling and blue whiting has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

10.10.3.40 The sensitivity of Atlantic salmon and sea trout has been assessed as **Medium**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

TYPE 3

10.10.3.41 The sensitivity of twaite shad and European eel has been assessed as **Medium**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not significant**, which is not significant in EIA terms.

10.10.3.42 The sensitivity of all other Type 3 IEFs has been assessed as **Medium**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not significant**, which is not significant in EIA terms.

EGGS AND LARVAE

10.10.3.43 The sensitivity of all egg IEFs has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SHELLFISH

10.10.3.44 The sensitivity of all shellfish IEFs has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SEA TURTLE

10.10.3.45 The sensitivity of leatherback turtle has been assessed as **Low**, with the magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

PROPOSED MITIGATION

10.10.3.46 No additional mitigation is proposed for this effect.

RESIDUAL EFFECT ASSESSMENT

10.10.3.47 The significance of effect from underwater noise and vibration from the operation and maintenance of the WTGs is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. As such, no ecologically significant adverse residual effects have been predicted in respect of underwater noise and vibration.

10.10.4 Impact 4 – Injury and/or disturbance to basking shark and sea turtles from increased vessel activities.

10.10.4.1 Increased vessel movement during the construction, operational and maintenance and decommissioning phases has the potential to lead to an increased risk of collision on basking shark and leatherback turtle as these species may occur near the surface and therefore within the potential zone of impact.

SENSITIVITY OF THE RECEPTOR

10.10.4.2 The sensitivity of the receptors is the same as that given in Project Design Option 1 (section 10.9.4).

Construction phase

MAGNITUDE OF THE IMPACT

10.10.4.3 The design scenario is the same for both Project Design Options and therefore the magnitude of Injury and/or disturbance to basking shark and sea turtles from increased vessel activities for Project Design Option 2 is the same as that for Project Design Option 1 (described in section 10.9.4).

SIGNIFICANCE OF EFFECT

10.10.4.4 The magnitude of the impact has been assessed as **Negligible**, with the sensitivity of basking sharks and sea turtles as **High**. Therefore, the significance of effect from collision risk will be **Not Significant**, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.4.5 The effects of injury and/or disturbance to basking shark and sea turtles from increased vessel activities is not significant in EIA terms, Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.4.6 The significance of effect from injury and/or disturbance to basking shark and sea turtles from increased vessel activities is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of injury and/or disturbance to basking shark and sea turtles from increased vessel activities.

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.10.4.7 The design scenario is the same for both Project Design Options and therefore the magnitude of Injury and/or disturbance to basking shark and sea turtles from increased vessel activities for Project Design Option 2 is the same as that for Project Design Option 1 (described in section 10.9.4).

SIGNIFICANCE OF EFFECT

10.10.4.8 The magnitude of the impact has been assessed as **Negligible**, with the sensitivity of basking sharks and sea turtles as **High**. Therefore, the significance of effect of injury and/or disturbance to basking shark and sea turtles from increased vessel activities will be **Not significant**, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.4.9 The effects of collision risk on basking sharks and sea turtles is not significant in EIA terms, Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.4.10 The significance of effect of injury and/or disturbance to basking shark and sea turtles from increased vessel activities is not significant in EIA terms. As such, no additional mitigation to that

already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of injury and/or disturbance to basking shark and sea turtles from increased vessel activities.

Decommissioning phase

MAGNITUDE OF IMPACT

10.10.4.11 The design scenario is the same for both Project Design Options and therefore the magnitude of Injury and/or disturbance to basking shark and sea turtles from increased vessel activities for Project Design Option 2 is the same as that for Project Design Option 1 (described in section 10.9.4).

SIGNIFICANCE OF EFFECT

10.10.4.12 The magnitude of the impact has been assessed as **Negligible**, with the sensitivity of basking sharks and sea turtles as **High**. Therefore, the significance of effect from collision risk will be **Not Significant**, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.4.13 The effects of injury and/or disturbance to basking shark and sea turtles from increased vessel activities is not significant in EIA terms, Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.4.14 The significance of effect injury and/or disturbance to basking shark and sea turtles from increased vessel activities is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of injury and/or disturbance to basking shark and sea turtles from increased vessel activities.

10.10.5 Impact 5 – Accidental pollution from vessels, vehicles, equipment and machinery

10.10.5.1 Accidental release of pollutants (such as fuel, lubricants, and anti-fouling biocides) from vessels or equipment associated with the Proposed Development has the potential to occur during the construction, operational and maintenance and decommissioning phases as a result of the installation/removal of foundations, presence of operational equipment, maintenance activities, and the installation of inter-array cables, interconnector cables and offshore export cables.

SENSITIVITY OF THE RECEPTOR

10.10.5.2 The sensitivity of the receptors is the same as that given in Project Design Option 1 (section 10.9.5).

Construction phase

MAGNITUDE OF THE IMPACT

10.10.5.3 The design scenario is the similar for both Project Design Options and therefore the magnitude of Accidental pollution from vessels, vehicles, equipment and machinery for Project Design Option 2 is the same as that for Project Design Option 1 (described in section 10.9.5).

10.10.5.4 Accidental release of pollutants during all construction phase is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed), infrequent and of low consequence. The magnitude is therefore, considered to be **Low.**

SIGNIFICANCE OF THE EFFECT

10.10.5.5 The magnitude of the impact has been assessed as **Low.**

10.10.5.6 The sensitivity of shellfish IEFs and fish species which spawn within the Proposed Development is **Medium**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

10.10.5.7 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.5.8 The effect of accidental pollution is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.5.9 The significance of effect from accidental pollution is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of accidental pollution.

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.10.5.10 The design scenario is the similar for both Project Design Options and therefore the magnitude of Accidental pollution from vessels, vehicles, equipment and machinery for Project Design Option 2 is the same as that for Project Design Option 1 (described in section 10.9.5).

10.10.5.11 Accidental release of pollutants during the operational and maintenance phase is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed), infrequent and of low consequence. The magnitude is therefore, considered to be **Negligible.**

SIGNIFICANCE OF EFFECT

10.10.5.12 The magnitude of the impact has been assessed as **Negligible.**

10.10.5.13 The sensitivity of shellfish IEFs and fish species which spawn within the Proposed Development is **Medium**. Therefore, the significance of effect will be **Not Significant**, which is **not significant** in EIA terms.

10.10.5.14 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Not Significant**, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.5.15 The effect of accidental pollution is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.5.16 The significance of effect from accidental pollution is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of accidental pollution.

Decommissioning phase

MAGNITUDE OF IMPACT

10.10.5.17 The design scenario is the similar for both Project Design Options and therefore the magnitude of accidental pollution from vessels, vehicles, equipment and machinery for Project Design Option 2 is the same as that for Project Design Option 1 (described in section 10.9.5).

10.10.5.18 Accidental release of pollutants during the decommissioning phase is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed), infrequent and of low consequence. The magnitude is therefore, considered to be **Low.**

SIGNIFICANCE OF EFFECT

10.10.5.19 The magnitude of the impact has been assessed as **Low.**

10.10.5.20 The sensitivity of shellfish IEFs and fish species which spawn within the Proposed Development is **Medium**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

10.10.5.21 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.5.22 The effect of accidental pollution is not significant in EIA terms. As such, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.5.23 The significance of effect from accidental pollution is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of accidental pollution.

10.10.6 Impact 6 – Long term habitat loss

10.10.6.1 Long-term habitat loss will occur directly under all foundation structures, associated scour protection and cable protection (including at crossings) where this is required. This impact considers the habitat loss occurring during the operational and maintenance phases.

SENSITIVITY OF THE RECEPTOR

10.10.6.2 The sensitivity of the receptors is the same as that given in Project Design Option 1 (section 10.9.6).

Operational and maintenance phase

MAGNITUDE OF THE IMPACT

10.10.6.3 Project Design Option 1 factored in a maximum of 662,800 m^2 of long-term habitat loss (section 10.9.6). For Project Design Option 2 the area of scour protection for WTG foundations is less than that for Project Design Option 1 due to a small number of WTG foundations, equating to a maximum long term habitat loss of 618,921 m^2. Given the small degree of change, the magnitude is the same as that for Project Design Option 1.

10.10.6.4 Long-term habitat loss is predicted to be of highly localised spatial extent (restricted to discrete areas within the Array Area and Cable Corridor and Working Area), long-term duration and continuous throughout the 36.5-year operational and maintenance phase. It is predicted that the impact will affect fish, shellfish and sea turtle receptors directly or indirectly depending on species' life strategy. The magnitude is therefore, considered to be **Low.**

SIGNIFICANCE OF THE EFFECT

10.10.6.5 The magnitude of the impact has been assessed as **Low.**

10.10.6.6 The sensitivity of sprat, blue mussel, common whelk, *Nephrops*, leatherback turtle and basking shark is **Negligible**. Therefore, the significance of effect will be **Imperceptible** significance, which is **not significant** in EIA terms.

10.10.6.7 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.6.8 The effects of long-term habitat loss is not significant in EIA terms. Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.6.9 The significance of effect from long term habitat loss is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of collision risk to basking sharks and sea turtles.

10.10.7 Impact 7 – Alteration of seabed habitats arising from changes in physical processes

10.10.7.1 The presence of the WTG and OSP foundations and associated scour protection may lead to changes in the physical processes within the Array Area and potentially further afield and subsequently alteration of seabed habitats. Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling, describes in detail the changes that could occur as a result of the presence of foundation structures and associated scour protection.

