Dublin Array
Generation for generations

EIAR Volume 3: Offshore Infrastructure Assessment Chapters Chapter 3: Benthic Subtidal and Intertidal Ecology

Kish Offshore Wind Ltd.

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Dublin Array Offshore Wind Farm

Environmental Impact Assessment Report

Volume 3, Chapter 3: Benthic Subtidal and Intertidal Ecology

Contents

Annexes

Annex A: Benthic and Intertidal Ecology Policy

Figures

Tables

Acronyms

Term	Definition
ADO	Alternative Design Options
CD	Chart Datum
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CIEEM	Chartered Institute of Ecology and Environmental Management
CTV	Crew Transfer Vessel
DBT	Dibutyl Tin
DCCAE	Department of Communications, Climate Action and Environment
DDV	Drop down video
DECC	Department of Environment, Climate and Communications
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Field
EU	European Union
HDD	Horizontal Directional Drilling
IAC	Inter-Array Cabling
IAS	Invasive Alien Species
IFI	Inland Fisheries Ireland
INFOMAR	Integrated Mapping for the Sustainable Development of Ireland's Marine Resource
JNCC	Joint Nature Conservation Committee
JUV	Jack Up Vessel
LAT	Lowest Astronomical Tide
LOI	Limiting oxygen index
MarESA	Marine Evidence based Sensitivity Assessment
MarLIN	Marine Life Information Network
MDO	Maximum Design Option
MFE	Mass Flow Excavation
MHWS	Mean High Water Springs
MI	Marine Institute
MLWS	Mean Low Water Springs
MPA	Marine Protected Area

Term	Definition
MW	Megawatt
NIS	Natura Impact Statement
NPWS	National Parks and Wildlife Service
OESEA	Offshore Energy Strategic Environmental Assessment
O&M	Operations and Maintenance
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PEMP	Project Environmental Management Plan
PSA	Particle Size Analysis
PSD	Particle Size Distribution
SAC	Special Ares of Conservation
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
TBT	Tributyltin
THC	Total Hydrocarbon
TSHD	Trailer Suction Hopper Dredger
TJB	Transition Joint Bays
TOC	Total Organic Carbon
WTG	Wind Turbine Generator
ZoI	Zone of Influence

Glossary

Term	Definition
Abundance	Number of individuals in a community.
Array area	The area within which the WTGs and OSP's will be located.
Benthic ecology	Benthic ecology encompasses the study of the organisms living in and on the sea floor, the interactions between them and impacts on the surrounding environment.
Biotope	A region of habitat associated with a particular ecological community.
Diversity	Number of different species in a community.

Term	Definition
Drop Down Video (DDV)	A non-invasive, passive survey method in which imagery of habitat is collected, used predominantly to survey marine environments.
EIAR	Environmental Impact Assessment Report – a report to inform an Environmental Impact Assessment.
Offshore Export Cable Corridor (Offshore ECC)	Corridor for an export transmission cable from the array to landfall.
Intertidal	The area of the shoreline which is covered at high tide and uncovered at low tide.
Lowest astronomical tide	The lowest tide level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions.
Macro	Large scale.
Mean High-Water Springs (MHWS)	MHWS is the highest level that spring tides reach on the average over a period of time (often 19 years). The height of MHWS is the average throughout the year (when the average maximum declination of the moon is 23.5°) of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
Mean Low Water Springs (MLWS)	MLWS is the average of the levels of each pair of successive low waters when the range of the tide is greatest. The height of MLWS is the average throughout a year of the heights of two successive low waters during those periods of 24 hours (approximately once a fortnight) when the range of the tide is greatest.
Subtidal	The region where the seabed is below the lowest tide
Total Organic Carbon (TOC)	The total amount of carbon found within an organic compound.
Zone of Influence (ZoI)	The area or 'zone' where impacts from the proposed development may impact upon benthic and intertidal ecology receptors.

Biotopes

Biotope code (JNCC and EUNIS 2022)	Definition
IR.HIR	Atlantic and Mediterranean high energy infralittoral rock
IR.LIR	Low energy infralittoral rock
LR.HLR	High energy littoral rock
CR.HCR	High energy circalittoral rock
LR.FLR.Eph.EphX EUNIS Code MA4211	Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata
LR.MLR.BF.Fser.R EUNIS Code MA125441	*Fucus serratus* and red seaweed on moderately exposed lower eulittoral rock
LR.HLR.MusB.Sem EUNIS Code MA1223	*Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock
SS.SBR.SMus.ModMx EUNIS Code MC2232	*Modiolus modiolus* beds on open coast circalittoral mixed sediment
SS.SCS.CCS.MedLumVenEUNIS Code MC3212	*Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in circalittoral coarse sand or gravel
IR.MIR.KR.Ldig.Bo EUNIS Code MB12172	*Laminaria digitata* forest on boulders
LS.Lsa.MuSa.Lan EUNIS Code MB12172	*Lanice conchilega* in littoral sand
LS.LCS.Sh.BarSh EUNIS Code MA3211	Barren littoral shingle
LS.LSa.St.Tal EUNIS Code MA5211	Talitrids on the upper shore and strand-line.
LS.LSa.FiSa.Po.Aten EUNIS Code MA52412	Fine sands with *Angulus tenuis* community complex and / Polychaetes and *Angulus tenuis* in littoral fine sand
SS.SMx.CMx.MysThyMx EUNIS Code MC4213	*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed
LS.LMp.LSgr.Znol EUNIS Code MA6231	*Zostera noltei* beds in littoral muddy sand
SS.SSa.IFiSa.IMoSa EUNIS Code MB5231	Infralittoral mobile clean sand with sparse fauna
SS.SCS.ICS.Glap EUNIS Code MB3235	*Glycera lapidum* in impoverished infralittoral mobile gravel and sand
SS.SSA.CFiSa.ApriBatPo EUNIS CODE MC5212	*Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand
SS.SSA.IFiSa.NcirBat EUNIS Code MB5233	*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand
SS.SSA.CMuSa.AalbNuc EUNIS Code MC5214	*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment
SS.SMx.CMx.OphMx EUNIS Code MC4215	*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment
SS.SCS.CCS.PomB EUNIS Code MC3211	*Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles
SS.SSa.IMuSa.FfabMag EUNIS Code MB5236	*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand

Biotope code (JNCC and EUNIS 2022)	Definition
SS.SCS.ICS EUNIS Code MB32	Infralittoral coarse sediment
SS.Smu.CsaMu.AfilMysAnit EUNIS Code MC6211	*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud

3 Benthic Subtidal & Intertidal Ecology

3.1 Introduction

3.1.1 This chapter presents the results of the Environmental Impact Assessment (EIA) for the potential impacts of the construction, operation and maintenance (O&M), and decommissioning phases within the array area and offshore Export Cable Corridor (the latter referred to as the Offshore ECC (Figure 1) on benthic subtidal and intertidal ecology.

3.1.2 This EIAR chapter should be read in conjunction with the following documents included within the EIAR, due to interactions between the technical aspects:

- Volume 4, Appendix 4.3.3-2: Intertidal Survey Report (hereafter referred to as the Intertidal Survey Report): to be referred to for supporting information regarding the intertidal Particle Size Analysis (PSA) survey, in addition to sediment sampling analysis and interpretation;
- Volume 4, Appendix 4.3.3-3: Subtidal Survey Report (hereafter referred to as the Subtidal Survey Report): to be referred to for supporting information regarding the subtidal PSA survey, in addition to sediment sampling analysis and interpretation;
- Volume 4, Appendix 4.3.3-5: Dublin Array Offshore Windfarm - Underwater Image Analysis Report (hereafter referred to as the Underwater Image Analysis Report) to be referred to for information regarding the presence and extent of any geogenic or biogenic reef habitats in the nearshore area;
- Volume 4, Appendix 4.3.1-1: Physical Processes Technical Baseline (hereafter referred to as the Physical Processes Technical Baseline): to be referenced for a detailed description of the surficial sediment properties, suspended sediments and seabed features;
- Volume 3, Chapter 1: Physical Processes (hereafter referred to as the Physical Processes chapter): to be referenced for an overview on the surficial sediment properties, suspended sediments and seabed features. This chapter also provides an assessment of the potential impacts of the project upon the marine geology, oceanography and physical processes;
- Volume 4, Appendix 4.3.1-2: Physical Processes Modelling Report: to be referenced for a detailed description of the modelling of potential impacts on local hydrodynamics and sediment disposition and dispersion resulting from construction activities;
- Volume 4, Appendix 4.3.4-1: Fish and Shellfish Ecology Technical Baseline (hereafter referred to as the Fish and Shellfish Ecology Technical Baseline): to be referenced for a detailed description of the fish and shellfish ecology of the site;

- Volume 3, Chapter 5: Fish and Shellfish Ecology (hereafter referred to as the Fish and Shellfish Ecology Chapter): to be referenced for a detailed description of the fish and shellfish ecology of the site. This chapter also provides an assessment of the potential impacts of the project upon fish and shellfish ecology; and

- Volume 3, Chapter 2: Marine Water and Sediment Quality (hereafter referred to as the Marine Water and Sediment Quality chapter): to be referenced for a review of the marine water and sediment quality receiving environment. This chapter also provides an assessment of the potential impacts of the project upon marine water and sediment quality.

3.1.3 A technical baseline report providing a detailed characterisation of the receiving benthic subtidal and intertidal environment is provided in Volume 5, Appendix 5.3.4-1 of the EIAR (hereafter referred to as the Benthic Technical Baseline). Information from the baseline report has been summarised within this chapter.

3.2 Regulatory background

3.2.1 The legislation, policy and guidance relevant to the whole Planning Application is set out in Volume 2, Chapter 2: Consents, Legislation, Policy & Guidance (hereafter referred to as the Policy Chapter). The principal legislation, policy and guidance relevant to this chapter is set out in Annex A.

3.2.2 The assessment of potential impacts upon benthic, subtidal and intertidal receptors have been made with specific reference to the relevant regulations, guidelines and guidance, which include:

- Guidance and guidelines

  - Guidance on Marine Baseline Ecological Assessments & Monitoring Activities for Offshore Renewable Energy Projects Parts 1 and 2 (Department of Communications, Climate Action & Environment (DCCAE, 2018);

  - Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (Chartered Institute of Ecology and Environmental Management (CIEEM, 2018);

  - Guidance on Survey and Monitoring in Relation to Marine Renewables Deployments in Scotland Volume 5: Benthic Habitats (Scottish National Heritage, 2011);

  - Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Centre for Environment, Fisheries and Aquaculture Science (Cefas), 2012)[1];

[1] Cefas forms part of the Department for Environment, Food and Rural Affairs in the UK

- Guidance on Assigning Benthic Biotopes using EUNIS or the Marine Habitat Classification of Britain and Ireland (JNCC, Revised 2019);

- Guidance from the Marine Life Information Network (MarLIN) on assessing habitat sensitivity using Marine Evidence based Sensitivity Assessment (MarESA) and Integrated Mapping for the Sustainable Development of Ireland's Marine Resources (Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR); and

- Guidelines for the assessment of dredge material for disposal in Irish waters (Cronin *et al*., 2006) and addendum (Marine Institute, 2019).

3.2.3 Consideration of designated and proposed, or candidate European sites is required under The European Communities (Birds and Natural Habitats Regulations 2011 (S.I. No. 477 of 2011)), as amended, which transpose the European Union (EU) Habitats Directive (Council Directive 92/43/EEC) and Birds Directive (Council Directive 2009/147/EC). An assessment of the impact of the Dublin Array offshore and onshore infrastructure on European sites and their supporting species and habitat qualifying interests is presented in the Natura Impact Statement (NIS) (Part 4: Habitats Directive Assessments, Volume 4: NIS).

3.2.4 Where specific Irish guidance is not available due to the infancy of offshore wind in Ireland, other guidance documents specific to benthic ecology are considered. Such guidance documents are available from jurisdictions/countries with established offshore renewable energy sectors where comprehensive guidance has been developed.

3.2.5 The relevance of the above with regards to benthic and intertidal ecology and how these have been addressed within this assessment are presented in Annex A of this chapter.

3.3 Consultation

3.3.1 As part of the EIA for Dublin Array, non-statutory consultation has been undertaken with various statutory and non-statutory bodies. A Scoping report (RWE, 2020) was made publicly available and issued to statutory consultees on 9th October 2020. Table 1 provides a summary of the consultation undertaken for Benthic, Subtidal and Intertidal Ecology to date for Dublin Array.

