Environmental Impact Assessment Report - Volume 2B

Chapter 8
Benthic Subtidal and Intertidal Ecology

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

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ORIEL WIND FARM PROJECT

Environmental Impact Assessment Report
Chapter 8: Benthic Subtidal and Intertidal Ecology

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8.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) provides an assessment of the potential impacts of the Oriel Wind Farm Project (hereafter referred to as "the Project") on benthic subtidal and intertidal ecology below the High-Water Mark (HWM) during the construction, operational and maintenance, and decommissioning phases.

Article 3 of Directive 2011/92/EU as amended by Directive 2014/52/EU requires that the EIAR identifies, describes and assesses the direct and indirect significant effects of a project on biodiversity. Biodiversity is addressed within a number of chapters of this EIAR as follows:

- Chapter 8: Benthic Subtidal and Intertidal Ecology;
- Chapter 9: Fish and Shellfish Ecology;
- Chapter 10: Marine Mammals and Megafauna;
- Chapter 11: Offshore Ornithology; and
- Chapter 19: Onshore Biodiversity (volume 2C).

This chapter addresses benthic ecology which are the organisms that make up the ocean floor and intertidal ecology, which relates to the organisms present between the low and high-water marks.

A detailed baseline that underpins the impact assessment is included in section 8.7 of this chapter. This provides a characterisation of the benthic subtidal and intertidal ecology within the Benthic Subtidal and Intertidal Ecology Study Area and the wider western Irish Sea. It is based on existing literature sources and site-specific surveys undertaken within the Benthic Subtidal and Intertidal Ecology Study Area.

This chapter also summarises information contained within technical reports for the subtidal and intertidal site-specific surveys, which are included in appendix 8-1: Intertidal Phase 1 Report and appendix 8-2: Benthic Survey Reports (Aquafact, 2020). The assessment presented is informed by the technical information presented in chapter 7: Marine Processes.

The details and competencies of the specialist who prepared this chapter can be found in volume 2A, chapter 1: Introduction.

8.2 Purpose of this chapter

The primary purpose of the EIAR is to provide an assessment of the likely direct and indirect significant effects of the Project on benthic subtidal and intertidal ecology. In particular, this EIAR chapter on benthic subtidal and intertidal ecology:

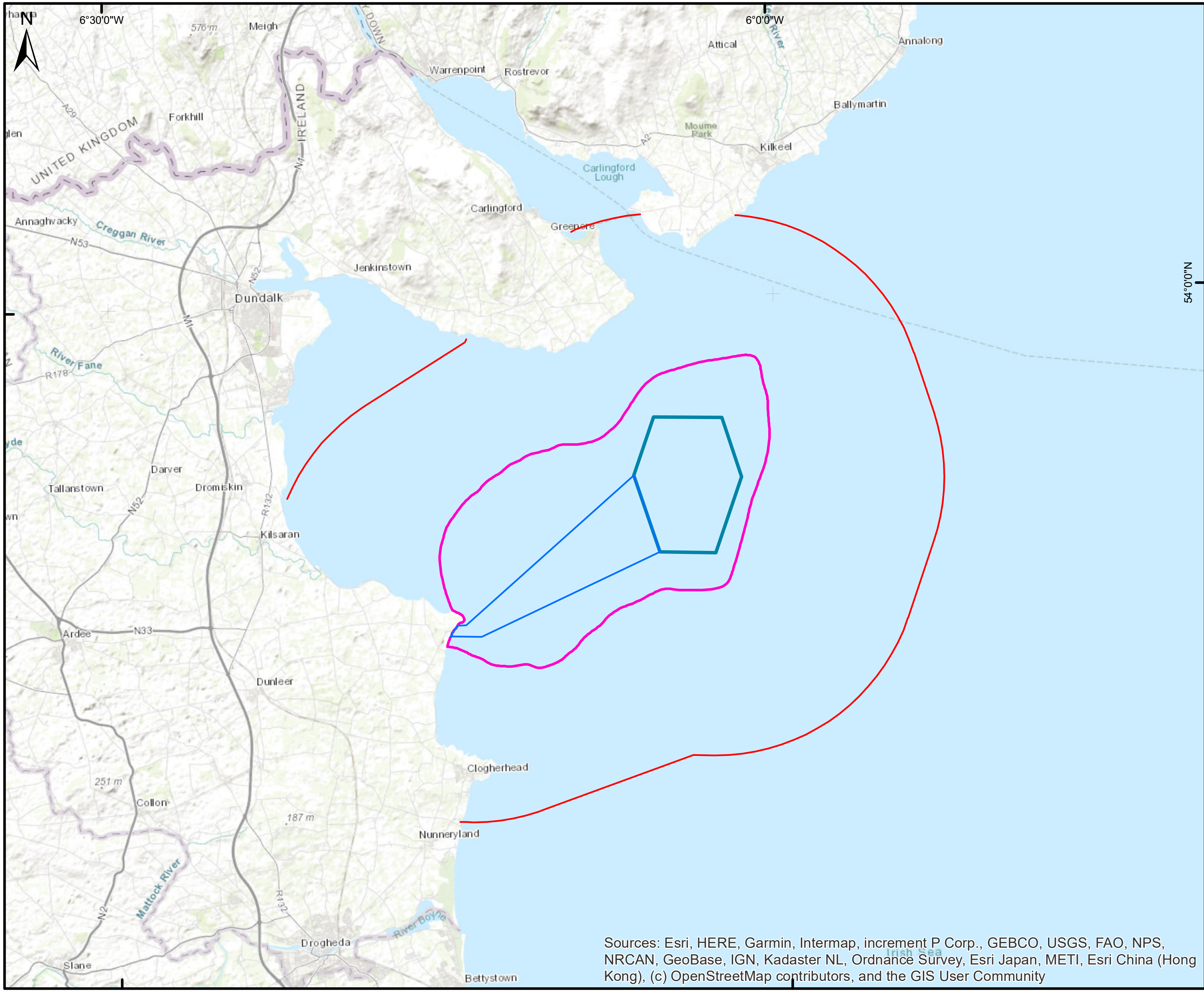
- Presents the existing environmental baseline established from desk studies, site-specific surveys and consultation (section 8.7);
- Identifies any assumptions and limitations encountered in compiling the environmental information (section 8.7.6);
- Presents an assessment of the potential likely significant effects on benthic subtidal and intertidal ecology arising from the Project, based on the information gathered and the analysis and assessments undertaken. An assessment of potential cumulative impacts is provided in section 8.11 and an assessment of transboundary effects is outlined in section 8.12; and

- Highlights any necessary monitoring (section 8.10.10) and/or measures (see section 8.8.2 and 8.10.9)to prevent, minimise, reduce or offset the likely significant environmental effects identified in the assessment.

8.3 Study area

The Benthic Subtidal and Intertidal Ecology Study Area is shown in Figure 8-1 and has been chosen to include all areas that are within the Zone of Influence (ZoI) of the Project that have benthic subtidal or intertidal ecological features. The Benthic Subtidal and Intertidal Ecology Study Area encompasses the offshore wind farm area, offshore cable corridor (including intertidal habitats up to the HWM) plus a buffer of 10 km. The Benthic Subtidal and Intertidal Ecology ZoI is up to one tidal excursion from the offshore wind farm area and offshore cable corridor (i.e. the extent within which plume effects would be expected to occur). chapter 7: Marine Processes has indicated a maximum tidal excursion of 3.5 km (Figure 8-1). The 10 km buffer from the offshore wind farm area and offshore cable corridor is considered to examine habitats from the wider area including the 3.5 km ZoI. The 10 km buffer is therefore, considered to be precautionary.

The benthic subtidal and intertidal ecology characterisation also considers benthic subtidal habitats and communities within the wider western Irish Sea region, to provide a wider context.

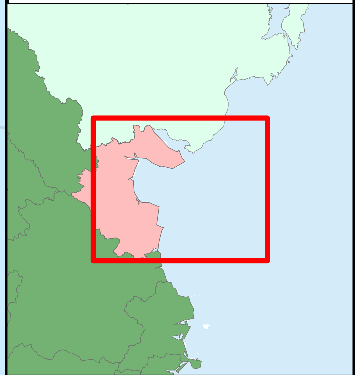


Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Typical Tidal Excursion (based on Figure 7-1, chapter 7: Marine Processes)
- Benthic Subtidal and Intertidal Ecology Study Area

Data Sources: Client, Ordnance Survey Ireland, RPS



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 8-1
Benthic Subtidal and Intertidal Ecology Study Area

rps
A TETRA TECH COMPANY

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

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Date: 28/02/2024	Geographic Co-ordinates: ETRS89

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8.4 Policy context

Planning policy on renewable energy infrastructure is presented in volume 2A, chapter 2: Policy and Legislation. This section presents planning policy which specifically relates to benthic subtidal and intertidal Ecology (DECC, 20212022). Planning policy, specifically in relation to benthic subtidal and intertidal ecology, is contained in the Offshore Renewable Energy Development Plan (OREDP) (Department of Communications, Energy and Natural Resources (DCENR), 2014), and the National Marine Planning Framework (NMPF) (Department of Housing, Local Government and Heritage (DHLGH), 2021). The OREDP and NMPF include guidance on what matters are to be considered in the assessment. These are summarised in Table 8-1 and Table 8-2, with other relevant policy provisions set out in Table 8-3.

In February 2023, the 'OREDP II - National Spatial Strategy for the transition to the Enduring Regime' was published in draft and subject to consultation. The key objectives of OREDP II are:

- *"Assess the resource potential for ORE in Ireland's maritime area;*
- *Provide an evidence base to facilitate the future identification of Broad Areas most suitable for the sustainable deployment of ORE in Ireland's maritime area;* and
- *Identify critical gaps in marine data or knowledge and recommend prioritised actions to close these gaps"*

The OREDP II will provide an evidence base to facilitate the future identification of Broad Areas of Interest most suitable for the sustainable deployment of ORE in Ireland's maritime area, to be assessed in greater detail at regional scale. This assessment will subsequently inform the identification of more refined areas as part of the designation process for Designated Maritime Area Plans (DMAP).

When published, the OREDP II will update the original OREDP published in 2014.

Table 8-1: Summary of OREDP provisions relevant to benthic subtidal and intertidal ecology (DCENR, 2014).

Summary of OREDP – Suggested project-level mitigation measures	How and where considered in the EIAR
Benthic Ecology	
Damage/loss to habitats and nonmobile species: Careful site selection avoiding sensitive sites for devices and offshore cables (i.e. areas with known sensitive intertidal and subtidal benthic habitats); benthic survey to characterise the seabed and identify sensitive sites and species; avoid installation during sensitive seasons.	Volume 2A chapter 4: Consideration of Alternatives provides information on site selection and avoidance of sensitive habitats. Intertidal and subtidal benthic habitats have been identified through a desktop study and site-specific surveys and are discussed in section 8.7. No reefs were found within the offshore wind farm area or offshore cable corridor in the 2006 or 2019 surveys. There are no areas of known sediment contamination within 500 m of the infrastructure. The potential effects of the construction, operational and maintenance and decommissioning phases of the Project have been assessed in section 8.10. Measures included in the Project are discussed in section 8.8.2
Suspended sediment and increased turbidity/ smothering: Careful site selection avoiding sensitive sites for devices and offshore cables (i.e. areas with known sensitive intertidal and subtidal benthic habitats); benthic survey to characterise the seabed and identify sensitive sites and species; modelling of sediment transport; avoid installation during sensitive seasons.	
Contamination – from sediment disturbance: Avoid infrastructure placement within 500 m of areas of known sediment contamination; survey to identify potential sources of seabed contamination; benthic survey to characterise seabed and identify sensitive sites and species.	
Scouring (devices with fixed foundations / structures): Benthic survey to characterise seabed and identify sensitive sites and species; modelling of sediment transport; Use of scour protection around fixed structure foundations to reduce effects of scour on habitats/non mobile species	Intertidal and subtidal benthic habitats have been identified through a desktop study and site-specific surveys and are discussed in section 8.7.

Summary of OREDP – Suggested project-level mitigation measures	How and where considered in the EIAR
	Marine Processes are considered within chapter 7: Marine Processes. Measures include in the Project are discussed in section 8.8.2.
Accidental contamination: Design devices to minimise risk of leakage of pollutants; risk assessment and contingency planning; Implementation of Shipboard Oil Pollution Emergency Plan (SOPEP); benthic survey to characterise seabed and identify sensitive sites and species.	Intertidal and subtidal benthic habitats have been identified through a desktop study and site-specific surveys and are discussed in section 8.7. Measures included in the Project to address the risk of accidental contamination are discussed in section 8.8.2.
Changes in wave regime and tidal flow: Benthic survey to characterise seabed and identify habitats and species sensitive to changes in wave or tidal regimes; hydrodynamic modelling to determine potential for energy extraction in certain locations; avoidance of important habitats though careful site selection.	Intertidal and subtidal benthic habitats have been identified through a desktop study and site-specific surveys and are discussed in section 8.7. Marine Processes are considered within chapter 7: Marine Processes. The potential effects of the construction, operational and maintenance and decommissioning phases of the Project have been assessed in section 8.10. Measures included in the Project are discussed in section 8.8.2. Volume 2A chapter 4: Consideration of Alternatives provides information on site selection and avoidance of sensitive habitats.
Substratum change: Careful site selection avoiding sensitive sites for devices and offshore cables (i.e. areas with known sensitive intertidal and subtidal benthic habitats); benthic survey to characterise seabed and identify sensitive sites and species.	

Table 8-2: Summary of NMPF provisions relevant to benthic subtidal and intertidal ecology.

Summary of NMPF provision	How and where considered in the EIAR
Biodiversity	
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 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 avoid, minimise, or mitigate significant adverse impacts on species adaptation or migration, or on natural native habitat connectivity.	Intertidal and subtidal benthic habitats have been identified through a desktop study and site-specific surveys and are discussed in section 8.7. The potential effects of the construction, operational and maintenance and decommissioning phases of the Project have been assessed in section 8.10 and no significant adverse effects are predicted. Measures included in the Project are discussed in section 8.8.2. The Project will not result in significant adverse effects on biodiversity.
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.	
Biodiversity Policy 3: Where marine or coastal natural capital assets are recognised by Government; Proposals must seek to enhance marine or coastal natural capital assets where possible. Proposals must demonstrate that they will in order of preference, and in accordance with legal requirements: avoid, minimise, or mitigate significant adverse impacts on marine or coastal natural capital assets, or if it is not possible to mitigate significant adverse impacts on marine or coastal natural capital assets proposals must set out the reasons for proceeding.	

Summary of NMPF provision	How and where considered in the EIAR
Biodiversity Policy 4: Proposals must demonstrate that they will in order of preference and in accordance with legal requirements: avoid, minimise, or mitigate significant disturbance to, or displacement of, highly mobile species.	
Marine Protected Sites	
Protected Marine Sites Policy 1: Proposals must demonstrate that they can be implemented without adverse effects on the integrity of Special Areas of Conservation (SACs) or Special Protection Areas (SPAs). Where adverse effects from proposals remain following mitigation, in line with Habitats Directive Article 6(3), consent for the proposals cannot be granted unless the prerequisites set by Article 6(4) are met.	Marine Protected Areas have been identified through a desktop study and are discussed in section 8.7.3. The potential effects of the construction, operational and maintenance and decommissioning phases of the Project have been assessed in section 8.10. Measures included in the Project are discussed in section 8.8.2. A Natura Impact Statement (NIS) has also been prepared for the Project and has concluded that there are no significant adverse effects on European Sites.
Protected Marine Sites Policy 2: Proposals supporting the objectives of protected marine sites should be supported and be informed by appropriate guidance; must demonstrate that they are in accordance with legal requirements, including statutory advice provided by authorities relevant to protected marine sites.	
Protected Marine Sites Policy 3: Proposals that enhance a protected marine site's ability to adapt to climate change, enhancing the resilience of the protected site, should be supported and; be informed by appropriate guidance; must demonstrate that they are in accordance with legal requirements, including statutory advice provided by authorities relevant to protected marine sites.	
Protected Marine Sites Policy 4: Until the ecological coherence of the network of protected marine sites is examined and understood, proposals should identify, by review of best available evidence (including consultation with the competent authority with responsibility for designating such areas as required), the features, under consideration at the time the application is made, that may be required to develop and further establish the network. Based upon identified features that may be required to develop and further establish the network, proposals should demonstrate that they will, in order of preference, and in accordance with legal requirements avoid, minimise, or mitigate significant impacts on features that may be required to develop and further establish the network, or if it is not possible to mitigate significant impacts, proposals should set out the reasons for proceeding.	
Non-indigenous Species	
Non-indigenous Species Policy 1: Reducing the risk of the introduction and / or spread of non-indigenous species is a requirement of all proposals. Proposals must demonstrate a risk management approach to prevent the introduction of and / or spread of non-indigenous species, particularly when; moving equipment, boats or livestock (for example fish or shellfish) from one water body to another; introducing structures suitable for settlement of non-indigenous species, or the spread of non-indigenous species known to exist in the area of the proposal.	Non-indigenous species have been identified through a desktop study and are discussed in section 8.7. The potential effects of the construction, operational and maintenance and decommissioning phases of the Project from increased risk of Non-indigenous species has been assessed in section 8.10.8. Measures included in the Project to minimise spread of non-indigenous species are discussed in section 8.8.2.

Table 8-3: Summary of other policy provisions relevant to benthic subtidal and intertidal ecology.

Summary of provision	How and where considered in the EIAR
Benthic Subtidal Ecology	
Marine Strategy Framework Directive (MSFD): adopted in July 2008. The overarching goal of the Directive is to achieve 'Good Environmental Status' (GES) by 2020 across Europe's marine environment. To this end, Annex I of the Directive identifies 11 high level qualitative	Effects of construction, operational and maintenance, and decommissioning phases of the Project on benthic subtidal and intertidal ecology, including biodiversity, non-indigenous species, pollution and changes in hydrodynamics, have been assessed in section 8.10.

Summary of provision	How and where considered in the EIAR
descriptors for determining GES. These include: biological diversity, non-indigenous species, elements of marine food webs, sea floor integrity, alteration of hydrographical conditions and contaminants (European Union, 2008).	Chapter 7: Marine Processes also examines the MSFD and *concludes that the Project* not impact on the GES under the MSFD. Measures included in the Project are discussed in section 8.8.2.
Ireland's National Biodiversity Plan 2023-2030: sets out Ireland's vision, objectives and outcomes for biodiversity in Ireland. Objective number 2 is to 'Meet Urgent Conservation and Restoration Needs. Outcome 2D: Biodiversity and ecosystem services in the marine and freshwater environment are conserved and restored. This includes 16 targets and 21 actions. (Department of Housing, Local Government and Heritage, 2023).	Effects of construction, operational and maintenance, and decommissioning phases of the Project on Benthic Subtidal and Intertidal Ecology, including biodiversity, have been assessed in section 8.10 with appropriate mitigation identified for the receptors with greatest biodiversity importance.
Ireland's Integrated Marine Plan (2012): identifies the marine environment as an area that needs to be protected, managed and developed and as a key component of Ireland's economic recovery and sustainable growth. The second goal of the Integrated Marine Plan is to 'achieve healthy ecosystems that provide monetary and non-monetary goods and services (Inter-Departmental Marine Coordination Group, 2012).	Effects of construction, operational and maintenance, and decommissioning phases of the Project on benthic subtidal and intertidal ecology, including the benthic ecosystems, have been assessed in section 8.10 with appropriate measures included in section 8.9.2.

8.5 Consultation

Consultation with identified benthic ecology stakeholders was undertaken in late 2019 and early 2021. The purpose of consultation in 2019 was for the applicant to agree the intertidal survey scope with the then Department of Culture, Heritage and the Gaeltacht. In 2021 consultation was undertaken to update stakeholders on proposed changes to the project design, present findings of the baseline surveys and to seek responses on the EIAR including scoping. Stakeholders were consulted individually through direct contact from the project team following a request for engagement.

Table 8-4 summarises the key issues identified during consultation activities undertaken to date, which are relevant to benthic subtidal and intertidal ecology, together with how these issues have been considered in the preparation of this EIAR chapter. Chapter 6: Consultation (volume 2A) provides details on the types of consultation activities undertaken for the Project between 2019 and 2024 and the consultees that were contacted.

Table 8-4: Summary of key consultation issues on benthic subtidal and intertidal ecology.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
October 2019	Department of Culture, Heritage and the Gaeltacht – Email and telephone	Details of intertidal survey scope methodology, which was agreed in advance with the Department.	Intertidal survey methodology is discussed in section 8.7.2 and in appendix 8-1: Intertidal Phase 1 Report.
March 2021	Marine Institute - Email	Provided additional data sets to be used to characterise the baseline including Marine Institute data and monitoring reports from offshore wind parks in Belgium. The Marine Institute recommended the consideration of ecosystem service provision of habitats assessed. Suggested it would be useful to provide a list of the designated conservation sites to be considered in the assessment.	Additional data sets have been included to characterise the baseline in section 8.7. Designated sites considered are listed in Table 8-8. Impact on ecosystem services have indirectly been assessed whereby the baseline ecological features have been considered alongside identified benefits to humans as part of chapter: 12: Commercial Fisheries and chapter 16: Infrastructure, Marine Recreation and Other users

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
April 2021	NPWS - Meeting	Discussion regarding the baseline data sources, the results of the benthic validation survey in 2019, assessment methodology, important ecological receptors and impacts scoped in/out.	The results of the benthic validation survey report are presented in section 8.7.2 and appendix 8-2: Benthic Survey Reports.
August 2021	Louth County Council - Email	Query regarding presence of seagrass beds in the offshore wind farm area and offshore cable corridor.	No seagrass beds were identified during baseline surveys.
January 2024	Environmental Protection Agency – meeting	Discussion regarding the potential requirement for a dumping at sea permit.	The Applicant will require a Dumping at Sea permit for the construction of the foundations and offshore cables.
September 2023	DAERA – transboundary scoping	Consideration to Annex I Marine Habitats recorded in NI waters.	Section 8.6.3 outlines the designated sites included in the assessment. See also Figure 8-2 which shows the seabed habitats within the Benthic Subtidal and Intertidal Ecology Study Area, which extends into Northern Ireland.

8.6 Methodology to inform the baseline

8.6.1 Desktop study

An evidence-based approach has been used to inform the baseline for benthic subtidal and intertidal ecology. This involved utilising existing data and information from sufficiently similar studies. This evidence-based approach means that it is not always necessary for new data to be collected, or new modelling studies to be undertaken, to characterise potential impacts with sufficient confidence for the purposes of EIA.

The baseline characterisation has been carried out in accordance with the Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects from DCCAE (DCCAE, 2018).

Data has been acquired through relevant historical data, previous studies and surveys (including from the offshore wind farm area), to characterise the Benthic Subtidal and Intertidal Ecology Study Area. The EMODnet and Ireland's Marine Atlas provide data on an interactive map of the seabed habitats within the western Irish Sea.

Other sources of information within the western Irish Sea include studies on muddy habitats in the northwestern Irish Sea (Hensley, 1996; Clements *et al.,* 2018; Lundy *et al.,* 2019), regional studies of offshore benthic communities of the Irish Sea (Mackie, 1990) and studies on communities associated with Irish Sea sandbank habitats. These have also been used to inform the baseline characterisation.

The key sources (i.e. data and reports) used to inform the baseline characterisation of the Benthic Subtidal and Intertidal Ecology Study Area are summarised in Table 8-5 below. These sources provide the most up to date data for this assessment.

Table 8-5: Summary of key desktop sources.

Title	Source	Year	Author
Oriel Windfarm Limited Offshore Wind Farm, Environmental Impact Statement, chapter 9: Marine and Terrestrial Ecology.	Oriel Windfarm Limited.	2007	Aquafact
Ireland's Marine Atlas [Accessed 05/2023]:	Marine Institute	2023	N/A

Title	Source	Year	Author
• Designated Sites			
National Parks and Wildlife Service website • Designated Sites	National Parks and Wildlife Service	2023	N/A
EMODnet Seabed habitats.	EMODnet	2023	N/A
A preliminary survey of benthos from the *Nephrops norvegicus* mud grounds in the northwestern Irish Sea.	Estuarine, Coastal and Shelf Science	1996	Hensley
Western Irish Sea Nephrops Grounds (FU15) 2018 UWTV Survey report and catch options for 2019.	Marine Institute	2018	Clements *et al.*
Western Irish Sea Nephrops Grounds (FU15) 2019 UWTV Survey report and catch options for 2020.	Marine Institute	2019	Lundy *et al.*
Diversity of demersal and megafaunal assemblages inhabiting sandbanks of the Irish Sea.	Scientific publication – Marine Biodiversity	2013	Atalah *et al.* 2013
Offshore benthic communities of the Irish Sea.	Scientific publication – Nature conservation	1990	Mackie
Marine Institute provided benthic survey raw data from Dundalk Bay and the Western Irish Sea	Marine Institute	April 2021	Marine Institute

8.6.2 Site-specific surveys

In order to inform the EIAR, site-specific surveys were undertaken. A summary of the surveys undertaken to inform this assessment is outlined in Table 8-6. Detailed site-specific benthic ecology surveys were carried out within the offshore wind farm area in 2006 which investigated and classified the sediment types and fauna present in this area. Further site-specific sampling was undertaken within the offshore wind farm area and offshore cable corridor in 2019 to validate the baseline acquired from the previous site-specific surveys undertaken in 2006. The results of this survey (Aquafact, 2020) are summarised in section 8.7.2 and fully presented in appendix 8.2: Benthic Subtidal Survey Reports. The 2019 site-specific surveys were undertaken based on industry best practice and published guidance. The approach to the 2019 site-specific surveys was informed by DCCAE's Guidance on Marine Baseline Ecological Assessments and Monitoring Activities (DCCAE, 2018) and with reference to standard intertidal survey methodologies as outlined in the Joint Nature Conservation Committee (JNCC) Marine Monitoring Handbook (Davies *et al.,* 2001) and The Handbook for Marine Intertidal Phase 1 Biotope Mapping Survey (Wyn *et al.,* 2006; appendix 8.1: Intertidal Phase 1 Report).