SENSITIVITY OF THE RECEPTOR

10.10.7.2 The sensitivity of the receptors is the same as that given in Project Design Option 1 (section 10.9.7).

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.10.7.3 The magnitude will be of a similar nature to that of Project Design Option 1 (section 10.9.7), with the only difference being Project Design option 2 having fewer WTGs and therefore a smaller scour protection footprint. Given the small degree of difference, the magnitude is the same as that for Project Design Option 1.

10.10.7.4 The potential alteration to seabed habitats due to changes in physical processes is predicted to be of near field (very localised) spatial extent, long term duration, continuous and of low consequence. The magnitude is therefore, considered to be **Low.**

SIGNIFICANCE OF EFFECT

10.10.7.5 The magnitude of the impact has been assessed as **Low.**

10.10.7.6 The sensitivity of basking shark and leatherback turtle is **Negligible**. Therefore, the significance of effect from alterations of seabed habitats arising from changes in physical processes is **Imperceptible**, which is **not significant** in EIA terms.

10.10.7.7 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from alterations of seabed habitats arising from changes in physical processes is **Slight** adverse, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.7.8 The effect of alteration of seabed habitats arising from changes in physical processes is not significant in EIA terms. Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.7.9 The significance of effect from alteration of seabed habitats arising from changes in physical processes is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of alteration of seabed habitats arising from changes in physical processes.

10.10.8 Impact 8 – Temporary Changes in Electromagnetic Fields (EMF) from subsea electrical cabling

10.10.8.1 The conduction of electricity through subsea power cables has the potential to emit a localised EMF which could potentially affect the sensory mechanisms of some species of fish and shellfish.

SENSITIVITY OF THE RECEPTOR

10.10.8.2 The sensitivity of the receptors is the same as that given in Project Design Option 1 (section 10.9.8).

Operational and maintenance phase

MAGNITUDE OF IMPACT

10.10.8.3 The design scenario is the same for both Project Design Options and therefore the magnitude of temporary changes in EMF from subsea electrical cabling for Project Design Option 2 is the same as that for Project Design Option 1 (described in section 10.9.8).

10.10.8.4 The impact is predicted to be of near-field extent (i.e. restricted to within the Array Area and Cable Corridor and Working Area), long term duration (i.e. the lifetime of the Proposed Development), continuous and of low consequence. The magnitude is therefore, considered to be **Low.**

SIGNIFICANCE OF EFFECT

10.10.8.5 The magnitude of the impact has been assessed as **Low**, with the sensitivity of IEFs as **Low.** Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

PROPOSED MITIGATION

10.10.8.6 The effect of changes in EMFs is not significant in EIA terms. Therefore, no mitigation measures are proposed.

RESIDUAL EFFECT ASSESSMENT

10.10.8.7 The significance of effect from changes in EMFs is not significant in EIA terms. As such, no additional mitigation to that already identified in Table 10.13 are considered necessary. Therefore, no ecologically significant adverse residual effects have been predicted in respect of changes in EMFs.

10.11 Cumulative impacts assessment methodology

10.11.1 Methodology

10.11.1.1 The Cumulative Impact Assessment (CIA) takes into account the impacts associated with the Proposed Development together with other proposed and reasonably foreseeable projects, plans and existing and permitted projects. The projects and plans selected as relevant to the CIA presented within this chapter are based upon the results of a screening exercise (see Volume III, Appendix 3.2: Cumulative Impact Assessment Screening). Each project and plan has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon, effect-receptor pathways and the spatial/temporal scales involved.

10.11.1.2 A tiered approach is adopted to provide an assessment of the Proposed Development as a whole. The tiering methodology is provided in Volume III, Appendix 3.2: CIA Screening.

10.11.1.3 A screening range of 80 km has been applied to encompass potential cumulative effects arising from the impacts. This will encompass the maximum distance of underwater noise effects (50 km for TTS effects from project specific modelling), as well as encapsulates the extent of known fish spawning and nursery grounds within the western Irish Sea. The projects included in the cumulative assessment are in close proximity to the Proposed Development therefore are all likely to have very similar seabed features and fish and shellfish assemblages to the Proposed Development.

10.11.1.4 Due to the commitments made by the Developer in respect of the Foreshore Licence FS007339 and Foreshore Licence Application FS007555 (Table 10.13), FS007339 and FS007555 have been screened out of the cumulative impact assessment.

Table 10.20: List of other projects and plans considered within the cumulative impact assessment

Project/Plan	*Status*	*Distance from Array Area (km)*	*Distance from Export Cable Corridors*	*Description of Project/Plan*	*Dates of Construction*	*Dates of Operation*	*Justification for screening in*
Tier 1							
ABWP1 operation	Operational	0	0.5	Initial foreshore licence granted in 2002	Complete	2003/04 onwards	Temporal overlap of operational phase with the Proposed Development construction and operation and maintenance phases.
Hibernia Atlantic Telecom	Operational	15.4	14.8	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and operation and maintenance phases.
UK-Ireland 2 Telecom	Operational	39.0	38.4	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed

							Development construction and operation and maintenance phases.
ESAT 2	Operational	46.3	45.4	Telecom	2021	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and operation and maintenance phases.
CeltixConnect - Sea Fibre Networks	Under Construction	49.2	48.3	Telecom cable	2022 - 2026	2026 onwards	Potential for temporal overlap of construction and operation with Proposed Development construction and operation and maintenance phases.
Hibernia Atlantic – Hibernia C	Operational	54.8	53.9	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development

							construction and operation and maintenance phases.
ZAYO Emerald Bridge One - Telecom	Operational	58.5	57.6	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and operation and maintenance phases.
SIRIUS South - Telecom	Operational	58.7	57.8	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and operation and maintenance phases.
Rockabill	Operational	64.9	64.0	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and operation and

							maintenance phases.
UK-Ireland crossing 1	Operational	67.0	66.4	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and operation and maintenance phases.
East West Interconnector	Operational	68.5	67.6	Power	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and operation and maintenance phases.
ESAT 1	Operational	68.9	68.3	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and operation and maintenance phases.

SOLAS	Operational	69.0	68.4	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and operation and maintenance phases.
Havhingsten	Operational	70.3	69.3	Telecom	2021	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and operation and maintenance phases.
Greenlink interconnector	Under Construction	79.6	79.0	Power	2021-2024	2024 onwards	Potential for temporal overlap of operation with Proposed Development construction and operation and maintenance phases.

Dublin Port Company dredge disposal	Operational	45.1	44.2	Disposal of 1,102,723 tonnes of dredged material	N/A	2022 onwards	Potential for temporal overlap with Proposed Development construction and operation and maintenance phases.	
Wexford County council dredge disposal	Operational	75.9	75.3	Disposal of dredged material	N/A	2021-2027	Potential for temporal overlap with Proposed Development construction phase.	
Tier 3								
ABWP1 Decommissioning Assumptions		0	0	Constructed in 2003/04 consisting of seven wind turbines with a capacity of 25.2 Megawatt (MW). Included as part of the baseline environment.		Anticipated duration of four months during 2025-2027	N/A	Potential for temporal overlap of decommissioning with Proposed Development construction phase.
Mares Connect	Proposed	37.5	36.6	Power cable	2024 - 2027	2027 onwards		Potential for temporal overlap of construction and operation with Proposed Development construction and operation and maintenance phases.
Phase one Projects								

Codling Wind Park (formerly known as Codling I and Codling II)	Early planning	10.3	9.4	Application expected to be made under the Maritime Area Planning (MAP) Act 2021. 60 to 70 WTGs and up to three OSPs.	2027 - 2028	2028 onwards	Potential for temporal overlap of construction and operation with Proposed Development construction and operation and maintenance phases.
Dublin Array (formerly known as Bray and Kish Offshore Windfarms)	Proposed	25.8	24.9	Updated application expected to be made under the MAP Act 2021.	2028-2032	2032 onwards	Potential for temporal overlap of construction and operation with Proposed Development construction and operation and maintenance phases.
North Irish Sea Array	Early planning	65.1	64.1	Updated application expected to be made under the MAP Act 2021.	2027 - 2029	2029 onwards	Potential for temporal overlap of construction and operation with Proposed Development construction and operation and maintenance phases.

10.11.1.6 Table 10.21 presents the potential impacts, development phase, and the list of projects / plans with which the two Project Design Options have been cumulatively assessed.

Table 10.21: Cumulative assessment impacts, phases, scenarios, and projects to be considered cumulatively

Potential cumulative impact	Phase			Projects considered cumulatively	Justification for projects considered cumulatively
	C	O	D		
Temporary Habitat loss	✓	✓	✓	Project parameters associated with Project Design Option 1 or 2 plus the following projects: **Tier 1** All power cable and telecom projects **Tier 3** Mares Connect and ABWP1 decommissioning. **Phase one** • ABWP1; • Codling Wind Park; • Dublin Array; and • North Irish Sea Array	Temporary habitat loss will result from construction activities, as well as repair activities associated with those projects.
Increased suspended sediment concentrations and associated sediment deposition	✓	✓	✓	Project parameters associated with Project Design Option 1 or 2 plus the following projects: **Tier 1** • All power cable and telecom projects; • Dublin Port Company dredge disposal; and • Wexford county Council dredge disposal **Tier 3**	Increased suspended sediment concentrations and associated sediment deposition will result from construction activities, as well as repair activities associated with those projects and dredge disposal activities.