3.3.2 In accordance with recommendations outlined in the DCCAE guidance[2] the Applicant sought to consult during the scoping stage with the Environmental Protection Agency (EPA), National Parks and Wildlife Service (NPWS), the Marine Institute, the Irish Wildlife Trust and Coastwatch: Environmental Pillar.

[2] Guidance on Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) Preparation for Offshore Renewable Energy Projects (Environmental Working Group of the Offshore Renewable Energy Steering Group and the DCCAE, 2017)

Table 1 Summary of consultation relating to benthic subtidal and intertidal ecology

Date	Consultation type	Consultation and key issues raised	Section where provision is addressed
10th November 2020	Meeting with NPWS	NPWS advised the project to ensure the assessment was very explicit about extent of plumes associated with different sediment fractions as planning applications had been challenged on this previously where there was ambiguity within the application documents.	As detailed within Section 3.16.4 *et seq*., increases in Suspended Sediment Concentration (SSC) and sediment deposition because of individual construction activities at Dublin Array have been assessed. Coarse and fine sediment fractions are discussed as these fundamentally settle out of the water column differently and therefore present a different impact for assessment.
		NPWS asked whether a Non-Native Species (NNS) Protocol was proposed to be developed.	As part of the outline Project Environmental Management Plan (PEMP) (Volume 7, Appendix.1) a marine biosecurity plan has been included which details how the risk of introduction and spread of invasive non-native species will be minimised (Table 11).
23rd November 2020	Inland Fisheries Ireland (IFI)	IFI recommend that a robust assessment of the cumulative impacts to biota, plankton and fish of this development with other significant projects including the proposed Arklow, NISA and Codling Wind Farms together with Ringsend and Shanganagh Wastewater Treatment plants.	A comprehensive Cumulative Effects Assessment has been provided within Section 3.19, in relation to benthic subtidal and intertidal ecology receptors. Other aspect chapters also include detailed assessments of other receptors.
30th November 2020	Marine Institute (MI)	MI advise that the scale of effects be considered beyond the footprint of the turbines and the licenced area.	Secondary impacts across a wider area Zone of Influence (ZoI) have been determined through the assessment of changes to physical processes, which have been thoroughly assessed within the EIAR for all benthic subtidal and intertidal ecology receptors (Section 3.16 *et seq*.)
		The consideration of effects at larger scale using ecosystem services as potential metrics may result in modification of the proposed receptors identified in the EIAR.	Any significant impacts from changes to benthic subtidal and intertidal ecology will be assessed by other technical disciplines to ensure that there are no negative impacts to ecosystem services. A holistic approach to assessment has been undertaken with technical disciplines cross referencing the findings of individual chapters.

Date	Consultation type	Consultation and key issues raised	Section where provision is addressed
03 October 2023 Online	NPWS	The key sensitive benthic habitats included reef features and sandbanks which meet the criteria of Annex I habitat *'Sandbanks which are slightly covered by sea water all the time'.* Suggested the use of the 10m contour to delimit the extent of the sandbank may be appropriate but confirmed that the use of the 20 m contour as proposed was sensible and precautionary. Advised that the potential extent of the nearshore reef which had been mapped was more extensive than indicated in reference material sourced.	Features of conservation interest are discussed in Section 1.9. Survey of nearshore reef habitat was undertaken in May 2024 and has informed the assessment presented in this chapter (see Underwater Image Analysis Report).

3.4 Methodology

3.4.1 For a full description of the methodology as to how this EIAR was prepared, see Volume 2 Chapter 3, Methodology Chapter (hereafter referred to as the EIA Methodology Chapter. The methodology that follows below is specific to this chapter.

Study area

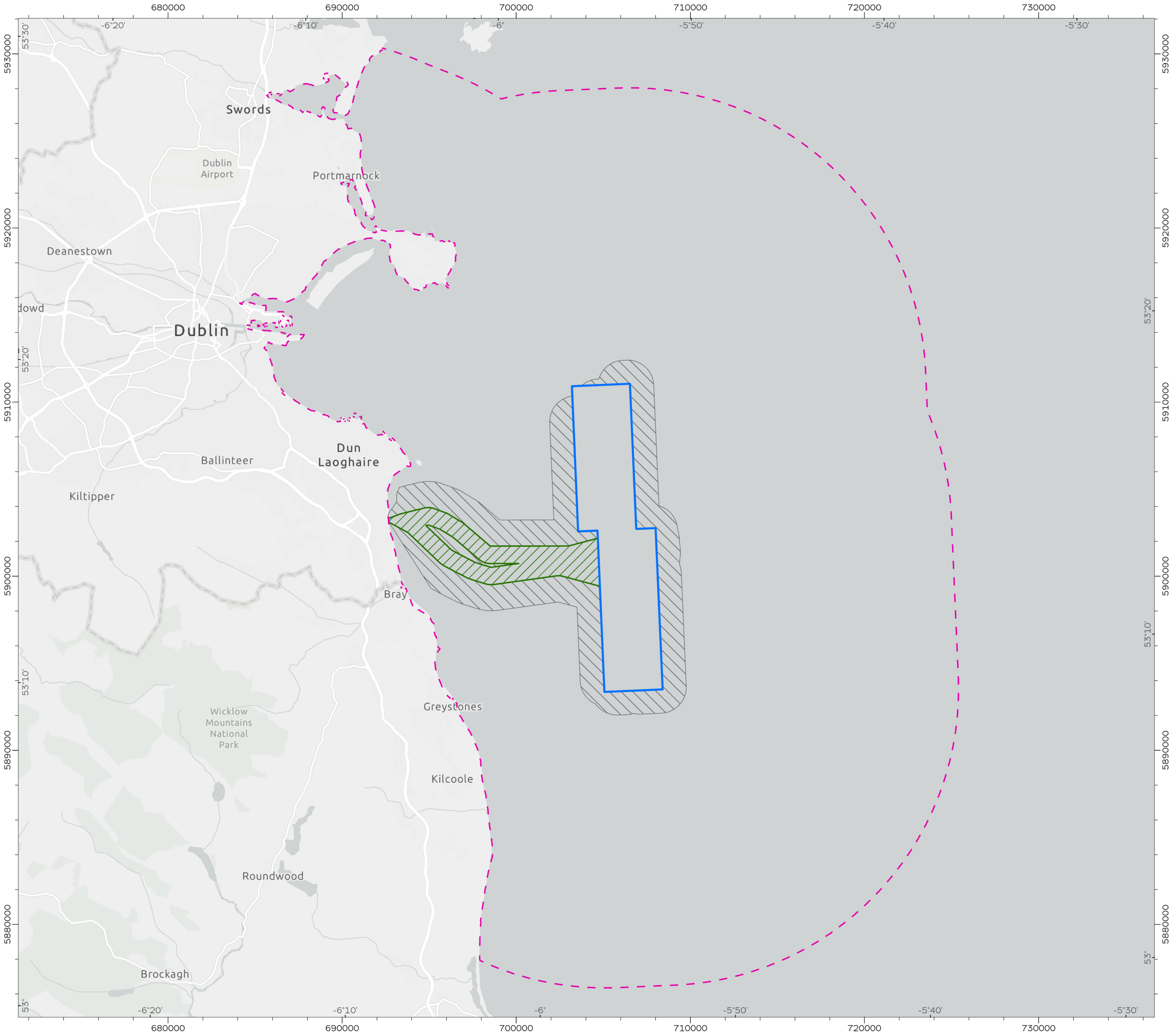
3.4.2 DCCAE guidance (DCCAE, 2017) recommends that the ZoI and ecology and benthic study area are established at the scoping stage. It is acknowledged that these zones may differ depending upon the pressure or ecosystem component under consideration. Data and identification of features of interest within the zones that might be impacted by an offshore renewable energy project are required so that a source – pathway – receptor risk assessment can be carried out and the subsequent evaluation of effects can be undertaken for key features.

3.4.3 For the purposes of this chapter, the subtidal study area is defined as the project boundary, which includes all offshore works including array area, Offshore ECC and temporary works area[3], together with the ZoI that incorporates secondary (or indirect) impacts) below Mean High Water Springs (MHWS)(Figure 1). The ZoI has been defined as 17[4] km using a spring tidal excursion (i.e. the maximum distance travelled by tidal flow over a tidal cycle) based on the project specific hydrodynamic modelling which indicated a spring tidal excursion as being 16 km (Physical Processes Modelling Report). Therefore, a study area of a 17 km buffer around Dublin Array is considered to be precautionary and to encapsulate the area within which all of the potential significant secondary or indirect effects on the benthic environment might occur. The benthic ecology study area is limited to the marine and coastal environment below Mean High Water Springs (MWHS).

3.4.4 The intertidal study area is defined by the intertidal zone extending from Mean Low Water Springs (MLWS) up to the MHWS mark within the Offshore ECC (Figure 2 Dublin Array Offshore Wind farm intertidal study area and ZoI.). This study area has been defined in order to reflect the extent of potential direct impacts within the intertidal area, considered within the assessment.

[3] Activities undertaken within the temporary works area, namely the use of jack-up vessels and anchors during the construction, O&M, and decommissioning phases have been screened out within the physical processes chapter for suspended sediment and deposition with their use not resulting in notable changes in SSC and associated sediment deposition, however the use of a buffer ensures a precautionary approach is taken.

[4] All distances are taken from the outer boundary of all offshore works incorporating the offshore infrastructure, the buffer also incorporates the temporary works area and as such are inherently precautionary



Benthic Ecology Study Area (17km Buffer)
Array Area
Temporary Occupation Area
Export Cable Corridor

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Dublin Array Offshore Wind Farm Subtidal Study Area

DRAWING NUMBER: 1
PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-24	For Issue	GB	BB	SS

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0 1 2 3 4 nm
N
GRID NORTH

SCALE	1:225,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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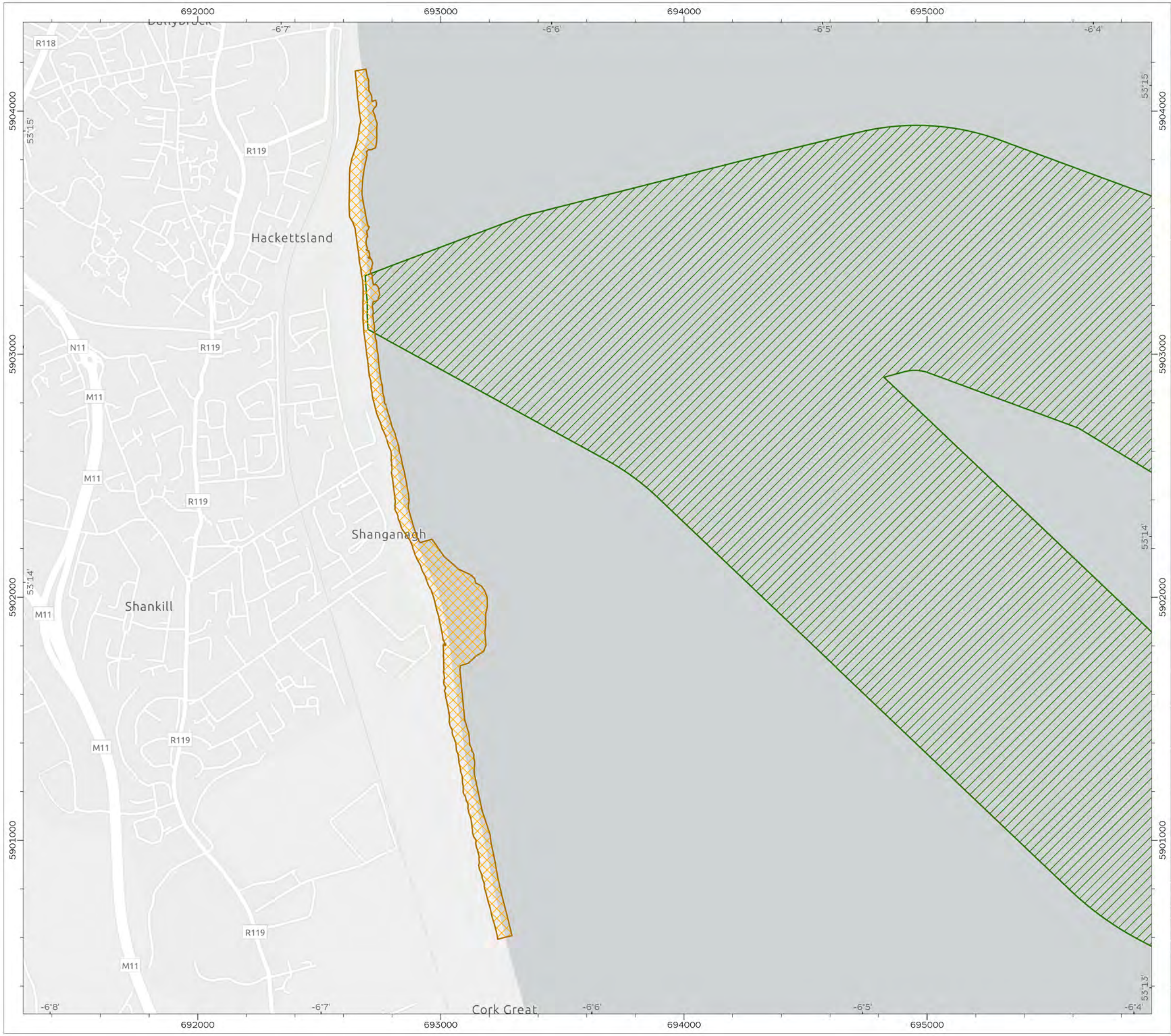

Export Cable Corridor

Intertidal Survey Area

DRAWING STATUS

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Dublin Array Offshore Windfarm Intertidal Survey Area

DRAWING NUMBER: **2**

PAGE NUMBER: **1 of 1**

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0 0.05 0.1 0.15 0.2 nm

N

SCALE	1:16,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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Baseline Data

3.4.5 Site-specific surveys undertaken to characterise the baseline for the assessment were carried out in the subtidal and intertidal study areas in 2021. A further survey was undertaken in Spring 2024 with the aim of identifying the characteristics and extent of potential geogenic and biogenic reef in the nearshore portion of the offshore ECC (APEM, 2024). The surveys are summarised in Table 2 below. The full detailed methodologies and analyses of the Dublin Array site-specific surveys are available within the Subtidal Survey Report and Intertidal Survey Report.