With respect to intertidal ecology, there were no available desktop data sources for the landfall location, and as such, site-specific surveys were undertaken to characterise the intertidal sediments and ecological communities at the landfall location (see section 8.7.2).

Table 8-6: Summary of site-specific survey data.

Title	Extent of survey	Overview of survey	Survey contractor	Date	Reference to further information
Marine Benthic and Sedimentology Survey	Foreshore Licence Area and possible offshore cable routes to shore	Boat based benthic grab samples taken for Particle Size Analysis (PSA), organic carbon and faunal analysis.	Aquafact	2006	Oriel Wind Farm Limited (2007)
Intertidal survey	200 m corridor at the intertidal landfall location	Phase 1 intertidal walkover survey with mapping of sediments and habitats.	RPS	2019	Appendix 8.1: Intertidal Phase 1 Report
Subtidal survey	Foreshore Licence Area	Boat-based benthic grab samples taken for PSA and faunal analysis. Seabed imagery to collect data on broadscale sediment types and epifauna. Survey undertaken to validate surveys of the offshore wind farm area undertaken in 2006 (see above).	Aquafact	2019	Appendix 8.2: Benthic Survey Report

8.6.3 Identification of designated sites

All designated sites within the Benthic Subtidal and Intertidal Ecology Study Area and qualifying interests (QIs) that could be affected by the construction, operational and maintenance, and decommissioning phases of the Project were identified using the three-step process described below:

- Step 1: All designated sites of international, national and local importance within the Benthic Subtidal and Intertidal Ecology Study Area were identified using a number of sources. These included the National Park and Wildlife Service website (https://www.npws.ie/) and the Atlas of Marine Protection website (https://mpatlas.org/);
- Step 2: Information was compiled on the relevant benthic subtidal and intertidal ecology QIs for each of these sites; and
- Step 3: Using the above information and expert judgement, sites were included for further consideration if:
  - A designated site with benthic subtidal and intertidal ecology features directly overlaps with the offshore wind farm area or offshore cable corridor and therefore has the potential to be directly affected by the Project; or
  - A designated site and associated features are located within the potential ZoI for impacts associated with the Project therefore have the potential to be indirectly affected by the Project.

8.7 Baseline environment

8.7.1 Western Irish Sea

The Benthic Subtidal and Intertidal Ecology Study Area is located on the continental shelf in the western Irish Sea, within the Celtic Seas Ecoregion. Subtidal sediments in the western Irish Sea are reported on the EMODnet seabed habitats interactive map and by the integrated mapping for the sustainable development of Ireland's Marine Resource (INFOMAR) programme (Figure 8-2) (EMODnet, 2023). The western Irish Sea is dominated by mud and muddy sand which extends to the Scottish point of Cairngaan on the Mull of Galloway in the north, the Isle of Man in the east and to Dublin in the south. This is a well-documented area of mud, found in a deep basin with low tidal energy. This low energy environment creates an area of static bedform, providing stable habitats which contribute to the overall diversity of the seabed.

In the inshore areas of the western Irish Sea, the predominant substrates are sand and coarse sediments with occasional patches of mixed sediment and rocks and boulders (EMODnet, 2023). However, these areas also have extensive fields of sand ribbons and sand waves as well as sandbanks. Although sandbanks and sand waves can often be mobile benthic features, the larger sandbanks within the Irish Sea are relatively stable. The Annex 1 habitats 'Sandbanks which are slightly covered by sea water all the time' are found in the nearshore of the southern half of the Irish Sea and south of the Benthic Subtidal and Intertidal Ecology Study Area. They are a series of north-south trending sandbanks which include Bennet, Burford, Kish, Frazer, Bray, Codling, India, Arklow, Seven Fathom Bank, Glassgorman, Rusk, Blackwater/Moneyweights, Lucifer, Long and Holdens Banks, none of which are within the Benthic Subtidal and Intertidal Ecology Study Area.

As discussed above, the EMODnet data shows that the western Irish Sea is dominated by low energy deep circalittoral mud which is located in the large mud basin (Figure 8-2). Within the mud basin there are patches of low energy sublittoral sediment and low energy deep circalittoral rock or other hard substrata (EMODnet, 2019). Around the outside of this mud basin there is moderate energy deep circalittoral sand, this is more extensive in areas to the south of the mud basin. Closer inshore there is a more complex mosaic of habitats (EMODnet, 2023). Towards the south of Dundalk Bay and parallel to the shore, there are large swaths of moderate energy deep circalittoral sand, moderate energy shallow circalittoral sandy mud and high energy shallow circalittoral fine sand (EMODnet, 2023; Figure 8-2). To the north of Dundalk Bay there is an extensive area of moderate energy shallow circalittoral mixed sediment.

Generalised maps of the faunal communities in the Irish Sea were produced by Dickson in 1987 and later updated (Mackie, 1990). Seven main macrofaunal communities were identified across the Irish Sea with five in the western Irish Sea. The communities identified within the western Irish Sea were: Shallow Venus, Deep Venus, Amphiura, and Brissopsis, with small areas of hard ground at the coast. The communities in the western Irish Sea are described in Table 8-7below.

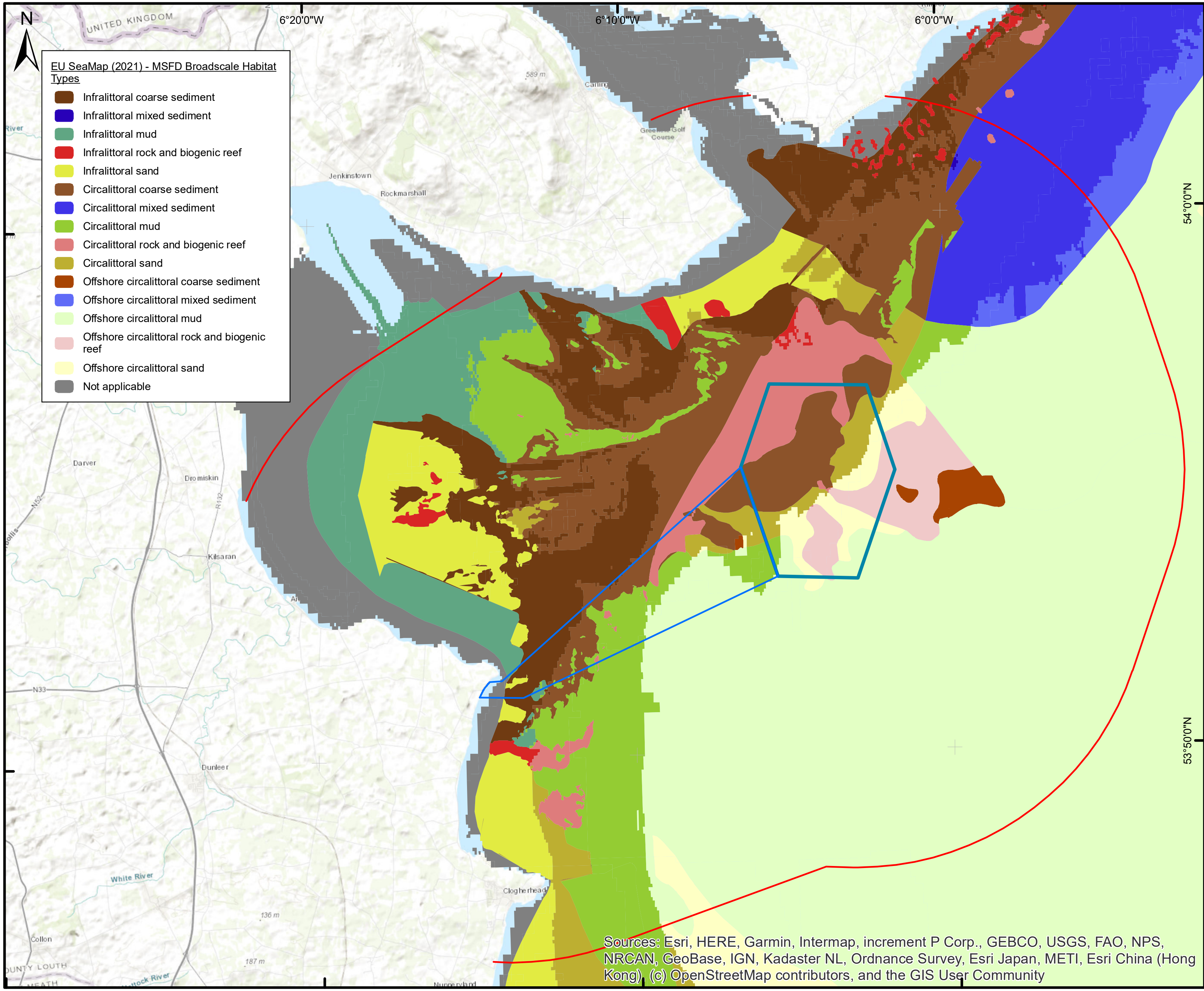
Table 8-7: Communities identified in the Irish Sea (Mackie, 1990).

Community	Habitats	Depth range (m)	Typical species	Location in Ireland
Shallow Venus	Nearshore sands with strong currents	5 to 40	*Fabulina fabula*, *Magelona mirabilis, Spisula elliptica* and *Nephtys cirrosa*.	Widely distributed around the Irish coastline.
Deep Venus	Coarse sand and gravel	40 to 100	Urchin *Spatangus purpureus* and bivalves *Glycymeris*, *Astarte sulcata* and 'Venus' spp. (*Venus casina, Clausinella fasciata, Timoclea ovata*).	Dominates the benthos throughout the Irish Sea.
Amphiura	Offshore muddy sands	15 to 100	Brittlestar *Amphiura filiformis*, urchin *Echinocardium cordatum* and tower shell *Turritella communis*.	Occurs between Ireland and the Isle of Man.
Brissopsis	Offshore muds	15 to 100	Urchin *Brissopsis lyrifera* and brittlestar *Amphiura chiajei*.	Western basin deeper than 70 m.
Hard ground	High water movement where bed rock and boulders are exposed	All	In areas not subject to sand scour the benthos is dominated by epifaunal species attached to the stones.	Patches off the north of Anglesey.

Within the western Irish Sea mud basin and the wider Irish Sea, the Marine Institute carry out under water television (TV) surveys of the *Nephrops norvegicus* functional units (FU) to independently estimate abundance, distribution and stock sizes of *N. norvegicus*. The Benthic Subtidal and Intertidal Ecology Study Area falls within FU15 – western Irish Sea. Surveys in 2018 and 2019 found soft mud in the centre of the western Irish Sea with burrowing species present such as *N.norvegicus, Calocaris macandreae* and *Goneplax rhomboides* (Clements *et al*., 2018; Lundy *et al*., 2019).

Benthic data collected in 2016 and 2019 by the Marine Institute south of the Benthic Subtidal and Intertidal Ecology Study Area displayed mainly fine sand and very fine sand and with small percentages of silt and coarse sand sediment types. These samples recorded polychaete and bivalve dominated communities with high abundances of the polychaetes *Magelona johnstoni, Magelona filiformis, Sigalion mathildae* as well as the bivalves *Kurtiella bidentata, Abra alba, Fabulina fabula, Nucula nitidosa, Donax vittatus* and *Thracia phaseolina.* Samples collected in 2019, displayed mainly fine sand with areas of sandy mud, coarse sand, mud and gravely mud sediment types. These samples similar to data collected in 2016 recorded a bivalve dominated community with high abundances of *N. nitidosa, Mytilus edulis, K. bidentata, F. fabula* and *T. phaseolina*. Echinoderms *Ophiura sp.* and *Amphiura filiformis* were also recorded in high abundances, especially in samples around Lambay Island. Survey data taken from inner Dundalk Bay (small coastal area outside the Benthic Subtidal and Intertidal Ecology Study Area to the north of Dundalk Bay near Gyles Quay) in 2016 recorded fine sand sediments. Faunal communities were dominated by *Mytilus* sp. with this taxon recording an abundance eight times higher than the next most abundant taxa (the bivalves *F. fabula* and *Donax vittatus*).

In 1996, a survey targeting benthic communities associated with the mud sediments within an area 5 nm x 5 nm just south of the Benthic Subtidal and Intertidal Ecology Study Area reported that the mud sediments were not homogenous. Silt-clay content ranged from 20% in the west to 94% towards the north, and there was no correlation between depth and grain size (Hensley, 1996). The faunal analysis of samples taken in the mud basin showed that the centre of the basin is species poor compared to the peripheral areas however the author noted that this may be a result of the sampling procedure. All samples were dominated by polychaetes, especially the sedentary polychaetes *Capitellidae*, *Cirratulidae, Paraonidae* and *Spionidae*. Crustaceans and molluscs were also found regularly (Hensley, 1996).



Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Benthic Subtidal and Intertidal Ecology Study Area

Data Sources: Client, Ordnance Survey Ireland.

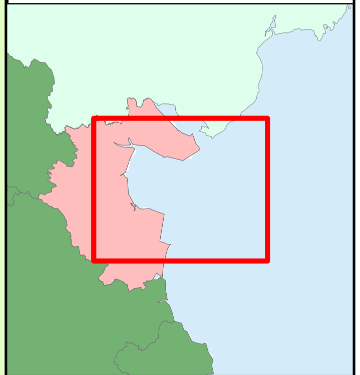


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Figure 8-2
Seabed Habitats within the Benthic Subtidal and Intertidal Ecology Study Area

rps A TETRA TECH COMPANY
West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.
Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

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8.7.2 Benthic Subtidal and Intertidal Ecology Study Area

8.7.2.1 Subtidal ecology

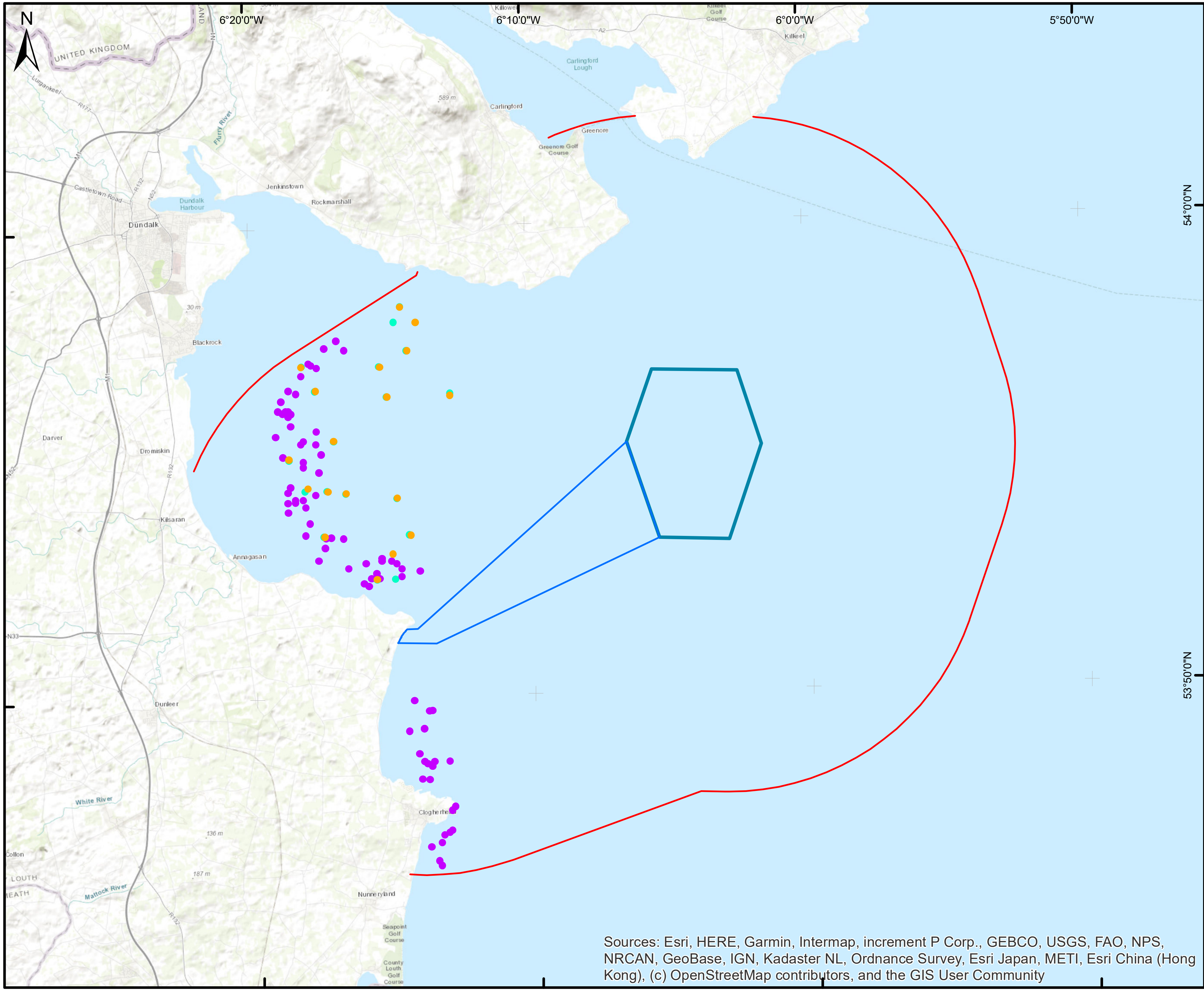
Desktop datasets

The EMODnet seabed habitat map presented in Figure 8-2 shows that sediments within the offshore wind farm area are dominated by circalittoral coarse sediments which cover a large proportion of the northern half of the offshore wind farm area. The northern half of the offshore wind farm area also includes areas of circalittoral sand and circalittoral rock and biogenic reef. The southern half of the offshore wind farm area is characterised by finer sediments, mainly offshore circalittoral sand which extends up the northeast boundary of the offshore wind farm area. Offshore circalittoral rock and biogenic reef is present within the centre of the southern half of the offshore wind farm area, extending to the southern boundary of the offshore wind farm area where there is offshore circalittoral mud (EMODnet, 2019). This dataset indicates a higher proportion of coarse sediment and hard substrata compared with the findings of the site-specific surveys carried out in 2006 (see section: *Site-Specific Benthic Subtidal Ecology Surveys* below).

In April 2021 the Marine Institute provided benthic survey raw data taken in 2016 and 2019 from within Dundalk Bay and the Benthic Subtidal and Intertidal Ecology Study Area (Table 8-5). No samples overlapped with the offshore wind farm area or the offshore cable corridor (Figure 8-3) (Marine Institute, 2021). Survey data taken from the outer Dundalk Bay and North Irish Sea in 2016 recorded sediments of very fine sand, very coarse silt and fine sand. Faunal communities were dominated by the echinoderms *Amphiurafiliformis*, the bivalves *Kurtiella bidentata*, *Fabulina fabula, Nucula hanleyi* and the polychaetes *Melinna palmata, Euclymene oerstedii* and *Galathowenia oculata*. Survey data taken from the outer Dundalk Bay in 2019 recorded sand, muddy sand, gravelly muddy sand and sandy mud. As expected, the faunal communities were polychaete and bivalve dominated with high abundances of the same species as were recorded in the 2016 survey.

The offshore cable corridor is characterised by circalittoral mud and coarse sediment. There is a small area of circalittoral rock and biogenic reef to the northeast of the offshore cable corridor with several small patches extending into the centre of the offshore cable corridor. The northeast of the offshore cable corridor also contains small areas of circalittoral sand. The nearshore area of the offshore cable corridor contains areas of infralittoral sand and mud, which is likely to extend west towards the foreshore (Figure 8-2; EMODnet, 2019).

As outlined in section 8.7.1 above, generalised maps of the faunal communities in the Irish Sea updated by Mackie in 1990 identified seven main macrofaunal communities. The community identified within the Benthic Subtidal and Intertidal Ecology Study Area was the Shallow Venus community. This community occurs in shallow (5-40 m) nearshore sands and often occurs in areas subject to strong currents and sandbank or sand wave systems (Figure 8-2). The characteristic species was reported to be the bivalve *Chamelea gallina*. The Shallow Venus community is widely distributed around the Irish Sea coastline.



Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Benthic Subtidal and Intertidal Ecology Study Area

Marine Institute 2016 benthic survey data

- Outer Dundalk Bay
- North Irish Sea

Marine Institute 2019 benthic survey data

- Outer Dundalk Bay

Data Sources: Client, Ordnance Survey Ireland, Marine Institute

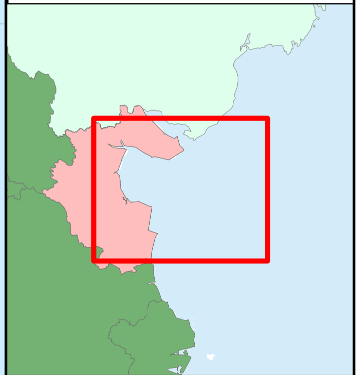


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Figure 8-3
Marine Institute benthic sampling locations

A TETRA TECH COMPANY

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

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Site-specific benthic subtidal ecology surveys

Site-specific surveys were undertaken for the Project in 2006 (Oriel Windfarm Limited, 2007) comprising 57 stations sampled with a modified van Veen grab for sediment and faunal analysis (Figure 8-4). 44 of these samples are within the offshore wind farm area, with the remaining stations located on transects stretching southwest of the offshore wind farm area towards the shore just north of Balbriggan and stretching west of the offshore wind farm area towards the shore in Dundalk Bay (Figure 8-4). The majority of the sediment samples taken were classified as silt-clay sediments. Silt-clay sediments were found in the southeast of the offshore wind farm area with some found along the eastern and western boundaries of the offshore wind farm area. Sediments in the middle of the offshore wind farm area comprised mainly very fine sand which graduated though to medium sand and then to gravel at the northwest corner of the offshore wind farm area. Samples could not be collected from several of the stations within the offshore wind farm area due to the nature of the sediments preventing penetration, suggesting the presence of rock.

The 2019 benthic validation survey (Aquafact, 2020), which included collection of grab samples and video data (Figure 8-4), recorded sediments in the north and east of the offshore wind farm area as dominated by mixed and coarse sediments, whereas sediments in the southwest of the offshore wind farm area were dominated by sandy muds. The offshore cable corridor contained mostly sandy muds with some sample stations reporting sand sediments and infralittoral rock.

Epifauna observed in the offshore wind farm area included: Brittlestars *Ophiothrix fragilis*, large starfish *Luidia ciliaris* and sea urchin *Echinus esculentus*. Epifauna observed in the offshore cable corridor includes: the sea urchin *Echinus esculentus* and the starfish *Asterias rubens*. Species diversity and species richness was highest in the eastern and northeastern regions of the offshore wind farm area. The species reported are all commonly found along the east coast of Ireland and no uncommon, rare or protected species were found (Oriel Windfarm Limited, 2007). The video data identified the biotope SS.SMx.CMx.Oph.Mx in the northwest corner of the offshore wind farm area. The centre of the offshore cable corridor was classified as SS.SCS.CCS.SpiB /SS.SMx.CMx.FluHyd and SS.SMu.CSaMu. The stations closest to the landfall location within the offshore cable corridor were characterised by areas of coarse sediment and rock, with kelps, and were classified as the IR.MIR.KP biotope (Figure 8-5). In this deeper location light penetration does not allow for colonisation of coarse sediments by the seaweed species recorded in inshore areas (i.e. the IR.MIR.KP biotope (Figure 8-5)). Other video sample stations recorded a sediment description only for which a separate biotope classification was not provided.

These results are largely consistent with the EMODnet seabed habitats map which shows the dominant sediment type in the western Irish Sea is mud and muddy sand. However, from the EMODnet seabed habitats map it would be expected that a higher proportion of boulders and coarse sediment would be found and a lower proportion of mud and silt-clay (EMODnet, 2023; Figure 8-2).

Faunal analysis was carried out on the 44 grab samples taken in 2006 within the offshore wind farm area. These samples were dominated by polychaetes (57 taxa), crustaceans (41 taxa), molluscs (30 taxa) and echinoderms (nine taxa). Other genus recorded included one genus of chelicerata (sea spiders) and two genera of phoronids (horseshoe worms).

As outlined in section 8.6.2 a further subtidal survey has been undertaken in 2019 to validate the results of the 2006 survey. Seven grab sample locations were selected from the original 44 within the offshore wind farm area to re-sample. Ten sample locations were selected along the offshore cable corridor to confirm the subtidal sediments and benthic fauna. The location of the samples for the 2019 validation survey are presented alongside the locations and faunal group classifications of the samples for the 2006 survey in Figure 8-4.

The faunal data from the 2006 survey were classified into nine faunal groups based on Similarity Percentage Analysis (SIMPER) statistical analysis (Figure 8-5), which are summarised below.