				Mares Connect and ABWP1 decommissioning. **Phase one** • ABWP1; • Codling Wind Park; • Dublin Array; and • North Irish Sea Array	
Injury and/or disturbance to fish and shellfish from underwater noise and vibration	✓	✓	×	Project parameters associated with Project Design Option 1 or 2 plus the following projects: **Tier 1** All power cable and telecom projects **Tier 3** Mares Connect and ABWP1 decommissioning. **Phase one** • ABWP1; • Codling Wind Park; • Dublin Array; and • North Irish Sea Array	Underwater noise and vibration effects will result from construction activities, as well as repair activities associated with those projects.
Injury and/or disturbance to basking shark and sea turtles from increased vessel activities	✓	✓	✓	Project parameters associated with Project Design Option 1 or 2 plus the following projects: **Tier 1** • All power cable and telecom projects; • Dublin Port Company dredge disposal; and • Wexford county Council dredge disposal **Tier 3**	Increased vessel activities will occur during construction periods for these projects, as well as during repair activities of the operational phase.

				Mares Connect and ABWP1 decommissioning. **Phase one** • ABWP1; • Codling Wind Park; • Dublin Array; and • North Irish Sea Array	
Accidental pollution	✓	✓	✓	Project parameters associated with Project Design Option 1 or 2 plus the following projects: **Tier 1** • All power cable and telecom projects; • Dublin Port Company dredge disposal; and • Wexford county Council dredge disposal **Tier 3** Mares Connect and ABWP1 decommissioning. **Phase one** • ABWP1; • Codling Wind Park; • Dublin Array; and • North Irish Sea Array	Accidental pollution could occur from construction activities, as well as repair activities associated with those projects.
Long term habitat loss	×	✓	×	Project parameters associated with Project Design Option 1 or 2 plus the following projects: **Tier 1** All power cable and telecom projects **Tier 3**	Long term habitat loss could result from the presence of infrastructure and rock protection associated with these projects.

				Mares Connect. **Phase one** • ABWP1; • Codling Wind Park; • Dublin Array; and • North Irish Sea Array	
Alterations of seabed habitats arising from changes in physical processes	×	✓	×	Project parameters associated with Project Design Option 1 or 2 plus the following projects: **Tier 1** All power cable and telecom projects **Tier 3** Mares Connect **Phase one** • ABWP1; • Codling Wind Park; • Dublin Array; and • North Irish Sea Array	Alterations of seabed habitats arising from changes in physical processes could result from the presence of infrastructure and rock protection associated with these projects
Temporary Changes in Electromagnetic Fields (EMF) from subsea electrical cabling	×	✓	×	Project parameters associated with Project Design Option 1 or 2 plus the following projects: **Tier 1** All power cable and telecom projects **Tier 3** Mares Connect **Phase one** • ABWP1; • Codling Wind Park; • Dublin Array; and • North Irish Sea Array	EMFs could be emitted during the operation of cables associated with these projects.

10.12 Cumulative impact assessment

10.12.1.1 Tier 1 projects screened in include a number of power and telecommunication cables. All, other than CeltixConnect, will be operational at the time construction works of the Proposed Development commence. The construction of CeltixConnect may overlap with the construction phase for the Proposed Development and the operation of all Tier 1 cables may overlap the construction and operational phase of the Proposed Development.

10.12.1.2 Tier 1 projects screened in also includes dredge disposal. Dublin Port company are licensed for the disposal of 1,102,723 tonnes of dredged material and the exact numbers on the extent and volume of sediment to be disposed of are not available for Wexford County Council dredge disposal. Disposal is scheduled to take place during the construction and operational and maintenance phases of the Proposed Development for Dublin Port Company and during the construction phase of the Proposed Development for Wexford County Council. Tier 1 projects also include the operation of ABWP1. ABWP1 is currently operational and consists of seven WTGs and the operational phase of ABWP1 may overlap with the construction and operational phases of the Proposed Development.

10.12.1.3 Tier 3 projects screened in include the construction and operation of Mares Connect and decommissioning of ABWP1. The construction and operation of Mares Connect may overlap with the construction and operational and maintenance phase of the Proposed Development. The decommissioning of ABWP1 may overlap with the construction phase of the Proposed Development.

10.12.1.4 Decommissioning of ABWP1 will involve the cutting of monopiles at a depth of 3m below seabed, removal of monopiles and cutting, burial and backfilling of proportions of the inter-array cables. Decommissioning is anticipated to take 4 months between 2025 and 2027.

10.12.1.5 Phase one projects screened in include Codling wind Park, Dublin Array and North Irish Sea Array. The construction phase of Codling Wind Park, Dublin Array and North Irish Sea Array may overlap with the construction phase of the Proposed Development. The operational phase of Codling Wind Park, Dublin Array and North Irish Sea Array may overlap with the construction and/or operational phases of the Proposed Development.

10.12.1.6 Plans for Dublin Array indicate that the proposed development will comprise a maximum of 61 WTGs, three OSP's and three export cables (Innogy, 2020). Plans for Codling Wind Park indicate that the proposed development may comprise 60 to 70 WTGs and up to three OSPs. Plans for North Irish Sea Array indicate 35 to 46 WTGs with associated OSPs and cabling (Arup, 2021). All the Phase one projects show similar construction, operation and decommissioning activities and therefore the impacts and magnitudes of the impacts are expected to be similar in nature to that of the Proposed Development.

10.12.1.7 A description of the significance of cumulative effects upon fish, shellfish and sea turtles arising from each identified impact is given below.

10.12.2 Project Design Option 1 and 2 - Impact 1 - Temporary habitat loss/disturbance

SENSITIVITY OF THE RECEPTOR

10.12.2.1 The sensitivity of the receptors is described in detail in section 10.9.1 and was determined as Negligible to Medium.

Construction phase

TIER 1

MAGNITUDE OF IMPACT

10.12.2.2 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the construction phase. The Proposed Development, together with the Tier 1 projects and plans identified, may lead to cumulative temporary habitat loss/disturbance.

10.12.2.3 Any cumulative temporary habitat loss / disturbance as a result of the construction phase of the Proposed Development and the construction and operation of the Tier 1 projects, is expected to be small in the context of the available habitats within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude remains as Low.

TIER 3

MAGNITUDE OF IMPACT

10.12.2.4 The magnitude of the impact for both Project Design Options 1 and 2 was determined as Low for the construction phase. Any cumulative temporary habitat loss / disturbance as a result of the construction phase of the Proposed Development and the construction and operation of Mares Connect and decommissioning of ABWP1, is expected to be small in the context of the available habitats within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude remains as Low.

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.2.5 The magnitude of the impact for both Project Design Options 1 and 2 was determined as Low for the construction phase.

10.12.2.6 From the Phase one projects, temporary habitat loss / disturbance may occur as a result of the installation of WTGs, OSPs and associated cables during the construction phase of Codling Wind Park, Dublin Array and North Irish Sea Array, and during repair and maintenance activities associated with Codling Wind Park and North Irish Sea Array.

10.12.2.7 Any cumulative temporary habitat loss / disturbance as a result of the construction phase of the Proposed Development and the construction and operation of the Phase one projects, is expected to be small in the context of the available habitats within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude remains as Low.

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.2.8 The magnitude of the impact for both Project Design Options 1 and 2 was determined as Low for the construction phase. Any cumulative temporary habitat loss / disturbance as a result of the construction phase of the Proposed Development and the construction, operation and decommissioning of the Tier 1, Tier 3 and Phase one projects, is expected to be small in the context of the available habitats within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude remains as Low.

SIGNIFICANCE OF EFFECT

10.12.2.9 Overall, the cumulative magnitude of the impact is deemed to be **Low** for both Project Design Options.

10.12.2.10 The sensitivity of *Nephrops*, sprat, leatherback turtle and basking shark is **Negligible.** Therefore, the significance of effect from temporary habitat loss to these IEFs is **Imperceptible,** which is **not significant** in EIA terms.

10.12.2.11 The sensitivity of fish species with overlapping nursery grounds is **Medium**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Slight** adverse, which is **not significant** in EIA terms.

10.12.2.12 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from temporary habitat loss to all other IEFs is **Slight** adverse, which is **not significant** in EIA terms.

Operational and maintenance phase

TIER 1

MAGNITUDE OF IMPACT

10.12.2.13 The magnitude of the impact for both Project Design Options 1 and 2 was determined as Negligible. Any cumulative temporary habitat loss / disturbance as a result of the operational and maintenance phase of the Proposed Development and the operation of the Tier 1 projects, is expected to be small in the context of the available habitats within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude remains as Negligible.

TIER 3

MAGNITUDE OF IMPACT

10.12.2.14 The magnitude of the impact for both Project Design Options 1 and 2 was determined as Negligible for the operational phase. Any cumulative temporary habitat loss / disturbance as a result of the operational and maintenance phase of the Proposed Development and the operation of Mares Connect, is expected to be small in the context of the available habitats within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude remains as Negligible.

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.2.15 The magnitude of the impact for both Project Design Options 1 and 2 was determined as Negligible.

10.12.2.16 From the Phase one projects, temporary habitat loss / disturbance will occur as a result of the installation of WTGs, OSPs and associated cables during the construction phase of Dublin Array, and during repair and maintenance activities associated with Codling Wind Park, Dublin Array and North Irish Sea Array.

10.12.2.17 When assessed cumulatively with the Phase one projects the magnitude is considered to be higher than that for the operational and maintenance phase of the Proposed Development alone, given the coincidence with the construction of Dublin Array. Any cumulative temporary habitat loss / disturbance as a result of the operational and maintenance phase of the Proposed

Development and the construction and operational phases of the Phase one projects, is expected to be similar in nature to that described for the cumulative impact during the construction phase. The cumulative impact will be small in the context of the available habitat within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude has been assessed as Low.

TIER 1 + TIER 2 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.2.18 The magnitude of the impact for both Project Design Options 1 and 2 was determined as Negligible for the operational and maintenance phase. Any cumulative temporary habitat loss / disturbance as a result of the construction phase of the Proposed Development and the construction, operation and decommissioning of the Tier 1, Tier 3 and Phase one projects, is expected to be small in the context of the available habitats within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude has been assessed as Low.