Table 2 Dublin Array site-specific benthic and intertidal survey summary

Title	Summary	Coverage of Dublin Array
Appendix 4.3.3-3: Fugro – WPM 1, WPM 2 & WPM 3 Main Array and ECR – Benthic Ecology Monitoring Report	Benthic subtidal surveys undertaken 14 February to 19 March 2021, consisting of Drop Down Video (DDV) along 29 transects and grab sampling at 28 stations. DDV was undertaken to inform seabed habitat classification. Grab sampling was undertaken using a 0.1m^2 Hamon Grab, with all samples subject to faunal and particle size distribution (PSD) analysis. Day grabs (0.1m^2) were undertaken at 15 of the grab stations for chemistry sampling (with a focus on muddy habitats).	Coverage of the Dublin Array Offshore ECC and array area.
Aquafact International Services Ltd, (2021). Marine Intertidal Ecological Survey, Shanganagh & Poolbeg, Co. Dublin. Report for Kish Offshore Wind Ltd & Bray Offshore Wind Ltd.	Walkover surveys, intertidal transects and faunal cores undertaken 30 March and 1 April 2021 in the intertidal areas of the landfall site.	Coverage of intertidal study area.
Dublin Array Offshore Wind Farm - Underwater Image Analysis (APEM, 2024)	Identification and characterisation of reef habitats in Killiney Bay from DDV analysis.	Covers shallow subtidal area off Shanganagh landfall.

3.4.6 The site-specific surveys provide a robust and current dataset utilised to characterise the benthic environment. These data are supported by a detailed desktop review undertaken for the Dublin Array benthic subtidal and intertidal ecology study areas, and wider Irish Sea region.

3.4.7 A detailed baseline description of benthic subtidal and intertidal ecology resources and the data sources used are presented within the Benthic and Intertidal Ecology Technical Baseline. A list of the supporting data sources used to inform the baseline is presented in Table 3 and the extents of the data are presented in Figure 2 and Figure 3.

Table 3 Key sources of pre-existing benthic ecology data

Data Source	Type of data	Spatial coverage	Limitations
Scally *et al.* (2020).	Sublittoral and littoral benthic sampling for EU Habitats Directive (Council Directive 92/43/EEC) Article 17 reporting.	North Dublin Bay SAC and South Dublin SAC which are 16km west of the array area.	Relevant to inshore areas only.
Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR, 2006-2016).	INFOMAR is a twenty-year programme to map the physical, chemical and biological features of Ireland's seabed. INFOMAR is funded by the DCCAE, and delivered by joint management partners Geological Survey Ireland and the Marine Institute. This baseline draws upon the predictive substrate modelling which characterises the sediment type.	Point data across the whole of the benthic ecology study area and the wider Irish Sea region. Complete modelled coverage up to MHWS.	Data from a variety of surveys over a temporally variable period.
EMODnet broad-scale seabed habitat map of Europe (EUSeaMap, 2021).	Interactive map of benthic data and habitat maps.	Complete coverage up to MHWS.	Predictive habitat mapping.
Dublin Port Company Maintenance Dredging. Assessment of Potential Benthic and Fisheries Impacts (Aquatic Services Unit, 2019).	A total of 22 subtidal samples collected in Dublin Bay in June 2016, using a 0.1 m^2 van-Veen grab for PSA, organic matter and faunal analysis. DDV data were also collected at 15 stations.	Samples have been collected around Burford Bank dump site 6 km west of the array area and 6 km north of the Offshore ECC but within the benthic subtidal study area.	Relevant to inshore areas only.
Marine Ecological Assessment of Dublin Array Wind Farm (Aquafact International Services Ltd., 2017).	Historic subtidal benthic surveys were undertaken across Dublin Array and the wider subtidal benthic study area. A total of 22 samples were collected in October 2017 using a biological dredge sampler for PSA organic matter and faunal analysis. An intertidal survey of the proposed Offshore ECC and landfall site was undertaken in July 2017. Walkover survey and collection of five replicate sediment cores were collected along	Overlap with Dublin Array and wider benthic subtidal and intertidal ecology study area (Kish and Bray Banks and southern Offshore ECC including landfall area).	Qualitative data due to methodologies employed, although biotope identification represents useful reference.

Data Source	Type of data	Spatial coverage	Limitations
	a transect (upper, mid and low locations) to be analysed for fauna and PSA.		
A marine ecological study of the Kish and Bray Banks for a proposed offshore wind farm development: Re-characterisation survey (Ecological Consultibg Services, 2008).	Historic benthic surveys (intertidal and subtidal) undertaken across the array area, Offshore ECC and landfall at Shanganagh. Intertidal survey of the proposed landfall site at Shanganagh. Walkover survey and collection of two core samples at each landfall location to be analysed for fauna and Particle Size Analysis (PSA).	Overlap with Dublin Array and wider benthic subtidal and intertidal ecology study area (Kish and Bray Banks and southern Offshore ECC including the intertidal).	Historic data. Qualitative data due to methodologies employed, although biotope identification represents useful reference
Benthic surveys of sandbanks in the Irish Sea (Roche *et al.*, 2007).	Two subtidal grab surveys were undertaken on Blackwater and Kish Banks during 2005. 12 stations (with 5 replicates) were sampled using a 0.1 m^2 Day grab to be analysed for fauna and PSA. The survey was undertaken in support of NPWS baseline characterisation of sandbanks.	Overlap with Dublin Array and wider benthic subtidal and intertidal ecology study area (Kish Bank and Blackwater Bank).	Historic data.
Marine Institute 2014 - Water Framework Directive (WFD) monitoring.	Sublittoral benthic sampling for WFD compliance.	Tolka Estuary, inner Dublin Bay and Killiney Bay.	Relevant to inshore areas only.
Marine Institute 2017 - Benthos Monitoring in the Marine Environment	Monitoring surveys of Irish Sea, Celtic Sea, Saint Georges Channel and North Atlantic Ocean.	Overlap with Dublin Array and wider benthic subtidal ecology study area (Kish Bank and Blackwater Bank).	Historic data.
Marine sites, habitats and species data collected during the BioMar survey of Ireland (Picton *et al*. 1997).	Sublittoral benthic sampling for characterisation of sandbank habitats.	Kish Bank.	Historic data.

Data Source	Type of data	Spatial coverage	Limitations
Short autumn Survey of seagrass (*Zostera noltii*) in Dublin Bay, October 2021 (Hagan & Dubsky, 2021)	Mapping of intertidal seagrass beds on Sandymount/Merrion Strand, Bull Island and the coastline from Irishtown beach to the Poolbeg lighthouse.	Intertidal area to the west of Dun Laoghaire harbour between Irishtown Beach and Merrion Strand.	Short autumn Survey of seagrass (*Zostera noltii*) in Dublin Bay, October 2021 (Hagan & Dubsky, 2021)
Littoral and sublittoral Reef habitats of Dún Laoghaire-Rathdown County Council area (MERC Consultants, 2022)	Identification and mapping of intertidal and subtidal reef habitat between Dún Laoghaire and Bray.	Covers shallow subtidal area off Shanganagh landfall.	Relevant to inshore area of Offshore ECC only.

Assessment methodology

3.4.8 As described in Section 3.4 the baseline was established through the compilation of best available evidence from desk-based studies and site-specific field surveys.

3.4.9 The assessment of potential impacts on benthic subtidal and intertidal ecology receptors has considered the magnitude and duration of the impact, the reversibility of the impact and the timing and frequency of the activity. The sensitivity of different receptors has also been considered as part of the impact assessment for which MarESA[5] will be a key resource. The sensitivity assessment of individual species has taken into account their current status and importance (locally, regionally, nationally or internationally), as detailed within Section 3.5, Assessment Criteria.

3.4.10 The assessment has also considered likely naturally occurring variability in, or long-term changes to, the benthos within the project lifetime due to natural cycles and/ or climate change. This is important as it enables a reference baseline level to be established against which the potentially modified benthic receptors can be compared, throughout the project lifecycle. Baseline conditions are described in detail within the 'future receiving environment' section (section 3.9) and include for the potential effects of climate change.

3.5 Assessment Criteria

3.5.1 This assessment for benthic subtidal and intertidal resources is consistent with the EIA Methodology Chapter. The criteria for determining the sensitivity of the receiving environment and the magnitude of impacts for the benthic subtidal and intertidal ecology assessment are defined in Table 5 and Table 6 respectively. A matrix was used for the determination of significance in EIA terms (see Table 7). The combination of the magnitude of the impact with the sensitivity of the receptor determines the assessment of significance of effect.

Sensitivity of receptor criteria

3.5.2 Sensitivity can be defined as a product of the likelihood of damage (termed intolerance or resistance) due to a pressure and the rate of (or time taken for) recovery (termed recoverability, or resilience) once the pressure has abated or been removed (Tyler-Walters *et al*., 2023). Or in other words "a species (population) is defined as very sensitive when it is easily adversely affected by human activity (e.g. low resistance) and recovery is only achieved after a prolonged period, if at all (e.g. low resilience or recoverability)" (OSPAR, 2008; Laffoley *et al*., 2000)".

[5] https://hub.jncc.gov.uk/assets/fcf9a4ea-2430-4396-8fa9-46a059cfc656

3.5.3 The sensitivities of different biotopes have been classified by The Marine Life Information Network (MarLIN[6]) on the MarESA four-point scale (high, medium, low and not sensitive). This is applied to ecological groups based on community characteristic of the biotopes and biogenic habitats identified according to the methodology described by Tillin and Tyler-Walters (2014). The scale takes account of the resistance and recoverability (resilience) of a species or biotope in response to a stressor. The resistance (i.e. tolerance) and resilience (which incorporates adaptability and recoverability) scores are combined to give an overall sensitivity value, although it should be noted that this is not absolute but is relative to the magnitude, extent, duration and frequency of the pressure affecting the species or community and habitat in question i.e. the assessment scores are very dependent on the pressure benchmark levels used. Specific benchmarks (duration and intensity) are defined for the different impacts for which sensitivity has been assessed (e.g. smothering, abrasion or habitat alteration). Detailed information on the benchmarks used and for further information on the definition of resistance and resilience can be found on the MarLIN website and are summarised in Table 4.