- Group A contained 16 taxa comprising 80 individuals. Three taxa accounted for 76.26% of the faunal abundance of this group: the brittlestar *Ophiothrix* sp., the polychaete *Spriobranchus* sp. and Tunicata;
- Group B contained 61 taxa comprising 460 individuals. Four taxa accounted for 61.5% of the faunal abundance of this group: the polychaetes *Nephtys* sp., *Prionospio* sp., the bivalve *Abra* sp. and

Nemertea. *Ampelisca* sp. was identified as the characterising taxa of this group. The sediment type in this group was classified as silt/clay with very fine sand present at only one station;

- Group C contained 34 taxa comprising 365 individuals. Four taxa accounted for 82.5% of the faunal abundance of this group: the gastropod *Turritella* sp., the polychaetes *Nephtys* sp., *Amphiura* sp. and the anthozoan *Edwardsia* sp. The sediment type in this group was classified as very fine sand;

- Group D contained 40 taxa comprising 387 individuals. Four taxa accounted for 74.42% of the faunal abundance of this group: the gastropod *Turritella* sp., the sipunculan *Golfingia* sp., the polychaete *Nephtys* sp. and aorid amphipods. The sediment type in this group was classified as silt/clay;

- Group E contained 128 taxa comprising 2,540 individuals. Four species accounted for 51% of the faunal abundance of this group: the brittlestar *Amphiura* sp., the gastropod *Turritella* sp., the anthozoan *Edwardsia* sp. and the polychaete *Lumbrineris* sp. The sediment type in this group was classified as both silt/clay and very fine sand;

- Group F contained 85 taxa comprising 787 individuals. Six species accounted for 51% of the faunal abundance of this group: the brittlestars *Amphiura* sp., *Ophiura* sp., the bivalves *Abra* sp., *Thracia* sp., the polychaetes *Nephtys* sp. and the anthozoan *Edwardsia* sp. The sediment type in this group ranged from gravel through medium sands, very fine sands to silt/clay;

- Group G contained 40 taxa comprising 158 individuals. Five taxa accounted for 60% of the faunal abundance: the bivalves *Thracia* sp., *Dosinia* sp., the polychaetes *Lumbrineris* sp. and *Nephtys* sp. and the anthozoan *Edwardsia* sp. The sediment types in this group was classified as medium sand;

- Group H contained 101 taxa comprising 956 individuals. Four taxa accounted for 38% of the faunal abundance: the anthozoan *Edwardsia* sp., the polychaetes *Lumbrineris* sp., *Exogone* sp. and the bivalve *Thracia* sp. Group H was the most diverse and had the highest richness across all the groups. The majority of the stations within this group were classified as medium sand with very fine sand present at only one station; and

- Group I contained 46 taxa comprising 227 individuals. Four taxa accounted for 57.71% of the faunal abundance: the polychaetes *Lumbrineris* sp., *Nephtys* sp., the brittlestar *Amphiura* sp. and the anthozoan *Edwardsia* sp. The sediment type in this group was classified as coarse sediments.

The faunal data from the 2019 benthic validation survey were classified into four faunal groups based on Similarity Percentage Analysis (SIMPER) statistical analysis, which are summarised below. A full description of these faunal groupings and the analysis undertaken to classify these, is provided in appendix 8-2: Benthic Subtidal Survey Report.

- Group A contained nine taxa comprising 23 individuals. Four taxa accounted for almost 74% of the faunal abundance: the bivalves *Nucula* sp. (juv.), *F. fabula*, *Nucula nitidosa* and the polychaete *Nephtys cirrosa*. This can be classified as the biotope SS.SSa.IMuSa.FfabMag *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand. This biotope was recorded in the centre of the offshore cable corridor;

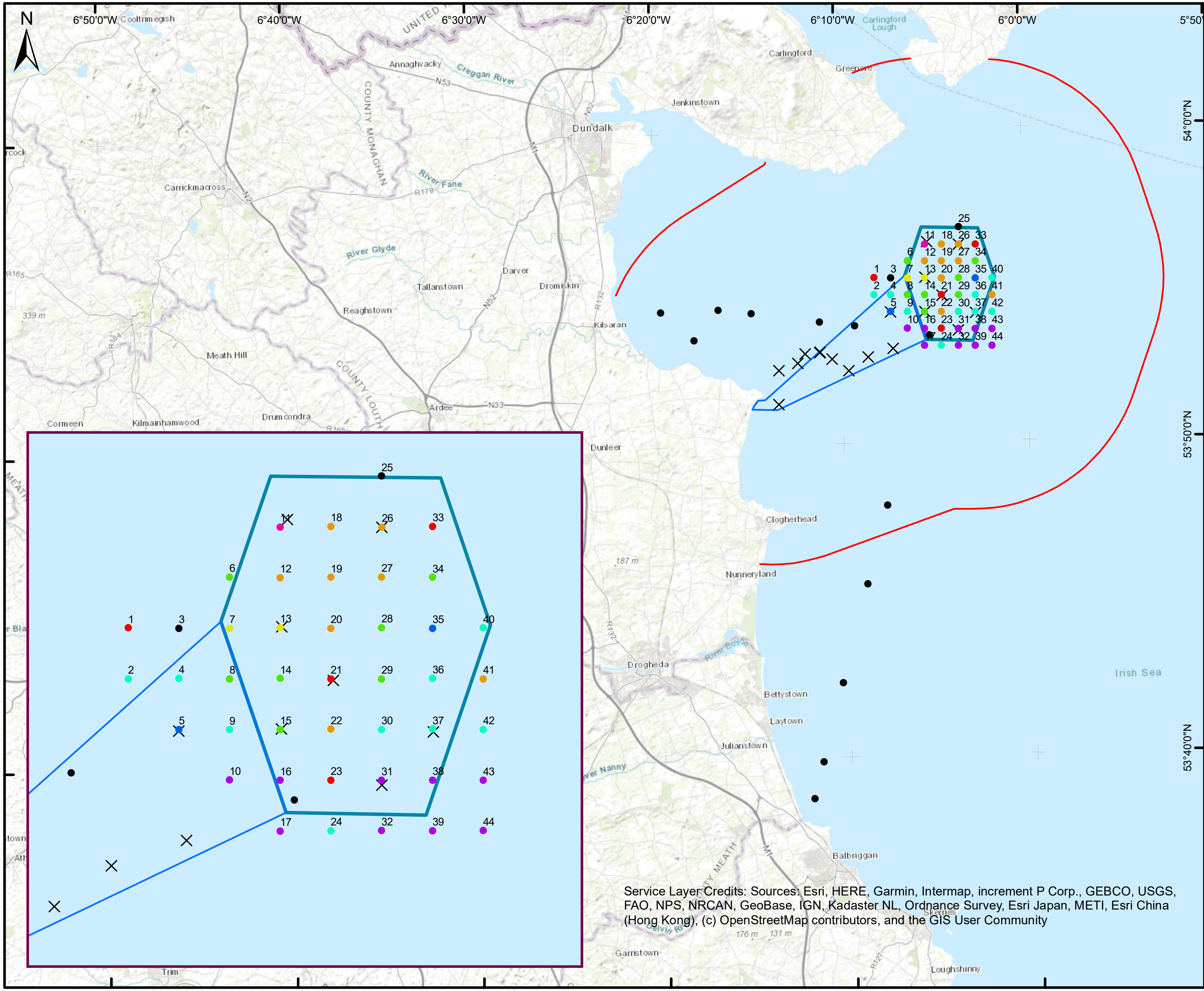
- Group B contained 35 taxa comprising 133 individuals. Five species accounted for almost 52% of the faunal abundance: the polychaetes *Prionospio* sp., *Magelona minuta*, *Nephtys incisa*, *Levinsenia gracili*, and the bivalve molluscs *Abra nitida.* This biotope can be classified as SS.SMu.OMu.LevHet *Levinsenia gracilis* and *Heteromastus filiformis* in offshore circalittoral mud and sandy mud. This biotope was recorded in the centre of the offshore cable corridor;

- Group C contained 74 taxa comprising 814 individuals. Four species accounted for almost 59% of the faunal abundance: *Turritella communis*, the bivalve *A.nitida*, the brittlestar *A. filiformis* and the amphipod *Abludomelita obtusata*. This biotope can be classified as SS.SMu.CSaMu.AfilKurAnit *Amphiura filiformis*, *Kurtiella bidentata* and *Abra nitida* in circalittoral sandy mud. This biotope was recorded in the southwest of the offshore wind farm area and the northeast of the offshore cable corridor, closest to the offshore wind farm area; and

- Group D contained 97 taxa comprising 4,949 individuals. Seven species accounted for just under 49% of the faunal abundance: the polychaetes *Scoloplos armiger*, *Lumbrineris cingulata*, *Diplocirrus glaucus*, the brittlestar *Ophiura* sp. (juv), the bivalve *Thracia phaseolina*, *Nemertea* (indet) and *Nematoda*. This biotope can be classified as SS.SCS.CCS.MedLumVen *Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in circalittoral coarse sand or gravel. This biotope was recorded throughout the northeast and centre west of the offshore wind farm area.

The benthic faunal groups identified from grab samples were amalgamated with the benthic drop-down video data to present a biotope classification for each sample station visited during the 2019 survey, these have been presented alongside the 2006 benthic survey biotope classifications (Figure 8-5). Only two sample stations (CR3 and S13) within the 2019 survey recorded grab and video data from the same location therefore for most stations the biotope has been taken from the applicable grab or video sample characterisation. For one sample station (S13) in the central west of the offshore wind farm area that recorded grab and video data, the video data only recorded sediment type with no macro or megafauna observed. The sediment data was amalgamated with the grab data to provide a final biotope. The biotopes SS.SSa.IMuSa.FfabMag and SS.SCS.CCS.SpiB /SS.SMx.CMx.FluHyd were found in the grab and video samples for the same station in the centre of the offshore cable corridor with infralittoral rock on the inshore side and sand habitats on the offshore side. This area shows a transition from a sandy sediment area into a more coarse sediment /rock area which is sand scoured.

The results of the 2019 survey are broadly consistent with the results of the 2006 survey. In addition, the results are consistent with the Marine Institute data from within Dundalk Bay recorded in 2016 and 2019 (Table 8-5). Since the 2006 survey, two stations (S15 and S31) in the southwest of the offshore wind farm area recorded changes in sediment composition and benthic community types. At both of these stations there was a recorded increase in coarse sediment and a reduction in silt-clay content. As a result, these stations have switched from an *Abra* dominated community to an *Amphiura* community. Both *Abra* and *Amphiura* communities are common throughout the Irish Sea (Aquafact, 2020).



Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor

2006 Benthic Sample Stations

- Unclassifed
- Faunal group a
- Faunal group b
- Faunal group c
- Faunal group e
- Faunal group f
- Faunal group g
- Faunal group h
- Faunal group i
- 2019 Benthic Sample Locations
- Benthic Subtidal and Intertidal Ecology Study Area

Data Sources: Client, OSI, Aquafact.

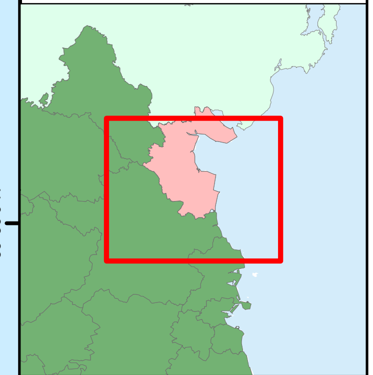


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Figure 8-4
Benthic Sampling Locations and Faunal Community Groups

RPS
A TETRA TECH COMPANY

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

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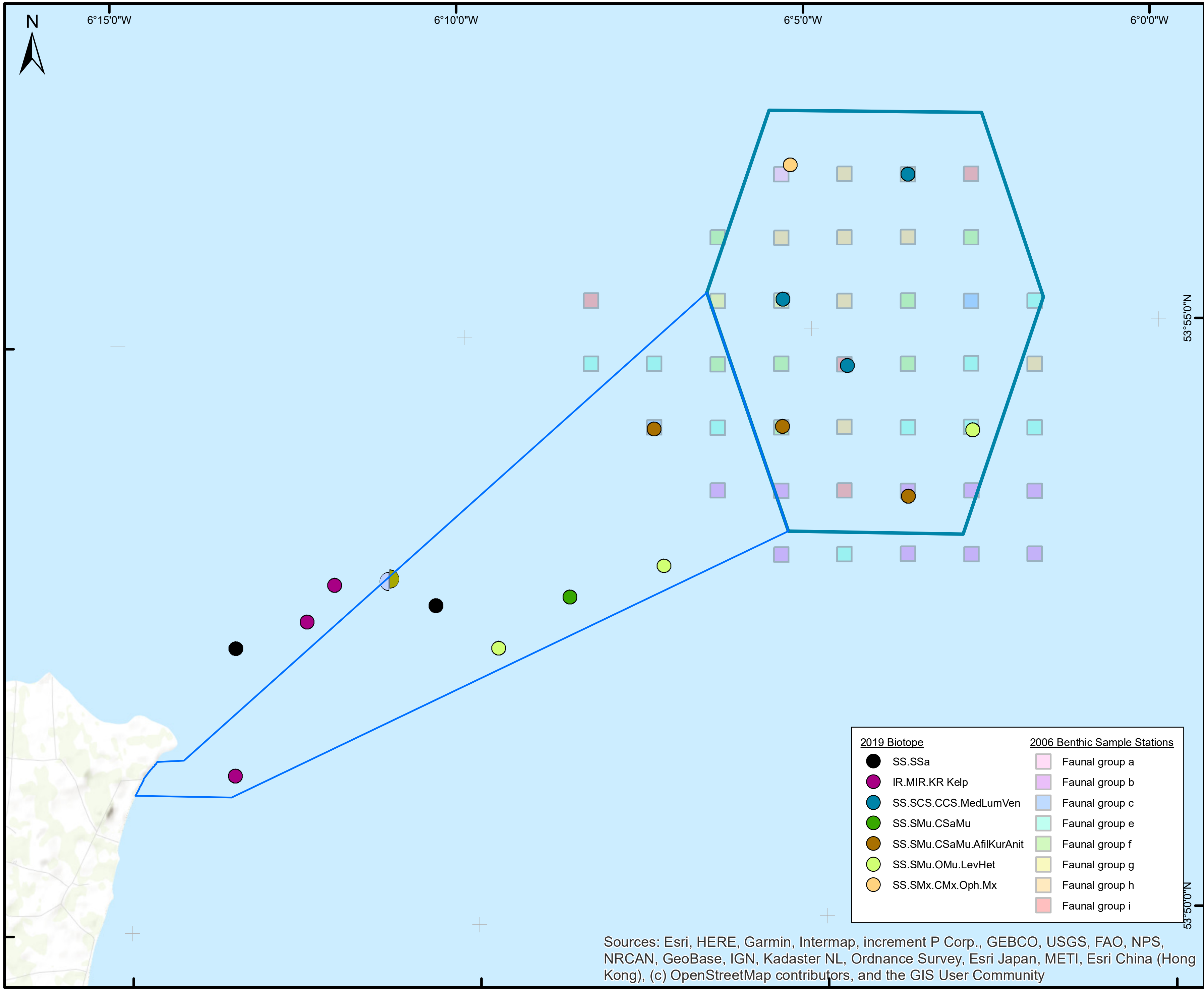

Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor

Data Sources: Client, Ordnance Survey Ireland.

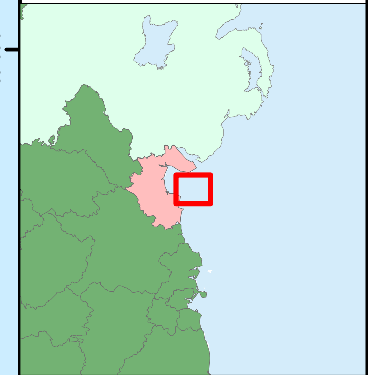

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Figure 8-5
Benthic subtidal biotopes across the Benthic Subtidal and Intertidal Ecology Study Area

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

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Date: 12/03/2024	Geographic Co-ordinates: ETRS89

Reef habitats

As noted in section 8.7.2, the EMODnet seabed habitat data indicates that biogenic reef may be present within the offshore wind farm area and offshore cable corridor. No evidence of biogenic reef was found during the site-specific benthic subtidal surveys. Any reef that may be present in this area is likely ephemeral, however, there is potential for these habitats to develop over time.

Biogenic reefs are habitats listed under the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and therefore are considered to be priorities for protection. The OSPAR reef habitats are *Modiolus modiolus* beds and *Sabellaria spinulosa* beds. *M. modiolus* beds are horse mussel beds which can form 70 m deep on a range of substrates, from hard substrates through to muddy gravel and sands. *S. spinulosa* are tube-building polychaetes which can form dense aggregations on mixed substrate and rocky habitats (OSPAR, 2019). Reefs are also designated as Annex I habitats under the Habitats Directive. This includes rocky marine habitats as well as the biogenic reefs formed by blue mussels *Mytilus edulis*, horse mussels *M. modiolus*, ross worms *Sabellaria* spp. and Serpulid worms *Serpula vermicularis* (JNCC, 2019).

8.7.2.2 Intertidal ecology

The northeast coast of Ireland is characterised by extensive linear sandy and shingle beaches, with rocky shores confined to small areas along the coast north of Dublin Bay.

Site-specific survey

A standard Phase 1 intertidal walkover survey and dig-over macrofauna sampling was undertaken in October 2019 to characterise the landfall location. The Phase 1 intertidal walkover survey was undertaken by an experienced marine ecologist following guidance set out in the JNCC Marine Monitoring Handbook (Davies *et al*., 2001) and the Handbook for Marine Intertidal Phase 1 Biotope Mapping Survey (Wyn *et al*., 2006).

The survey included observations of ecological and physical characteristics, and description of broadscale sediment types and conspicuous fauna. Biotopes present were identified and their extents mapped using aerial photography and GPS recorders. The full details of the surveys carried out are set out in appendix 8-1: Intertidal Phase 1 Report.

The landfall survey area contained a mix of mobile rocky habitat and intertidal sand. A steep and narrow band of shingle was present at the landward end of the beach after which a very shallow slope occurred dominated by intertidal sand/sandflats. The talitrid amphipod *Orchestia gammarellus* was recorded albeit very sparsely under stones and patches of decaying seaweed, originally washed onto the strandline during high tides. The classification for this biotope is LS.LSa.St.Tal (Figure 8-6).

The sandflat was generally fine grained and clean with a relatively low mud content without a prominent anoxic layer. This band was classified as LS.LSa.MuSa.MacAre. *Limecola balthica* and *Arenicola marina* in littoral muddy sand were present immediately below the shingle zone and extended throughout most of the intertidal to the lower shore (Figure 8-6). Oligochaete worms, a spionid worm and the polychaete worms *Hediste diversicolour*, *Scoloplos armiger* and *Lanice conchilega* were also recorded in dig-over sampling. A second band of this biotope also occurred on the lower shore.

In the mid shore, areas of rocky substrate were recorded, comprising areas of bedrock and boulders. An area of LR.LLR.F.Fves *Fucus vesiculosus* on moderately exposed to sheltered mid eulittoral rock was present at the northern end of the site. The barnacle *Semibalanus balanoides* was abundant while the molluscs *Nucella lapillus*, *M. edulis* and *Patella vulgata* occurred occasionally. In the southern half of the midshore, the area of rocky substrate was characterised by an area of LR.FLR.Eph.EntPor biotope containing an abundance of *Ulva intestinalis* and *Porphyra umbilicalis*. This area was more sand scoured towards the south of the survey area, where a mosaic of less diverse LR and LR.FLR.Eph.EntPor biotopes was mapped (Figure 8-6).

In the lower shore, sandy sediments dominated. Where dense populations of *L. conchilega* occurred and *Arenicola marina* was less abundant, if present, the biotope LS.LSa.MuSa.Lan, *L. conchilega* in littoral sand was ascribed (Figure 8-6). This biotope occurred in clean sand mainly along the mid and lower shores with polychaetes *Euclymene lombricoides*, *Nephtys hombergii*, *S. armiger* and *Arenicola marina* often present.

As outlined above, the intertidal sand and muddy sand habitat (as defined by the LS.LSa.MuSa.MacAre biotope) was found to comprise a significant proportion of the intertidal survey area (Figure 8-6). This habitat is offered protection by conservation legislation, being listed under the EU Habitats Directive, although the landfall location is not within a Special Area of Conservation (SAC). The intertidal surveys have identified no other intertidal habitats covered by the EU Habitats Directive.

Aerial extrapolation

The intertidal survey undertaken in 2019 focussed on a survey area of approximately 200 m along Dunany Beach. Since the survey was undertaken, the extent of the offshore cable corridor on the approach to the landfall has been adjusted to minimise the extent of the offshore cable corridor in the North west Irish Sea cSPA. To inform the baseline a further assessment of the intertidal area and biotope classification was undertaken using aerial imagery, and where possible, photographs have been used to extrapolate out the biotopes from the 2019 survey. As specific species of the biotope are undeterminable from aerial imagery, higher biotope classifications have been used and denoted in Figure 8-6 as ‘Extrapolated Habitat’. This allows for a more conservative approach to the assessment in the extrapolated area.

The extrapolated area contained a mix of littoral sand, bedrock and cobbles, with green and red seaweed likely to be present (based on the surveyed biotopes; Figure 8-6).

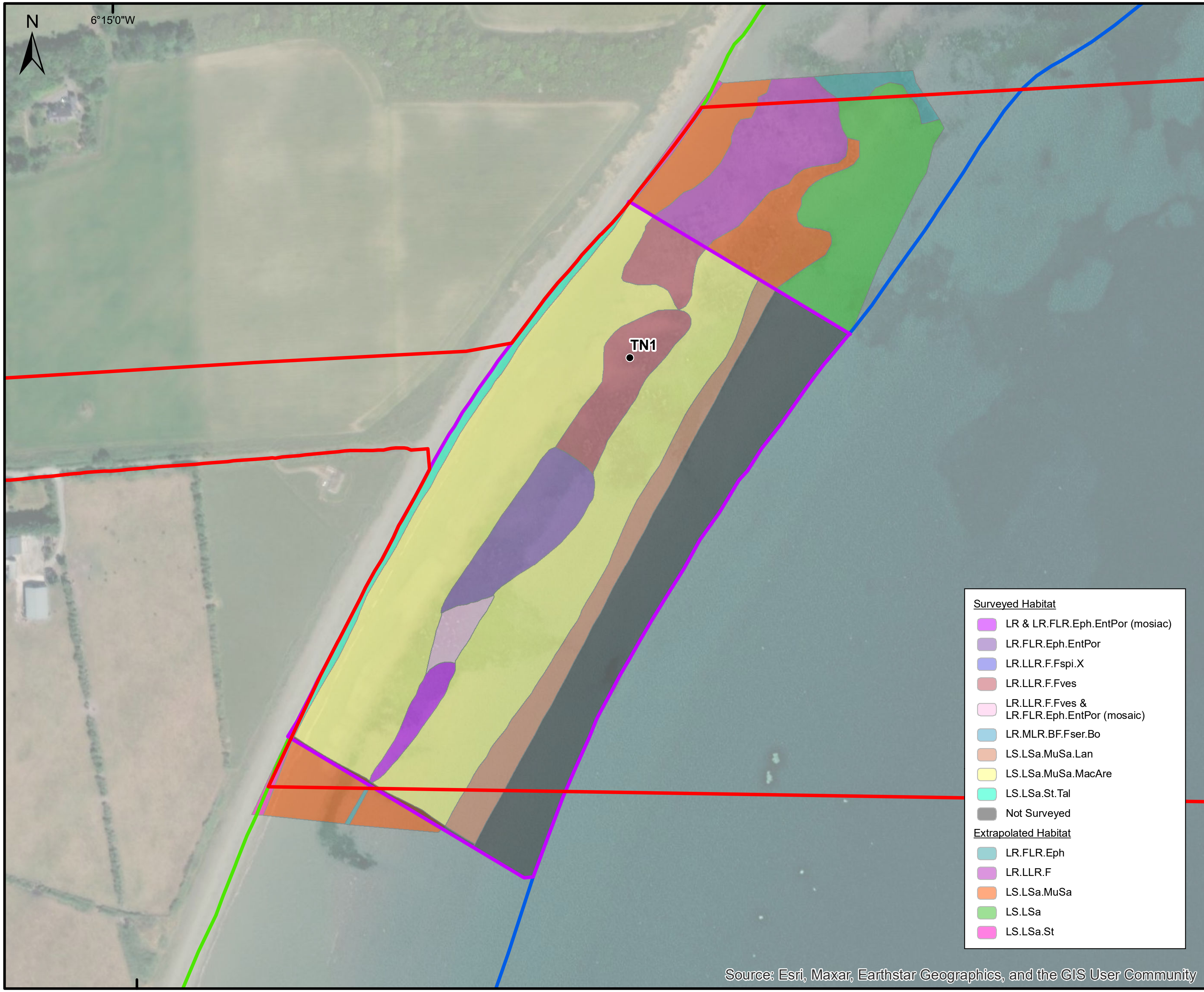
Along the upper shore line, LS.LSa.St Strandline was identified due to the lack of any physical features seen on the aerial and extrapolated from the LS.LSa.Lt.Tal biotope identified in the survey. LS.LSa.MuSa Polychaete/bivalve-dominated muddy sand shores was extrapolated out from the LS.LSa.MuSa.MacAre biotope to the revised offshore cable corridor width, and could be seen below the LS.LSa.St biotope.

Along the mid shore, areas of LR.LLR.F Fucoids on sheltered marine shores, were identified due to the presence of a green colouration on the aerial imagery, with LS.LSa.MuSa located further down the shore. LR.FLR.Eph Ephemeral green or red seaweed communities (freshwater or sand-influenced) could potentially be found at the southern or northern extents of the mid shore.

At lower shore, LS.LSa Littoral sand was identified due to the beige sandy environment and lack of flora or faunal discolouration to the aerial imagery. Furthermore, this biotope can likely be attributed to the ‘not surveyed’ biotope within the surveyed area.

Beyond the low water mark, the subtidal broadscale habitat type is expected to be a mix of infralittoral coarse sediment and sand.

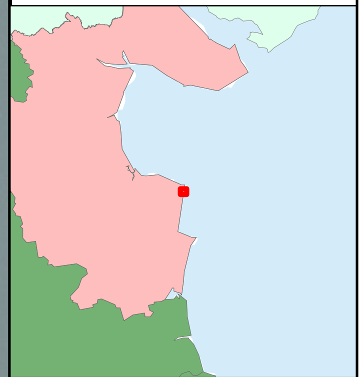
Of these environments, the LS.LSA.MuSa identified along the upper shore could be categorised, based on the precautionary principle, as an extension of the LS.LSa.MuSa.MacAre. This habitat was found to comprise a significant proportion of the intertidal survey area and is offered protection by conservation legislation, being listed under the EU Habitats Directive, although the landfall location is not within a Special Area of Conservation (SAC).