SIGNIFICANCE OF EFFECT

10.12.2.19 Overall, the cumulative magnitude of the impact is deemed to be **Low** for both Project Design Options.

10.12.2.20 The sensitivity of *Nephrops*, sprat, leatherback turtle and basking shark is **Negligible.** Therefore, the significance of effect from temporary habitat loss to these IEFs is **Imperceptible,** which is **not significant** in EIA terms.

10.12.2.21 The sensitivity of fish species with overlapping nursery grounds is **Medium**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Slight** adverse, which is **not significant** in EIA terms.

10.12.2.22 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from temporary habitat loss to all other IEFs is **Slight** adverse, which is **not significant** in EIA terms.

Decommissioning phase

TIER 1

MAGNITUDE OF IMPACT

10.12.2.23 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the decommissioning phase. Any cumulative temporary habitat loss / disturbance as a result of the decommissioning phase of the Proposed Development and the Tier 1 projects, is expected to be small in the context of the available habitats within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude remains as **Low.**

TIER 3

MAGNITUDE OF IMPACT

10.12.2.24 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the decommissioning phase. Any cumulative temporary habitat loss / disturbance as a result of the decommissioning phase of the Proposed Development and the Tier 3 projects, is

expected to be small in the context of the available habitats within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude remains as **Low.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.2.25 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the decommissioning phase. Any cumulative temporary habitat loss / disturbance as a result of the decommissioning phase of the Proposed Development and the Phase one projects, is expected to be small in the context of the available habitats within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude remains as **Low.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.2.26 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the decommissioning phase. Any cumulative temporary habitat loss / disturbance as a result of the decommissioning phase of the Proposed Development and the Tier 1, Tier 3 and Phase one projects, is expected to be small in the context of the available habitats within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area and would be temporary and reversible. Therefore, the magnitude remains as **Low.**

SIGNIFICANCE OF EFFECT

10.12.2.27 Overall, the cumulative magnitude of the impact is deemed to be **Low** for both Project Design Options.

10.12.2.28 The sensitivity of *Nephrops*, sprat, leatherback turtle and basking shark is **Negligible.** Therefore, the significance of effect from temporary habitat loss to these IEFs is **Imperceptible,** which is **not significant** in EIA terms.

10.12.2.29 The sensitivity of fish species with overlapping nursery grounds is **Medium**. Therefore, the significance of effect from temporary habitat loss to these IEFs is **Slight** adverse, which is **not significant** in EIA terms.

10.12.2.30 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from temporary habitat loss to all other IEFs is **Slight** adverse, which is **not significant** in EIA terms.

10.12.3 Project Design Option 1 and 2 - Impact 2 - Temporary increases in suspended sediment concentrations and associated deposition

SENSITIVITY OF THE RECEPTOR

10.12.3.1 The sensitivity of the receptors is described in detail in section 10.9.2 and was determined as **Negligible** to **Low.**

Construction phase

TIER 1

MAGNITUDE OF IMPACT

10.12.3.2 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low.** Changes in SSCs during construction and maintenance activities as part of Tier 1 projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be small in the context of available suitable habitats for sensitive receptors in the study area and wider region. Therefore, the magnitude remains as **Low.**

TIER 3

MAGNITUDE OF IMPACT

10.12.3.3 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low.** Changes in SSCs during construction and operation of Mares Connect and decommissioning of ABWP1 are also expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be small in the context of available suitable habitats of sensitive receptors in the study area and wider region. Therefore, the magnitude remains as **Low.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.3.4 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low.**

10.12.3.5 From the Phase one projects, increased suspended sediments will occur as a result of the installation of WTGs, OSPs and associated cables during the construction phase of Codling Wind Park, Dublin Array and North Irish Sea Array, and during repair and maintenance activities associated with Codling Wind Park and North Irish Sea Array.

10.12.3.6 Changes in SSCs during construction, maintenance, and decommissioning activities as part of the Phase one projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be small in the context of available suitable habitats of sensitive receptors in the study area and wider region. Therefore, the magnitude remains as **Low.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.3.7 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low.**

10.12.3.8 As discussed above, changes in SSCs during construction, maintenance and decommissioning activities as part of the Tier 1, Tier 3 and Phase one projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Therefore, the magnitude remains as **Low** (the same as that for the project alone assessments).

SIGNIFICANCE OF EFFECT

10.12.3.9 Overall, the cumulative magnitude of the impact is deemed to be **Low** for both Project Design Options.

10.12.3.10 The sensitivity of basking shark and sea turtle is **Negligible**. Therefore, the significance of effect from increased suspended sediment and deposition is **Imperceptible**, which is **not significant** in EIA terms.

10.12.3.11 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from increased suspended sediment and deposition is **Slight** adverse, which is **not significant** in EIA terms.

Operational and maintenance phase

TIER 1

MAGNITUDE OF IMPACT

10.12.3.12 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low**. Changes in SSCs during operational activities as part of the Tier 1 projects are also expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be small in the context of available suitable habitats of sensitive receptors in the study area and wider region. Therefore, the magnitude remains as **Low.**

TIER 3

MAGNITUDE OF IMPACT

10.12.3.13 Changes in SSCs during operational activities associated with Mares Connect are also expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be small in the context of available suitable habitats of sensitive receptors in the study area and wider region. Therefore, the magnitude remains as **Low.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.3.14 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low.**

10.12.3.15 From the Phase one projects, increased suspended sediments will occur as a result of the installation of WTGs, OSPs and associated cables during the construction phase of Dublin Array, and during repair and maintenance activities associated with Codling Wind Park, Dublin Array and North Irish Sea Array.

10.12.3.16 Changes in SSCs during construction, maintenance and decommissioning activities as part of the Phase one projects are also expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be small in the context of available suitable habitats of sensitive receptors in the study area and wider region. Therefore, the magnitude remains as **Low.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.3.17 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low**. As discussed above, changes in SSCs during construction, maintenance and decommissioning activities as part of the Tier 1, Tier 3 and Phase one projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Therefore, the magnitude remains as **Low** (the same as that for the project alone assessments).

SIGNIFICANCE OF EFFECT

10.12.3.18 Overall, the cumulative magnitude of the impact is deemed to be **Low** for both Project Design Options.

10.12.3.19 The sensitivity of basking shark and sea turtle is **Negligible**. Therefore, the significance of effect from increased suspended sediment and deposition is **Imperceptible**, which is **not significant** in EIA terms.

10.12.3.20 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from increased suspended sediment and deposition is **Slight** adverse, which is **not significant** in EIA terms.

Decommissioning phase

TIER 1

MAGNITUDE OF IMPACT

10.12.3.21 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low**. Changes in SSCs during activities as part of the Tier 1 projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be small in the context of available suitable habitats of sensitive receptors in the study area and wider region. Therefore, the magnitude remains as **Low.**

TIER 3

MAGNITUDE OF IMPACT

10.12.3.22 Changes in SSCs during activities as part of the Tier 3 projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be small in the context of available suitable habitats of sensitive receptors in the study area and wider region. Therefore, the magnitude remains as **Low.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.3.23 The magnitude of the impact for both Project Design Options 1 and 2 was determined as Low. Changes in SSCs during activities as part of the Phase one projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected

to be small in the context of available suitable habitats of sensitive receptors in the study area and wider region. Therefore, the magnitude remains as **Low.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.3.24 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low**. As discussed above, changes in SSCs during activities as part of the Tier 1, Tier 3 and Phase one projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Therefore, the magnitude remains as **Low** (the same as that for the project alone assessments).

SIGNIFICANCE OF EFFECT

10.12.3.25 Overall, the cumulative magnitude of the impact is deemed to be **Low** for both Project Design Options.

10.12.3.26 The sensitivity of basking shark and sea turtle is **Negligible**. Therefore, the significance of effect from increased suspended sediment and deposition is **Imperceptible**, which is **not significant** in EIA terms.

10.12.3.27 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from increased suspended sediment and deposition is **Slight** adverse, which is **not significant** in EIA terms.

10.12.4 Project Design Option 1 and 2 - Impact 3 – Injury and/or disturbance to fish and shellfish from underwater noise and vibration

SENSITIVITY OF THE RECEPTOR

10.12.4.1 The sensitivity of the receptors is described in detail in section 10.9.3 and was determined as **Low** to **Medium.**

Construction phase

TIER 1

MAGNITUDE OF IMPACT

10.12.4.2 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** to **Low** for the construction phase. The Proposed Development, together with the Tier 1 projects and plans identified, may lead to cumulative injury and disturbance form underwater noise and vibration.

10.12.4.3 All Tier 1 projects, other than CeltixConnect, will be operational at the time construction works of the Proposed Development commence. The construction of CeltixConnect may overlap with the construction phase for the Proposed Development. The underwater noise generated as a result of the Tier 1 projects in expect to be low in comparison to the noise generated by pilling for WTG and OSP installation. Therefore, the cumulative magnitude has been assessed as no greater than the magnitude for the project alone.

TIER 3

MAGNITUDE OF IMPACT

10.12.4.4 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** to **Low** for the construction phase.

10.12.4.5 The construction of Mares Connect may overlap with the construction phase for the Proposed Development and the decommissioning of ABWP1 may overlap with the construction of the Proposed Development. The underwater noise generated as a result of the Tier 3 projects in expect to be low in comparison to the noise generated by pilling for WTG and OSP installation. Therefore, the cumulative magnitude has been assessed as no greater than the magnitude for the project alone.

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.4.6 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** to **Low** for the construction phase.