Table 4 Assessment scale for resistance and resilience

Scale	Definition
Resistance	
High	No significant effects on the physicochemical character (i.e the physical and chemical characteristics of the sediment) of the habitat and no effect on the population viability of key/characterizing species but may affect feeding, respiration and reproduction rates.
Medium	Some mortality of species (can be significant where these are not keystone structural/functional and characterizing species) without change to habitats relates to the loss of <25% of the species or habitat component.
Low	Significant mortality of key and characterizing species with some effects on the physicochemical character of habitat. A significant decline/reduction relates to the loss of 25-75% of the extent, density, or abundance of the selected species or habitat component e.g. loss of 25-75% of the substratum.
None	Key functional, structural, characterizing species severely decline and/or physicochemical parameters are also affected e.g. removal of habitats causing a change in habitat type. A severe decline/reduction relates to the loss of 75% of the extent, density or abundance of the selected species or habitat component e.g. loss of 75% substratum (where this can be sensibly applied).
Resilience	
High	Full recovery within 2 years
Medium	Full recovery within 2-10 years
Low	Full recovery within 10-25 years
Very low	Negligible or prolonged recovery; at least 25 years to recover structure and function

[6] https://www.marlin.ac.uk/sensitivity/sensitivity_rationale

3.5.4 The MarESA methodology is based on scientific evidence that has been used to inform assessments on biotope sensitivity to pressures which is deemed the most appropriate method to assess biotope sensitivities. The MarESA methodology has been applied in various analogous projects across the UK and Europe to define the sensitivities of biotopes. Specific examples of the application of this method include the Arklow Bank Offshore Wind Park, North Irish Sea Array, Norfolk Boreas Offshore Wind Farm EIA, Hornsea Three Offshore Wind Farm EIA, Moray West Offshore Wind farm EIA, Thanet Extension Offshore Wind Farm, and Norfolk Vanguard Offshore Wind Farm.

3.5.5 For the purposes of this assessment, four sensitivity categories have been defined in Table 5, each reflecting one of the four MarESA categories.

3.5.6 It should be noted that the sensitivity is an inherent characteristic determined by the biology/ecology of the biotope concerned and is not related specifically to the conservation status/designation. However, individual biotopes are representative of Annex 1 habitats and are highlighted throughout the assessment.

Table 5 Sensitivity/importance of the environment

Receptor sensitivity	Definition
High	Equivalent to MarLIN MarESA sensitivity category 'High'. ▪ The habitat or species is noted as exhibiting 'None' or 'Low' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover only over very extended timescales i.e. > 25 years or not at all (resilience is 'Very Low'); or ▪ The habitat or species is noted as exhibiting 'None' or 'Low' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover only over very extended timescales i.e. > 10 or up to 25 years (resilience is 'Low').
Medium	Equivalent to MarLIN MarESA sensitivity category 'Medium'. ▪ The habitat or species is noted as exhibiting 'None' or 'Low' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over medium timescales i.e. over two or up to 10 years (resilience is 'Medium'); or ▪ The habitat or species is noted as exhibiting 'None' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over fewer than two years (resilience is 'High'); or ▪ The habitat or species is noted as exhibiting 'Medium' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over medium to very long timescales, i.e. over two years or up to 25 years or not at all (resilience is 'Medium', 'Low' or 'Very Low').
Low	Equivalent to MarLIN MarESA sensitivity category 'Low'. ▪ The habitat or species is noted as exhibiting 'Low' or 'Medium' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over fewer than two years (resilience is 'High'); or ▪ The habitat or species is noted as exhibiting 'High' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over medium to very long timescales, i.e. over two years or up to 25 years or not at all (resilience is 'Medium', 'Low' or 'Very Low').

Receptor sensitivity	Definition
Negligible	Equivalent to MarLIN MarESA sensitivity category 'Not Sensitive'. ▪ The habitat or species is noted as exhibiting 'High' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over short timescales, i.e. fewer than two years (resilience is 'High').

Magnitude of impact criteria

3.5.7 It is noted here that a distinction is made throughout the assessment between the magnitude, as defined by the extent, duration[7], frequency, probability[8] and consequences of the impact and the resulting significance of the 'effects' upon benthic receptors. The descriptions of magnitude are specific to the assessment of benthic impacts and are considered against the magnitude descriptions presented in Table 6. Potential impacts have been considered in terms of whether they are adverse or beneficial effects.

3.5.8 Where an effect could reasonably be assigned to more than one level of magnitude, professional judgement concerning the pressure and the receptors concerned has been used to determine which level is the most appropriate for the impact. The level has been assigned based on the most appropriate potential consequences of the impact as defined for each level of magnitude (see Table 6). For example, an impact may occur constantly throughout the O&M period but is not discernible or measurable in practice, therefore it would be concluded to be of a negligible magnitude despite the frequency of the impact.

3.5.9 For the purposes of the definitions below in Table 6, near-field has been defined as within the array area and Offshore ECC. Far-field has been defined as extending beyond these limits but within the defined ZoI.

Table 6 Magnitude of the impact

Magnitude	Definition
High	**Extent:** Impact across the near-field and far-field areas beyond the ZoI. **Duration:** The impact is anticipated to be permanent (i.e. over 60 years). **Frequency:** The impact will occur constantly throughout the relevant project phase. **Consequences:** Permanent changes to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Medium	**Extent:** The maximum extent of the impact is restricted to the far field areas (i.e. the defined study area). **Duration:** The impact is anticipated to be medium-term (i.e. seven to 15 years) to long-term (15 to 60 years). **Frequency:** The impact will occur constantly throughout a relevant project phase. **Consequences:** Noticeable change to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Low	**Extent:** The maximum extent of the impact is restricted to the near-field and adjacent far-field areas.

[7] Note: this is the duration of the impact and not the time taken for the receptor to recover.
[8] All impacts assessed within this EIAR chapter are considered reasonably likely to occur, and so the probability of the impact has not been a consideration in defining the magnitude of the impact.

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

Defining the significance of effect

3.5.10 The significance of effect associated with the impact will be dependent upon the sensitivity of the receptor and the magnitude of the effect. The assessment methodology for the significance of potential effects is described in Table 7. For the purposes of this assessment, effects on benthic receptors defined as Significant, Very Significant or Profound are considered significant in EIA terms.

Table 7 Significance of potential effects

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

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

3.6 Receiving environment

3.6.1 The subtidal and intertidal study areas encompass the array area as well as the Offshore ECC, up to and including the intertidal zone at Shanganagh, defined as ending at MHWS. The array area and Offshore ECC, and 17 km buffer area effectively characterises the predicted ZoI of potential primary (direct) and secondary (indirect) impacts of the development on benthic receptors respectively (Physical Processes Chapter).

3.6.2 A technical report has been prepared to provide a detailed characterisation of the receiving baseline (Benthic Technical Baseline). A review of the key findings from that study have been incorporated into the description of the receiving environment below.

Benthic subtidal ecology

Subtidal sediments

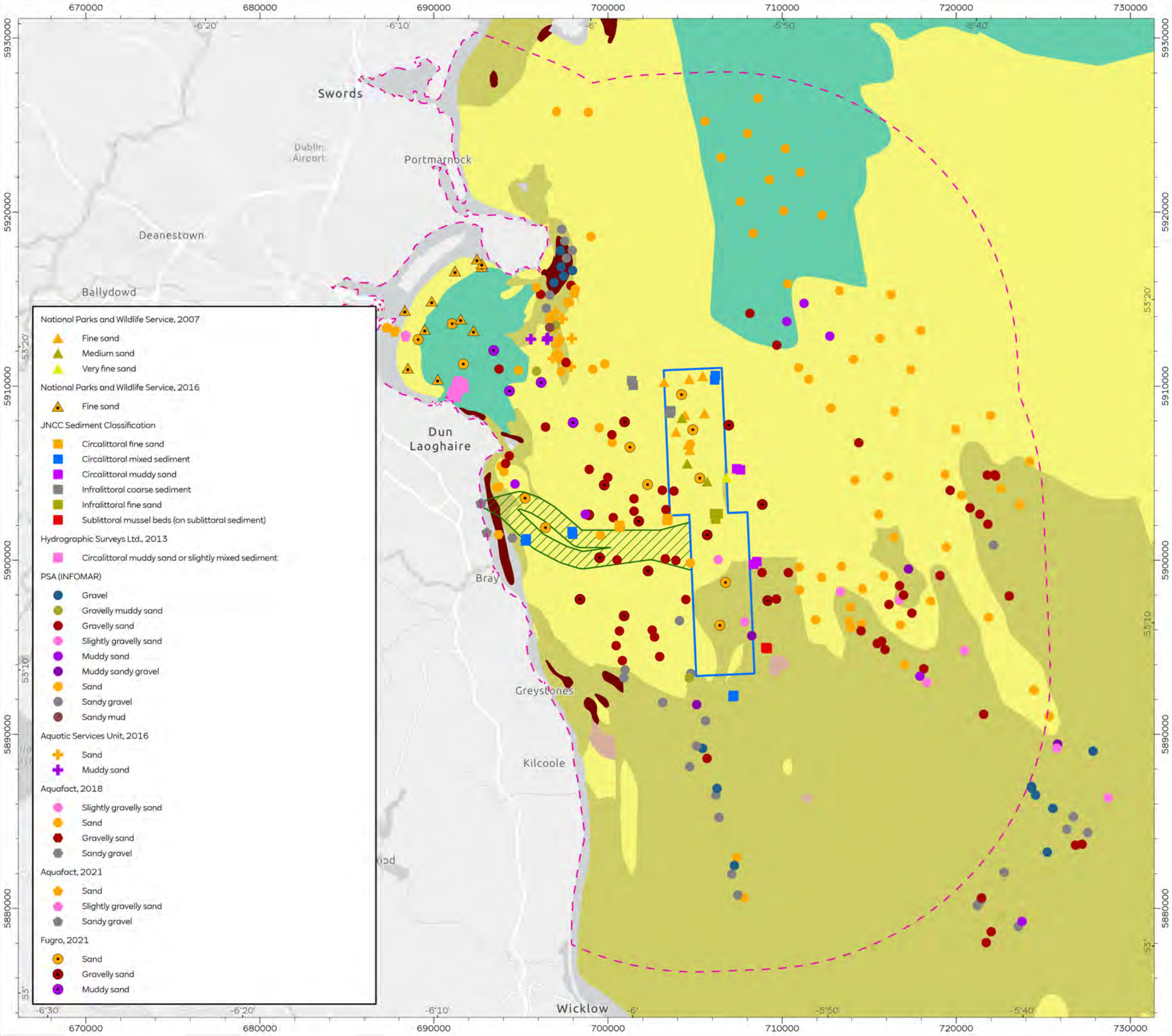
3.6.3 The Kish and Bray Banks are a system of coast-parallel, north-south trending linear sandbanks located within the outer Dublin Bay area, consisting mainly of sand and gravel. The northern 10-12 km of the bank system is called the Kish Bank. The Bray bank lies to the south extending a further 10. The banks are approximately 2.2 km wide at their widest point.

3.6.4 Subtidal site-specific surveys (Appendix 4.3.3-3: Fugro – WPM 1, WPM 2 & WPM 3 Main Array and ECR – Benthic Ecology Monitoring Report) defined a relatively homogenous predominantly sandy seabed across the array area and Offshore ECC, with sand and gravelly sand being the typical substates with some muddy sands also present (Figure 3).

3.6.5 EUSeaMap (EMODnet, 2022) data supports these findings, characterising sediments in the northern half of the array area as predominantly sand and the southern half of the array area as sand and coarser gravelly material. Wheeler *at al*. (2001) reported that the Kish and Bray Banks were characterised by sands with variable proportions of coarser material. The EUSeaMap data defines the inshore portion of the offshore ECC as predominantly sand with some gravels present. Further offshore the ECC is characterised primarily as gravelly sands and sands, with a stretch of sandy mud to muddy sands situated across the mid-section. The EUSeaMap data and data from the site-specific survey across the subtidal areas of the project are further supported by characterisation historic baseline data covering the study area (INFOMAR, 2021; EcoServe, 2008; Aquafact, 2017[9]), Dublin Port dredge disposal site (Aquatic Services Unit, 2019) and the Irish Sea Sandbanks data (Roche *et al*., 2007) which all recorded similar particle size distributions across the site.

3.6.6 The site-specific data has been presented alongside the EUSeaMap (EMODnet, 2022) data and the supporting baseline data in Figure 3, and as shown there is generally good agreement between the regional sediment data (INFOMAR), re-characterisation data and the site-specific grab samples collected. Therefore, the regional data is considered to be representative and appropriate for the purposes of EIA of the benthic habitats within the proposed development site.