Legend

- TN1 - Damaged *Fucus vesiculosus*
- Application Boundary
- Intertidal Survey Area
- High Water Mark
- Low Water Mark

Data Sources: Client, Ordnance Survey Ireland.



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 8-6
Intertidal Survey Habitats

A TETRA TECH COMPANY

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

Drawn By: NG	**Project No.** EOR0822 (MDR1520B)
Checked By: NG	**File Ref:**
Approved By: AOS	EOR0822_BEN_E_1106_FINAL
Scale: 1:4,000 @ A4	**Projection:** ITM (IRENET95)
Date: 22/02/2024	Geographic Co-ordinates: ETRS89

8.7.3 Designated sites

Designated sites and relevant QIs identified for this chapter are described in Table 8-8 below. This includes Dundalk Bay SAC, Dundalk Bay Ramsar site, Carlingford Lough Ramsar site and Carlingford Lough Area of Special Scientific Interest (ASSI), which are described further in the sections below.

Ireland has committed to establishing Marine Protected Areas (MPAs) to protect biodiversity. No legislation[1] is currently used in Ireland to legally underpin protected areas established to fulfil commitments to the OSPAR convention (the Convention for the Protection of the Marine Environment of the North-East Atlantic). Therefore, since the creation of OSPAR MPAs would not afford any legal protection to the relevant areas on their own, Ireland has established a number of its SACs as OSPAR MPAs for marine habitats (NPWS, 2021).

The Habitats Directive (92/43/EEC), on the conservation of natural habitats and of wild fauna and flora, protects habitats and species of European nature conservation importance. Special Areas of Conservation (SACs) are designated under the Habitats Directive and promote the protection of flora, fauna and habitats. The Habitats Directive and Birds Directive are transposed into Irish law by the European Communities (Birds and Natural Habitats Regulations 2011 (S. I. No. 477 of 2011) with later amendment regulations (S.I. No. 290 of 2013; S.I. No. 499 of 2103; and S.I. No. 355 of 2015). These regulations are hereafter referred to as the 2011 Habitats Regulations.

Ireland has established a number of SACs for marine habitats, including Dundalk Bay SAC [Site Code 000455]. The Dundalk Bay SAC QIs of interest include estuaries, mudflats and sandflats not covered by seawater at low tide, Salicornia and other annuals colonising mud and sand, Atlantic salt meadows and Mediterranean salt meadows (NPWS, 2014). The landfall location is 4.4 km from the Dundalk Bay SAC. Further detail on designated sites can be found in appendix 8-1: Intertidal Phase 1 Report.

A number of designated sites within the Benthic Subtidal and Intertidal Ecology Study Area have been designated for coastal features found above the High Water Mark including saltmarsh and vegetated stony banks (Dundalk Bay SAC, Carlingford Shore SAC, Clogher Head SAC and Dunany Point proposed National Heritage Area; pNHA). Given these habitats occur above high water mark they have not been considered further in this chapter. Designated sites with onshore coastal features (above high water mark) have been considered within volume 2C, chapter 19: Onshore Biodiversity.

Table 8-8: Designated sites and relevant qualifying interests for the benthic subtidal and intertidal ecology assessment (see Figure 8-7).

Designated Site	Closest Distance to offshore wind farm area (km)	Closest Distance to offshore cable corridor (approx. km)	Relevant Qualifying Interests
Dundalk Bay SAC (000455)	9.3	4.4	Annex I Habitats Estuaries [1130] Mudflats and sandflats not covered by seawater at low tide [1140] Salicornia and other annuals colonising mud and sand [1310] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Mediterranean salt meadows (*Juncetalia maritimi*) [1410]
Dundalk Bay (Ramsar site; 7IE026)	10.5	4.4	Wetland of international Importance

[1] New legislation 'the Marine Protected Areas Bill' (when enacted) will legally underpin the designation of Marine Protected Areas in Ireland.

Designated Site	Closest Distance to offshore wind farm area (km)	Closest Distance to offshore cable corridor (approx. km)	Relevant Qualifying Interests
Carlingford Lough (Ramsar Site; UK)	8.1	11.0	Wetland of International Importance Supports internationally important breeding population of sandwich terns Supports an important assemblage of vulnerable and endangered Irish Red Book bird species Supports internationally important numbers of overwintering light bellied Brent geese.
Carlingford Lough ASSI (NI; UK)	7.5	10.5	Unusual and rich littoral communities Sheltered shore supporting invertebrate species
Dunany Point pNHA	9.9	Intersects the offshore cable corridor	Composed of a range of coastal habitats from cliff habitats through to intertidal habitats, including: - sandy sediments - mudflats - rocky outcrops; and - shingle banks.

Dundalk Bay SAC

Dundalk Bay SAC is designated under the Habitats Directive as a Site of Community Importance for a range of marine and coastal habitats (NPWS, 2011a). A list of the Dundalk Bay SAC Annex I habitats relevant to this chapter are presented in Table 8-8 and described below.

The conservation objectives are to maintain the favourable conservation status of the Estuaries and Mudflats and sandflats not covered by seawater at low tide (NPWS, 2011b).

In addition, Dundalk Bay SAC also encompasses other Annex I habitats (e.g. Atlantic Salt Meadows [1330], Perennial vegetation of stony banks [1220]).

Other designated sites

Dundalk Bay Ramsar

Dundalk Bay is also designated as a Ramsar site as it has extensive saltmarshes, intertidal sand and mudflats encompassing the estuaries of five rivers (Dee, Glyde, Fane, Castletown and Flurry). The mudflats support diverse fauna and flora of bivalve mollusc, marine worms and crustaceans that provide a key food source for tens of thousands of water birds. The site is internationally important for water birds, supporting over 20,000 birds and over 1% of the northwest European/east Atlantic Flyway populations. It also encompasses extensive saltmarsh of different classifications which fringe shingle beach, supporting intertidal flora (Dundalk Bay Ramsar Sites Information Service (RSIS), 2019). This site has been included as it is within the Benthic Subtidal and Intertidal Ecology Study Area however it does not overlap with the offshore wind farm area and offshore cable corridor.

Carlingford Lough Ramsar

Carlingford Lough is designated as a Ramsar site as the site is a wetland of international importance. The benthic communities provide food and habitat for a number of important assemblages of birds (see chapter 11: Offshore Ornithology). This site has been included as it is within the Benthic Subtidal and Intertidal Ecology Study Area however it does not overlap with the offshore wind farm area and offshore cable corridor. It contains features of interest under Criterion 3c of the convention on wetlands (Ramsar), supporting internationally important breeding populations of sandwich tern. The site also qualifies under

Criterion 2a as it supports an important assemblage of vulnerable and endangered Irish Red Data Book bird species. It also supports nationally important breeding populations of common, roseate and Arctic terns. The site forms part of an extended cross-border area which qualifies under Criterion 3c for regularly supporting internationally important numbers of overwintering light-bellied Brent geese (DAERA, 2019).

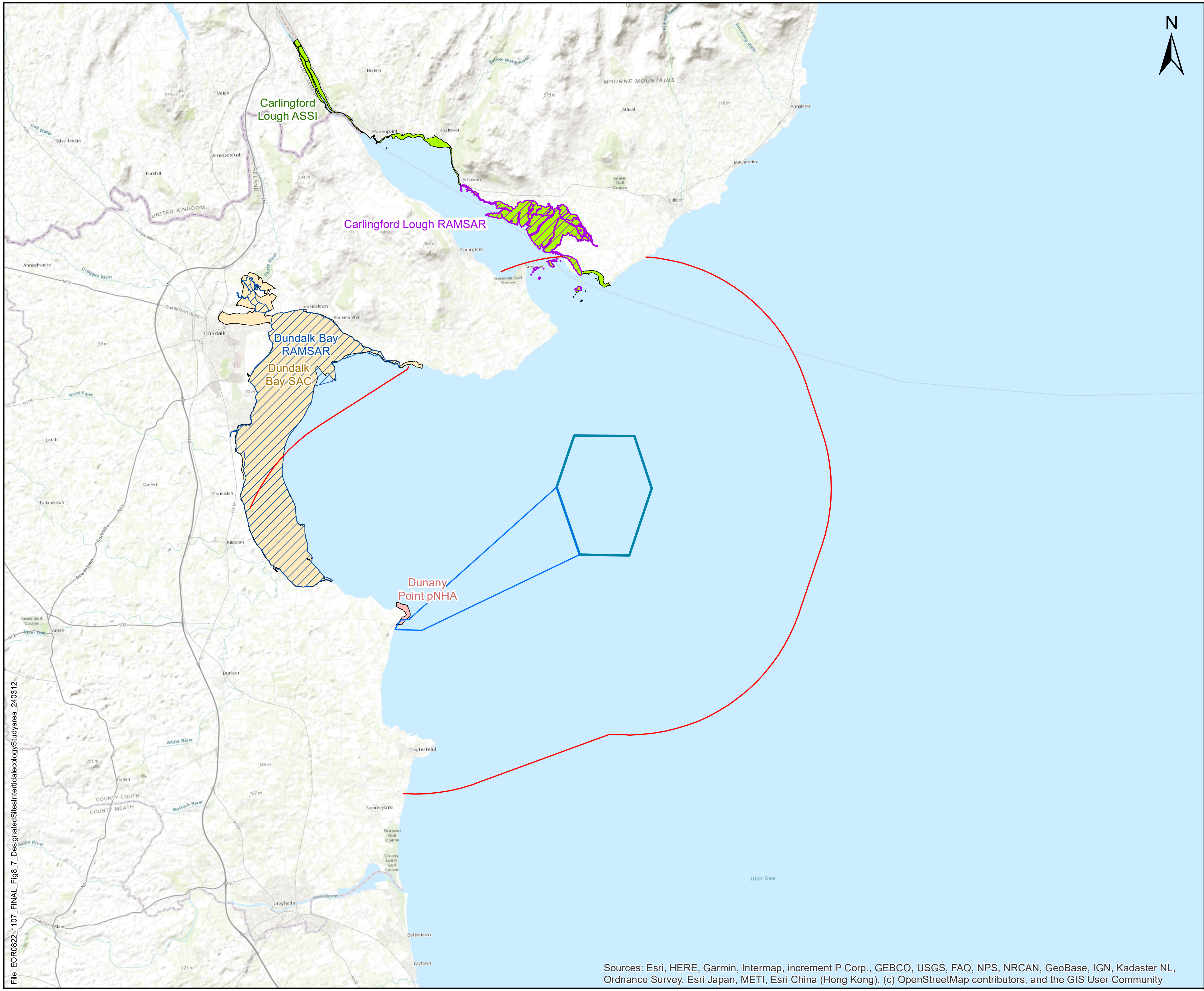
Carlingford Lough ASSI

Carlingford Lough Area of Special Scientific Interest (ASSI; NI) has been designated as an ASSI due to its unusual and rich littoral communities. This site has been included as it is within the Benthic Subtidal and Intertidal Ecology Study Area however it does not overlap with the offshore wind farm area and offshore cable corridor. Cranfield point (within Carlingford Lough ASSI) holds the highest intertidal densities of sea potato *E. cordatum* in Northern Ireland, a species which is usually sublittoral. Carlingford Lough ASSI also has a unique community in Northern Ireland with a boulder based fucoid zonation on wide mud and sand flats. One area of the ASSI features three of the four major intertidal sedimentary communities found in Northern Ireland. Killowen Point is a sheltered boulder shore which is very rich in invertebrate species. A number of normally sublittoral species occur within the intertidal zone, including the anemone *Metridium senile*, Feather-star *Antedon bifida*, the starfish *Solaster endeca* and Green Sea-urchin *Psammechinus miliaris*. This is the only example of this type of shore community in Northern Ireland outside Strangford Lough (DAERA, 1996).

8.7.3.1 Dunany Point pNHA

Dunany Point pNHA is a proposed Natural Heritage Area which coincides with the offshore cable landfall location for the Project. A list of the Dunany Point pNHA designated habitats relevant to this chapter are presented in Table 8-8 and described below.

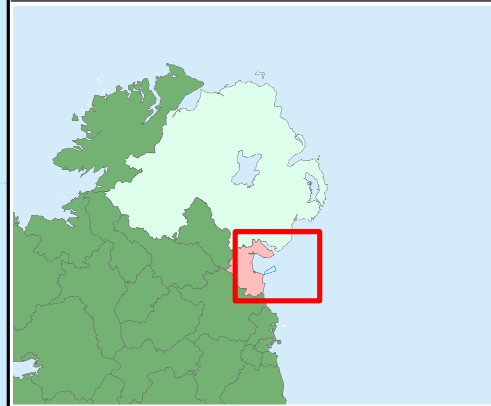
The site is dominated by a prominent low sea cliff composed of large and medium sized rock fragments in a clay matrix. The foreshore contains rocky habitats including small pebbles to boulder sized fragments of siltstone, limestone and sandstone. At the southern end the beach is characterised of sandy sediment and mudflats with tall banks of shingle between the mean high water and mean low water marks at the northern end (NPWS, 2009).



Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Benthic Subtidal and Intertidal Ecology Study Area
- Dundalk Bay RAMSAR
- Carlingford Lough RAMSAR
- Carlingford Lough ASSI
- Dundalk Bay SAC
- Dunany Point pNHA

Data Sources: Client. Ramsar - Ramsar Sites information Service and Irelands Marine Atlas NPWS. DAERA



Client

Oriel Windfarm Limited

Project

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Title **Figure 8-7**
Designated sites within the Benthic Subtidal and Intertidal Ecology Study Area

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

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Scale: 1:200,000 @ A3	Projection: ITM (IRENET95)
Date: 12/03/2024	Geographic Co-ordinates: ETRS89

NOTE: 1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. Ordnance Survey Ireland Licence EN 0005019 ©Copyright Government of Ireland.

8.7.4 Important ecological features

The important ecological features (IEF) of an area are those that are considered to be important and potentially affected by the Project. Importance may be due to quality or extent of habitats, habitat or species rarity or the extent to which they are threatened (CIEEM, 2018). Species and habitats are considered IEFs if they have a specific biodiversity importance recognised through international or national legislation or through local, regional or national conservation plans (e.g. Annex I habitats under the Habitats Directive, OSPAR, National Biodiversity Plan or the Marine Strategy Framework Directive). The criteria used to inform the valuation of IEFs are presented in Table 8-9 and the IEFs, their conservation status and valuation are presented in Table 8-10.

Table 8-9: Criteria used to inform the valuation of the IEFs in the Benthic Subtidal and Intertidal Ecology Study Area.

Value of IEF	Criteria to define value
International	Internationally designated sites. Habitats and species protected under international law (i.e. Annex I habitats within a SAC boundary).
National	Nationally designated sites. Species protected under national law. OSPAR List of Threatened and/or Declining Species and Habitats Annex I habitats not within a SAC boundary.
Regional	Regionally important habitats/communities within the Benthic Subtidal and Intertidal Ecology Study Area. Habitats or species that provide important prey items for other species of conservation or commercial value.
Local	Habitats and species which are not protected under conservation legislation which form a key component of the benthic ecology within the Benthic Subtidal and Intertidal Ecology Study Area.

Table 8-10: Important Ecological Features (IEFs) within the Benthic Subtidal and Intertidal Ecology Study Area.

IEF	Description and Representative biotopes	Protection status	Conservation interest	Importance within the Benthic Subtidal and Intertidal Ecology Study Area
Subtidal Sandy Mud Sediment	Subtidal sandy mud sediments with rich infaunal communities SS.SMu.CSaMu.AfilKurAnit SS.SMu.OMu.LevHet	None	Of local conservation interest	Local
Subtidal Sand Sediment	Subtidal sandy sediments with moderately diverse infaunal communities SS.SSa.CFiSa.EpusOborApri SS.SSa.CFiSa.ApriBatPo SS.SSa.IMuSa.FfabMag	None	Of local conservation interest	Local
Subtidal Coarse Sediment	Subtidal coarse sediments of sand and gravels with moderately diverse infaunal and epifaunal communities. SS.SCS.CCS.MedLumVen SS.SCS.CCS.SpiB/ SS.SMx.CMx.FluHyd SS.SMx.CMx.Oph.Mx	None	Of local conservation interest	Local
Subtidal Infralittoral Rock	Subtidal Rock with Kelp IR.MIR.KR	None	Of local conservation interest	Local

IEF	Description and Representative biotopes	Protection status	Conservation interest	Importance within the Benthic Subtidal and Intertidal Ecology Study Area
Annex 1 Habitat Features of SACs				
Estuaries	A mosaic of subtidal and intertidal habitats, which are closely associated with surrounding terrestrial habitats. They are the downstream part of a river valley, subject to the tide and extending from the limit of brackish water.	Annex I Habitats Directive	QI of the Dundalk Bay SAC and Dundalk Bay Ramsar.	International – part of European designated site (Dundalk Bay SAC and Ramsar).
Mudflats and sandflats not covered by seawater at low tide	Intertidal mudflats and sandflats are submerged at high tide and exposed at low tide. They can occur on mobile, coarse-sand beaches on wave-exposed coasts to stable, fine-sediment mudflats in estuaries and other marine inlets.	Annex I Habitats Directive	QI of the Dundalk Bay SAC.	International – part of European designated site (Dundalk Bay SAC).
Intertidal Habitats				
Littoral Sand	LS.LSa.MuSa.MacAre / LS.LSa.MuSa.Lan	None	Qualifies as an Annex I habitat under the Habitats Directive although not within a SAC.	National
Eulittoral Rock	LR / LR.LLR.F.Fves / LR.FLR.Eph.EntPor	None	Local	Local
Dunany Point pNHA	Proposed NHA (overlapping the proposed landfall location) proposed to be designated for a range of coastal habitats from cliff habitats through to intertidal habitats, including: • Sandy sediments; • Mudflats; • Rocky outcrop; and • Shingle banks.	National	Proposed NHA	National

8.7.5 Future baseline scenario

The European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (hereafter the EIA Regulations 2018) requires that "*a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without development 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*" is included within the EIAR.

In the event that the Project is not constructed, an assessment of the future baseline conditions has been carried out and is described within this section.

The baseline environment is not static and will exhibit some degree of natural change over time, even if the Project is not constructed, due to naturally occurring cycles and processes. Therefore, when undertaking impact assessments, it will be necessary to place any potential impacts in the context of the envelope of change that might occur naturally over the timescale of the Project. Benthic communities are also predicted to be influenced by anthropogenic activities including contamination or seabed disturbing activities such as trawling, dredging and development (OREDP, 2010). Further to potential change associated with existing cycles and processes, it is necessary to take into account the potential effects of climate change on the marine environment. Variability and long-term changes on physical influences may bring direct and indirect changes to benthic habitats and communities by the mid-century (e.g. Increasing storm surge events, continued warming of Irish waters and sea level rise) (DHPLG, 2019).

Records of sea surface temperature from around Ireland show a mean warming trend below the global average of 0.3˚C between 1850 and 2008. However, recent temperature records around Ireland show an accelerated rate of warming with temperatures rising by 0.6˚C per decade since 1994. Part of this dramatic increase has been attributed to global warming. The warmest sea temperature years on record have been 2005, 2006 and 2007 with particularly strong warming in the southeast of Ireland (Nolan, 2010). Wave heights have also steadily increased around Ireland with an increase in monthly significant wave height of 0.6 m in the northeast Atlantic between 1988 and 2002. In the southwest of Ireland, significant wave heights have increased by 0.8 m per decade (Nolan, 2010). Any changes that may occur during the design life span of the Project should be considered in the context of both greater variability and sustained trends occurring on national and international scales in the marine environment.

8.7.6 Data validity and limitations

The data sources used in this chapter are detailed in Table 8-5 and Table 8-6 above. The desktop data used are the most up to date publicly available information which can be obtained from the applicable data sources as cited. There is potential for the benthic communities to have developed and evolved in the intervening period since the site-specific surveys were carried out in 2006 and 2019. However, as noted in the baseline characterisation above (section 8.7.1), the communities associated with this part of the western Irish Sea are generally stable over time, with consistency in the communities recorded over time. However, to ensure an up-to-date baseline characterisation, the 2006 data has been verified with site-specific surveys undertaken in 2019, alongside other desktop data sources (see section 8.6.1).

Although the sampling design and collection process for the survey data provided robust data on the benthic communities, interpreting these data has limitations. It is often difficult to interpolate data collected from discrete sample locations to cover a very extensive area and define the precise extents of each biotope. Benthic communities generally show a transition from one biotope to another and therefore boundaries of where one biotope ends and the next begins cannot be precisely defined, rather these boundaries indicate where communities grade into one another. The classification of the community data into biotopes is not always straightforward, as some communities do not readily fit the available descriptions in the biotope classification system.

Due to the limitations described above, the biotope map shown (Figure 8-5) should not be interpreted as definitive areas.

There is no specific guidance available which guides the assessment of the validity of the data used. However, RPS considered that the data provides a suitable baseline characterisation which describes the main habitats and communities within the offshore wind farm area and offshore cable corridor for the purposes of EIA.

8.8 Key parameters for assessment

8.8.1 Project design parameters

The project description is provided in volume 2A, chapter 5: Project Description. Table 8-11 outlines the project design parameters that have been used to inform the assessment of potential impacts of the construction, operation and maintenance and decommissioning phases of the Project on benthic, subtidal and intertidal ecology.

Due to the potential for unexpected ground conditions and obstructions, the final route and length of the offshore export cable and offshore inter array cables will be confirmed during construction (see design flexibility details in chapter 5: Project Description (volume 2A). For the purposes of the assessment presented in section 8.10, the maximum length of cables has been considered to ensure the potential for maximum impact is assessed. Should the lengths of cables be lower than those specified (e.g. 15 km of offshore cable in constructed), then the potential for effects will be the same (or slightly less) than those outlined in assessment in section 8.10. An alternative route within the offshore wind farm area or offshore cable corridor will also not change the assessment in section 8.10.

Table 8-11: Project design parameters considered for the assessment of potential impacts on benthic subtidal and intertidal ecology.

<table>
<tr><th rowspan="2">Potential impact</th><th colspan="3">Phase[1]</th><th rowspan="2">Project Design Parameters</th><th rowspan="2">Justification</th></tr>
<tr><th>C</th><th>O</th><th>D</th></tr>
<tr><td>Temporary subtidal habitat loss/disturbance</td><td>✓</td><td>✓</td><td>✓</td><td>Construction phase
709,500 m² of temporary habitat loss/disturbance due to:
Use of jack-up vessels during foundation installation, with two jack-up events per Wind Turbine Generator (WTG) and four jack-up events for the OSS;
Installation of 41 km inter-array cables and 16 km offshore cable with seabed disturbance width of 10 m; and
Sand wave clearance for 10% of inter-array cables and 10% of the offshore cable.
Offshore construction phase duration up to 15 months.
Operational and maintenance phase
387,000 m² of temporary habitat loss/disturbance due to:
Component replacement activities using jack-up vessel associated with 25 WTGs (average of two major component replacements per year);
Inter-array cables: seven repair events and seven reburial events over the lifetime of the Project; and
Offshore cable: three subtidal repair events and three subtidal reburial events over the lifetime of the Project.
Operational phase of 40 years.
Decommissioning phase
624,000 m² of temporary habitat loss/disturbance. Parameters are assumed to be the same as for the construction phase however seabed preparation and seabed clearance (prior to foundation installation) will not take place during the decommissioning phase.</td><td>These values accounts for project specific WTG and OSS foundation types, and maximum length of cables resulting in greatest extent of temporary habitat loss. Maximum proportion of cables requiring seabed clearance prior to cable installation.</td></tr>
<tr><td>Temporary intertidal habitat loss/disturbance</td><td>✓</td><td>✓</td><td>✓</td><td>Construction phase
Cable installation at the landfall location via open trenching:
Installation of one cable in one trench between HWM and LWM with dimensions 5 m x 800 m x 3 m (width x length x depth), with 15 m working area either side of trench, leading to 28,000 m² of temporary intertidal habitat loss/disturbance; and
Vessel grounding and vehicle movements across the foreshore (within the 30 m wide working area).
Installation duration of 3 months.