10.12.4.7 From the Phase one projects, underwater noise will occur as a result of the installation of WTGs, OSPs and associated cables during the construction phase of Codling Wind Park, Dublin Array and North Irish Sea Array, and during repair and maintenance activities associated with Codling Wind Park and North Irish Sea Array.

10.12.4.8 The greatest risk of cumulative impacts from underwater noise has been identified as that generated during the concurrent piling of the construction phase of the Proposed Development along with the construction phases of the Phase one projects.

10.12.4.9 The piling during the construction of Codling Bank Wind Park is due to take place the year before that of pilling at the Proposed Development during 2027 and pilling for Dublin Array is due to take place the year after that of pilling at the Proposed Development during 2029. The pilling at North Irish Sea Array is due to take place during the same year as that of the Proposed Development and therefore pilling may temporally overlap. Piling operations during the construction of these Phase one projects are expected to be similar to that of the Proposed Development (intermittent and short-term duration).

10.12.4.10 Mortality and mortal injuries and recoverable injuries are expected to be small in extent, with mobile fish, shellfish and sea turtle species being able to avoid the noise sources during soft start procedures before the onset of these effects. TTS and behavioural effects will affect a larger number of individuals, however most fish, shellfish and sea turtle receptors are expected to be able to fully recover between project pilling periods.

10.12.4.11 The pilling at North Irish Sea Array is due to take place during the same year as that of the Proposed Development and therefore pilling may temporally overlap. As identified in section 10.9.3, Atlantic salmon, European eel, twaite shad and sea trout occur within the Slaney River Valley SAC and may migrate past the Proposed Development. While these species are highly mobile and able to avoid noise sources before the onset of mortality and recoverable injuries, disruption and delay to their migration may occur as a result. Should pilling at the Proposed Development and North Irish Sea Array coincide with each other, as well as coinciding with migration periods for diadromous species, the effect may be greater than that for the project alone. Furthermore, pilling at all the Phase one projects during migratory periods could result in prolonged impacts to diadromous species (i.e. disruption to migration over several years). Therefore, the cumulative magnitude of underwater noise generated during pilling on diadromous species has been determined as **Medium.**

10.12.4.12 Given the broadscale distribution of potential spawning and nursery grounds and appropriate habitats for all other fish, shellfish and sea turtle IEFs and/or their ability to avoid the impact, together with the low duration and low frequency of pilling events, the cumulative magnitude has been assessed as **Low** on all other IEFs for underwater noise generated during pilling.

10.12.4.13 Noise generated from continuous noise sources and UXO detonations are likely to be low in extent and intermittent. Therefore, the magnitude remains the same as that given for project alone.

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.4.14 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** to **Low** for the construction phase.

10.12.4.15 The greatest risk of cumulative impacts from underwater noise has been identified as that generated during the piling of the construction phase of the Proposed Development along with the construction phases of the Phase one projects. Therefore, the cumulative magnitude of the Proposed Development alongside the Tier 1, Tier 3 and Phase one projects is the same as the cumulative magnitude given above for the Phase one projects.

SIGNIFICANCE OF EFFECT - PILE DRIVING

TYPE 1

10.12.4.16 The sensitivity of sandeel to noise produced during piledriving has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is **not significant** in EIA terms.

10.12.4.17 The sensitivity of all other Type 1 IEFs to noise produced during piledriving has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is **not significant** in EIA terms.

TYPE 2

10.12.4.18 The sensitivity of ling and blue whiting to noise produced during piledriving has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is **not significant** in EIA terms.

10.12.4.19 The sensitivity of Atlantic salmon and sea trout to noise produced during piledriving has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Medium**, therefore the impact will be of **Moderate adverse** significance. Given the short-term duration of the impact and the mobile nature of both these species the impact has been determined as **not significant** in EIA terms.

TYPE 3

10.12.4.20 The sensitivity of twaite shad and European eel to noise produced during piledriving has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Medium**, therefore the impact will be of **Moderate adverse** significance. Given the short-term duration of the impact and the mobile nature of both these species the impact has been determined as **not significant** in EIA terms.

10.12.4.21 The sensitivity of all other Type 3 IEFs to noise produced during piledriving has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Low,** therefore the impact will be of **Slight adverse** significance, which is **not significant** in EIA terms.

EGGS AND LARVAE

10.12.4.22 The sensitivity of all egg IEFs to noise produced during piledriving has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is **not significant** in EIA terms.

SHELLFISH

10.12.4.23 The sensitivity of all shellfish IEFs to noise produced during piledriving has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is **not significant** in EIA terms.

SEA TURTLE

10.12.4.24 The sensitivity of leatherback turtle to noise produced during piledriving has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

SIGNIFICANCE OF EFFECT - CONTINIOUS NOISE SOURCES

TYPE 1

10.12.4.25 The sensitivity of sandeel to continuous noise sources has been assessed as **Medium,** with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is **not significant** in EIA terms.

10.12.4.26 The sensitivity of all other Type 1 IEFs to continuous noise sources has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is **not significant** in EIA terms.

TYPE 2

10.12.4.27 The sensitivity of ling and blue whiting to continuous noise sources has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is **not significant** in EIA terms.

10.12.4.28 The sensitivity of Atlantic salmon and sea trout to continuous noise sources has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Negligible,** therefore the impact will be **Not Significant**, which is not significant in EIA terms.

TYPE 3

10.12.4.29 The sensitivity of twaite shad and European eel to continuous noise sources has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Low,** therefore the impact will be of **Slight adverse** significance, which is **not significant** in EIA terms.

10.12.4.30 The sensitivity of all other Type 3 IEFs to continuous noise sources has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is **not significant** in EIA terms.

EGGS AND LARVAE

10.12.4.31 The sensitivity of all egg IEFs to continuous noise sources has been assessed as **Low,** with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SHELLFISH

10.12.4.32 The sensitivity of all shellfish IEFs to continuous noise sources has been assessed as **Low,** with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SEA TURTLE

10.12.4.33 The sensitivity of leatherback turtle to continuous noise sources has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SIGNIFICANCE OF EFFECT - UXO

TYPE 1

10.12.4.34 The sensitivity of sandeel to noise produced during UXO detonation has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.12.4.35 The sensitivity of all other Type 1 IEFs to noise produced during UXO detonation has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

TYPE 2

10.12.4.36 The sensitivity of ling and blue whiting to noise produced during UXO detonation has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.12.4.37 The sensitivity of Atlantic salmon and sea trout to noise produced during UXO detonation has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

TYPE 3

10.12.4.38 The sensitivity of twaite shad and European eel to noise produced during UXO detonation has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

10.12.4.39 The sensitivity of all other Type 3 IEFs to noise produced during UXO detonation has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Low,** therefore the impact will be of **Slight adverse** significance, which is not significant in EIA terms.

EGGS AND LARVAE

10.12.4.40 The sensitivity of all egg IEFs to noise produced during UXO detonation has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be **Negligible Significance**, which is not significant in EIA terms.

SHELLFISH

10.12.4.41 The sensitivity of all shellfish IEFs to noise produced during UXO detonation has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be **Negligible Significance**, which is not significant in EIA terms.

SEA TURTLE

10.12.4.42 The sensitivity of leatherback turtle to noise produced during UXO detonation has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Low**, therefore the impact will be **Negligible Significance**, which is not significant in EIA terms.

Operational and maintenance phase

TIER 1

MAGNITUDE OF IMPACT

10.12.4.43 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** for the operational and maintenance phase.

10.12.4.44 The operation of several subsea cables overlap with the operational and maintenance phase of the Proposed Development. The underwater noise generated during the operation of the Tier 1 projects is expected to be low. Therefore, the cumulative magnitude has been assessed as **Negligible.**

TIER 3

MAGNITUDE OF IMPACT

10.12.4.45 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** for the operational and maintenance phase.

10.12.4.46 The underwater noise generated during the operation of Mares Connect is expected to be low. Therefore, the cumulative magnitude has been assessed as **Negligible.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.4.47 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** for the operational and maintenance phase.

10.12.4.48 The impact during the operational and maintenance phases of the Proposed Development and the Phase one projects is expected to be low in extent, long term and continuous in the case of WTGs and short term and infrequent in the case of noise generated during repair activities. The cumulative magnitude for all hearing groups has therefore been assessed as **Negligible.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.4.49 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** for the operational and maintenance phase.

10.12.4.50 The impact during the operational and maintenance phases of the Proposed Development and the Tier 1, Tier 3 and Phase one projects is expected to be low in extent, long term and continuous in the case of WTGs and short term and infrequent in the case of noise generated during repair activities. The cumulative magnitude for all hearing groups has therefore been assessed as **Negligible.**

SIGNIFICANCE OF EFFECT

TYPE 1

10.12.4.51 The sensitivity of sandeel has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

10.12.4.52 The sensitivity of all other Type 1 IEFs has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

TYPE 2

10.12.4.53 The sensitivity of ling and blue whiting has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

10.12.4.54 The sensitivity of Atlantic salmon and sea trout has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

TYPE 3

10.12.4.55 The sensitivity of twaite shad and European eel has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not significant**, which is not significant in EIA terms.

10.12.4.56 The sensitivity of all other Type 3 IEFs has been assessed as **Medium**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not significant**, which is not significant in EIA terms.

EGGS AND LARVAE

10.12.4.57 The sensitivity of all egg IEFs has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SHELLFISH

10.12.4.58 The sensitivity of all shellfish IEFs has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

SEA TURTLE

10.12.4.59 The sensitivity of leatherback turtle has been assessed as **Low**, with the cumulative magnitude of the effect being assessed as **Negligible**, therefore the impact will be **Not Significant**, which is not significant in EIA terms.