[9] https://www.gov.ie/en/foreshore-notice/60c81-bray-offshore-wind-ltd/



Array Area

Export Cable Corridor

Benthic Ecology Study Area (17km Buffer)

EMODnet Seabed Substrate (Folk 7)

1.2 sandy Mud

2. Sand

3. Coarse substrate

4. Mixed sediment

5. Rock and boulders

DRAWING STATUS

FINAL

MAP NOTES / DATA SOURCES:

Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri UK, Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS ©Ordnance Survey Ireland 2023 © Tailte Eireann. (CYSL50270365) Not to be used for Navigation

PROJECT TITLE

Dublin Array

DRAWING TITLE

Sediment Classification from Samples Obtained Across the Dublin Array Study Area

DRAWING NUMBER: 3

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-24	For Issue	GB	BB	SS

0 2 4 6 8 km

0 1 2 3 4 nm

N

SCALE	1:225,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

Organic content of the sediment

3.6.7 Terrestrially derived carbon from run-off and fluvial systems, combined with primary production from sources (including planktonic blooms), contribute to the Total Organic Carbon (TOC) levels recorded in marine sediments. TOC represents the proportion of organic detritus present. Organic detritus is metabolised by heterotrophic bacteria but is also consumed directly by a wide range of marine invertebrates and is therefore an important source of food for benthic fauna (Sanders, 1958; Pearson and Rosenberg, 1978; Snelgrove and Butman, 1994). Organic enrichment (i.e. elevated levels of sediment TOC) can lead to benthic community changes which can be characterised by lower diversity and increased abundance along with changes in trophic functioning and increasing dominance of small, stress tolerant species. These changes are driven by impacts associated with increased deposition and changes in sediment chemistry associated with the elevated supply of organic material (Leppäkoski, 1975; Pearson and Rosenberg, 1978).

3.6.8 TOC levels in sediments collected during the site-specific subtidal survey were relatively low with recorded values of between < 0.02 % and 1.43 %, with a median of 0.09 % - the majority of values were between 0.05% and 0.51%. Higher levels of TOC tended to be found at inshore sites while the lowest values were recorded primarily further offshore in association with the coarser sediments of the southern half of the array area and the offshore portion of the ECC.

3.6.9 There was a clear positive correlation between TOC and proportion of silt and clay, as would be expected as the fine fraction of a sediment retains more organic matter than coarser fractions, a pattern related to a greater adsorption capacity of fine-grained particles due to the proportionally greater surface area available for adsorption, compared to coarser material (Keil and Hedges, 1993; Burdige, 2007). Moreover, fine-grained particles enhance the preservation of organic matter through reduced redox potential and/or remineralisation rates (Hedges and Keil, 1995; Dauwe *et al.*, 2001; Burdige, 2007).

3.6.10 Results from site-specific surveys discussed above were consistent with those reported historically from this area which described the sediments on the Kish and Bray Banks as having very low organic carbon content (Aquafact, 2018).

3.6.11 Similarly, reported levels of TOC from Dun Laoghaire harbour in the vicinity of the O&M base were low with a mean level of 1.5%, while in the coarser sediments in the immediate adjacent coastal waters the mean value was 0.25% (Hydrographic Services, 2015).

Sediment contaminants

3.6.12 Contaminant levels are often examined in isolation, without reference to the possible effects associated with the natural variability of sediment characteristics. Muds and silts tend to have naturally higher levels of metals compared with coarser sands owing to a large surface area with oxyhydride and organic coatings which readily sequester metals (Davis and Kent, 1990) compared to coarser sands and gravels which are generally accepted as carrying a much lower contamination risk (Grant and Middleton, 1998). Consequently, information regarding sediment granulometry is an important step in assessing the potential contamination risk to the marine environment if sediments are disturbed as a result of development.

3.6.13 As noted above, sediments throughout most of the proposed development area are dominated by sand, and as such, sediment bound contaminants are predicted to be low. Results from the site-specific survey confirmed these predictions, with levels of sediment bound contaminants found to be low in the array area and within the majority of the Offshore ECC. The level of metals present in the sediment samples collected within the array area and Offshore ECC were analysed in accordance with the Guidelines for the Assessment of Dredged Material for Disposal in Irish Waters (Cronin *et al*, 2006) and addendum (Marine Institute, 2019) which provide upper and lower Irish Action Levels[10]. All contaminants with concentrations below the lower action level (Class 1) are considered a low risk to the marine environment. Concentrations between the lower and upper action levels (Class 2) are considered marginally contaminated. Concentrations higher than the upper action level (Class 3) are considered likely to cause harm to a marine environment.

3.6.14 There were no occurrences of contaminants exceeding the lower Irish Action Level in subtidal sediments, with the exception of one site within the array area located at the south of the Kish and Bray Banks, where the arsenic concentration was marginally higher than the lower Action Level; this concentration is characterised as Class 2 (i.e. marginally contaminated) and when considering marginal elevation spatial patterns observed is not considered to constitute an environmental risk.

3.6.15 Contaminant levels in intertidal sediments were generally low. As observed subtidally, arsenic concentrations in intertidal sediments exceeded the lower Irish Action Level, although the observed levels were only marginally above the quideline and are not considered to represent ecological risk.

3.6.16 Whilst reported aluminium levels are appreciably higher at two sites from the Offshore ECC compared to other subtidal sites, these higher concentrations align with naturally expected levels associated with the local geology[11] (pers.comm, Cronin, 2021). It should be noted that aluminium, which is the third most abundant element in the earth's crust, is a conservative element and is rarely elevated as a result of pollution (Cronin *et al*., 2006).

3.6.17 All samples collected for the project reported levels of Dibutyl Tin (DBT) and Tributyl Tin (TBT) that were well below the relevant lower Irish Action Levels.

[10] The Irish Action Levels were defined as lower and upper threshold guidance levels based on ecotoxicological data (Cronin et al,, 2006). Below the lower thresholds ecotoxicological effects are not expected whereas above the upper threshold they may be.

[11] Aluminium is included because its concentrations reflect the natural geochemistry of the area and can help to explain variations in the levels of other metals i.e. it is used as normalisers.

3.6.18 None of the sediment samples collected across the array area and Offshore ECC as part of the site-specific survey exhibit Polycyclic Aromatic Hydrocarbon (PAH) or Polychlorinated Biphenyl (PCB) levels in exceedance of the guidelines detailed by Cronin *et al*. (2006). In addition, analysis of the Total Hydrocarbon (THC) and n-Alkanes revealed no elevated levels. Furthermore, levels of DBT and TBT were well below the Irish Sediment Quality Lower Level. Consequently, sediments from the array and Offshore ECC are considered to be Class 1 where organic chemicals are concerned. For a full breakdown of the sediment contaminants sampling, results and analysis (see Appendix 4.3.3-3: Benthic Ecology Monitoring Report)), while a summary of the results is presented within Marine Water and Sediment Quality chapter which also includes the historical background of the study area in terms of temporal an spatial patterns of sediment contaminants.

3.6.19 Sediments collected from Dun Laoghaire harbour showed no elevated levels of PAHs when compared to Irish Sediment Quality guidelines; with the exception of one marginally elevated level of the pesticide DDT at one site, no detectable traces of other organic contaminants were recorded (Hydrographic Services, 2015). Consequently, sediments from the harbour in the vicinity of the planned O&M base are Class 1 when considering organic chemicals.

Benthic subtidal fauna

3.6.20 Sandy sediments that characterise the Kish and Bray Banks sand bank features are typically colonised by burrowing polychaete worms, crustaceans and bivalve molluscs. Epifauna at the surface of the sandbank may also include mysid shrimps, gastropod molluscs, crabs and fish. Sand-eels (*Ammodytes* spp.), an important food resource for birds, often inhabit sandy sediments, whereas coarse stable substrates, such as shells or stones, are inhabited by hydroids, bryozoans and ascidians (Roche *et al*., 2007).

3.6.21 Site-specific surveys undertaken across the array area and the Offshore ECC complement this, with macrofaunal communities identified as comprising infaunal and epifaunal taxa dominated by polychaetes and molluscs; crustaceans and other groups were less represented by comparison. Characterising polychaetes identified from the site-specific surveys included *Spirobranchus lamarcki*, *Lumbrineris* cf. *cingulata*, *Pholoe baltica*, *Ophelia borealis*, *Nephtys cirrosa*, *Spiophanes bombyx* and *Owenia borealis*. Mollusc species included opportunistic species such as the bivalves *Nucula nucleus*, *Kurtiella bidentata*, *Abra alba*, *Nucula nitidosa*, *Fabulina fabula* and *Tellimya ferruginosa*, along with the gastropod *Euspira nitida*. Overall, it is concluded that the faunal communities identified are indicative of a dynamic seabed and typical of a high energy environment.

3.6.22 Site-specific surveys and supporting historic data (Aquafact, 2017; Aquatic Services Unit, 2019; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016) collected from across the study area identified the presence of the following subtidal biotopes (the distribution of the biotopes is presented in Figure 5):

- ***Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand (SS.SSa.IMuSa.FfabMag / EUNIS Code MB5236):** The biotope is described as stable, fine, compacted sands and slightly muddy sands in the infralittoral and littoral fringe, hosting communities dominated by venerid bivalves. Communities at three of the site-specific survey sites within the nearshore section of the northern Offshore ECC were assigned this biotope.

- **Atlantic and Mediterranean high energy infralittoral rock (IR.HIR / EUNIS Code MC15):** This biotope is is one that 'may occur within', is 'contained within' or is considered 'typical of' Annex I Habitats as designated under the Habitats Directive (Council Directive 92/43/EEC). The biotope is described as a rocky habitat in the infralittoral zone subject to, exposed to extremely exposed, wave action or strong tidal streams; epibiota include kelp, such as *Laminaria hyperborea* with foliose seaweeds and invertebrates, the latter becoming more prominent in areas of strong water movement (EEA, 2022). Typified at a single station, in the nearshore section of the southern Offshore ECC in site-specific surveys.

- **Infralittoral coarse sediment** (**SS.SCS.ICS / EUNIS Code MB3):** This biotope was recorded across the array area, and the nearshore section of the southern Offshore ECC. The biotope is described as being typical of moderately exposed habitats with coarse and/or gravelly sand, shingle and gravel in the infralittoral, subject to disturbance by tidal streams and wave action. As consequence of the physical disturbance, the fauna of this habitat is restricted to robust infaunal polychaetes, crustaceans and venerid bivalves.

- ***Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSa.CMuSa.AalbNuc / EUNIS Code MC5214):** This biotope is representative of non-cohesive muddy sands or slightly shelly/gravelly muddy sand characterised by the bivalves *Abra alba* and *Nucula nitidosa*. Other important taxa include *Nephtys* spp., *Chaetozone setosa* and *Spiophanes bombyx* with the bivalve *Fabulina fabula* also common in many areas. The echinoderms *Ophiura albida* and *Asterias rubens* may also be present. During the site-specific surveys this biotope was identified at seven stations spread throughout the array and Offshore ECC. It was also recorded across the wider study area in other characterisation surveys (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; and INFOMAR, 2006-2016).

- ***Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud (SS.SMu.CSaMu.AfilMysAnit / EUNIS Code MC6211):** This biotope is often found in cohesive sandy mud off wave exposed coasts with weak tidal streams in muddy sands in moderately deep water. It is characterised by super-abundant populations of the brittlestar *Amphiura filiformis* with the bivalves *Kurtiella bidentata* and *Abra nitida.* Other important taxa may include the sipunculid *Thysanocardia procera* and the polychaetes *Nephtys incisa*, *Phoronis* sp. and *Pholoe* sp., with cirratulids also common in some areas. Other taxa such as the polychaete *Nephtys hombergii*, the sea potato *Echinocardium cordatum*, bivalve *Nucula nitidosa, and the crustaceans Callianassa subterranea* and *Eudorella truncatula* may also occur in offshore examples of this biotope. This biotope was identified at four site-specific surveys in the offshore section of the Offshore ECC. Historical survey data from across the area recorded the biotope at sites outside the project boundary adjacent to the northern Offshore ECC (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007 and INFOMAR, 2006-2016).

- ***Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in circalittoral coarse sand or gravel (SS.SCS.CCS.MedLumVen / EUNIS Code MC3212):** This biotope is classified as being one that 'may occur within', is 'contained within' or is considered 'typical of' Annex I Habitats as designated under the Habitats Directive (Council Directive 92/43/EEC). This biotope is characterised by circalittoral gravels, coarse to medium sands, and shell gravels, sometimes with a small amount of silt and is generally found in relatively deep water (generally over 15-20 m). It may be characterised by polychaetes such as *Mediomastus fragilis*, *Lumbrineris* spp., *Glycera lapidum* with the sea urchin *Echinocyamus pusillus*. Other taxa may include Nemerteans, the polychaetes *Protodorvillea kefersteini*, *Owenia fusiformis*, and *Spiophanes bombyx* and the brittlestar *Amphipholis squamata* along with amphipods such as *Ampelisca spinipes*. The biotope was near shore to the south of the ECC (Aquafact, 2017).