Operational Phase
Cable repair and reburial at the landfall location via open trench</td><td>These values account for the footprint within intertidal zone due to offshore cable installation at the landfall location. The project design parameters are based on open cut trenching.
Disturbance corridor includes: cable trenching, vehicle movements and vessel grounding.</td></tr>
</table>

<table>
<tr><th>Potential impact</th><th>Phase[1]
C</th><th>
O</th><th>
D</th><th>Project Design Parameters</th><th>Justification</th></tr>
<tr><td></td><td></td><td></td><td></td><td>• Offshore cable in the intertidal area: three intertidal repair events and three intertidal reburial events, leading to temporary habitat loss/disturbance of 126,000 m^2.
Operational phase of 40 years.
Decommissioning Phase
• Removal of one cable leading to 28,000 m^2 of temporary intertidal habitat loss/disturbance.
Decommissioning duration of 3 months.</td><td></td></tr>
<tr><td>Increased suspended sediment concentrations and associated sediment deposition</td><td>✓</td><td>✓</td><td>✓</td><td>Construction Phase
WTGs and OSS installed on monopile foundations:
• Drilled installation of 9.6 m diameter pile.
• Installation of inter-array and offshore cables:
– Disturbance of seabed material from a 3 m wide and 3 m deep trench for offshore cable and 1 m wide and 3 m deep for inter-array cables; and
– Modelled cable lengths over areas of sand and muddy sand.
Operational and Maintenance Phase
Cable repair/reburial activities:
• Inter-array cables: seven repair events and seven reburial events over the lifetime of the project; and
• Offshore cable: three repair events and three reburial events over the lifetime of the project.
Decommissioning Phase
WTGs and OSS on monopile foundations:
• Cutting and removal of monopile foundations to approximately 2 m below seabed.
Removal of inter-array and offshore cables:
• Disturbance of seabed material from a 3 m wide and 3 m deep trench for offshore cable and 1 m wide and 3 m deep for inter-array cables.</td><td>• Greatest volume of sediment released into the water column. See chapter 7: Marine Processes for further justification.</td></tr>
<tr><td>Seabed disturbance leading to the potential release of sediment contaminants and resulting potential effects on benthic ecology</td><td>✓</td><td>✓</td><td>✓</td><td>Construction Phase
WTGs and OSS installed on monopile foundations:
• Installation of inter-array and offshore cables:
– Disturbance of seabed material from a 3 m wide and 3 m deep trench for offshore cable and 1 m wide and 3 m deep for inter-array cables.
– Sand wave clearance for 10% of inter-array cables and 10% of the offshore cable.
Operational and Maintenance Phase
Cable repair/reburial activities:
• Inter-array cables: seven repair events and seven reburial events over the lifetime of the Project; and</td><td>• Greatest volume of sediment released into the water column. Therefore, the highest potential for release of sediment contaminants.</td></tr>
</table>

Potential impact	Phase[1] C	O	D	Project Design Parameters	Justification
				• Offshore cable: three subtidal repair events and three subtidal reburial events over the lifetime of the Project. **Decommissioning Phase** WTGs and OSS on monopile foundations: • Removal of inter-array and offshore cables; and • Disturbance of seabed material from a 3 m wide and 3 m deep trench for offshore cable and 1 m wide and 3 m deep for inter-array cables.	
Long-term subtidal habitat loss	×	✓	×	**Operational and Maintenance Phase** 332,121 m² of long-term habitat loss due to: • Presence of 26 (i.e. 25 x WTG + 1 x OSS) monopile foundations with a diameter of 9.6 m and associated scour protection; and • Presence of cable protection associated with 41 km inter-array cables and 16 km offshore cable. Assumes 50% of inter-array cable route and 50% of offshore cable route may require cable protection. Operational phase of 40 years.	• These values account for the WTG and OSS foundation types and associated scour protection, maximum length of cables and cable protection resulting in greatest extent of habitat loss.
Colonisation of foundations, scour protection and cable protection	×	✓	×	**Operational and Maintenance Phase** Long-term habitat creation of 356,807 m² due to: • Presence of 26 (i.e. 25 x WTG + 1 x OSS) monopile foundations, including scour protection; and • Presence of cable protection associated with 41 km inter-array cables and 16 km offshore cable. Operational phase of 40 years.	• These values account for the WTG and OSS foundation types and associated scour protection, maximum length of cables and cable protection resulting in greatest surface area for colonisation.
Alteration of seabed habitats arising from effects of physical processes	×	✓	×	**Operational and Maintenance Phase** WTGs and OSS installed on monopile foundations: • Presence of 25 WTG foundations and one OSS foundation of 9.6 m diameter each; • Minimum spacing 944 m; • Inclusion of approximately 1,810 m² of scour protection for each foundation; 47,060 m² of scour protection across the site. Operational phase of 40 years.	• Obstruction to flow in the water column. See chapter 7: Marine Processes.
Increased risk of introduction and spread of invasive and non-native species	✓	✓	✓	**Construction Phase** Increased risk of invasive and non-indigenous species (INIS) due to: • 475 vessel round trips during the construction phase. Offshore construction phase duration of 15 months. **Operational and Maintenance Phase** Increased risk of INIS due to: • The long-term creation of 359,807 m² of hard substrates due to foundations, associated scour protection and cable protection (see previous impact); and	• These values account for the surface area created by offshore infrastructure and maximum number of vessel movements during construction, operational and maintenance and decommissioning phases.

Potential impact	Phase[1] C	O	D	Project Design Parameters	Justification
				• 352 vessel round trips per year during the operational and maintenance phase. Operational phase of 40 years. **Decommissioning Phase** Increased risk of INIS due to: • 475 vessel round trips during the decommissioning phase. Decommissioning duration assumed to be similar to that for construction.	

1. C= Construction, O = Operation, D = Decommissioning.

8.8.2 Measures included in the Project

As part of the project design process, a number of measures have been proposed to reduce the potential for impacts on benthic subtidal and intertidal ecology (see Table 8-12). These measures include designed-in and management measures (controls). As there is a commitment to implementing these measures, they are considered inherently part of the design of the Project and have therefore been considered in the assessment presented in section 8.10 below (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.

Table 8-12: Measures included in the Project.

Measures included in the Project	Justification
An Environmental Management Plan (EMP) (*see* volume 2A, appendix 5-2: Environmental Management Plan) will be implemented during the construction, operation and maintenance and decommissioning phases of the Project. The EMP includes Project specific measures and commitments and a Marine Pollution Contingency Plan (MPCP *(see* volume 2A, appendix 5-2: Environmental Management Plan). Measures also include designated areas for refuelling where spillages can be easily contained, storage of chemicals in secure designated areas in line with appropriate regulations and guidelines, double skinning of pipes and tanks containing hazardous substances, and storage of these substances in impenetrable bunds.	To ensure that the potential for release of pollutants from construction, operational and maintenance, and decommissioning plant is minimised. In this manner, accidental release of contaminants from vessels will be strictly controlled, thus providing protection for marine life across all phases of the Project development.
A pre-construction survey will be undertaken within the offshore wind farm area and offshore cable corridor to identify any areas of reef habitat (particularly *Modiolus* beds and *S. spinulosa* reef habitats). This will include a drop-down video survey to determine the extent, distribution and quality/condition of any reef. Should reef areas be identified during pre-construction surveys, appropriate measures will be agreed with regulatory and nature conservation bodies to avoid direct impact on these features. Where possible, features will be avoided by layout refinement of foundations and cables.	• Biogenic reef habitats have been identified as having the potential to occur in the offshore wind farm area (see Figure 8-2) however no evidence of these have been recorded during site-specific surveys. As these are OSPAR habitats and/or Annex I habitats protected under the Habitats Directive, direct impacts on these habitats should be avoided wherever possible. Pre-construction surveys to determine extent, distribution and quality/condition of reef habitats will inform appropriate mitigation measures (e.g. layout refinement) to avoid such impacts.
A Marine Invasive Non-Indigenous Species Management Plan (volume 2A, appendix 5-3: Marine Invasive Non-Native Species Management Plan) will be implemented. The plan outline measures to ensure vessels comply with the International Maritime Organisation (IMO) ballast water management guidelines, it will consider the origin of vessels and contain standard housekeeping measures for	To manage and minimise the risk of potential introduction and spread of Invasive Non-Indigenous Species.

Measures included in the Project	Justification
such vessels as well as measures to be included in the event that a high alert species is recorded.	
Reinstatement of rock in the intertidal zone following cable installation. Any cut rock will be placed back on top of the cable to backfill the trench.	To promote recovery of associated communities within the area affected.

8.8.3 Impacts scoped out of the assessment

On the basis of the baseline environment and the project description outlined in volume 2A, chapter 5: Project Description, a number of impacts are proposed to be scoped out of the assessment for benthic subtidal and intertidal ecology. These impacts are outlined, together with a justification for scoping them out, in Table 8-13.

There will be no direct impact on the ecological features of interest of the marine protected areas within the Benthic Subtidal and Intertidal Ecology Study Area (Dundalk Bay SAC, Dundalk Bay Ramsar site, Carlingford Lough Ramsar site, Carlingford Lough ASSI and Dunany Point pNHA) as no infrastructure will be installed within these protected areas. No indirect impacts will occur as they are greater than one tidal excursion (3.5 km) away therefore there is no impact receptor pathway. As there is no route for impact, the ecological features of interest of the marine protected areas within the Benthic Subtidal and Intertidal Ecology Study Area have not been considered further.

Table 8-13: Impacts scoped out of the assessment for benthic subtidal and intertidal ecology.

Potential impact	Justification
Accidental release of pollutants	The measures set out in the EMP will minimise the likelihood of accidental release of pollutants (e.g. spillage of chemicals) and in the unlikely event that such an incident occurs, they will limit the severity of any such release. The offshore wind farm area is relatively close to operational port facilities therefore offshore refuelling is unlikely. All offshore operations will be subject to the measures set out in an EMP and MPCP (volume 2A, appendix 5-2). As such, there is no potential for significant effects on benthic subtidal and intertidal ecology receptors from this impact and this impact has therefore been scoped out from the assessment.
Intertidal long-term habitat loss	There is no proposed cable protection within the intertidal area and the installed offshore cable will run beneath the intertidal habitats. Therefore, there will be no long-term habitat loss and this impact has been scoped out from the assessment.

8.9 Impact assessment methodology

8.9.1 Overview

The assessment on benthic subtidal and intertidal has followed the methodology set out in volume 2A, chapter 3: EIA Methodology. Specific to the benthic subtidal and intertidal ecology impact assessment, the following guidance documents have also been considered:

- EPA (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports; and
- Guidelines for Ecological Impact Assessment (EcIA) in the UK and Ireland. Terrestrial, Freshwater and Coastal (CIEEM, 2018).

In addition, the benthic subtidal and intertidal ecology assessment has considered the legislative framework as defined by:

- The Wildlife Act 1997 (Amendment 2000); and
- European Communities (Birds and Natural Habitats) Regulations 2011.

8.9.2 Impact assessment criteria

Determining the significance of effects is a process that involves defining the magnitude of the impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in volume 2A, chapter 3: EIA Methodology.

The criteria for defining impact magnitude in this chapter are outlined in Table 8-14 below.

Table 8-14: Definition of terms relating to the magnitude of an impact.

Magnitude of impact	Definition
High	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse)
	Large scale or major improvement or resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial)
Medium	Loss of resource, but not adversely affecting integrity of resource; partial loss of/damage to key characteristics, features or elements (Adverse)
	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial)
Low	Some measurable change in attributes, quality or vulnerability, minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse)
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial)
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse)
	Very minor benefit to, or positive addition of one or more characteristics, features or elements (Beneficial)

The sensitivity of benthic subtidal and intertidal ecology IEFs has been defined by the Marine Evidence based Sensitivity Assessment (MarESA), as a product of the likelihood of damage (resistance) due to a pressure and the rate of recovery (recoverability) once the pressure has been removed. Recoverability is the ability of a habitat to return to the state of the habitat that existed before the activity or event which caused change. Full recovery does not necessarily mean that every component species has returned to its prior condition, abundance or extent but that the relevant functional components are present, and the habitat is structurally and functionally recognisable as the initial habitat of interest.

The MarESA has been drawn upon to support the assessment of sensitivity of the benthic subtidal and intertidal ecology receptors within the Benthic Subtidal and Intertidal Ecology Study Area. The MarESA is a database which has been developed through the Marine Life Information Network (MarLIN) of Britain and Ireland and is maintained by the Marine Biological Association (MBA). This database comprises a detailed review of available evidence on the effects of pressures on marine species or habitats, and a subsequent scoring of sensitivity against a standard list of pressures, and their benchmark levels of effect. The evidence base presented in the MarESA is peer reviewed and represents the largest review undertaken to date on the effects of human activities and natural events on marine species and habitats. It is considered to be one of the best available sources of evidence relating to recovery of seabed species and habitats. The benchmarks for the relevant MarESA pressures which have been used to inform each impact assessment have also been referenced under each impact assessment in section 8.10.

The process for defining receptor sensitivity in this chapter follows that defined by the MarESA sensitivity assessment, which correlates resistance and recoverability to categorise sensitivity, as set out in Table 8-15.

Table 8-15: Definition of terms relating to the sensitivity of the receptor (reproduced from MarESA sensitivity assessment).

Recoverability	Resistance			
	None	Low	Medium	High
Very Low	High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Low	High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Medium	Medium sensitivity	Medium sensitivity	Medium sensitivity	Low sensitivity
High	Medium sensitivity	Low sensitivity	Low sensitivity	Not sensitive (Negligible)

The significance of the effect upon benthic subtidal and intertidal 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 8-16. Where a range of significance of effect is presented in Table 8-16, the final assessment for each effect is based on calculated assessment and professional judgement.

For the purposes of this assessment, any effects with a significance level of slight or less have been concluded to be not significant in terms of the EIA regulation.

Table 8-16: Matrix used for the assessment of the significance of the effect.

Sensitivity of receptor	Magnitude of impact			
	Negligible	**Low**	**Medium**	**High**
Negligible	Imperceptible	Imperceptible or slight	Imperceptible or slight	Slight
Low	Imperceptible or slight	Imperceptible or slight	Slight	Slight or moderate
Medium	Imperceptible or slight	Slight	Moderate	Moderate or major
High	Slight	Slight or moderate	Moderate or major	Major or Profound

8.9.3 Identification of designated sites

Where Natura 2000 sites (i.e. internationally designated sites) are considered, this chapter summarises the assessments made on the Qualifying Interest (Qis) of internationally designated sites as described within section 8.7.3 of this chapter. The full assessment on each protected site is contained in the Natura Impact Statement (NIS) for the Project. The NIS has been prepared in accordance with guidance on the preparation of EIS and NIS for offshore renewable energy projects (Department of Communications, Climate Action and Environment, 2018).

With respect to nationally and locally designated sites, where these sites fall within the boundaries of an internationally designated site and where qualifying interests of the Natura site are also features of interest of the nationally designated sites (e.g. natural heritage areas (NHAs) which underpin a Natura site), only the international site has been taken forward for assessment. This is because potential effects on the integrity and conservation status of the nationally designated site are assumed to be inherent within the assessment of the internationally designated site (i.e. a separate assessment for the national site is not undertaken).

However, no nationally designated sites within the Benthic Subtidal and Intertidal Ecology Study Area fall within the boundaries of an internationally designated site (see section 8.7.3).

8.10 Assessment of significance

The potential impacts arising from the construction, operational and maintenance and decommissioning phases of the Project are listed in Table 8-11, along with the project design parameters against which each impact has been assessed.

A description of the potential effect on benthic subtidal and intertidal ecology receptors caused by each identified impact is given below.

8.10.1 Temporary subtidal habitat loss/disturbance

Direct temporary habitat loss/disturbance of subtidal habitats within the offshore wind farm area and offshore cable corridor during the construction, operational and maintenance, and decommissioning phases (Table 8-11) will occur as a result of a range of activities including use of jack-up vessels during foundation installation/maintenance, installation and maintenance of inter-array and offshore cables.

The relevant MarESA pressures and their benchmarks which have been used to inform this impact assessment are as follows:

- Abrasion/disturbance at the surface of the substratum or seabed: the benchmark for which is damage to surface features (e.g. species and physical structures within the habitat). This pressure corresponds to the impacts associated with jack-up vessel operations; and

- Penetration and/or disturbance of the substratum subsurface: the benchmark for which is damage to sub-surface features (e.g. species and physical structures within the habitat). This pressure corresponds to the impacts associated with cable installation and jack-up vessel operations.

Seabed preparation activities will occur in advance of installation of the inter-array and offshore cables. Dredged material resulting from seabed preparations (if required) will be side cast adjacent to the area of disturbance. This will be the subject of a separate Dumping at Sea Permit to allow for side casting of dredge spoil and drill cuttings adjacent to point of disturbance.. In addition, where foundations are installed by drilling, drill arisings are likely to be deposited on the seabed immediately adjacent to the foundation, which may result in temporary loss/disturbance of seabed habitats (e.g. deep smothering of benthic communities). However, this will occur in the same area assumed to be covered by scour protection around foundations (see long term habitat loss below) and therefore to avoid double counting impacts, these are not included in the maximum footprint for temporary habitat loss presented here.

Construction phase

Magnitude of impact

The installation of infrastructure within the offshore wind farm area and offshore cable corridor may lead to temporary subtidal habitat loss/disturbance. The project design parameters include for 709,500 m^2 of temporary habitat loss/disturbance during the construction phase (Table 8-11). This equates to 0.11% of the Benthic Subtidal and Intertidal Ecology Study Area and 1.3% of the offshore wind farm area and offshore cable corridor combined, therefore this represents a very small proportion of each area respectively.

Jack-up footprints associated with foundation installation will result in compression of seabed sediments beneath spud cans (i.e. the base cones on the jack-up vessels) 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 wind farms (BOWind, 2008; EGS, 2011). Monitoring at the Barrow offshore wind farm showed depressions were almost entirely infilled 12 months after construction (BOWind, 2008). Monitoring at the Lynn and Inner Dowsing (LID) offshore wind farm also showed some infilling of the footprints, although the depressions were still visible a couple of years post-construction (EGS, 2011). In areas were mobile sands and coarse sediments are present such as in the majority of the offshore wind farm area (Figure 8-2), jack-up depressions are likely to be temporary features which will only persist for a period of months to a small number of years.

Temporary habitat loss will also occur as a result of the installation of 41 km of inter-array cables and 16 km of offshore cable, with seabed disturbance occurring within a 10 m wide corridor. Seabed clearance activities will occur within a 15 m corridor for 10% of the inter-array cables and 10% of the offshore cable. A recent study commissioned by The Crown Estate reviewed the effects of cable installation on subtidal sediments and habitats, drawing on monitoring reports from over 20 UK offshore wind farms (RPS, 2019). This review showed that sandy sediments (e.g. Subtidal Sand Sediments IEF) 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 course and mixed sediments and muddy sediments (e.g. Subtidal Coarse Sediment and Subtidal Sandy Mud Sediment IEFs) were conspicuous for several years after installation. However, these shallow depressions were of limited depth (10s 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).

Activities resulting in the temporary subtidal habitat loss/disturbance will occur intermittently throughout the construction phase. The offshore construction phase which includes activities resulting in temporary habitat loss/disturbance will occur over a period of up to 15 months. As set out in Table 8-12, a pre-construction survey will be undertaken within the offshore wind farm area and offshore cable corridor to identify any areas of reef habitat. If reef habitat is identified, mitigation will be discussed with statutory bodies to avoid direct impact on these features where possible.

The temporary habitat loss/disturbance is predicted to be of localised spatial extent, medium term duration (although only a small proportion of the total area will be affected at any one time with individual elements of construction having much shorter durations), intermittent and high reversibility following the construction phase. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

The key receptors which are expected to be affected by temporary subtidal habitat loss/disturbance are listed in Table 8-10. The sensitivity of the IEFs to temporary subtidal habitat loss are presented in Table 8-17, based on the MarESA sensitivities for the representative biotopes for each IEF.

The Subtidal Sandy Mud Sediment IEF has increased (medium) sensitivity to temporary subtidal habitat loss (Table 8-17). The communities that characterise sandy mud sediments are predominantly infaunal mobile species which can re-enter the substrate following disturbance. For example, the venerid bivalves *Kurtiella bidentata* and *Abra nitida* and the polychaetes *Nephtys incisa, Phoronis* sp. and *Phloe* sp. Many of these species are active burrowers capable of reburying themselves (e.g. *A.nitida*, *N. incisa* and *Phoronis* sp.) (Ballerstedt, 2006, Richards, 2007). However, while at the sediment surface, any displaced infauna may be vulnerable to predation from bottom feeding fish and urchins (e.g. the pea urchin *Echinocyamus pusillus*).

The Subtidal Coarse Sediment IEF also has increased (medium) sensitivity to temporary subtidal habitat loss (Table 8-17). Characterising brittle stars are epifaunal and have fragile arms so are likely to be directly exposed and damaged by abrasion. However, they can tolerate considerable damage to arms and even the disk without suffering mortality and are capable of arm and even some disk regeneration (Sköld, 1998). Therefore, recovery is expected after short term discrete disturbance. The infaunal species within the Subtidal Coarse Sediments IEF buried within the sediment experience are sheltered from this impact and will recover quickly. Recovery of these habitats would occur following the construction phase (i.e. in line with the timescales for recovery of the seabed sediments as outlined above), although full recovery may take between two to a maximum of ten years for complete recovery.

The Subtidal Infralittoral Rock IEF also has increased (medium) sensitivity to temporary subtidal habitat loss (Table 8-17). Recovery is expected to occur within 2 to 6 years (Christie *et al*. 1998). This IEF was only recorded within the offshore cable corridor and not the offshore wind farm area so therefore the main impact on this habitat will be from cable installation.

With respect to remnant trenches and jack-up footprints, based on information from the analogous industries (notably aggregate extraction), it has been reported that benthic communities associated with soft sediments (e.g. muds, sands and gravels) readily recover into adjacent areas if the sediment type is reflective of the baseline environment (e.g. Tillin *et al*., 2011; Robinson *et al*., 2005; Marine Ecology Surveys Ltd, 2008; Newell *et al*., 2004; Pearce *et al*., 2007, as reported by RPS, 2019). Therefore, assuming the sediment composition within these shallow trenches is similar to the surrounding sediments, recovery of communities will also occur (as evidenced from other industries, e.g. aggregates).

Table 8-17: Sensitivity of the benthic subtidal IEFs to temporary subtidal habitat loss/disturbance.

IEF	Representative biotopes	Sensitivity to defined MarESA pressure	
		Abrasion/disturbance at the surface of the substratum or seabed	Penetration and/or disturbance of the substratum subsurface
Subtidal Sandy Mud Sediment	SS.SMu.CSaMu.AfilKurAnit SS.SMu.OMu.LevHet	Medium	Medium
Subtidal Sand Sediment	SS.SSa.CFiSa.EpusOborApri SS.SSa.CFiSa.ApriBatPo SS.SSa.IMuSa.FfabMag	Low	Low
Subtidal Coarse sediment	SS.SCS.CCS.MedLumVen SS.SCS.CCS.SpiB/ SS.SMx.CMx.FluHyd SS.SMx.CMx.Oph.Mx	Low to medium	Low to medium
Subtidal Infralittoral Rock	IR.MIR.KR.Lhyp.GzFt[1]	Medium	N/A

[1] IR.MIR.KR.Lhyp.GzFt has been selected as a suitable biotope to use as a proxy for the IR.MIR.KR biotope identified in Appendix 8-2: Benthic Studies (Aquafact, 2020). This is a suitable proxy due to similar sediment, water depths and fauna present however there are difference e.g. the presence of *Laminaria hyperborea*.

Significance of the effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-17) is considered to be low to medium. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

Operational and maintenance phase

Magnitude of impact

Operational and maintenance phase activities within the offshore wind farm area and offshore cable corridor may lead to temporary subtidal habitat loss/disturbance. The Project will incur a maximum of 387,000 m^2 temporary habitat loss/disturbance during the operational and maintenance phase (Table 8-11). This equates to 0.06% of the Benthic Subtidal and Intertidal Ecology Study Area and 0.73% of the offshore wind farm area and offshore cable corridor combined, therefore this represents a very small proportion of each area respectively. It should also be noted that only a small proportion of the total habitat loss/disturbance is likely to be occurring at any one time over the 40-year operational lifetime.

Temporary habitat loss will occur as a result of the use of jack-up vessels during any component replacement activities and during any inter-array and offshore cable repair activities. Impacts of jack-up vessel activities will be similar to those identified for the construction phase above and will be restricted to the immediate area around the WTG foundation or cable repair site, where the spud cans are placed on the seabed, with recovery occurring following removal of spud cans.

The spatial extent of this impact is very small in relation to the total Benthic Subtidal and Intertidal Ecology Study Area, although there is the potential for repeat disturbance to the habitats in the immediate vicinity of the foundations because of these activities. Inter-array and offshore cable repair or reburial activities will also affect benthic habitats in the immediate vicinity of these operations, with effects on seabed habitats and associated benthic communities expected to be similar to the construction phase. Activities resulting in the temporary subtidal habitat loss/disturbance will occur intermittently throughout the 40-year operational and maintenance period.

The temporary habitat loss/disturbance is predicted to be of localised spatial extent, short term duration (individual maintenance operations would occur over a period of days to weeks), intermittent and high reversibility. It is predicted that the impact will affect benthic subtidal ecology receptors directly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

The sensitivity of the receptors can be found in the construction phase assessment and Table 8-17 above.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors (Table 8-17) is considered to be low to medium. The effect will, therefore, be of **imperceptible or slight adverse significance**, which is not significant in EIA terms.

Decommissioning phase

Magnitude of impact

Decommissioning phase activities within the offshore wind farm area and offshore cable corridor may lead to temporary subtidal habitat loss/disturbance. The Project will incur a maximum of 624,000 m^2 of temporary habitat loss/disturbance during the decommissioning phase (Table 8-11). This equates to 0.10% of the Benthic Subtidal and Intertidal Ecology Study Area and 1.18% of the offshore wind farm area and offshore cable corridor combined, therefore this represents a very small proportion of each area respectively. For the purposes of this assessment, the impacts of the decommissioning phase are predicted to be similar to those identified for the construction phase, as set out above.

The temporary habitat loss/disturbance is predicted to be of localised spatial extent, medium term duration (although only a small proportion of the total area will be affected at any one time with individual elements of the decommissioning phase having much smaller durations), intermittent and high reversibility following the decommissioning phase. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

The sensitivity of the receptors can be found in the construction phase assessment and Table 8-17 above.

Significance of the effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-17) is considered to be low to medium. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

8.10.2 Temporary intertidal habitat loss/disturbance

Direct temporary habitat loss/disturbance of intertidal habitats within the offshore cable corridor during the construction and decommissioning phases (Table 8-11) will occur as a result of the installation of 800 m of offshore cable through the intertidal zone, associated vessel groundings and vehicle movements across the foreshore.

The relevant MarESA pressures and their benchmarks which have been used to inform this impact assessment are as follows:

- Abrasion/disturbance at the surface of the substratum: the benchmark for which is damage to surface features (e.g. species and physical structures within the habitat). This pressure corresponds to the impacts associated with vessel groundings and plant and vehicle movements;
- Penetration and/or disturbance below the surface: the benchmark for which is damage to sub-surface features (e.g. species and physical structures within the habitat). This pressure corresponds to the burial of the offshore cable in intertidal sediments; and

- Physical change (to another seabed type): the benchmark for which is Change in sediment type by one Folk class or change from sedimentary or soft rock substrata to hard rock or artificial substrata or vice-versa. This pressure corresponds to the installation of the offshore cable though the eulittoral rock habitat.