10.12.5 Project Design Option 1 and 2 - Impact 4 – Injury and/or disturbance to basking shark and sea turtles from increased vessel activities

SENSITIVITY OF THE RECEPTOR

10.12.5.1 The sensitivity of the receptors is described in detail in section 10.9.4. The sensitivity of both basking sharks and sea turtles was determined as **High.**

Construction phase

TIER 1

MAGNITUDE OF IMPACT

10.12.5.2 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible.**

10.12.5.3 The potential for cumulative effects of collision risk on basking shark and leatherback turtle are considered with respect to increased vessel activity during construction of the Proposed Development alongside vessel activities associated with other projects.

10.12.5.4 Vessel activities associated with the maintenance of other developments are expected to be far less than those described for the construction phase of the Proposed Development. Similarly, to the Proposed Development, vessel activities associated with the construction and operation of Tier 1 projects are expected to be restricted to within the Development Working Area and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

TIER 3

MAGNITUDE OF IMPACT

10.12.5.5 The magnitude of the impact for both Project Design Options 1 and 2 was determined as Negligible. Vessel activities associated with the maintenance of Mares Connect are expected to be far less than those described for the construction phase of the Proposed Development. Similarly, to the Proposed Development, vessel activities associated with the construction and operation of Mares Connect and decommissioning of ABWP1 are expected to be restricted to within the Development Working Area and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.5.6 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible.**

10.12.5.7 From the Phase one projects, increased vessel activity will occur during the construction phase of Codling Wind Park, Dublin Array and North Irish Sea Array, and during repair and maintenance activities associated with Codling Wind Park and North Irish Sea Array.

10.12.5.8 Vessel activities associated with the maintenance of other developments are expected to be far less than those described for the construction phase of the Proposed Development. Similarly, to the Proposed Development, vessel activities associated with the construction and operation of

the Phase one projects are expected to be restricted to within the project areas and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.5.9 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible**. Vessel activities associated with the maintenance of other developments are expected to be far less than those described for the construction phase of the Proposed Development. Similarly, to the Proposed Development, vessel activities associated with the construction and operational phases are expected to be restricted to within the project areas and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

SIGNIFICANCE OF EFFECT

10.12.5.10 Overall, the cumulative magnitude of the impact has been assessed as **Negligible**, with the sensitivity of basking sharks and sea turtles as **High**. Therefore, the significance of effect from collision risk will be **Not Significant**, which is **not significant** in EIA terms.

Operational and maintenance phase

TIER 1

MAGNITUDE OF IMPACT

10.12.5.11 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible.**

10.12.5.12 The potential for cumulative effects of collision risk on basking shark and leatherback turtle are considered with respect to increased vessel activity during operation and maintenance of the Proposed Development alongside vessel activities at other projects.

10.12.5.13 Vessel activities associated with the maintenance of other developments are expected to be far less than those described for the construction phase of the Proposed Development. Similarly, to the Proposed Development, vessel activities associated with the operation of Tier 1 projects are expected to be restricted to within the project areas and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

TIER 3

MAGNITUDE OF IMPACT

10.12.5.14 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible**. Vessel activities associated with the maintenance of Mares Connect are expected to be far less than those described for the construction phase of the Proposed Development. Similarly, to the Proposed Development, vessel activities associated with the operation of Mares Connect are expected to be restricted to within the project areas and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.5.15 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible.**

10.12.5.16 From the Phase one projects, increased vessel activity will occur during the construction phase of Dublin Array, and during repair and maintenance activities associated with Codling Wind Park, Dublin Array and North Irish Sea Array.

10.12.5.17 Similarly, to the Proposed Development, vessel activities associated with the construction of Phase one projects are expected to be restricted to within the project areas and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.5.18 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible**. Similarly, to the Proposed Development, vessel activities associated with the construction phases are expected to be restricted to within the project areas and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

SIGNIFICANCE OF EFFECT

10.12.5.19 Overall, the cumulative magnitude of the impact has been assessed as **Negligible**, with the sensitivity of basking sharks and sea turtles as **High**. Therefore, the significance of effect from collision risk will be **Not Significant**, which is **not significant** in EIA terms.

Decommissioning phase

TIER 1

MAGNITUDE OF IMPACT

10.12.5.20 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible.**

10.12.5.21 The potential for cumulative effects of collision risk on basking shark and leatherback turtle are considered with respect to increased vessel activity during decommissioning of the Proposed Development alongside vessel activities at other projects.

10.12.5.22 Vessel activities associated with the Tier 1 projects are expected to be restricted to within the project areas and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

TIER 3

MAGNITUDE OF IMPACT

10.12.5.23 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible**. Vessel activities associated with the Tier 3 projects are expected to be restricted to within the project areas and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.5.24 The magnitude of the impact for both Project Design options 1 and 2 was determined as **Negligible**. Vessel activities associated with the Phase one projects are expected to be restricted to within the project areas and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.5.25 The magnitude of the impact for both Project Design options 1 and 2 was determined as **Negligible**. Vessel activities associated with the Tier 1, Tier 3 and Phase one projects are expected to be restricted to within the project areas and existing shipping routes to/from port. Therefore, the magnitude remains as **Negligible.**

SIGNIFICANCE OF EFFECT

10.12.5.26 Overall, the cumulative magnitude of the impact has been assessed as **Negligible**, with the sensitivity of basking sharks and sea turtles as **High**. Therefore, the significance of effect from collision risk will be **Not Significant**, which is **not significant** in EIA terms.

10.12.6 Project Design Option 1 and 2 - Impact 5 – Accidental pollution from vessels, vehicles, equipment and machinery

SENSITIVITY OF THE RECEPTOR

10.12.6.1 The sensitivity of the receptors is described in detail in section 10.9.5 and was determined as **Low** to **Medium.**

Construction phase

TIER 1

MAGNITUDE OF IMPACT

10.12.6.2 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the construction phase. Accidental release of pollutants during the construction phase of the Proposed Development and the construction and operational phases of other Tier 1 projects is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed) and infrequent. Considering the low likelihood of a pollution event occurring the magnitude remains as **Low.**

TIER 3

MAGNITUDE OF IMPACT

10.12.6.3 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the construction phase. Accidental release of pollutants during the construction and operation of Mares Connect and decommissioning of ABWP1 is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed) and infrequent. Considering the low likelihood of a pollution event occurring the magnitude remains as **Low.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.6.4 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the construction phase.

10.12.6.5 From the Phase one projects, accidental pollution may occur as a result of vessels and machinery required for installation of WTGs, OSPs and associated cables during the construction phase of Codling Wind Park, Dublin Array and North Irish Sea Array, and during repair and maintenance activities associated with Codling Wind Park and North Irish Sea Array.

10.12.6.6 Accidental release of pollutants during the construction phase of the Proposed Development and the construction and operational phases of the Phase one projects is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed) and infrequent. Considering the low likelihood of a pollution event occurring the magnitude remains as **Low.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.6.7 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the construction phase. Accidental release of pollutants during the construction phase of the Proposed Development and the construction and operational phases of the Tier 1, Tier 3 and Phase one projects is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed) and infrequent. Considering the low likelihood of a pollution event occurring the magnitude remains as **Low.**

SIGNIFICANCE OF EFFECT

10.12.6.8 Overall, the cumulative magnitude of the impact has been assessed as **Low.**

10.12.6.9 The sensitivity of shellfish IEFs and fish species which spawn within the Proposed Development is **Medium**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

10.12.6.10 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

Operational and maintenance phase

TIER 1

MAGNITUDE OF IMPACT

10.12.6.11 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** for the operational and maintenance phase. Accidental release of pollutants during the operational and maintenance phase of the Proposed Development and the operation of the Tier 1 projects is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed) and infrequent. Considering the low likelihood of a pollution event occurring the magnitude remains as **Negligible.**

TIER 3

MAGNITUDE OF IMPACT

10.12.6.12 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** for the operational and maintenance phase. Accidental release of pollutants during the operational and maintenance phase of the Proposed Development and the operation of Mares Connect is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed) and infrequent. Considering the low likelihood of a pollution event occurring the magnitude remains as **Negligible.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.6.13 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** for the operational and maintenance phase.

10.12.6.14 From the Phase one projects, accidental pollution may occur as a result of vessels and machinery required for the installation of WTGs, OSPs and associated cables during the construction phase of Dublin Array, and during repair and maintenance activities associated with Codling Wind Park, Dublin Array and North Irish Sea Array.

10.12.6.15 When assessed cumulatively with the Phase one projects the magnitude is considered to be higher than that for the operational and maintenance phase of the Proposed Development alone. Any cumulative accidental release of pollutants as a result of the operational and maintenance phase of the Proposed Development and the construction and operational phases of the Phase one projects, is expected to be similar in nature to that described for the cumulative impact during the construction phase. Therefore, the magnitude has been assessed as **Low.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.6.16 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Negligible** for the operational and maintenance phase. When assessed cumulatively with the Tier 1, Tier 3 and Phase one projects the magnitude is considered to be higher than that for the operational and maintenance phase of the Proposed Development alone. Any cumulative accidental release of pollutants as a result of the operational and maintenance phase of the Proposed Development and the construction and operational phases of other Tier 2 projects, is expected to be similar in nature to that described for the cumulative impact during the construction phase. Therefore, the magnitude has been assessed as **Low.**

SIGNIFICANCE OF EFFECT

10.12.6.17 Overall, the magnitude of the impact has been assessed as **Low.**

10.12.6.18 The sensitivity of shellfish IEFs and fish species which spawn within the Proposed Development is **Medium**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

10.12.6.19 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Slight adverse** significance, which is **not significant** in EIA terms.