- ***Kurtiella bidentata* and *Thyasira spp.* in circalittoral muddy mixed sediment (SS.SMx.CMx.MysThyMx / EUNIS Code MC4213)**: This biotope is often found in moderately exposed or sheltered, circalittoral muddy sands and gravels where a community characterised by the bivalves *Thyasira* spp. (often *Thyasira flexuosa*), *Kurtiella bidentata* and the polychaete *Prionospio fallax* may develop. Infaunal polychaetes such as *Lumbrineris gracilis*, *Chaetozone setosa* and *Scoloplos armiger* are also common whilst amphipods such as *Ampelisca* spp. and the cumacean *Eudorella truncatula* may also be found in some areas. The brittlestar *Amphiura filiformis* may also be abundant at some sites. Conspicuous epifauna may include encrusting bryozoans *Escharella* spp., particularly *Escharella immersa*. This biotope was recorded in historic surveys across the Dublin Array project boundary (both in the array area and Offshore ECC) (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007 and INFOMAR, 2006-2016).

- **Infralittoral mobile clean sand with sparse fauna (SS.SSa.IFiSa.IMoSa / EUNIS Code MB5231)**: This biotope is characterised by medium to fine sandy sediment in shallow water, often formed into dunes, on exposed or tide-swept coasts and often contains very little infauna due to the mobility of the substratum. Some opportunistic populations of infaunal amphipods may occur, particularly in less mobile examples in conjunction with low numbers of mysids such as *Gastrosaccus spinifer*, the polychaete *Nephtys cirrosa* and the isopod *Eurydice pulchra*. Sand eels *Ammodyte*s sp. may occasionally be observed. Common epifaunal species such as the crabs *Pagurus bernhardus*, *Liocarcinus depurator* and *Carcinus maenas* and the common starfish *Asterias rubens* may be encountered and are the most conspicuous species present. This biotope was also recorded during historical surveys across the array area (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; and Roche *et al*., 2007 and INFOMAR, 2006-2016).

- ***Glycera lapidum* in impoverished infralittoral mobile gravel and sand (SS.SCS.ICS.Glap / EUNIS Code MB3235)**: This biotope is characterised by infralittoral mixed slightly gravelly sands on exposed open coasts where impoverished communities characterised by the polychaete *Glycera lapidum* (agg.) may be found. *Glycera lapidum* is quite widespread and may occur in a variety of coarse sediments. However, *G. lapidum* is rarely considered a characteristic species and where this is the case it is normally due to the exclusion of other species. Consequently, it is considered that habitats containing this biotope may be subject to continual or periodic sediment disturbance from wave action, which prevents the establishment of a more stable community. Other taxa include spionid polychaetes such as *Spio martinensis* and *Spiophanes bombyx*, the catworm *Nephtys* spp. and in some areas the bivalve *Spisula elliptica*. This biotope was recorded in complex with other biotopes described below and was recorded within the northern part of the array area and to the north of the ECC in other studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; and INFOMAR, 2006-2016).

- ***Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (SS.SSA.CFiSa.ApriBatPo / EUNIS Code MC5212):** This biotope is often found in circalittoral and offshore medium to fine sands between 25 m and 100 m depth. The community is characterised by the bivalve *Abra prismatica*, the amphipod *Bathyporeia elegans* and polychaetes such as *Scoloplos armiger*, *Spiophanes bombyx*, *Aonides paucibranchiata*, *Chaetozone setosa*, *Ophelia borealis* and *Nephtys longosetosa* may be found. Crustacea such as the cumacean *Eudorellopsis deformis* and the polychaetes such as *Ophelia borealis*, *Travisia forbesii* or *Ophelina neglecta* are often present in this biotope and the brittlestar *Amphiura filiformis* may also be common at some sites. This biotope was recorded within the northern part of the array area and at locations to the north of the Offshore ECC and during historical studies from the area (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; and INFOMAR, 2006-2016).

- ***Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand (SS.SSA.IFiSa.NcirBat / EUNIS Code MB5233)**: This biotope is representative of well-sorted medium and fine sands characterised by the catworm *Nephtys cirrosa* and the amphipod *Bathyporeia* spp., which occur in the shallow sublittoral to at least 30 m depth. This biotope occurs in sediments subject to physical disturbance, because of wave action (and occasionally strong tidal streams). The magelonid polychaete *Magelona mirabilis* may be frequent in this biotope in more sheltered, less tideswept areas whilst in coarser sediments the opportunistic polychaete *Chaetozone setosa* may be commonly found. The faunal diversity of this biotope is considerably reduced compared to less disturbed biotopes (such as FfabMag) and for the most part consists of the more actively-swimming amphipods. Sand eels *Ammodytes* spp. may occasionally be observed in association with this biotope (and others) and spionid polychaetes such as *Spio filicornis* and *S. martinensis* may also be present. Occasional the sand mason *Lanice conchilega* may be visible at the sediment surface. This biotope was recorded across the Kish Bank within the northern array area in supporting studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

- ***Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment (SS.SMx.CMx.OphMx / EUNIS Code MC4215):** This biotope is representative of circalittoral sediment dominated by brittlestars (hundreds or thousands per m^{-2}) forming dense beds, living on boulder, gravel or sedimentary substrata. *Ophiothrix fragilis* and *Ophiocomina nigra* are the main bed-forming species. Brittlestar beds vary in size and usually have a patchy internal structure, with localized concentrations of higher animal density. This biotope was recorded at a station within the nearshore portion of the Offshore ECC in supporting studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

- ***Modiolus modiolus* beds on open coast circalittoral mixed sediment (SS.SBR.SMus.ModMx / EUNIS Code MC2232)**: This biotope is one that 'may occur within', is 'contained within' or is considered 'typical of' Annex I Habitats as designated under the Habitats Directive (Council Directive 92/43/EEC). This biotope is characterised by muddy gravels and coarse sands in deeper water of continental seas which venerid bivalves with beds of the horse mussel *Modiolus modiolus*. The clumping of the byssus threads of the *M. modiolus* creates a stable habitat that attracts a very rich infaunal community with a high density of polychaete species including *Glycera lapidum, Paradoneis lyra, Aonides paucibranchiata, Laonice bahusiensis, Protomystides bidentata, Lumbrineris spp., Mediomastus fragilis* and syllids such as *Exogone* spp. and *Sphaerosyllis* spp. Bivalves such as *Spisula elliptica, Timoclea ovata* and other venerid species are also common while brittlestars such as *Amphipholis squamata* may also occur. This biotope was reportedly located outside of the southern array area in supporting studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

- ***Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (SS.SCS.CCS.PomB / EUNIS Code MC3211):** This biotope is characterised by ubiquitous robust and/or fast-growing ephemeral species which can colonise pebbles and unstable cobbles and slates which are regularly moved by wave and tidal action. The main cover organisms tend to be restricted to calcareous tube worms such as *Spirobranchus triqueter* (or *P. lamarcki*), small barnacles including *Balanus crenatus* and *Balanus balanus*, bryozoan and coralline algal crusts. Scour action from the mobile substratum prevents colonisation by more delicate species. Occasionally in tide-swept conditions tufts of hydroids such as *Sertularia argentea* and *Hydrallmania falcata* are present. This biotope was recorded in the near shore to the south of the Offshore ECC in supporting studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

- **Polychaetes and *Angulus tenuis* in littoral fine sand (SS.LSa.FiSa.Po.Aten / EUNIS Code MA52412)**: This biotope complex is likely to occur on the mid and lower shore on moderately wave-exposed and sheltered coasts, with predominantly fine sand which remains damp throughout the tidal cycle. The sediment is often rippled, and an anoxic layer may occasionally occur below a depth of 10 cm, though it is often patchy. The infaunal community is dominated by the abundant bivalve *Angulus tenuis* together with a range of polychaetes. The presence of polychaetes may be seen as coloured burrows running down from the surface of the sediment. Polychaetes that are characterising for this biotope include *Nephtys cirrosa*, *Paraonis fulgens* and *Spio filicornis*. Burrowing amphipods *Bathyporeia* spp. may occur in some examples of this biotope. This biotope was recorded north of the Offshore ECC and surrounding area in supporting studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

3.6.23 Further site-specific DDV surveys undertaken in the near shore portion of the ECC indicated the presence of five biotopes or biotope complexes (APEM, 2024). The most widespread habitat complex recorded in the survey area was ‘Circalittoral fine mud’ SS.SMu.CFiMu / EUNIS Code MC611), followed by ‘Dense foliose red seaweeds on moderately exposed Atlantic infralittoral silty rock’ (IR.MIR.KR.XFoR / EUNIS Code MB121B). The sedimentary biotope ‘Faunal communities of Atlantic circalittoral mixed sediment’ (SS.SMx.CMx / EUNIS Code MC421) as were the rock biotopes ‘Faunal turf communities on Atlantic circalittoral rock’ (CR.HCR.FaT / EUNIS Code MC121) and ‘Kelp and seaweed communities on Atlantic infralittoral rock’ (IR.HIR.KFaR / EUNIS Code MB121).

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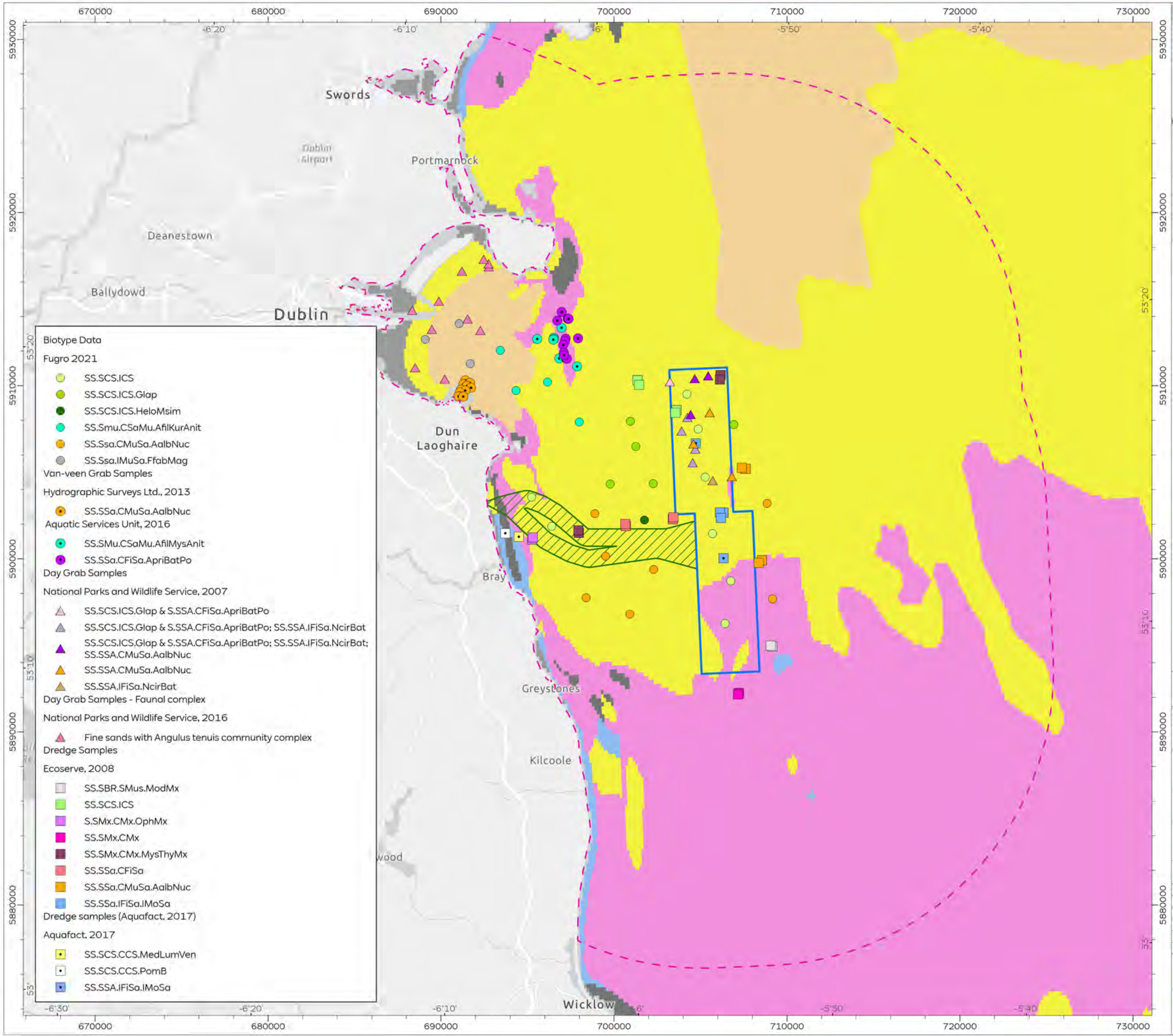