Construction phase

Magnitude of impact

The installation of the offshore cable within the intertidal section of the offshore cable corridor may lead to temporary intertidal habitat loss/disturbance. The Project will incur a maximum of 28,000 m^2 of temporary intertidal habitat loss/disturbance within intertidal habitats at the offshore cable landfall location during the construction phase (Table 8-11). This includes all cable laying activities, associated vessel groundings and vehicle movements in a 15 m corridor centred on the offshore cable, which will be installed in a 5 m wide cable trench.

The cable trench and construction corridor will be located within the intertidal area between the HWM and the LWM. It will cross a number of biotopes (Figure 8-6) therefore there is only potential for a very small proportion of any one habitat to be affected by cable burial (i.e. a 3 m wide trench), with the majority of impacts within the 15 m wide corridor expected to comprise disturbance due to vehicle movements. Following cable installation, the cable trench will either be backfilled (e.g. where rock is excavated, this will be placed back into the cable trench) or subject to natural recovery (e.g. infilling of trench by sand due to wave and tidal action). Installation and burial of the offshore cable within the intertidal zone will occur over a period of 3 months.

The temporary intertidal habitat loss/disturbance is predicted to be of localised spatial extent, short term duration, intermittent and high reversibility following the construction phase. It is predicted that the impact will affect intertidal ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

The Intertidal Littoral Sand IEF (and representative biotopes) is reported to have varying sensitivities to surface abrasion and penetration, with representative biotopes having no sensitivity to high sensitivity to these impacts (Table 8-18). Where the LS.LSa.MuSa.MacAre biotope has high sensitivity to penetration, it should be noted that the offshore cable will be installed in a 3 m deep, 5 m wide trench in the intertidal area and therefore penetration of the sediment will only occur in a very narrow corridor of the high sensitivity habitat which is likely to recover quickly from adjacent areas. The vast majority of the 15 m wide disturbance corridor in the intertidal area will be subject to lower levels of disturbance via vehicle movements, vessel grounding etc.

The Intertidal Eulittoral Rock IEF has high sensitivity to physical change (to another seabed type).Again, this will only occur within a 5 m wide trench and therefore will only occur in a very narrow corridor of the high sensitivity habitat. Furthermore, eulittoral rock only makes up a very small percentage of the intertidal habitats therefore cable installation activities are unlikely to cross large areas of this habitat. Following cable installation, the cut rock will be used to backfill the trench to allow for recovery of associated communities within the area affected.

The intertidal features of interest of the Dunany Point pNHA are also within the offshore cable corridor and therefore could be affected by temporary intertidal habitat loss/disturbance from offshore cable installation. The pNHA contains features which are similar or identical to the Intertidal Littoral Sand IEF and Intertidal Eulittoral Rock IEF (i.e. sandy sediments, mudflats, rocky outcrop). Based on the assessment of these IEFs it is likely that the rock features of the Dunany Point pNHA will have a high sensitivity to physical change (Table 8-18), but it will occur in a very limited area. Any rocks which may be side cast as a result of offshore cable installation will be replaced allowing the communities to recover. The sandy habitats are likely to have varying sensitivities to surface abrasion and penetration (Table 8-18) which will again occur in a very limited area with the vast majority of the affected area experiencing low level disturbance from vehicle movement. Therefore the majority of sand and rock-based habitats of Dunany Point pNHA are likely to have low levels of sensitivity to the activities occurring within the intertidal zone, with recovery of both sediments/substrates and associated communities expected to occur quickly following cable installation.

Table 8-18: Sensitivity of the benthic intertidal IEFs to temporary intertidal habitat loss/disturbance.

IEF	Representative biotopes	Sensitivity to defined MarESA pressure		
		Abrasion/ disturbance at the surface of the substratum or seabed	Penetration and/or disturbance of the substratum subsurface	Physical change (to another seabed type)
Intertidal Littoral Sand	LS.LSa.MuSa.MacAre	Low	High	N/A
	LS.LSa.MuSa.Lan	Not sensitive	Not sensitive	N/A
Intertidal Eulittoral Rock	LR.LLR.F.Fves	Medium	Not relevant	High
	LR.FLR.Eph.EntPor	Low	Not relevant	High

Significance of the effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-18) is considered to be negligible (i.e. not sensitive) to high. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

Operational and maintenance phase activities within the offshore cable corridor may lead to temporary intertidal habitat loss/disturbance. The Project will incur a maximum of 126,000 m^2 of temporary habitat loss/disturbance during the operational and maintenance phase (Table 8-11). This equates to 0.02% of the Benthic Subtidal and Intertidal Ecology Study Area and a very small proportion of the intertidal area available. It should also be noted that only a small proportion of the total habitat loss/disturbance is likely to be occurring at any one time over the 40-year operational lifetime.

Temporary habitat loss will occur as a result of any offshore cable repair activities. This includes all cable laying activities, associated vessel groundings and vehicle movements in a 15 m corridor centred on the offshore cable. Intertidal cable repair or reburial events will cross a number of biotopes (Figure 8-6) therefore there is only potential for a very small proportion of any one habitat to be affected by cable burial (i.e. a 3 m wide trench), with the majority of impacts within the 15 m wide corridor expected to comprise disturbance due to vehicle movements. Following cable repair or reburial, the cable trench will be backfilled.

The temporary habitat loss/disturbance is predicted to be of localised spatial extent, short term duration (individual maintenance operations would occur over a period of days to weeks), intermittent and high reversibility. It is predicted that the impact will affect benthic intertidal ecology receptors directly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

The sensitivity of the receptors can be found in the construction phase assessment and Table 8-18 above.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors (Table 8-18) is considered to be negligible (i.e. not sensitive) to high. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

Decommissioning phase

Magnitude of impact

Decommissioning of the offshore cable within the intertidal section of the offshore cable corridor may lead to temporary intertidal habitat loss/disturbance. The Project will incur a maximum of 28,000 m^2 of temporary intertidal habitat loss/disturbance during the decommissioning phase (Table 8-11). This includes all cable removal activities and associated vessel groundings and vehicle movements in a 15 m corridor around the cable trench.

The cable trench and decommissioning activity will be located within the intertidal area between the HWM and the LWM. It will cross a number of biotopes therefore there is only potential for a very small area of any one habitat to be affected (Figure 8-6). For the purposes of this assessment, the impacts of the decommissioning phase are predicted to be similar to those for construction, as set out above.

The temporary intertidal habitat loss/disturbance is predicted to be of localised spatial extent, short term duration, intermittent and high reversibility following the decommissioning phase. It is predicted that the impact will affect intertidal ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

The sensitivity of the receptors can be found in the construction phase assessment and Table 8-18 above.

Significance of the effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-18) is considered to be not sensitive to high. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

8.10.3 Increased suspended sediment concentrations and associated sediment deposition

Increases of suspended sediments and associated sediment deposition are predicted to occur during the construction and decommissioning phases as a result of the installation/removal of monopile foundations, installation/removal of inter-array and offshore cables and sand wave clearance for inter-array and offshore cables. Increases of suspended sediments and associated sediment deposition are also predicted to occur during the operational and maintenance phase due to inter-array and offshore cable repair and reburial events. Chapter 7: Marine 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.

The benchmarks for the relevant MarESA pressures which have been used to inform this impact assessment are as follows:

- Changes in suspended solids (water clarity): the benchmark for which is a change in one rank on the Water Framework Directive (WFD) scale (e.g. from clear to intermediate for one year), caused by activities disturbing sediment or organic particulate material and mobilising it into the water column such as dredging, disposal at sea, cable and pipeline burial; and

- Smothering and siltation rate changes (light): the benchmark for light deposition is 5 cm of fine material added to the habitat in a single discrete event.

The CEFAS Climatology Report 2016 shows the spatial distribution of average non-algal Suspended Particulate Matter (SPM) for the majority of the UK continental shelf. For 1998-2005 the largest plumes are associated with large rivers such as the Thames estuary, the Wash and Liverpool Bay, which show mean values of SPM above 30 mg/l. Using this study, it is estimated that the average SPM associated with Dundalk Bay is approximately 2 mg/l to 3 mg/l (Silva *et al*., 2016) (see appendix 7-1: Marine Processes Technical Report).

Construction phase

Magnitude of impact

The installation of Project infrastructure within the offshore wind farm area and offshore cable corridor may lead to increases in suspended sediment concentrations and associated sediment deposition. The project design for foundation installation assumes all WTG and offshore substation foundations will be installed by drilling 9.6 m diameter monopiles (Table 8-11).

Modelling of suspended sediments associated with the foundation installation showed low levels of suspended sediments with peaks of 100 mg/l extending beyond the offshore wind farm area in all modelled scenarios. The average suspended sediment concentrations beyond the immediate vicinity of the offshore wind farm area are generally less than 30 mg/l with most of the sediment plume envelope having a suspended sediment concentration of less than 10 mg/l. Sediment deposition is predicted to be indiscernible from the background due to the limited quantity of material released, with the exception of directly at the drill site where cuttings fall to the seabed. Further detail can be found in chapter 7: Marine Processes.

Installation of inter-array cables through ploughing/jetting would involve disturbance of seabed material from 1 m wide and 3 m deep trenches. Modelling of suspended sediment concentrations associated with the installation of inter-array cables showed a peak concentration of 2,000 mg/l in the immediate vicinity of cable installation, with averages less than 3 mg/l. The sediment plume will only persist for a maximum of 2 to 3 hours in any location; following completion of the works, turbidity will return to normal within a couple of tidal cycles (see chapter 7: Marine Processes). Sedimentation will occur in the immediate vicinity of the inter-array cable installation activities, with no discernible levels of sedimentation modelled to occur beyond the offshore wind farm area. Further detail can be found in chapter 7: Marine Processes.

Installation of the offshore cable through ploughing/jetting would involve disturbance of seabed material from 3 m wide and 3 m deep trenches. Modelling of suspended sediment associated with the installation of the offshore cable showed general peak concentrations of 300 mg/l which is equivalent to turbidity levels during storm conditions, although this level of increase would only be recorded in very localised areas towards the landfall location, due to the shallow waters. Average concentrations were predicted to be less than 50 m/l. The sediment plume will only persist for a maximum of 3 to 4 hours in any location (see chapter 7: Marine Processes). Sedimentation will occur in the immediate vicinity of the offshore cable installation activities. The distribution of the sediment which is released during the operation is typically less than 20 mm in depth. The final settled depth being less than 5 mm outside the offshore cable corridor. Further detail can be found in chapter 7: Marine Processes.

Modelling of the installation of inter-array and offshore cables was carried out on the basis of a number of trenching techniques. Sand wave clearance activities would use ploughing techniques. The volume of material relocated per metre of bed preparation is of the same order of magnitude as the trenching, however the mobilisation of sediments into suspension would be less significant as the trenching lifts material off the bed whilst plough would move material along it. The sand wave clearance constitutes 10% of the cable lengths therefore the operations would be less extensive than cable burial. It may therefore be concluded that the magnitude of impacts arising from seabed clearance would be less than for cable trenching and therefore was not modelled and the conclusion for this impact is considered to be the same as for cable installation.

The increased suspended sediment concentrations and associated sediment deposition is predicted to be of localised spatial extent, short term duration, intermittent and high reversibility due to site hydrodynamics. It is predicted that the impact will affect subtidal and intertidal benthic ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

The sensitivity of the IEFs to increases in suspended sediment concentrations and associated sediment deposition are presented in Table 8-19. All subtidal IEFs were found to range in their sensitivity from being not sensitive to medium level of sensitivity to changes in suspended sediment and associated deposition.

The Intertidal Eulittoral Rock IEF was found to have medium sensitivity to changes in suspended sediment and associated light deposition (Table 8-19). This is primarily due to reduced light penetration during periods of increased turbidity which would reduce photosynthesis and potentially reduce growth rates for algal species associated with this habitat. However, the magnitude of the suspended sediments associated with the offshore cable installation do not reach the MarESA pressure sensitivity assessment benchmark. The plume effects will cause low increases in suspended sediment concentrations which will dissipate quickly, returning to background levels with a few tidal cycles.

The Subtidal Coarse Sediments IEF was found to be not sensitive to medium sensitivity to smothering and siltation rate changes (light) (Table 8-19). Characterising brittle stars tend not to persist in areas of excessive sedimentation, because high levels of sediment foul the brittle stars’ feeding apparatus (tube feet and arm spines), and ultimately suffocates them (Schäfer, 1962, cited in Aronson, 1992). However, fine sediments would be expected to mitigate this through resuspension of sediment with light deposition expected to be cleared within a few tidal cycles (De-Bastos, 2020).

The Subtidal Infralittoral Rock IEF was found to have medium sensitivity to changes in suspended solids (water clarity) (Table 8-19). An increase in suspended solids may decrease the light availability. Light availability and water turbidity are principal factors in determining the depth range of *L. hyperborea* (Birkett *et al*., 1998). However, *L. hyperborea* was not recorded in the offshore cable corridor where this IEF was recorded. Lower light levels may also affect algal growth however the characterizing *E. esculentus* can feed on alternative prey, detritus or dissolved organic material (Lawrence, 1975; Comely and Ansell, 1988).

Dunany Point pNHA overlaps with the offshore cable corridor and therefore its features are likely to be affected by increases in suspended sediments near the intertidal zone. The features of Dunany Point pNHA are similar or identical to the Intertidal Littoral Sand IEF and Intertidal Eulittoral Rock IEF (i.e. sandy sediments, mudflats, rocky outcrop). Based on the sensitivities of these IEFs (Table 8-19) the sandy features of Dunany Point pNHA are not likely to be sensitive to changes in suspended sediments and smothering. The rocky features of Dunany Point pNHA are likely to have medium sensitivity to changes in suspended sediments and associated light deposition as an increase in suspended solids may decrease the light availability which could have an adverse effect on epifaunal communities. However this change is likely to be temporary and light availability will return after a few tidal cycles.

Table 8-19: Sensitivity of the benthic subtidal and intertidal IEFs to increases in suspended sediment and associated deposition.

IEF	Representative biotopes	Sensitivity to defined MarESA pressure	
		Changes in suspended solids (water clarity)	Smothering and siltation rate changes (light)
Subtidal Sandy Mud Sediment	SS.SMu.CSaMu.AfilKurAnit SS.SMu.OMu.LevHet	Not Sensitive	Not Sensitive
Subtidal Sand Sediment	SS.SSa.CFiSa.EpusOborApri SS.SSa.CFiSa.ApriBatPo SS.SSa.IMuSa.FfabMag	Low	Low
Subtidal Coarse sediments	SS.SCS.CCS.MedLumVen SS.SCS.CCS.SpiB/ SS.SMx.CMx.FluHyd SS.SMx.CMx.Oph.Mx	Not sensitive to Low	Not sensitive to Medium
Subtidal Infralittoral Rock	IR.MIR.KR.Lhyp.GzFt[1]	Medium	Not sensitive
Intertidal Littoral Sand	LS.LSa.MuSa.MacAre LS.LSa.MuSa.Lan	Not Sensitive	Not Sensitive
Intertidal Eulittoral Rock	LR.LLR.F.Fves	Medium	Medium
	LR.FLR.Eph.EntPor	Not sensitive	Low

[1] IR.MIR.KR.Lhyp.GzFt has been selected as a suitable biotope to use as a proxy for the IR.MIR.KR biotope identified in Appendix 8-2: Benthic Studies (Aquafact, 2020). This is a suitable proxy due to similar sediment, water depths and fauna present however there are difference e.g. the presence of *Laminaria hyperborean*.

Significance of the effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-18) is considered to be negligible (i.e. not sensitive) to medium. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

Operational and maintenance phase

Magnitude of impact

Operational and maintenance activities within the offshore wind farm area and offshore cable corridor may lead to increases in suspended sediment concentrations and associated sediment deposition. The project design includes for seven inter-array cable repair and seven reburial events and three offshore cable repair and three reburial events over the Project lifetime (Table 8-11), using similar methods as those for cable installation activities (i.e. trenching/jetting).

Any suspended sediments and associated deposition will be of the same magnitude, or lower as for construction. For the purposes of this assessment, the impacts of the operational and maintenance phase activities are predicted to be similar to those for construction, as set out above.

The increased suspended sediment concentrations and associated sediment deposition is predicted to be of localised spatial extent, short term duration, intermittent and high reversibility due to site hydrodynamics. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

The sensitivity of the receptors can be found in the construction phase assessment and Table 8-19 above.

Significance of the effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-19) is considered to be negligible to medium. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

Decommissioning phase

Magnitude of impact

The decommissioning phase of the infrastructure within the offshore wind farm area and offshore cable corridor may lead to increases in suspended sediment concentrations and associated sediment deposition. The Project will incur the cutting and removal of monopile foundations to approximately 2 m below seabed, and the removal of inter-array and offshore cables.

Decommissioning of the foundations, inter-array cables and offshore cable are assumed to result in similar increases in suspended sediments and associated deposition as that during construction. For the purposes of this assessment, the impacts of the decommissioning phase activities are therefore predicted to be similar to those for construction, as set out above.

The increased suspended sediment concentrations and associated sediment deposition is predicted to be of localised spatial extent, short term duration, intermittent and high reversibility due to site hydrodynamics. It is predicted that the impact will affect subtidal benthic ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

The sensitivity of the receptors can be found in the construction phase assessment and Table 8-19 above.

Significance of the effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-19) is considered to be negligible to medium. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

8.10.4 Seabed disturbance leading to the potential release of sediment contaminants

Seabed disturbance leading to the potential release of sediment contaminants may occur during the construction and decommissioning phases as a result of the installation/removal of foundations and the installation/removal of inter-array and offshore cables. Seabed disturbance leading to the potential release of sediment contaminants may occur during the operational and maintenance phases due to inter-array and offshore cable repair and reburial events.

The benchmarks for the relevant MarESA pressures which have been used to inform this impact assessment are as follows:

- Transition elements and organo-metal contamination: The benchmark is compliance with all average annual environmental quality standards (AA EQS), conformance with Permissible Exposure Limits (PELs), Environment Assessment Criteria (EACs) and Effects Range Lows (ER-Ls);
- Hydrocarbon and Polycyclic Aromatic Hydrocarbons (PAH) contamination: The benchmark is compliance with all AA EQS, conformance with PELs, EACs, ER-Ls; and
- Synthetic compound contamination: The benchmark is compliance with all AA EQS, conformance with PELs, EACs, ER-Ls.

Site specific sediment sampling for contaminants will be carried out at the detailed design phase for the Project. Although site specific sediment contamination levels are unknown at this time, it is considered unlikely that transition elements, organo-metals, hydrocarbons, PAH compounds and synthetic compounds will be present in any greater concentrations than trace amounts. They are very likely to all be in compliance with the Marine Institute sediment quality guidance levels which are similar to the levels in the MarESA benchmark listed above (Cronin *et al*., 2006). It is therefore likely that any contaminants will be below the MarESA benchmark levels. There are few large infrastructure projects and no oil and gas exploration activities in this part of the western Irish Sea, with activities further limited in the immediate vicinity of the offshore wind farm area and offshore cable corridor. Therefore, there is currently no identified source of contamination. In addition, sediments within large parts of the offshore wind farm area and offshore cable corridor are composed of sand and coarse sediment, with low levels of fine sediments (i.e. muds) onto which contaminants would adhere. This further reduces the risk of contamination in these areas.

Construction Phase

Magnitude of impact

The installation of infrastructure within the offshore wind farm area and offshore cable corridor will cause seabed disturbance which may lead to the release of sediment bound contaminants. The project design parameters for foundation installation assume installation of inter-array and offshore cables as well as sand wave clearance for 10% of inter-array cables and 10% of the offshore cable (Table 8-11).

Modelled levels of disturbed and suspended sediments can be found under the impact ‘Increased suspended sediment concentrations and associated sediment deposition’ above. However, it is considered that levels of contamination will be negligible to low as there is no identified source of contamination and the coarse nature of the sediments with minimal fine content over much of the offshore wind farm area and offshore cable corridor will limit the risk further. In the unlikely event that sediment bound contaminants are present, the volumes of sediment disturbed will be small and any contaminants will be quickly diluted to levels which would not cause harm to benthic ecology receptors. The presence of contaminants will be established as part of the permitting process for the Dumping at Sea permit application.

The seabed disturbance leading to the potential release of sediment bound contaminants is predicted to be of localised spatial extent, short term duration, intermittent and of high reversibility due to site hydrodynamics. It is predicted that the impact will affect subtidal and intertidal benthic ecology receptors directly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

The MarESA has not concluded on the sensitivity to sediment contamination for any of the benthic subtidal and intertidal ecology IEFs. However, sensitivity has been described based on the MarESA sensitivity review of each habitat. It should be noted that the sensitivities assessed here are those associated with low levels of contamination, as would be expected within the sediments within the Benthic Subtidal and Intertidal Ecology Study Area.

Characterising bivalve species of the Subtidal Sandy Mud Sediment IEF are opportunistic species that have high dispersal potential (Larsen *et al*., 2007; Josefson, 1982) therefore can colonise areas where disturbance has occurred, assuming contamination has been adequately diluted so that it does not cause toxic effects. Some species are also considered to be fast growing with a lifespan of 5 to 6 years therefore can quickly recover a stable population (Künitzer, 1989). However, characterising brittle stars can take a few years to reach maturity (Pedrotti, 1993). Therefore, Subtidal Sandy Mud Sediment IEF is considered to have low sensitivity to the release of sediment contaminants.

Subtidal Sand Sediment IEF can recover from damage or disturbance through the migration of adults of mobile species such as the polychaetes *Glycera lapidum* and *Nephtys cirrosa*, amphipods and urchins. Many of the characterising species are mobile and therefore would be able to rapidly colonise affected areas from the surrounding habitat. This IEF also includes opportunistic species (e.g. *Spiophanes bombyx*, *Spio filicornis* and *Spirobranhchus lamarckii*). These species are likely to be the first to recolonise an area after damage or disturbance (Tillin *et al*., 2016, Tillin, 2016a, Tillin, 2016b). Communities associated with this IEF can also recover through larval dispersal of the venerid bivalves; the venerid bivalves in the biotope reach sexual maturity within two years and spawn at least once a year, therefore recruitment is likely to be high in areas of suitable habitat (Guillou and Sauriau, 1985; Dauvin, 1985). Therefore, Subtidal Sand Sediment IEF is considered to have low sensitivity to the release of sediment contaminants.

Subtidal Coarse Sediment IEF is considered to have high recovery potential, characterising hydroids exhibit rapid rates of recovery from disturbance through repair, asexual reproduction and larval colonization (Sparks, 1972). Many hydroid species also produce dormant, resting stages that are very resistant to environmental perturbation (Gili and Hughes, 1995). The species that are present in the biotope can be broadly characterised as either opportunist species that rapidly colonise disturbed habitats and increase in abundance (including the characterising polychaetes *Mediomastus fragilis* and *S.bombyx*), or species that are larger and longer-lived and that may be more abundant in an established, mature assemblage (Tillin, 2016c). These longer-lived species have a high potential rate of recolonisation of sediments, but the relatively slow growth-rate and long lifespan suggests that recovery of biomass following initial recolonisation by post-larvae is likely to take several years (MES Ltd, 2010). Therefore, Subtidal Coarse Sediment IEF is considered to have low sensitivity to the release of sediment contaminants.

The characterising species of the Subtidal Infralittoral Rock IEF (e.g. *Echinus esculentus)* are mobile species (Tyler-Walters, 2008) and could, therefore, migrate and re-populate an area quickly if removed or disturbed. The infralittoral rock itself would not be sensitive to the release of sediment contaminants and works in the vicinity of this habitat would be unlikely to cause the release of contaminants as the habitat is rock rather than sediment based. Therefore, Subtidal Infralittoral Rock IEF is considered to have negligible sensitivity to the release of sediment bound contaminants.

Characterising species of the Intertidal Littoral Sand IEF (*Lanice conchilega, Limecola balthica* and *Arenicola marina*) are sessile and larval colonisation are therefore the most important recovery mechanism however adult migration is also possible (McQuillan and Tillin, 2016). Strasser and Pielouth (2001) reported that *L. conchilega* larvae were observed to settle in areas where there were no adults and the population was subsequently re-established in three years. Beukema (1990) reported that following removal of entire intertidal populations (following a cold winter), *L. conchilega* populations recovered rapidly (within 1 and 2 years). Therefore, Intertidal Littoral Sand IEF is considered to have low sensitivity to the release of sediment contaminants.

The *Ulva* spp. and *Porphyra purpurea* that characterise the Intertidal Eulittoral Rock IEF are classified as opportunistic species that are able to rapidly colonise newly created gaps across a range of sediment types, shore heights, wave exposures and salinity regimes (Tillin. and Budd, 2016). Other species presented (e.g. *Fucus vesiculosus)* recruit readily to cleared areas of the shore and full recovery takes 1 to 3 years (Hartnoll and Hawkins, 1985). The eulittoral rock itself would not be sensitive to the release of sediment contaminants and works in the vicinity of this habitat would be unlikely to cause the release of contaminants as the habitat is rock rather than sediment based. Therefore, Intertidal Eulittoral Rock IEF is considered to have low sensitivity to the release of sediment contaminants.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be negligible to low. The effect will, therefore, be of **imperceptible significance**, which is not significant in EIA terms.

Operational and maintenance phase

Magnitude of impact

Operational and maintenance phase activities within the offshore wind farm area and offshore cable corridor will cause seabed disturbance which may lead to the release of sediment contaminants. The project design includes seven inter-array cable repair and seven reburial events, three offshore cable repair and three reburial events over the Project lifetime (Table 8-11), using similar methods as those for cable installation activities (i.e. trenching/jetting).

Any disturbed or suspended sediments will be of the same magnitude, or lower as for the construction phase. For the purposes of this assessment, the impacts of the operational and maintenance phase activities are predicted to be similar to those for construction phase, as set out above.