Decommissioning phase

TIER 1

MAGNITUDE OF IMPACT

10.12.6.20 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the decommissioning phase. Accidental release of pollutants during the decommissioning phase of the Proposed Development and the other Tier 1 projects is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed) and infrequent. Considering the low likelihood of a pollution event occurring the magnitude remains as **Low.**

TIER 3

MAGNITUDE OF IMPACT

10.12.6.21 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the decommissioning phase. Accidental release of pollutants during the decommissioning phase of the Proposed Development and the Tier 3 projects is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed) and infrequent. Considering the low likelihood of a pollution event occurring the magnitude remains as **Low.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.6.22 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the decommissioning phase.

10.12.6.23 Accidental release of pollutants during the decommissioning phase of the Proposed Development and the Phase one projects is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed) and infrequent. Considering the low likelihood of a pollution event occurring the magnitude remains as **Low.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.6.24 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the decommissioning phase. Accidental release of pollutants during the decommissioning phase of the Proposed Development and the Tier 1, Tier 3 and Phase one projects is predicted to be of near-field and adjacent far field extent, short-term duration (any pollutant will be quickly dispersed) and infrequent. Considering the low likelihood of a pollution event occurring the magnitude remains as **Low.**

SIGNIFICANCE OF EFFECT

10.12.6.25 Overall, the magnitude of the impact has been assessed as **Low.**

10.12.6.26 The sensitivity of shellfish IEFs and fish species which spawn within the Proposed Development is **Medium**. Therefore, the significance of effect will be **Slight** adverse significance, which is **not significant** in EIA terms.

10.12.6.27 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Slight adverse** significance, which is **not significant** in EIA terms.

10.12.7 Project Design Option 1 and 2 - Impact 6 – Long term habitat loss

SENSITIVITY OF THE RECEPTOR

10.12.7.1 The sensitivity of the receptors is described in detail in section 10.9.6 and was determined as **Negligible** to **Low.**

Operational and maintenance phase

TIER 1

MAGNITUDE OF IMPACT

10.12.7.2 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the operational and maintenance phase. The loss of seabed habitats associated with the other Tier 1 projects is also expected to be highly localised and restricted to discrete areas within the proposed development areas. Therefore, the magnitude remains as **Low.**

TIER 3

MAGNITUDE OF IMPACT

10.12.7.3 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the operational and maintenance phase. The loss of seabed habitats associated with Mares Connect is also expected to be highly localised and restricted to discrete areas within the proposed development area. Therefore, the magnitude remains as **Low.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.7.4 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the operational and maintenance phase.

10.12.7.5 From the Phase one projects, long term habitat loss may occur as a result of the installation of rock protection at Codling Wind Park, Dublin Array and North Irish Sea Array. Given the similarity in project designs, the loss of seabed habitats associated with the Phase one projects is expected to be highly localised and restricted to discrete areas within the proposed development areas. Therefore, the magnitude remains as **Low.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.7.6 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the operational and maintenance phase. The loss of seabed habitats associated with the Tier 1, Tier 3 and Phase one projects is also expected to be highly localised and restricted to discrete areas within the proposed development area. Therefore, the magnitude remains as **Low.**

SIGNIFICANCE OF EFFECT

10.12.7.7 Overall, the cumulative magnitude of the impact has been assessed as **Low.**

10.12.7.8 The sensitivity of sprat, blue mussel, common whelk, *Nephrops*, leatherback turtle and basking shark is **Negligible**. Therefore, the significance of effect will be **Imperceptible** significance, which is **not significant** in EIA terms.

10.12.7.9 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect will be **Slight adverse** significance, which is **not significant** in EIA terms.

10.12.8 Project Design Option 1 and 2 - Impact 7 – Alteration of seabed habitats arising from changes in physical processes

SENSITIVITY OF THE RECEPTOR

10.12.8.1 The sensitivity of the receptors is described in detail in section 10.9.7 and was determined as **Negligible** to **Low.**

Operational and maintenance phase

TIER 1

MAGNITUDE OF IMPACT

10.12.8.2 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the operational and maintenance phase. From the Tier 1 projects alterations to seabed habitats arising from changes in physical processes may occur as a result of the presence of infrastructure and rock protection at ABWP1 and along the cable routes of the Tier 1 power and telecom cables. However, alterations to physical processes are expected to be highly localised and restricted to discrete areas within the proposed development areas. Therefore, the magnitude remains as **Low.**

TIER 3

MAGNITUDE OF IMPACT

10.12.8.3 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the operational and maintenance phase. From the Tier 3 projects alterations to seabed habitats arising from changes in physical processes may occur as a result of the presence of infrastructure and rock protection along the cable route of Mares Connect. However, alterations to physical processes are expected to be highly localised and restricted to discrete areas within the proposed development area. Therefore, the magnitude remains as **Low.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.8.4 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low** for the operational and maintenance phase.

10.12.8.5 From the Phase one projects, alteration of seabed habitats arising from changes in physical processes may occur as a result of the presence of infrastructure and rock protection associated with Codling Wind Park, Dublin Array and North Irish Sea Array. Given the similarity in Project Design Options, alterations in physical processes are expected to be highly localised and

restricted to discrete areas within the proposed development areas. Therefore, the magnitude remains as **Low.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.8.6 Alteration of seabed habitats arising from changes in physical processes may occur as a result of the presence of infrastructure and rock protection associated with the Tier 1, Tier 3 and Phase one projects. However, alterations in physical processes are expected to be highly localised and restricted to discrete areas within the proposed development areas. Therefore, the magnitude remains as **Low.**

SIGNIFICANCE OF EFFECT

10.12.8.7 Overall, the cumulative magnitude of the impact has been assessed as **Low.**

10.12.8.8 The sensitivity of basking shark and leatherback turtle is **Negligible**. Therefore, the significance of effect from alterations of seabed habitats arising from changes in physical processes is **Imperceptible**, which is **not significant** in EIA terms.

10.12.8.9 The sensitivity of all other IEFs is **Low**. Therefore, the significance of effect from alterations of seabed habitats arising from changes in physical processes is **Slight adverse**, which is **not significant** in EIA terms.

10.12.9 Project Design Option 1 and 2 - Impact 8 - Temporary Changes in Electromagnetic Fields (EMF) from subsea electrical cabling

SENSITIVITY OF THE RECEPTOR

10.12.9.1 The sensitivity of the receptors is described in detail in section 10.9.8 and was determined as **Low.**

Operational and Maintenance phase

TIER 1

MAGNITUDE OF IMPACT

10.12.9.2 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low.** EMF affects associated with the Tier 1 projects are expected to be highly localised and restricted to discrete areas within the proposed development areas (within metres of the cables). Therefore, the magnitude remains as **Low.**

TIER 3

MAGNITUDE OF IMPACT

10.12.9.3 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low.** EMF affects associated with the Tier 1 projects are expected to be highly localised and restricted to discrete areas within the proposed development areas (within metres of the cables). Therefore, the magnitude remains as **Low.**

PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.9.4 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low.** From the Phase one projects, EMFs may be emitted by cables associated with Codling Wind Park, Dublin Array and North Irish Sea Array. Given the similarity in project designs, EMF affects associated with the Phase one projects are expected to be highly localised and restricted to discrete areas within the proposed development areas (within metres of the cables). Therefore, the magnitude remains as **Low.**

TIER 1 + TIER 3 + PHASE ONE PROJECTS

MAGNITUDE OF IMPACT

10.12.9.5 The magnitude of the impact for both Project Design Options 1 and 2 was determined as **Low.** EMF affects associated with the Tier 1, Tier 3 and Phase one projects are expected to be highly localised and restricted to discrete areas within the proposed development areas (within metres of the cables). Therefore, the magnitude remains as **Low.**

SIGNIFICANCE OF EFFECT

10.12.9.6 Overall, the cumulative magnitude of the impact has been assessed as **Low**, with the sensitivity of IEFs as **Low**. Therefore, the significance of effect will be **Slight adverse** significance, which is **not significant** in EIA terms.

10.13 Transboundary effects

10.13.1.1 Transboundary effects are defined as those effects upon the receiving environment of other states, whether occurring from the Proposed Development alone, or cumulatively with other projects in the wider area. A screening of transboundary impacts has been carried out and has identified that there was potential for significant transboundary effects with regard to fish, shellfish and sea turtles from the Proposed Development upon the interests of other states.

10.13.1.2 As set out throughout sections 10.9 and 10.10, the majority of impacts on fish, shellfish and sea turtle IEFs from the Proposed Development will be restricted to within the Proposed Development boundaries and the area immediately surrounding it. The only exception is the effect of underwater noise during the construction phase (particularly piling), which has the potential to result in injury and/or disturbance to fish, shellfish and sea turtle IEFs within the Wales EEZ, as well as to fish which migrate to and from other states.

10.13.1.3 However, as outlined in sections 10.9.3 and 10.10.3., the magnitude of the impact for pilling is deemed to be **Low** and the sensitivity of the receptors (including those which may migrate to/from other jurisdictions) is considered to be **Low** to **Medium**. The effect will, therefore, be of **slight adverse** significance, which is **not significant** in EIA terms.

10.14 Summary of effects

10.14.1.1 This chapter has investigated the potential effects on fish, shellfish and sea turtles arising from the Proposed Development. The range of potential impacts and associated effects has been informed by the Scoping Report and consultation responses from stakeholders, alongside reference to existing legislation and guidance.

10.14.1.2 Potential impacts considered in this chapter, alongside any mitigation and residual effects are summarised in Table 10.22: and Table 10.23:. Throughout the construction, operational and maintenance, and decommissioning phases of the Proposed Development, all impacts assessed were found to have either Imperceptible, Not Significant, or Slight adverse effects on all fish, shellfish and sea turtle receptors. As a result, no impact pathway was considered to be significant in terms of the EIA Regulations.