DRAWING STATUS

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Biotype (JNCC Marine Habitat Classification, 2015) and Faunal Complex Classifications Across the Zone of Influence

DRAWING NUMBER: 4

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-24	For Issue	GB	BB	SS

0 2 4 6 8 km
0 1 2 3 4 nm

N

SCALE	1:225,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

Intertidal Ecology

3.6.24 The proposed Offshore ECC landfall will be located to the south of Dublin at Shanganagh (Figure 2).

Intertidal Sediments

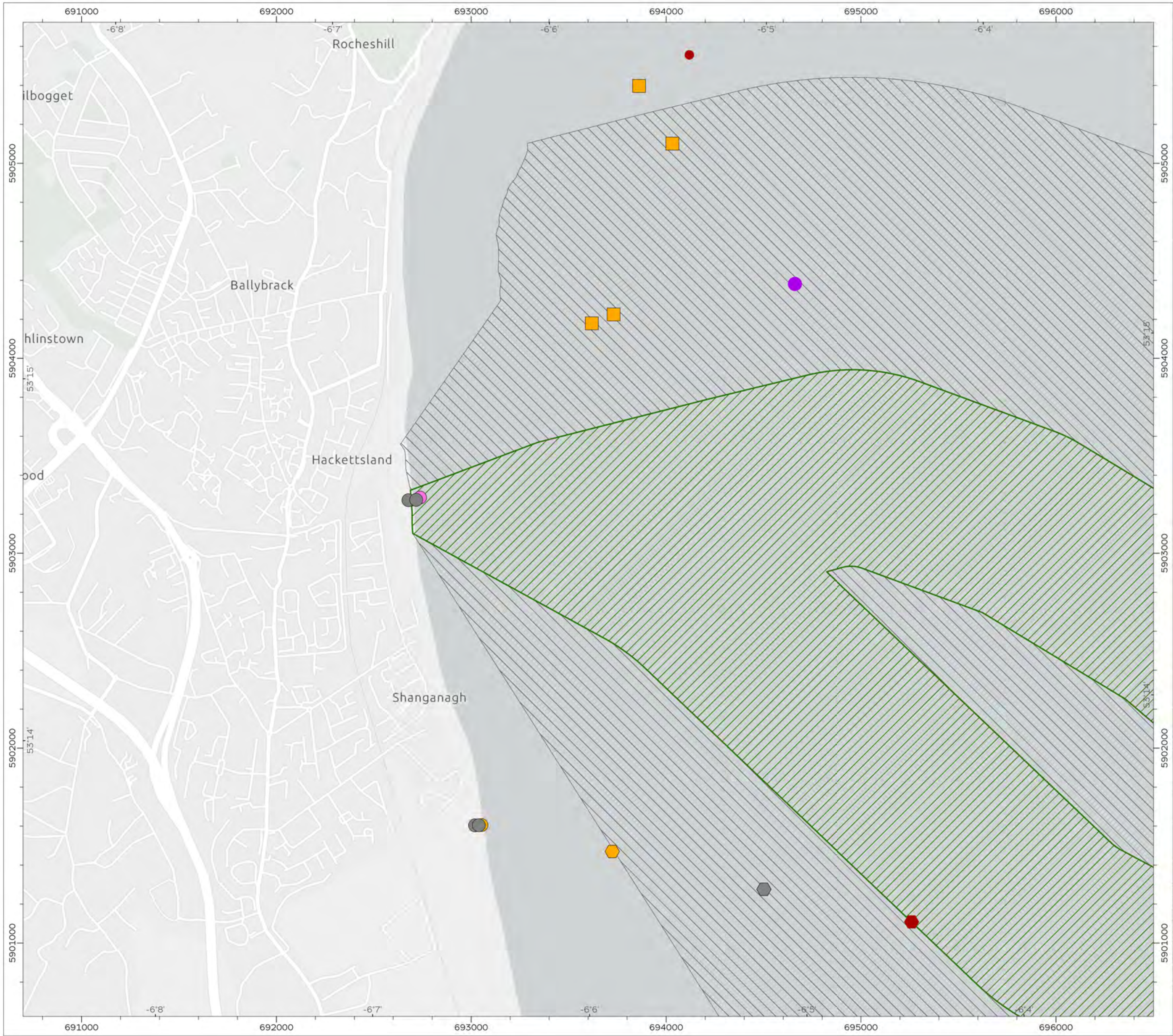
3.6.25 Intertidal granulometric data for samples collected during site-specific surveys identified sand as the predominant sediment type, with samples classified as sand, sandy gravel or slightly gravelly sand; fines represented less than 0.3% of all intertidal samples (Aquafact, 2021).

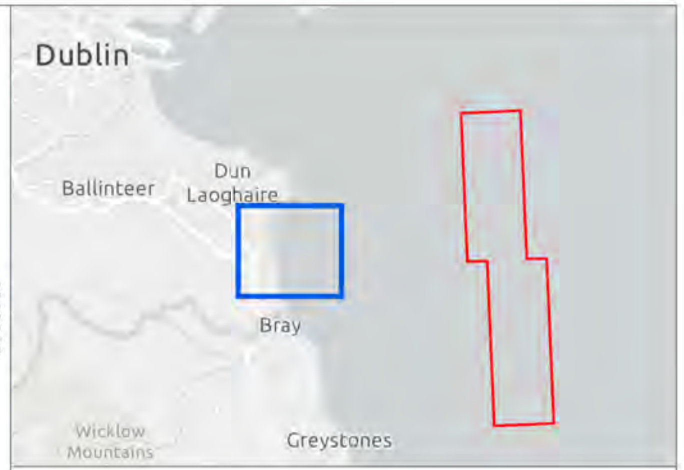
3.6.26 These observations are further supported by historic information which indicated that the upper shore consisted of a 10-20 m band of cobbles and pebbles with occasional boulders, which graded into finer gravel and coarse sand down the shore (Aquafact, 2021). This zone was classified as 'Barren littoral shingle' (LS.LCS.Sh.BarSh / EUNIS Code MA3211). The infaunal analysis revealed low numbers of oligochaetes and talitrid amphipods similar to the 'Talitrids on the upper shore and strand-line' (LS.LSa.St.Tal / EUNIS Code MA5211) biotope which commonly coexists with the LS.LCS.Sh.BarSh / EUNIS Code MA3211 biotope where driftlines of algae and other debris accumulate on the upper shore. Low faunal returns were consistent with low levels of organic carbon in the sediment (Aquafact, 2017).

3.6.27 The mid shore consisted of boulders and cobbles covered with ephemeral green algae (*Ulva intestinalis*) with some *Porphyra purporea*, consistent with the biotope 'Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata' (LR.FLR.Eph.Eph.X / EUNIS Code 4211). This biotope was present along almost the full length of the survey area varying in width from c. 6 m to <1 m. Along most of the shore this was bounded by the low shore sandy sediments. The lower shore along the transect length was consistent with the 'Polychaetes and *Angulus tenuis* in littoral fine sand' (LS.LSa.FiSa.Po.Aten / EUNIS Code MA5412) biotope. The sediment type in this zone was characterised as slightly gravelly sand (predominantly) fine sand. Organic carbon content was low (1.39%). Towards the southern end of the study area, where the lower shore consisted of boulders, cobbles and pebbles instead of sand, the ephemeral zone merged into a *F. serratus* dominated lower shore. A small transitional band of *F. vesiculosus* mixed with *F. serratus* and the limpet *Patella vulgata* and barnacles *Semibalabus balanoides* separated the two zones. Numerous red seaweeds were present in the lower shore and the biotope was '*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock' (LR.MLR.BF.Fser.R / EUNIS Code MA12441) (Aquafact, 2017).

3.6.28 Photographs were collected during a site-visit in January 2019, these photos demonstrated cobbles and pebbles with occasional boulders in the upper section which graded into a finer gravel and coarse sand down the shore, similar to that recorded during the Aquafact (2017) survey (Section 3.4.5). This zone was classified as 'Barren littoral shingle' (LS.LCS.Sh.BarSh /EUNIS Code MA3211).

Plate 1 Photograph of the intertidal area at Shanganagh (north view), collected during a site visit in January 2019.





Temporary Occupation Area
Export Cable Corridor

Folk Classification

Aquafact, 2018
- Sand
- Gravelly sand
- Sandy gravel

Aquafact, 2021
- Sand
- Slightly gravelly sand
- Sandy gravel

PSA (INFOMAR)
- Gravelly sand
- Muddy sand
- Sand

DRAWING STATUS

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Sediment Classification from Samples Obtained Across the Dublin Array Landfall Site

DRAWING NUMBER: 5

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-24	For Issue	GB	BB	SS

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0 0.1 0.2 0.3 0.4 nm

N

SCALE	1:20,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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Organic Content of the Sediment

3.6.29 As mentioned, organic detritus is an important source of food for benthic fauna (Snelgrove and Butman, 1994), although an over-abundance of TOC may lead to community changes and a reduction in diversity. Site-specific surveys undertaken by Aquafact (2021) recorded low values of TOC ranging from 0.1% to 0.22%, which were not unexpected given the coarse nature of the sediment at the landfall. Observations made within historic surveys across the study area (Aquafact, 2017) were consistent with the site-specific surveys (Aquafact, 2021).

Sediment Contaminants

3.6.30 Low contaminant levels were recorded in the intertidal sediment, with only the lower Irish Action Level for arsenic being exceeded. While exceedance of the lower arsenic Action Level occurred at all sites, the reported concentrations were consistently well below the upper Action Level and are therefore considered as being marginally contaminated according to the guidelines detailed by Cronin *et al*. (2006). As no other sediment bound metal concentration exceeds the relevant lower Action Level and the exceedance of the arsenic guideline was marginal it is considered that the levels of arsenic do not constitute an ecological risk.

3.6.31 No PAH concentrations exceeded the Irish Sediment Quality Guidelines. Analysis of the THC and n-Alkanes was also undertaken, with no samples reporting elevated levels. All samples collected for the project reported levels of DBT and TBT that were well below the Irish Sediment Quality Lower Action Level with all reported concentrations being less than 1 µg/kg for both contaminants (Aquafact, 2021). For a full breakdown of the sediment contaminants sampling, results and analysis see Aquafact (2021), in addition a summary of the results is presented within the Marine Water and Sediment Quality Chapter.

Benthic Intertidal Communities

3.6.32 As noted above, the Shanganagh landfall is characterised by cobbles, shingle and medium sand. Faunal cores collected along two transects in the intertidal zone as part of site-specific surveys (Aquafact, 2021) yielded sparse results with ten taxa recorded, consisting of five species of annelids, four arthropods and one mollusc species. The sparsity of fauna recorded is to be expected, especially in areas classified as 'barren littoral shingle' (LS.LCS.Sh.BarSh / EUNIS Code MA3211).

3.6.33 Site-specific walkover surveys of the landfall site (Aquafact, 2021) and supporting historic data collected across the area (Aquafact, 2017) identified the presence of the following biotopes (the distribution of the biotopes is presented in Figure 6).

- **Barren littoral shingle (LS.LCS.Sh.BarSh / EUNIS Code MA3211):** This biotope typically occurs on freely draining sandy beaches, particularly on the upper and mid shore, which lack a macrofaunal community due to their continual mobility. This biotope was observed in site-specific surveys (Aquafact, 2021) along much of the northern Shanganagh Beach area just below the Barren Littoral shingle biotope where upper shore merges into the middle to lower shore and the sediment particle size decreases. Supporting historic survey data (Aquafact, 2017) was consistent with these findings, recording the biotope along the upper shore at Shanganagh.

- ***Lanice conchilega* in Atlantic littoral sand (LS.LSa.MuSa.Lan / EUNIS Code MA5255):** This biotope was encountered in a small patch in the northern stretch of the Shanganagh Beach. This biotope is described as occurring on flats of medium fine sand, most often on the lower shore. It also occurs on the lower part of a predominately rocky or boulder shore where patches of sand occur between scattered boulders, cobbles and pebbles. The sediment supports dense populations of the sand mason *Lanice conchilega*.