The seabed disturbance leading to the potential release of sediment bound contaminants is predicted to be of localised spatial extent, short term duration, intermittent and high reversibility due to site hydrodynamics. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

The sensitivity of the receptors can be found in the construction phase assessment above.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors is considered to be negligible to low. The effect will, therefore, be of **imperceptible significance**, which is not significant in EIA terms.

Decommissioning phase

Magnitude of impact

Decommissioning of Project infrastructure within the offshore wind farm area and offshore cable corridor will cause seabed disturbance which may lead to the release of sediment contaminants. The project design parameters are represented by the removal of foundations, inter-array and offshore cables.

Decommissioning of the foundations, inter-array cables and offshore cables are assumed to result in similar increases in disturbed and suspended sediments as that during the construction phase. For the purposes of this assessment, the impacts of decommissioning phase activities are therefore predicted to be similar to those for the construction phase, as set out above.

The seabed disturbance leading to the potential release of sediment bound contaminants is predicted to be of localised spatial extent, short term duration, intermittent and high reversibility due to site hydrodynamics. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

The sensitivity of the receptors can be found in the construction phase assessment above.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors is considered to be negligible to low. The effect will, therefore, be of **imperceptible significance**, which is not significant in EIA terms.

8.10.5 Long-term subtidal habitat loss

Long-term habitat loss will occur directly under all foundation structures, associated scour protection and cable protection where this is required. This impact considers only the habitat loss occurring during the operational phase of the Project, because while these structures may be placed during the construction phase, the effect on benthic subtidal receptors (i.e. habitat loss effects) will be experienced throughout the 40-year lifetime of the Project.

The benchmark for the relevant MarESA pressure which has been used to inform this impact assessment is:

- The permanent change from sedimentary or soft rock substrata to hard rock or artificial substrata.

Operational and maintenance phase

Magnitude of impact

The presence of Project infrastructure within the offshore wind farm area and offshore cable corridor may result in long-term habitat loss. The Project will incur a maximum of 332,121 m^2 of long-term habitat loss due to the installation of monopile foundations and associated scour protection and cable protection associated with inter-array and offshore cables. This equates to 0.05% of the Benthic Subtidal and Intertidal Ecology Study Area and 0.62% of the offshore wind farm area and offshore cable corridor combined, therefore this represents a very small proportion of each area respectively. There is also some evidence of sediments becoming finer and organically enriched in close proximity (<40 m) to WTG foundations over a number of years with associated changes to species abundance and diversity (Degraer *et al*., 2020). These effects are thought to be due to the presence of filter feeders that colonise offshore artificial structures and as such would continue throughout the lifetime of the Project.

Long term subtidal habitat loss impacts will be continuous throughout the 40-year operational and maintenance phase.

The long-term habitat loss/disturbance is predicted to be of highly localised spatial extent (restricted to discrete areas within the offshore wind farm area and offshore cable corridor), long-term duration, continuous and high reversibility. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

All subtidal IEFs have high sensitivity to long-term subtidal habitat loss (Table 8-20), with no recovery potential following placement of infrastructure. As outlined above, this habitat change represents a very small proportion of the offshore wind farm area and offshore cable corridor.

A recent study commissioned by The Crown Estate (RPS, 2019) reviewed the effects of scour and cable protection on benthic communities (which could also be applied to impacts on benthic communities from placement of monopile foundations given the similar type of material used). While there is limited monitoring data it indicated that the effect of the change of substrate type caused by the installation of protection will depend on the baseline sediment/substrate type. In soft sediment areas, introduction of rocky substrates would result in a shift from a benthic community dominated by infaunal assemblages to one characterised by epifaunal assemblages. In contrast, changes to coarse sediments or rocky substrates may result in a less profound change of the baseline environment/substrate, therefore allowing some ecological function to continue in the areas affected (RPS, 2019).

Table 8-20: Sensitivity of the benthic subtidal IEFs to long term subtidal habitat loss.

IEF	Representative biotope	Sensitivity to defined MarESA pressure Physical change (to another seabed type)
Subtidal Sandy Mud Sediment	SS.SMu.CSaMu.AfilKurAnit SS.SMu.OMu.LevHet	High
Subtidal Sand Sediments	SS.SSa.CFiSa.EpusOborApri SS.SSa.CFiSa.ApriBatPo SS.SSa.IMuSa.FfabMag	High
Subtidal Coarse sediment	SS.SCS.CCS.MedLumVen SS.SCS.CCS.SpiB/ SS.SMx.CMx.FluHyd SS.SMx.CMx.Oph.Mx	High
Subtidal Infralittoral Rock	IR.MIR.KR.Lhyp.GzFt[1]	High

[1] IR.MIR.KR.Lhyp.GzFt has been selected as a suitable biotope to use as a proxy for the IR.MIR.KR biotope identified in Appendix 8-2: Benthic Studies (Aquafact, 2020). This is a suitable proxy due to similar sediment, water depths and fauna present however there are difference e.g. the presence of *Laminaria hyperborea*.

Significance of the effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-20) is considered to be high. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

8.10.6 Colonisation of foundations, scour protection and cable protection

Within the offshore wind farm area, sediments are dominated by mud and sand sediment with a smaller proportion of coarse sediments, while the offshore cable corridor is dominated by circalittoral mud and coarse sediment. As such, the introduction of hard substrates due to installation of foundation structures and associated scour protection, and any cable protection, will have a direct effect on benthic ecology receptors through the colonisation of these hard substrates. There is not an applicable MarESA pressure therefore sensitivity has been discussed qualitatively below.

Operational and maintenance phase

Magnitude of impact

The presence of infrastructure within the offshore wind farm area and offshore cable corridor may result in the colonisation of foundations, scour protection and cable protection. The project design includes are for 356,043 m^2 of habitat created due to the installation of monopile foundations, associated scour protection and cable protection associated with inter-array cables and offshore cable (Table 8-11). It is expected that the foundations and scour and cable protection will be colonised by species already occurring in the Benthic Subtidal and Intertidal Ecology Study Area (e.g. Tunicates, *Spriobranchus* sp, mussels and barnacles which are typical of the western Irish Sea). Colonisation of WTG foundations occurs as a short pioneer stage (above two years), a diverse intermediate stage (two to nine years) and a possible climax stage (about nine years for monopile structures). This climax stage has been described as likely to be a *M. senile*-*M.edulis* co-dominated assemblage, both species have been found in the vicinity of the offshore wind farm area (Degraer *et al*., 2019).

Activities resulting in the long-term colonisation of foundations, scour protection and cable protection will be continuous throughout the operational and maintenance phase. The operational and maintenance phase will occur over a period of 40 years.

Colonisation of foundations, scour protection and cable protection is predicted to be of localised spatial extent (restricted to the new areas of hard substrate), long-term duration, continuous and medium reversibility following the decommissioning phase. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

The introduction of new hard substrate will represent a shift from the baseline conditions from soft substrate areas (i.e. sands, muds and gravels) to hard substrate in the areas where infrastructure is present. This may produce some potentially beneficial effects, for example the likely increase in biodiversity and biomass, as has been observed at the Egmond aan Zee offshore wind farm in The Netherlands (Lindeboom *et al*., 2011). Species which are typical of rocky and intertidal habitats are likely to be the ones to colonise the new hard substrate.

Post-construction phase monitoring of the foundations at Egmond aan Zee offshore wind farm recorded colonisation of hard substrate in two distinct zones. The upper zone (7 to 10 m) was dominated by *M. edulis* and other fauna including barnacles and starfish. The lower zone (10 m to seabed) was dominated by anemones and the small crustacean *Jassa* spp. (Lindeboom *et al*., 2011). Colonisation by these species represented an increase in biodiversity and was a significant change compared to the situation if no hard substrates were present (Lindeboom *et al*., 2011).

The installation of scour protection may also have beneficial effects as it will increase the structural complexity of the substrata which will provide refuge and niche habitats as well as increasing feeding opportunities for larger and more mobile species. Studies at the Horns Rev offshore wind farm in Denmark have shown that offshore wind farm structures can be used as nursery habitats for the edible crab *Cancer pagurus* (BioConsult, 2006).

Colonisation of the WTG foundations, associated scour protection and cable protection may have indirect adverse effects on the baseline communities and habitats due to increased predation on and competition with the existing soft sediment species. These effects are difficult to predict, especially as monitoring to date has focused on the colonisation and aggregation of species close to the foundations rather than broad scale studies. Where scour and cable protection are deployed, use of smaller rock sizes, where possible, may facilitate the colonisation of rock protection by epifaunal species typical of coarse sediment which are found within the offshore wind farm area. Previous studies have shown that for artificial hard substrate to be colonised by a benthic community similar to that of the baseline, its structure should resemble that of the baseline habitat as far as possible (Coolen, 2017). The addition of smaller grained material to scour/cable protection will benefit the native colonising communities (Van Duren *et al*., 2017; Lengkeek *et al.,* 2017).

The Subtidal Sandy Mud Sediments, Subtidal Sand Sediment, Subtidal Coarse Sediment IEF and Subtidal Infralittoral Rock IEFs are deemed to be of low resistance, medium recoverability and local value. The sensitivity of the receptors is therefore, considered to be low.

Significance of the effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors is considered to be low. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

8.10.7 Alteration of seabed habitats arising from effects of physical processes

Operational and maintenance phase

Alteration of seabed habitats may arise from the effects of physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on marine ecology. Chapter 7: Marine Processes and appendix 7-1: Marine Processes Technical Report provides a full description of the assessment used to inform this chapter.

The relevant MarESA pressures used to inform this impact assessment are changes in local water flow (tidal current) and local wave exposure changes. The benchmarks for these pressures are:

- Changes in local water flow (tidal current): change in peak mean spring bed flow velocity between 0.1 m/s to 0.2 m/s for more than one year. The pressure is associated with activities that have the potential to modify hydrological energy flows. This pressure corresponds to the impacts associated with the presence of WTG and OSS foundations and cable protection; and

- Local wave exposure changes: change in nearshore significant wave height >3% but <5% for one year. This pressure corresponds to the impacts associated with the presence of WTG and OSS foundations and scour protection.

It is important to note that the predicted changes in wave and tidal regime (see chapter 7: Marine Processes) are lower than the MarESA benchmarks used to inform the assessment therefore significant effects on communities are not likely to occur.

Magnitude of impact

The presence of infrastructure within the offshore wind farm area will obstruct tidal flow and alter the wave climate within the offshore wind farm area. The project design includes for the installation of 25 WTGs and one offshore substation on monopile foundations and associated scour protection (Table 8-11). The modelling carried out presented the impact of 25 WTGs and one offshore substation on monopile foundations and associated scour protection.

Tidal flow is accelerated in the immediate vicinity of each structure as it is redirected around the foundation and there is a zone of reduced speed in the lee of the structure. These alterations in current speed are generally <0.004 m/s in the immediate vicinity of the structure, with lesser changes occurring across the wider offshore wind farm area. These changes are also limited to the immediate offshore wind farm area (appendix 7-1 Marine Processes Technical Report).

Examination of the one in two-year wave climate showed a reduction in significant wave height of around 40 mm which is typically less than 2%. This is limited to the immediate vicinity of the structures. For a more severe one in 50-year storm the level of change is less than the one in two year scenario, as the baseline wave height is increased. The combined effect of wave and tidal currents was also investigated. During the flood tide the tidal flow is in concert with the wave climate and the difference in littoral currents was both limited in magnitude (change of approximately 0.03 m/s) and also spatially (alteration in flow would be limited to the offshore wind farm area). The changes in littoral currents due to the structures were found to be imperceptible from the background levels within the modelling (appendix 7-1 Marine Processes Technical Report).

Alteration of seabed habitats arising from the effects of physical processes is predicted to be of localised spatial extent, long-term duration, continuous and high reversibility following the decommissioning phase. It is predicted that the impact will affect benthic ecology receptors indirectly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

As presented in Table 8-21, all subtidal IEFs are not sensitive to changes in local water flow or local wave exposure changes. Subtidal Sandy Mud Sediment IEF occurs in low energetic environments and therefore an increase in tidal flow could lead to resuspension and erosion of fine sediments and/or reduction in settlement rates of larvae and therefore reductions in recruitment. However, sand particles are most easily eroded at 0.2 m/s with silt and clays requiring higher velocities (Sundborg, 1956), significantly higher than the changes predicted as a result of the Project infrastructure outlined above. Mature adults buried at depth are unlikely to be affected as the muddy substrata are cohesive. Characterising species are likely to resist an increase in water flow at the benchmark level which is well above the levels expected to be reached by the Project.

Subtidal Sand Sediment IEF and Subtidal Coarse Sediment IEF are found where tidal flow varies between moderately strong (0.5 to 1.5 m/s) and weak (>0.5 m/s) (JNCC, 2015). Many of the characterising species of the Subtidal Coarse Sediment IEF occur in a range of sediment types, which suggests that these species are not sensitive to changes in water flow at the pressure benchmark. *Timoclea ovata* occur in muddy sands in areas that are sheltered and where fine sediments are deposited. *Glycera* spp. are found in areas with strong tidal streams where sediments are mobile (Roche *et al.*, 2007) and in extremely sheltered areas (Connor *et al.*, 2004). *Owenia fusiformis* is found in front of river outlets in the Mediterranean and can be subject to a wide range of water velocities. Changes in water flow may alter the topography of these habitats and may cause some shifts in abundance. However, a change at the pressure benchmark (increase or decrease) is unlikely to affect biotopes that occur in mid-range flows.

Changes in wave exposure may increase erosion of the fine sediment substratum and influence the supply of particulate matter for tube building and feeding activities of the characterising species of Subtidal Sandy Mud Sediment IEF. The Subtidal Sand Sediment IEF, Subtidal Coarse Sediment IEF and Subtidal Infralittoral Rock IEF are considered to have lower sensitivity to relatively low level changes in physical processes. It should be noted that the predicted changes in physical processes associated with the Project are well below the MarESA benchmark levels and therefore all receptors were considered to have negligible sensitivity (i.e. not sensitive) to this impact (see Table 8-21 below).

Table 8-21: Sensitivity of the benthic subtidal IEFs to the alteration of seabed habitats arising from the effects of physical processes.

IEF	Representative biotope	Sensitivity to defined MarESA pressure	
		Changes in local water flow (tidal current)	Local wave exposure changes
Subtidal Sandy Mud Sediment	SS.SMu.CSaMu.AfilKurAnit SS.SMu.OMu.LevHet	Not Sensitive	Not Sensitive
Subtidal Sand Sediment	SS.SSa.CFiSa.EpusOborApri SS.SSa.CFiSa.ApriBatPo SS.SSa.IMuSa.FfabMag	Not Sensitive	Not Sensitive
Subtidal Coarse Sediment	SS.SCS.CCS.MedLumVen SS.SCS.CCS.SpiB/ SS.SMx.CMx.FluHyd SS.SMx.CMx.Oph.Mx	Not Sensitive	Not Sensitive
Subtidal Infralittoral Rock	IR.MIR.KR.Lhyp.GzFt[1]	Not Sensitive	Not Sensitive

[1] IR.MIR.KR.Lhyp.GzFt has been selected as a suitable biotope to use as a proxy for the IR.MIR.KR biotope identified in appendix 8-2: Benthic Studies (Aquafact. 2020). This is a suitable proxy due to similar sediment, water depths and fauna present however there are difference e.g. the presence of *Laminaria hyperborean*.

Significance of the effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-22) is considered to be negligible (not sensitive). The effect will, therefore, be of **imperceptible adverse significance**, which is not significant in EIA terms.

8.10.8 Increased risk of introduction and spread of invasive and non-indigenous species

The risk of introduction and spread of INIS during the construction, operational and maintenance and decommissioning phases has been considered in this assessment. Magnitude has been considered for all three phases combined as the increased risk of introduction and spread of INIS is as a result of all phases combined. The relevant MarESA pressure that has been used for this assessment is:

- Introduction or spread of invasive non-indigenous species. The benchmark for this MarESA pressure is the direct introduction of one or more INIS.

Magnitude of impact

The installation of hard substrates and the presence of construction, operational and maintenance and decommissioning phase vessels may lead to an increased risk of introduction and spread of INIS. The project design parameters are represented by the introduction of 475 vessel round trips during the construction phase, 352 vessel round trips per year during the 40 year operational and maintenance phase and 475 vessel round trips during the decommissioning phase (Table 8-11).

There were approximately 1,300 vessels movements over two months (January and July 2022) occurring within the Benthic Subtidal and Intertidal Ecology Study Area, including cargo vessels, tankers, fishing vessels, recreational vessels and service vessels (appendix 13-1: Navigation Risk Assessment) therefore the additional Project vessels, which represents a 27% increase in vessel traffic within the Benthic Subtidal and Intertidal Ecology Study Area during the operation and maintenance phase, will not significantly add to the risk of introduction and spread of INNS.

As presented in Table 8-11, the risk of introduction and spread of INIS will be increased due to the creation of 359,807 m^2 of hard substrate from the installation of monopile foundations, associated scour protection and any cable protection. There are already natural hard substrates within the vicinity of the offshore wind farm area and offshore cable corridor (e.g. circalittoral rock or other hard substrata) (Figure 8-2). Therefore, the introduction of new hard substrates would not be a substantial change in the baseline and would not substantially increase the risk of introduction and spread of non-indigenous species.

Marine invasive species established in Ireland include carpet sea squirt *Didemnum vexillum* and the slipper limpet *Crepidula fornicata*, both of which are already found in the vicinity of the offshore wind farm area and offshore cable corridor (Invasive Species Ireland, 2019). There are several species which are of concern as potential marine invasive species for Ireland. These are the Asian rapa whelk *Rapana venosa*, oyster drill *Ceratostoma inornatum* and *Urosalpinx cinereal*, red king crab *Paralithodes camtschaticus* and striped eel catfish *Plotosus lineatus* (Invasive Species Ireland, 2019). Of these, the Asian rapa whelk is the only one thought to have a potential pathway to Ireland through ballast water (Invasive Species Ireland, 2019). The Project includes a Marine Invasive Non-Indigenous Species Management Plan and an EMP (see volume 2A appendix 5-3: Marine Invasive and Non-Indigenous Species Management plan and volume 2A appendix 5-2: Environmental Management Plan). The measures included in the abovementioned plans, such as, *inter alia*, ensuring any new infrastructure coming from another marine environment is cleaned and checked prior to installation and that vessels comply with the IMO ballast water management guidelines, will ensure that the risk of potential introduction and spread of INIS will be minimised.

Risk of introduction and spread of INIS is predicted to be of regional spatial extent, long term duration, continuous and low reversibility. It is predicted that the impact will affect benthic ecology receptors indirectly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

As presented in Table 8-22 there is a range in sensitivity of the IEFs present to the increased risk of introduction and spread of INIS. Subtidal Sand Sediment, Subtidal Coarse Sediment and Subtidal Infralittoral Rock IEF have a high sensitivity. Slipper limpets can smother bivalves in soft sediment communities where they can form dense carpets. *D. vexillum* has been recorded on gravelly and more coarse substrates where it can cover more than 50% of the seabed in parts (Valentine *et al*., 2007). It is commonly recorded in sheltered coastal locations but has been recorded in offshore habitats (e.g. at the Georges Bank fishing grounds off Long Island, New York) (Valentine *et al*., 2007). If the Asian rapa whelk and oyster drill colonise this habitat they could negatively affect the characterising bivalve species, however, the most likely path of invasion for oysters is through contaminated aquaculture seed stock and equipment, rather than ballast water or presence of offshore infrastructure.

Intertidal Littoral Sand (LS.LSa.MuSa.Lan) also has high sensitivity to the introduction or spread of INIS. This habitat may be colonised by the invasive non-indigenous species *C. fornicata* and the pacific oyster *Magallana gigas*. These species may consume larvae including the pelagic larvae of *Cerastoderma edule* and *Limecola balthica* and other characterising species, reducing recruitment (Smaal *et al*. 2005). *M. gigas* can create reefs on sedimentary flats which could change the character of this habitat. However, as stated above, the most likely path of invasion for oysters is through contaminated aquaculture seed stock and equipment, rather than ballast water or presence of offshore infrastructure.

Table 8-22: Sensitivity of the benthic subtidal and intertidal IEFs to the increased risk of introduction and spread of invasive and non-indigenous species.

IEF	Representative biotopes	Sensitivity to defined MarESA pressure Introduction or spread of invasive non-indigenous species
Subtidal Sandy Mud Sediment	*SS.SMu.CSaMu.AfilKurAnit* SS.SMu.OMu.LevHet	Not relevant
Subtidal Sand Sediment	*SS.SSa.CFiSa.EpusOborApri* *SS.SSa.CFiSa.ApriBatPo* SS.SSa.IMuSa.FfabMag	High
Subtidal Coarse Sediment	*SS.SCS.CCS.MedLumVen* SS.SCS.CCS.SpiB/ SS.SMx.CMx.FluHyd SS.SMx.CMx.Oph.Mx	Not sensitive to High
Subtidal Infralittoral Rock	IR.MIR.KR.Lhyp.GzFt[1]	High
Intertidal Littoral Sand	LS.LSa.MuSa.MacAre	No evidence
	LS.LSa.MuSa.Lan	High
Intertidal Eulittoral Rock	LR.LLR.F.Fves	Medium
	LR.FLR.Eph.EntPor	Not sensitive

[1] IR.MIR.KR.Lhyp.GzFt has been selected as a suitable biotope to use as a proxy for the IR.MIR.KR biotope identified in appendix 8-2: Benthic Studies (Aquafact, 2020). This is a suitable proxy due to similar sediment, water depths and fauna present however there are difference e.g. the presence of *Laminaria hyperborean*.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors (Table 8-22) is considered to be not sensitive to high. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

8.10.9 Mitigation and residual effects

The assessment of impacts has concluded that there are no significant effects with the implementation of the measures included in the Project (as outlined in section 8.8.2).

Residual effects

With the implementation of the measures included in the Project (section 8.8.2), the residual effects are as outlined in the assessment provided in section 8.10.

8.10.10 Future monitoring

No benthic, subtidal and intertidal ecology monitoring to test the predictions made within the impact assessment is considered necessary.

8.11 Cumulative Impact Assessment

8.11.1 Methodology

The Cumulative Impact Assessment (CIA) takes into account the impact associated with the Project together with other projects within the Zone of Influence (ZoI) of the Project (see section 8.3). The projects selected as relevant to the CIA presented within this chapter are based upon the results of a screening exercise (see volume 2A, appendix 3-1: Cumulative Impact Assessment (CIA) Screening Annex). Each project has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

The approach to CIA examines effects of the Project alongside the following projects if they fall within the 20 km buffer relative to the offshore wind farm area for the CIA on benthic subtidal and intertidal ecology:

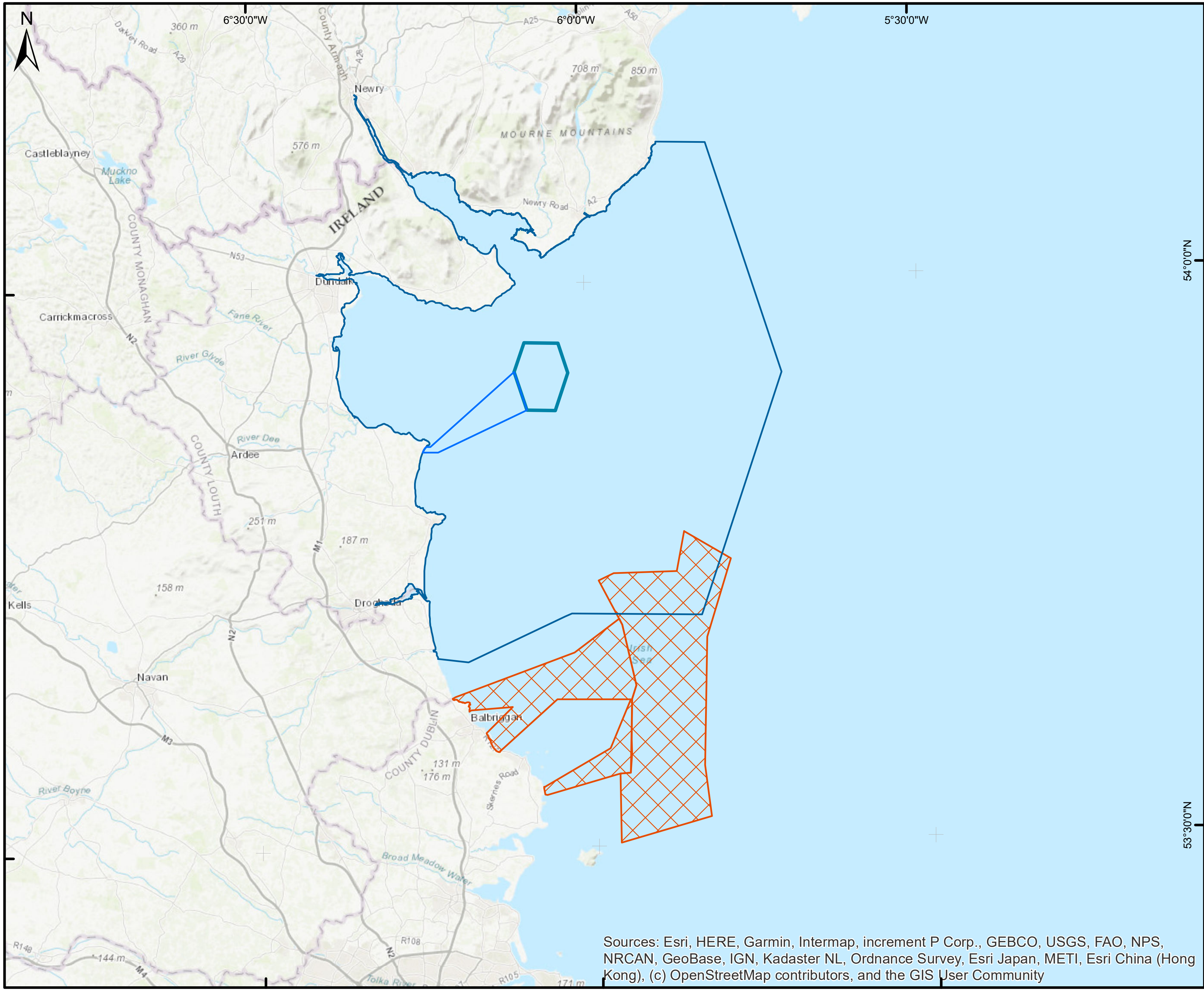
- Other projects with consent but not yet constructed/construction not completed;
- Other projects in a consent application process but not yet determined (including planning applications, foreshore lease/licence applications, Dumping at Sea Permit applications;
- Other projects currently operational that were not operational when baseline data were collected, and/or those that are operational but have an ongoing impact; and
- Projects, which satisfy the definition of 'relevant maritime usage' under the Maritime Area Planning Act (2021) (i.e. wind farm projects designated as 'Relevant Projects' or 'Phase 1 Projects') including Arklow Bank II, Bray Bank and Kish Bank; North Irish Sea Array, Codling Wind Park (I and II).