Table 10.22: Summary of potential environmental impacts, mitigation and monitoring for Project Design Option 1

Description of impact	Phase			Factored-in measures	Magnitude of impact	Sensitivity of Receptors	Significance of effect	Additional measures	Residual effect	Proposed monitoring
	C	O	D							
1. Temporary habitat loss/disturbance	✓	✓	✓	Development of and adherence to a Rehabilitation Schedule. Confirmatory Survey to be undertaken within the Array Area and Cable Corridor and Working Area to verify the presence/ absence of any areas of reef habitat and blue mussel beds. Full details of factored-in measures can be found in Section 10.7.3.	C: Low O: Negligible D: Low	C: Negligible to medium O: Negligible to medium D: Negligible to medium	C: Slight adverse (not significant in EIA terms) O: Imperceptible adverse (not significant in EIA terms) D: Slight adverse (not significant in EIA terms)	None	C: Slight adverse (not significant in EIA terms) O: Imperceptible adverse (not significant in EIA terms) D: Slight adverse (not significant in EIA terms)	None

2.	Increased suspended sediment concentrations and associated deposition.	✓	✓	✓	Development of and adherence to a Rehabilitation Schedule. Management of bentonite spills via good working practises. Scour protection will be installed as described in Volume II, Chapter 4: Description of Development.	C: Low O: Low D: Low	C: Negligible to Low O: Negligible to Low D: Negligible to Low	C: Imperceptible to Slight adverse (not significant in EIA terms) O: Imperceptible to Slight adverse (not significant in EIA terms) D: Imperceptible to Slight adverse (not significant in EIA terms)	None	C: Imperceptible to Slight adverse (not significant in EIA terms) O: Imperceptible to Slight adverse (not significant in EIA terms) D: Imperceptible to Slight adverse (not significant in EIA terms)	None
3.	Injury and/or disturbance to fish and shellfish from underwater noise and vibration	✓	✓	×	Development of and adherence to a Rehabilitation Schedule. Implementation of and adherence to Marine Mammal Mitigation Plan (MMMP).	C: Negligible to Medium O: Negligible	C: Low to Medium O: Low to Medium	C: Not significant to Slight adverse (not significant in EIA terms) O: Not significant (not significant in EIA terms)	None	C: Not significant to Slight adverse (not significant in EIA terms) O: Not significant (not significant in EIA terms)	None

					Adherence to soft starts and maximum piling energies as set out in Volume II, Chapter 4 Description of Development.					
4.	Injury and/or disturbance to basking shark and sea turtles from increased vessel activities	✓	✓	✓	Commitment to the maximum vessel numbers as set out in Volume II, Chapter 4 Description of Development. Development of and adherence to a Rehabilitation Schedule. Development and issue of an Environmental VMP to all project vessel operators	C: Negligible O: Negligible D: Negligible	C: High O: High D: High	C: Not significant (not significant in EIA terms) O: Not significant (not significant in EIA terms) D: Not significant (not significant in EIA terms)	None	C: Not significant (not significant in EIA terms) O: Not significant (not significant in EIA terms) D: Not significant (not significant in EIA terms)	None

5.	Accidental pollution from vessels, vehicles, equipment and machinery	✓	✓	✓	Development of and adherence to a Rehabilitation Schedule. Development of and implementation of an Environmental Management Plan (EMP). A Marine Pollution Contingency Plan will be included in the EMP.	C: Low O: Negligible D: Low	C: Low to Medium O: Low to Medium D: Low to Medium	C: Moderate (not significant in EIA terms) O: Not significant (not significant in EIA terms) D: Moderate (not significant in EIA terms)	None	C: Slight adverse (not significant in EIA terms) O: Not significant (not significant in EIA terms) D: Slight adverse (not significant in EIA terms)	None
6.	Long term habitat loss	×	✓	×	Cables will be buried where possible and protected where not possible. Operational and Maintenance asset monitoring commitments include survey of seabed and assets every 6	O: Low	O: Negligible to Low	O: Imperceptible to Slight adverse (not significant in EIA terms)	None	O: Imperceptible to Slight adverse (not significant in EIA terms)	None

					months for the first two years and annually thereafter (Volume II: Chapter 4: Description of Development).					
7.	Alterations of seabed habitats arising from changes in physical processes	×	✓	×	Development of and adherence to a Rehabilitation Schedule. Scour protection.	O: Low	O: Negligible to Low	O: Imperceptible to Slight adverse (not significant in EIA terms)	None	O: Imperceptible to Slight adverse (not significant in EIA terms)	None
8.	Temporary changes in EMF from subsea electrical cabling	×	✓	×	Cables will be buried where possible and protected where not possible.	O: Low	O: Low	O: Slight adverse (not significant in EIA terms)	None	O: Slight adverse (not significant in EIA terms)	None

Table 10.23: Summary of potential environmental impacts, mitigation and monitoring for Project Design Option 2

Description of impact	Phase			Factored-in measures	Magnitude of impact	Sensitivity of Receptors	Significance of effect	Additional measures	Residual effect	Proposed monitoring
	C	O	D							
1. Temporary habitat loss/disturbance	✓	✓	✓	Development of and adherence to a Rehabilitation Schedule. Confirmatory Survey to be undertaken within the Array Area and Cable Corridor and Working Area to verify the presence/ absence of any areas of reef habitat and blue mussel beds. Full details of factored-in measures can be found in Section 10.7.3.	C: Low O: Negligible D: Low	C: Negligible to medium O: Negligible to medium D: Negligible to medium	C: Slight adverse (not significant in EIA terms) O: Imperceptible adverse (not significant in EIA terms) D: Slight adverse (not significant in EIA terms)	None	C: Slight adverse (not significant in EIA terms) O: Imperceptible adverse (not significant in EIA terms) D: Slight adverse (not significant in EIA terms)	None

2.	Increased suspended sediment concentrations and associated deposition.	✓	✓	✓	Development of and adherence to a Rehabilitation Schedule. Management of bentonite spills via good working practises. Scour protection will be installed as described in Volume II, Chapter 4: Description of Development.	C: Low O: Low D: Low	C: Negligible to Low O: Negligible to Low D: Negligible to Low	C: Imperceptible to Slight adverse (not significant in EIA terms) O: Imperceptible to Slight adverse (not significant in EIA terms) D: Imperceptible to Slight adverse (not significant in EIA terms)	None	C: Imperceptible to Slight adverse (not significant in EIA terms) O: Imperceptible to Slight adverse (not significant in EIA terms) D: Imperceptible to Slight adverse (not significant in EIA terms)	None
3.	Injury and/or disturbance to fish and shellfish from underwater noise and vibration	✓	✓	×	Development of and adherence to a Rehabilitation Schedule. Implementation of and adherence to Marine Mammal Mitigation Plan (MMMP).	C: Negligible to Medium O: Negligible	C: Low to Medium O: Low to Medium	C: Not significant to Slight adverse (not significant in EIA terms) O: Not significant (not significant in EIA terms)	None	C: Not significant to Slight adverse (not significant in EIA terms) O: Not significant (not significant in EIA terms)	None

					Adherence to soft starts and maximum piling energies as set out in Volume II, Chapter 4 Description of Development.					
4.	Injury and/or disturbance to basking shark and sea turtles from increased vessel activities	✓	✓	✓	Commitment to the maximum vessel numbers as set out in Volume II, Chapter 4 Description of Development. Development of and adherence to a Rehabilitation Schedule. Development and issue of an Environmental VMP to all project vessel operators.	C: Negligible O: Negligible D: Negligible	C: High O: High D: High	C: Not significant (not significant in EIA terms) O: Not significant (not significant in EIA terms) D: Not significant (not significant in EIA terms)	None	C: Not significant (not significant in EIA terms) O: Not significant (not significant in EIA terms) D: Not significant (not significant in EIA terms)	None

5.	Accidental pollution from vessels, vehicles, equipment and machinery	✓	✓	✓	Development of and adherence to a Rehabilitation Schedule. Development of and implementation of an Environmental Management Plan (EMP). A Marine Pollution Contingency Plan will be included in the EMP.	C: Low O: Negligible D: Low	C: Low to Medium O: Low to Medium D: Low to Medium	C: Moderate (not significant in EIA terms) O: Not significant (not significant in EIA terms) D: Moderate (not significant in EIA terms)	None	C: Slight adverse (not significant in EIA terms) O: Not significant (not significant in EIA terms) D: Slight adverse (not significant in EIA terms)	None
6.	Long term habitat loss	×	✓	×	Cables will be buried where possible and protected where not possible. Operational and Maintenance asset monitoring commitments include survey of seabed and assets every 6	O: Low	O: Negligible to Low	O: Imperceptible to Slight adverse (not significant in EIA terms)	None	O: Imperceptible to Slight adverse (not significant in EIA terms)	None

					months for the first two years and annually thereafter (Volume II: Chapter 4: Description of Development).					
7.	Alterations of seabed habitats arising from changes in physical processes	×	✓	×	Development of and adherence to a Rehabilitation Schedule. Scour protection will be installed as described in Volume II, Chapter 4: Description of Development.	O: Low	O: Negligible to Low	O: Imperceptible to Slight adverse (not significant in EIA terms)	None	O: Imperceptible to Slight adverse (not significant in EIA terms)	None
8.	Temporary changes in EMF from subsea electrical cabling	×	✓	×	Cables will be buried where possible and protected where not possible.	O: Low	O: Low	O: Slight adverse (not significant in EIA terms)	None	O: Slight adverse (not significant in EIA terms)	None

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