Only one project has been screened into this CIA; the NISA offshore wind farm project (see Table 8-23).

Table 8-23: List of other projects considered within the CIA.

Project	Status	Approximate Distance from offshore wind farm area (km)	Approximate Distance from Offshore cable corridor (km)	Description of Project	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with Project
Offshore Wind Farms							
North Irish Sea Array (NISA)	Maritime Area Consent	16.2	18.1	EIA Scoping Report (2021) refers to the construction of an offshore wind farm of up to 500 MW, consisting of 36 turbines with a maximum height of 320 m and rotor diameter of up to 290 m. Offshore substation platforms may be required[2].	Unknown	Unknown (Design life minimum 35 years)	Potential for construction and operational phases to overlap with the Project. Potential for overlap for impacts such as SSC, habitat loss (temporary and long term) and colonisation of hard substrates.

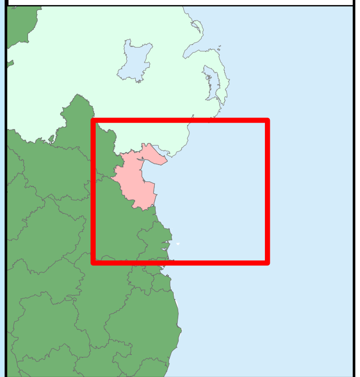
[2] Project website https://northirishseaarray.ie/: states that wind farm will consist of 35 to 46 turbines.



Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Cumulative Benthic Subtidal and Intertidal Ecology Study Area
- Statkraft North Irish Sea Array (NISA)

Data Sources: Client, Ordnance Survey Ireland, RPS



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title **Figure 8-8**
Other projects screened into the Cumulative Impact Assessment

rps
A TETRA TECH COMPANY

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

Drawn By: NG	**Project No.** EOR0822 (MDR1520B)
Checked By: NG	**File Ref:**
Approved By: AOS	EOR0822_BEN_E_1108_FINAL
Scale: 1:500,000 @ A4	**Projection:** ITM (IRENET95)
Date: 12/03/2024	Geographic Co-ordinates: ETRS89

NOTE: 1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. Ordnance Survey Ireland Licence EN 0005019 ©Copyright Government of Ireland.

Table 8-24 presents the relevant project design parameters from Table 8-11, which are used to assess the potential cumulative impact of the Project with the other projects identified in Table 8-23 (where information is available).

For the purposes of this chapter, cumulative impacts have been assessed within the Benthic Subtidal and Intertidal Ecology Study Area. Cumulative impacts associated with temporary intertidal habitat loss/disturbance has not been assessed, given that the project and the NISA project will be conducting the majority of their operations offshore in the subtidal environment and the landfall locations for the Project and NISA are not close to each other therefore the impacts associated with these two projects are unlikely to result in any combined effects.

Table 8-24: Project design parameters considered for the assessment of potential cumulative impacts on benthic subtidal and intertidal ecology.

Potential impact	Phase			Project design parameter	Justification
	C	O	D		
Temporary subtidal habitat loss/disturbance	✓	✓	✓	Project design parameter as described for the Project (Table 8-11) assessed cumulatively with NISA Offshore Wind Farm.	Maximum potential for cumulative effects from temporary subtidal habitat loss/disturbance from construction, operational and decommissioning phase activities within the Benthic Subtidal and Intertidal Ecology Study Area.
Increase in suspended sediment concentration (SSC) and associated deposition	✓	✓	✓		Maximum potential for cumulative effects from an increase in SSC and associated deposition from construction, operational and decommissioning phase activities within the Benthic Subtidal and Intertidal Ecology Study Area.
Seabed disturbance leading to the potential release of sediment contaminants	✓	✓	✓		Maximum potential for cumulative effects from seabed disturbance leading to the potential release of sediment contaminants from construction, operational and decommissioning phase activities within the Benthic Subtidal and Intertidal Ecology Study Area.
Long-term subtidal habitat loss	×	✓	×		Maximum potential for cumulative effects from long-term subtidal habitat loss from new infrastructure within the Benthic Subtidal and Intertidal Ecology Study Area.
Colonisation of foundations, scour protection and cable protection	×	✓	×		Maximum potential for cumulative effects from colonisation of foundations, scour protection and cable protection within the Benthic Subtidal and Intertidal Ecology Study Area.
Alteration of seabed habitats arising from effects of physical processes	×	✓	×		Maximum potential for cumulative effects from Alteration of seabed habitats arising from effects of physical processes from the installation of infrastructure within the Benthic Subtidal and Intertidal Ecology Study Area.
Increased risk of introduction and spread of invasive and non-indigenous species	✓	✓	✓		Maximum potential for cumulative effects from increased risk of introduction and spread of invasive and non-indigenous species from new infrastructure and vessel movements within the Benthic Subtidal and Intertidal Ecology Study Area.

8.11.2 Temporary subtidal habitat loss/disturbance

Construction phase

Magnitude of impact

The installation of foundations within the offshore wind farm area, together with the NISA project, may lead to temporary subtidal habitat loss/disturbance as a result of disturbance to the seabed for infrastructure installation and site preparation.

Temporary subtidal habitat loss/disturbance arising from construction phase activities at the NISA Offshore Wind Farm, such as cable laying and foundation installation, may result in adverse effects on benthic communities through abrasion, penetration of the seabed and the removal of some substrate (North Irish Sea Array Windfarm Ltd., 2021). Currently only a scoping report is available for this project which does not quantify the area likely to be impacted by temporary habitat disturbance. The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to the increase in temporary subtidal habitat loss/disturbance which will be expected as a result of the Project.

The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to temporary subtidal habitat loss/disturbance are fully detailed in Table 8-17.

Significance of effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-17) is considered to be low to medium. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

Operation and maintenance phase activities within the offshore wind farm area, together with the NISA project may lead to temporary subtidal habitat loss/disturbance as a result of disturbance to the seabed.

Temporary subtidal habitat loss/disturbance arising from operational phase activities at the NISA Offshore Wind Farm, such as cable remedial works, may result in adverse effects on benthic communities through abrasion, penetration of the seabed and the removal of some substrate (North Irish Sea Array Windfarm Ltd., 2021). Currently only a scoping report is available for this project which does not quantify the area likely to be impacted by temporary habitat disturbance. The scale of this impact associated with the NISA Offshore Wind Farm however likely to be similar to the temporary subtidal habitat loss/disturbance which will be expected as a result of the Project.

The temporary habitat loss/disturbance is predicted to be of localised spatial extent, short term duration (individual maintenance operations would occur over a period of days to weeks), intermittent and high reversibility. It is predicted that the impact will affect benthic subtidal ecology receptors directly. The magnitude is therefore, considered to be negligible.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to temporary subtidal habitat loss/disturbance are fully detailed in Table 8-17.

Significance of effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors (Table 8-17) is considered to be low to medium. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

Decommissioning phase

Magnitude of impact

The removal of foundations and cables within the Project offshore wind farm area, together with the NISA project, may lead to temporary habitat loss/disturbance as a result of disturbance to the seabed.

Temporary habitat loss/disturbance arising from decommissioning phase activities at the NISA Offshore Wind Farm, such as cable or turbine foundation removal, may result in adverse effects on benthic communities through abrasion, penetration of the seabed and the removal of some substrate (North Irish Sea Array Windfarm Ltd., 2021). Currently only a scoping report is available for this project which does not quantify the area likely to be impacted by temporary habitat disturbance. The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to the temporary subtidal habitat loss/disturbance which will be expected as a result of the Project.

The temporary habitat loss/disturbance is predicted to be of localised spatial extent, medium term duration (although only a small proportion of the total area will be affected at any one time with individual elements of the decommissioning phase having much smaller durations), intermittent and high reversibility following the decommissioning phase. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to temporary subtidal habitat loss/disturbance are fully detailed in Table 8-17.

Significance of effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-17) is considered to be low to medium. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

8.11.3 Increase in SSC and associated deposition

Construction phase

Magnitude of impact

The installation of foundations within the Project offshore wind farm area, together with the NISA project, may lead to increase in SSC and associated deposition as a result of disturbance to the seabed.

Sediment disturbance arising from construction phase activities at the NISA Offshore Wind Farm, such as cable laying and foundation installation, may result in adverse effects on benthic communities through smothering (North Irish Sea Array Windfarm Ltd, 2021). Currently only a scoping report is available for this project which does not quantify the area likely to be impacted or the SSCs which may be associated with the relevant activities. The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to the increase in SSC and the associated deposition which will be expected as a result of the Project.

The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to increases in SSC and associated deposition are fully detailed in Table 8-19.

Significance of effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-19) is considered to be negligible (i.e. not sensitive) to medium. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

Maintenance activities, including remedial burial of cables, within the offshore wind farm area, together with the NISA project, may lead to increase in SSC and associated deposition as a result of disturbance to the seabed.

Sediment disturbance arising from operational phase activities at the NISA Offshore Wind Farm, such as cable remedial works, may result in adverse effects on benthic communities through smothering (North Irish Sea Array Windfarm Ltd, 2021). Currently only a scoping report is available for this project which does not quantify the area likely to be impacted or the SSCs which may be associated with the relevant activities. The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to the increase in SSC and the associated deposition which will be expected as a result of the Project.

The impact is predicted to be of local spatial extent, short term duration (individual maintenance operations would occur over a period of days to weeks), intermittent and high reversibility It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to increases in SSC and associated deposition are fully detailed in Table 8-19.

Significance of effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-18) is considered to be negligible to medium. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

Decommissioning phase

The installation of foundations within the Project offshore wind farm area, together with the NISA project may lead to increase in SSC and associated deposition as a result of disturbance to the seabed.

Sediment disturbance arising from the decommissioning phase activities at the NISA Offshore Wind Farm, such as cable or turbine foundation removal, may result in adverse effects on benthic communities through smothering (North Irish Sea Array Windfarm Ltd., 2021). Currently only a scoping report is available for this project which does not quantify the area likely to be impacted or the SSCs which may be associated with the relevant activities. The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to the increase in SSC and the associated deposition which will be expected as a result of the Project.

The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to increases in SSC and associated deposition are fully detailed in in Table 8-19.

Significance of effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-19) is considered to be negligible to medium. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

8.11.4 Seabed disturbance leading to the potential release of sediment contaminants

Construction phase

Magnitude of impact

The installation of foundations within the Project offshore wind farm area, together with the NISA project, may lead to potential release of sediment contaminants as a result of disturbance to the seabed.

Seabed disturbance arising from construction phase activities at the NISA Offshore Wind Farm, such as cable laying and foundation installation, may result in adverse effects on benthic communities through release of contaminated sediments and/or accidental contamination (North Irish Sea Array Windfarm Ltd, 2021). Currently only a scoping report is available for this project which does not quantify the area likely to be impacted or concentrations of contaminants associated with the seabed within the NISA array area and offshore cable corridor. The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to potential for contaminant release from the seabed associated with the Project.

The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to seabed disturbance leading to the potential release of sediment contaminants are fully detailed in the assessment of significance (section 8.10.4).

Significance of effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be negligible to low. The effect will, therefore, be of **imperceptible significance**, which is not significant in EIA terms.

Operational and maintenance phase

Magnitude of impact

Maintenance activities, including remedial burial of cables within the Project offshore wind farm area, together with the NISA Offshore Wind Farm project, may lead to potential release of sediment contaminants as a result of disturbance to the seabed.

Seabed disturbance arising from operational phase activities at the NISA Offshore Wind Farm, such as cable remedial works, may result in adverse effects on benthic communities through release of contaminated sediments and/or accidental contamination (North Irish Sea Array Windfarm Ltd, 2021). Currently only a scoping report is available for this project which does not quantify the area likely to be impacted or concentrations of contaminants associated with the seabed within the NISA array area and offshore cable corridor. The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to potential for contaminant release from the seabed associated with the Project.

The seabed disturbance leading to the potential release of sediment bound contaminants is predicted to be of localised spatial extent, short term duration, intermittent and high reversibility due to site hydrodynamics. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be negligible.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to seabed disturbance leading to the potential release of sediment contaminants are fully detailed in assessment of significance (section 8.10).

Significance of effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors is considered to be negligible to low. The effect will, therefore, be of **imperceptible significance**, which is not significant in EIA terms.

Decommissioning phase

The removal of foundations within the Project offshore wind farm area, together with the NISA project, may lead to potential release of sediment contaminants as a result of disturbance to the seabed.

Seabed disturbance arising from the decommissioning phase activities at the NISA Offshore Wind Farm, such as cable and foundation removal activities, may result in adverse effects on benthic communities through release of contaminated sediments and/or accidental contamination (North Irish Sea Array Windfarm Ltd, 2021). Currently only a scoping report is available for this project which does not quantify the area likely to be impacted or concentrations of contaminants associated with the seabed within the NISA array area and offshore cable corridor. The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to potential for contaminant release from the seabed associated with the Project.

The seabed disturbance leading to the potential release of sediment bound contaminants is predicted to be of localised spatial extent, short term duration, intermittent and high reversibility due to site hydrodynamics. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be negligible.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to seabed disturbance leading to the potential release of sediment contaminants are fully detailed in the assessment of significance (section 8.10).

Significance of effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors is considered to be negligible to low. The effect will, therefore, be of **imperceptible significance**, which is not significant in EIA terms.

8.11.5 Long-term subtidal habitat loss

Operation and maintenance phase

Magnitude of impact

The placement of infrastructure such as wind turbine foundations within the offshore wind farm area, together with the NISA project, may lead to long-term subtidal habitat loss.

Long term loss or alteration of habitat arising from the placement of infrastructure as a result of the NISA Offshore Wind Farm, such as cable protection and turbine foundations, may result in adverse effects on benthic communities through the loss of seabed (North Irish Sea Array Windfarm Ltd, 2021). Currently only a scoping report is available for this project which does not quantify the area likely to be impacted by habitat loss or alteration. The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to the long term habitat loss or alteration which will be expected as a result of the Project.

The long-term habitat loss/disturbance is predicted to be of highly localised spatial extent (restricted to discrete areas within the offshore wind farm areas and offshore cable corridors), long-term duration, continuous and high reversibility. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to long term habitat loss are fully detailed in Table 8-20.

Significance of effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-20) is considered to be high. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

8.11.6 Colonisation of foundations, scour protection and cable protection

Operation and maintenance phase

Magnitude of impact

The placement of infrastructure such as wind turbine foundations, scour protection and cable protection within the offshore wind farm area, together with the NISA project, may lead to colonisation of this new hard substrate.

Colonisation of foundations, scour protection and cable protection as a result of the NISA Offshore Wind Farm, may result in adverse effects on benthic communities due an increase in local biodiversity and alterations to the prevailing benthic habitats and communities (North Irish Sea Array Windfarm Ltd, 2021). Currently only a scoping report is available for this project which does not quantify the area likely to be impacted by colonisation. The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to the colonisation which will be expected as a result of the Project.

Colonisation of foundations, scour protection and cable protection is predicted to be of localised spatial extent (restricted to the new areas of hard substrate), long-term duration, continuous and medium reversibility following the decommissioning phase. It is predicted that the impact will affect benthic ecology receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to colonisation of foundations, scour protection and cable protection are fully detailed in the assessment of significance (section 8.10.6).

Significance of effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors is considered to be low. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

8.11.7 Alteration of seabed habitats arising from effects of physical processes

Operation and maintenance phase

Magnitude of impact

The placement of infrastructure such as wind turbine foundations within the offshore wind farm area, together with the NISA project, may lead to alteration of seabed habitats arising from effects of physical processes as a result of the placement of infrastructure on the seabed.

Alteration of seabed habitats arising from effects of physical processes arising from the placement of infrastructure as a result of the NISA Offshore Wind Farm, such as cable protection and turbine foundations, may result in adverse effects on benthic communities through smothering (North Irish Sea Array Windfarm Ltd, 2021). Currently only a scoping report is available for this project which does not quantify the likely scale of the alteration of physical process which could be expected as a result of the NISA Offshore Wind Farm.

The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to the long term habitat loss or alteration which will be expected as a result of the Project.

Alteration of seabed habitats arising from the effects of physical processes is predicted to be of localised spatial extent, long-term duration, continuous and high reversibility following the decommissioning phase. It is predicted that the impact will affect benthic ecology receptors indirectly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to alteration of seabed habitats arising from effects of physical processes are fully detailed in Table 8-21.

Significance of effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors (Table 8-21) is considered to be negligible (not sensitive). The effect will, therefore, be of **imperceptible adverse significance**, which is not significant in EIA terms.

8.11.8 Increased risk of introduction and spread of invasive and non-indigenous species

All phases

Magnitude of impact

The installation, maintenance and decommissioning of hard substrates and the presence of vessels to undertake this work, together with the NISA project, may lead to an increased risk of introduction and spread of INIS.

An increased risk of introduction and spread of INIS from the installation of hard substrates and the presence of construction, operational and maintenance and decommissioning phase vessels at the NISA Offshore Wind Farm, may result facilitate the spread of non-native species and may subsequently impact biodiversity and benthic ecology of the area (North Irish Sea Array Windfarm Ltd, 2021). Currently only a scoping report is available for this project which does not quantify the number of vessel movements or the amount of new hard substrate which may be installed. The scale of this impact associated with the NISA Offshore Wind Farm however is likely to be similar to the increased risk of introduction and spread of INIS which will be expected as a result of the Project.

Risk of introduction and spread of INIS is predicted to be of regional spatial extent, long term duration, continuous and low reversibility. It is predicted that the impact will affect benthic ecology receptors indirectly. The magnitude is therefore, considered to be negligible.

Sensitivity of receptor

Sensitivities of the relevant benthic subtidal and intertidal ecology receptors to increased risk of introduction and spread of INIS are fully detailed in Table 8-22.

Significance of effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors (Table 8-22) is considered to be not sensitive to high. The effect will, therefore, be of **slight adverse significance**, which is not significant in EIA terms.

8.12 Transboundary effects

There is potential for the Project to result in an increased risk of introduction and spread of INIS to Northern Ireland as well as the Republic of Ireland. This impact is assessed in section 8.10. The significance of effect has been assessed as **slight adverse**, which is not significant in EIA terms. This was due to the regional extent of the effect (i.e. any potential risk would be limited to the vicinity of offshore structures and surrounding vessel traffic pathways) and the measures put in place to minimise the risk of significant effects (e.g. an Invasive Non-Indigenous Species Management Plan, including following best practice IMO guidelines with respect to ballast water). As such, any increased risk in Northern Ireland waters would be further reduced from that assessed in section 8.10.8.

8.13 Interactions

A description of the likely interactions arising from the Project on benthic subtidal and intertidal ecology is provided in volume 2C, chapter 32: Interactions.

8.14 Summary of impacts, mitigation measures and residual effects

A detailed baseline characterisation of the Benthic Subtidal and Intertidal Ecology Study Area was collected via a desk top study (Table 8-5) and site-specific surveys (section 8.6.2). Detailed reports on the site-specific surveys can be found in appendix 8-1: Intertidal Phase 1 Report and appendix 8-2: Benthic Subtidal Survey Report.

Table 8-25 presents a summary of the potential impacts, mitigation measures and residual effects in respect to benthic subtidal and intertidal ecology. Table 8-26 presents a summary of the potential cumulative impacts, mitigation measures and residual effects.

Overall, it was concluded that there will be no significant effects arising from the Project during the construction, operational and maintenance or decommissioning phases. This was due to the limited extent of the effects on the extensive receptors (species, communities and habitats) and the short term and reversable nature of the majority of effects.

A screening exercise was carried out to inform the CIA. The NISA offshore wind farm project was screened into the assessment. Overall it was concluded that there will be no significant effects.

Potential transboundary impacts have been identified in relation to the potential impact upon the risk of introduction and spread of INIS to Northern Ireland. Overall, it is concluded that there will be no significant transboundary effects arising from the Project.

Table 8-25: Summary of potential environment effects, mitigation and monitoring.

Description of impact	Phase C	O	D	Measures included in the Project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional Measures	Residual effect	Proposed monitoring
Temporary subtidal habitat loss/disturbance	✓	✓	✓	An Environmental Management Plan (EMP) will be implemented. A pre-construction phase survey will be undertaken to identify any areas of reef habitat. Should reef areas be identified, appropriate measures will be agreed with regulatory and nature conservation bodies to avoid direct impact on these features.	C: Low O: Negligible D: Low	Low to Medium	C: Slight adverse O: Imperceptible or slight adverse D: Slight adverse	None	C: Slight adverse O: Imperceptible or slight adverse D: Slight adverse	N/A
Temporary intertidal habitat loss/disturbance	✓	✓	✓	Reinstatement of rock in the intertidal zone following cable installation.	C: Low O: Negligible D: Low	Low to High	C: Slight adverse O: Slight adverse D: Slight adverse	None	C: Slight adverse O: Slight adverse D: Slight adverse	N/A
Increased suspended sediment concentrations and associated sediment deposition	✓	✓	✓	N/A	C: Low O: Low D: Low	Not Sensitive to Medium	C: Slight adverse O: Slight adverse D: Slight adverse	None	C: Slight adverse O: Slight adverse D: Slight adverse	N/A
Seabed disturbance leading to the potential release of sediment contaminants	✓	✓	✓	N/A	C: Negligible O: Negligible D: Negligible	Negligible to Low	C: Imperceptible O: Imperceptible D: Imperceptible	None	C: Imperceptible O: Imperceptible D: Imperceptible	N/A
Long term subtidal habitat loss	✗	✓	✗	An Environmental Management Plan (EMP) will be produced and followed. A pre-construction phase survey will be undertaken to identify any areas of reef habitat. Should reef areas be identified, appropriate	O: Low	High	O: Slight	None	O: Slight	N/A

Description of impact	Phase C O D	Measures included in the Project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional Measures	Residual effect	Proposed monitoring
		measures will be agreed with regulatory and nature conservation bodies to avoid direct impact on these features.						
Colonisation of foundations, scour protection and cable protection	× ✓ ×	N/A	O: Low	Low	O: Slight adverse	None	O: Slight adverse	N/A
Alteration of seabed habitats arising from effects of physical processes	× ✓ ×	N/A	O: Low	Not Sensitive	O: Imperceptible adverse	None	O: Imperceptible adverse	N/A
Increased risk of introduction and spread of invasive and non-indigenous species	✓ ✓ ✓	A Marine Invasive Non-Indigenous Species Management Plan will be produced and agreed in consultation with statutory consultees.	C: Negligible O: Negligible D: Negligible	Not Sensitive to High	C: Slight adverse O: Slight adverse D: Slight adverse	None	C: Slight adverse O: Slight adverse D: Slight adverse	N/A

Table 8-26: Summary of potential cumulative environment effects, mitigation and monitoring.

Description of impact	Phase C O D	Measures included in the Project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional Measures	Residual effect	Proposed monitoring
Temporary subtidal habitat loss/disturbance	✓ ✓ ✓	An Environmental Management Plan (EMP) will be implemented. A pre-construction phase survey will be undertaken to identify any areas of reef habitat. Should reef areas be identified, appropriate measures will be agreed with regulatory and nature conservation bodies to avoid direct impact on these features.	C: Low O: Negligible D: Low	Low to Medium	C: Slight O: Slight D: Slight	None	C: Slight O: Slight D: Slight	None

Description of impact	Phase C O D	Measures included in the Project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional Measures	Residual effect	Proposed monitoring
Increase in SCC and associated deposition	✓ ✓ ✓	N/A	C: Low O: Low D: Low	Not sensitive to Medium	C: Slight O: Slight D: Slight	None	C: Slight O: Slight D: Slight	None
Seabed disturbance leading to potential release of sediment contaminants	✓ ✓ ✓	N/A	C: Low O: Negligible D: Negligible	Negligible to Low	C: Slight O: Imperceptible D: Imperceptible	None	C: Slight O: Imperceptible D: Imperceptible	None
Long-term subtidal habitat loss	✗ ✓ ✗	An Environmental Management Plan (EMP) will be implemented. A pre-construction phase survey will be undertaken to identify any areas of reef habitat. Should reef areas be identified, appropriate measures will be agreed with regulatory and nature conservation bodies to avoid direct impact on these features.	O: Low	High	O: Slight	None	O: Slight	None
Colonisation of foundations, scour protection and cable protection	✗ ✓ ✗	N/A	O: Low	Low	O: Slight	None	O: Slight	None
Alteration of seabed habitats arising from effects of physical processes	✗ ✓ ✗	N/A	O: Low	Not Sensitive	O: Imperceptible	None	O: Imperceptible	None
Increased risk of introduction and spread of invasive and non-indigenous species	✓ ✓ ✓	A Marine Invasive Non-Indigenous Species Management Plan will be produced and agreed in consultation with statutory consultees.	C: Negligible O: Negligible D: Negligible	Not Sensitive to High	C: Slight O: Slight D: Slight	None	C: Slight O: Slight D: Slight	None

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