- ***Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders (IR.MIR.KR.Ldig.Bo / EUNIS Code MB12172):** This biotope was encountered in the extreme low water and was recorded in two locations along the Shanganagh/Shankill Beach in site-specific surveys (Aquafact, 2021). The biotope occurs on moderately exposed to sheltered boulder shores. Upper surfaces of the boulders are colonized by dense growth of the kelp *Laminaria digitata*, beneath which are a variety of seaweeds including *Mastocarpus stellatus*, *Chondrus crispus*, *Palmaria palmata*, *Lomentaria articulata*, *Osmundea pinnatifida*, *Rhodothamniella floridula*, encrusting red algae, *Cladophora rupestris* and *Ulva intestinalis.*

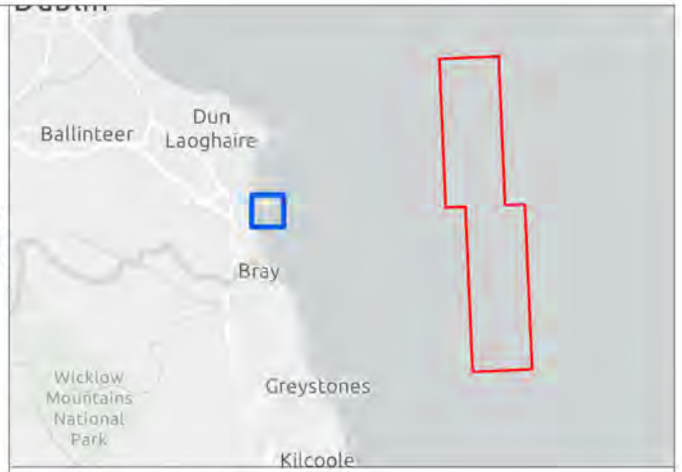
- **Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata (LR.FLR.Eph.EphX / EUNIS Code MA4211):** This biotope was recorded at the landfall in historic survey data (Aquafact, 2017) and is described as Eulittoral mixed substrata (pebbles and cobbles overlying sand or mud) that are subject to variations in salinity and/or siltation, characterised by dense blankets of ephemeral green and red seaweeds. The main species present are *Enteromorpha intestinalis, Ulva lactuca* and *Porphyra spp*., along with colonial diatoms covering the surface of the substratum. Small numbers of other species such as barnacles *Semibalanus balanoides* and *Elminius modestus* are confined to any larger cobbles and pebbles or on the shells of larger individuals of the mussel *Mytilus edulis*. Common shore crab (*Carcinus maenas*) and common periwinkle (*Littorina littorea*) can be present among the boulders, cobbles and seaweeds, while gammarid amphipods can be found in patches underneath the cobbles. In common with the other biotopes found on mixed substrata, patches of sediment are typically characterised by infaunal species including bivalves, for example, *Cerastoderma edule* and polychaetes *Arenicola marina* and *Lanice conchilega*.

- ***Fucus serratus* and red seaweed on moderately exposed lower eulittoral rock (LR.MLR.BF.Fser.R / EUNIS Code MA12441)**: This biotope was recorded at the Shanganagh in historic survey data (Aquafact, 2017), and is found on moderately exposed lower eulittoral bedrock characterised by mosaics of the wrack *Fucus serratus* and turf-forming red seaweeds including *Osmundea pinnatifida*, *Mastocarpus stellatus* or *Corallina officinalis*. The hydroid *Dynamena pumila* can occur in dense populations on the *F. serratus* fronds whilst the sponge *Halichondria panicea* can cover the bedrock beneath. Other red seaweed species may be present under the fucoid canopy including *Palmaria palmata*, *Lomentaria articulata*, *Membranoptera alata* and *Chondrus crispus*. Green seaweeds such as *Cladophora rupestris*, *Enteromorpha intestinalis* and *Ulva lactuca* are present though usually in small numbers. In addition, such shores provide a greater number of permanently damp refuges between the stones and underneath the seaweed canopy. Within these micro-habitat's species such as the limpet *Patella vulgata*, the barnacle *Semibalanus balanoides* or the whelk *Nucella lapillus* can be found in lower abundance than higher up the shore. Where are boulders are present the Common periwinkle and the Common shore crab can be found on or underneath the boulders.

- **LR.MLR.BF.Fser.R/LR.FLR.Eph.EphX mosaic**: A biotope exhibiting elements of both LR.MLR.BF.Fser.R and LR.FLR.Eph.EphX was observed throughout the length of Shanganagh/Shankill Beach where the substrate was comprised large boulders and cobbles in site-specific surveys (Aquafact, 2021).

- **Talitrids on the upper shore and strand-line. (LS.LSa.St.Tal / EUNIS Code MA5211)**: This biotope was recorded at Shanganagh in historic survey data (Aquafact, 2017), and is described as a community of sandhoppers (talitrid amphipods) that may occur on any shore where drift lines of decomposing seaweed and other debris accumulate on the strandline. The biotope occurs most frequently on medium and fine sandy shores but may also occur on a wide variety of sediment shores composed of muddy sediment, shingle and mixed substrata, or on rocky shores. The decaying seaweed provides cover and humidity for the sandhopper *Talitrus saltator*. In places where larger amounts of weed regularly accumulates *Talorchestia deshayesii* is often present. Oligochaetes, mainly enchytraeids, can occur where the stranded debris remains damp as a result of freshwater seepage across the shore or mass accumulation of weed in shaded situations. On shingle and gravel shores and behind saltmarshes the strandline talitrid species tend to be mainly *Orchestia* species. Abundances of the characterising species tend to be highly patchy.

- **Polychaetes and *Angulus tenuis* in littoral fine sand (LS.LSa.FiSa.Po.Aten / EUNIS Code 52412):** This biotope was located along the lower shore of Shanganagh landfall in historic survey data (Aquafact, 2017). This biotope is described in full in Section 1.7.17.



Export Cable Corridor
Shanganagh Biotopes (Aquafact, 2021)
- IR.MIR.KR.Ldig.Bo
- LC.LCS.Sh.BarSH
- LR.FLR.Eph.Eph.X
- LR.MLR.BF.Fser.R
- LR.MLR.BF.Fser.R/LR.FLR.Eph.Eph.X
- LS.Lsa.FiSa.Po.Aten
- LS.Lsa.MoSa.BarSa
- Ls.Lsa.MuSa.Lan

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MAP NOTES / DATA SOURCES:

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Intertidal Biotypes at the Dublin Array Landfall Site

DRAWING NUMBER: 6
PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-24	For Issue	GB	BB	SS

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0 0.07 0.15 0.22 0.3 nm

SCALE 1:16,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group
Dublin Array Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited

3.7 Designated Sites

3.7.1 As part of this report a review has been undertaken to identify designated sites within the Dublin Array subtidal and intertidal study areas, which are either designated for benthic and intertidal ecology interest or habitats/species which are dependent on or associated with benthic and intertidal ecology. A detailed assessment for the potential impacts from the offshore infrastructure of Dublin Array on local, national, European and international nature conservation sites for ecological features is provided in Volume 3, Chapter 8: Nature Conservation (hereafter referred to as the Nature Conservation Chapter.

3.7.2 The nature designations that have been considered within this as part of this report comprise of European sites i.e., Special Areas of Conservation (SAC)[12] and Special Protection Areas (SPA)[13], which are listed in Table 8, along with the benthic features for which they have been selected; the spatial distribution of these sites in relation to the Dublin Array offshore infrastructure are shown in Figure 5.

3.7.3 The assessment of the potential effects on the qualifying interests of these designated sites is presented within the Supporting Information for Screening for Appropriate Assessment report and Natura Impact Statement (NIS) that accompanies the EIAR as part of the documentation submitted to An Bord Pleanála to inform the Planning Application for development permission.

3.7.4 Marine monitoring of six Annex I Habitats recorded in Irish marine SACs as reported by Scally *et al.* (2020) provides the most recent conservation assessment of these features. Of those features assessed two are listed as features in designated sites located within the benthic study area: 'Mudflats and sandflats not covered by seawater at low tide' and 'Reefs'.

3.7.5 **Reef [1170]:** The Scally *et al* (2020) report indicated that the overall assessment of the status of this habitat around Ireland (Rockabill to Dalkey Island SAC was not included in assessment as no relevant information was available), which includes the offshore resource, has been assessed as Unfavourable-inadequate. It should be noted that when considering the inshore Reefs habitat alone, it was assessed as being in Favourable conservation status. It was noted that no change to the national conservation status of this habitat since the last reporting period in 2013. However, it noted that future threats were considered to include:

- The invasive alien species *Sargassum muticum* has been noted as an increased pressure on intertidal reef areas where it has become established in rock pools within this habitat;
- The collection of marine algae, particularly *Ascophyllum nodosum,* on a commercial scale has been carried out on intertidal reefs within Irish SACs for many years and continues to have a medium impact on this habitat. The mechanical harvesting of subtidal kelp beds is now identified as a potential future threat; and

[12] A Special Area of Conservation (SAC) protects one or more special habitats and/or species SACs and are designated under the EU Habitats Directive, transposed into Irish law by the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011), as amended.

[13] Special Protection Areas (SPAs) are designated under the EU Birds Directive (2009/147/EC) for the protection of: listed rare and vulnerable species, regularly occurring migratory species and wetlands especially those of international importance. The Birds Directive is transposed by S.I. No. 477 of 2011, as amended, and the Wildlife Acts 1976, as amended.

- The use of tangle nets for the capture of cray fish has been identified as a significant threat to subtidal reef habitat.

3.7.6 **Mudflats and sandflats not covered by seawater at low tide [1140]:** The Scally *et al.* (2020) report includes the assessment of 'Mudflats and sandflats not covered by seawater at low tide' [1140] which is a qualifying feature for both North Dublin Bay SAC and South Dublin Bay SAC. While nationally the conservation status for this feature was considered 'Unfavourable-Inadequate' due to conditions at three out of 21 sites in which it is a qualifying feature, the conservation status in South Dublin Bay and the North Dublin Bay SACs were considered favourable. Mudflats and sandflats are also a qualifying feature for both Baldoyle Bay SAC and Malahide Estuary SAC, although these sites were not assessed in the report as no relevant information was available.

3.7.7 The Scally *et al*. (2020) report noted no change to the conservation status of this habitat since the last reporting period in 2013. However, it noted that future threats were considered to include:

- Changes to the habitat as a result of natural causes, e.g. natural forces leading to a change in the area or general topographical feature of the habitat are considered a neutral threat;
- The development of wind farms on shallow sandbanks in the vicinity of SACs designated for this habitat has the potential to lead to an indirect impact on the habitat; and
- Impacts from benthic dredging (fisheries) is also considered to be a potential threat to this habitat.

3.7.8 The report noted the main pressures on this habitat included:

- Increased sedimentation as a result of surface waters via storm overflows or urban run-off in estuaries surrounded by or downstream of large urban settlements and maintenance dredging was considered to be a significant factor in the changes observed to sediment composition and observed species changes; and
- In some cases, the pressures acting on an area were unknown. This was particularly the case where changes in benthic sediment communities occurred, but no obvious source of the impact could be identified.

3.7.9 **Estuaries [1130]:** The Scally *et al.* (2020) report noted the main pressures on this habitat included:

- Nutrient enrichment of enclosed bays with poor mixing was particularly evident;
- The main contributing factors to increased nutrient enrichment was considered to be diffuse pollution as a result of agricultural and forestry activities and wastewater discharges; and
- In some cases, the pressures acting on an area were unknown.

3.7.10 Although not designated as a feature of an SAC within the study area, the detailed assessment of the seabed geomorphology and associated benthic habitats undertaken as part of the Dublin Array project specific surveys indicates that features of the Kish and Bray Banks are consistent with the Annex I habitat '**Sandbanks which are slightly covered by sea water all the time'** due to the following observed characteristics:

- The feature is permanently submerged;
- Water depths are seldom greater than 20 m; and
- Seabed sediments are predominately composed of sand.

3.7.11 Sandbanks in Irish waters are found predominantly in the Irish Sea (Roche, et al., 2007). Sandbanks which are slightly covered by seawater all the time are listed under Annex I of the EU Habitats Directive (92/43/EEC). Annex I highlight natural habitat types of community interest whose conservation requires the designation of an SAC. To date, Ireland has designated two Irish Sea sandbank SACs, Blackwater Bank (designated 2011) and Long Bank (designated 2001), both of which are located off the coast of County Wexford to the south of the Dublin Array benthic study area.

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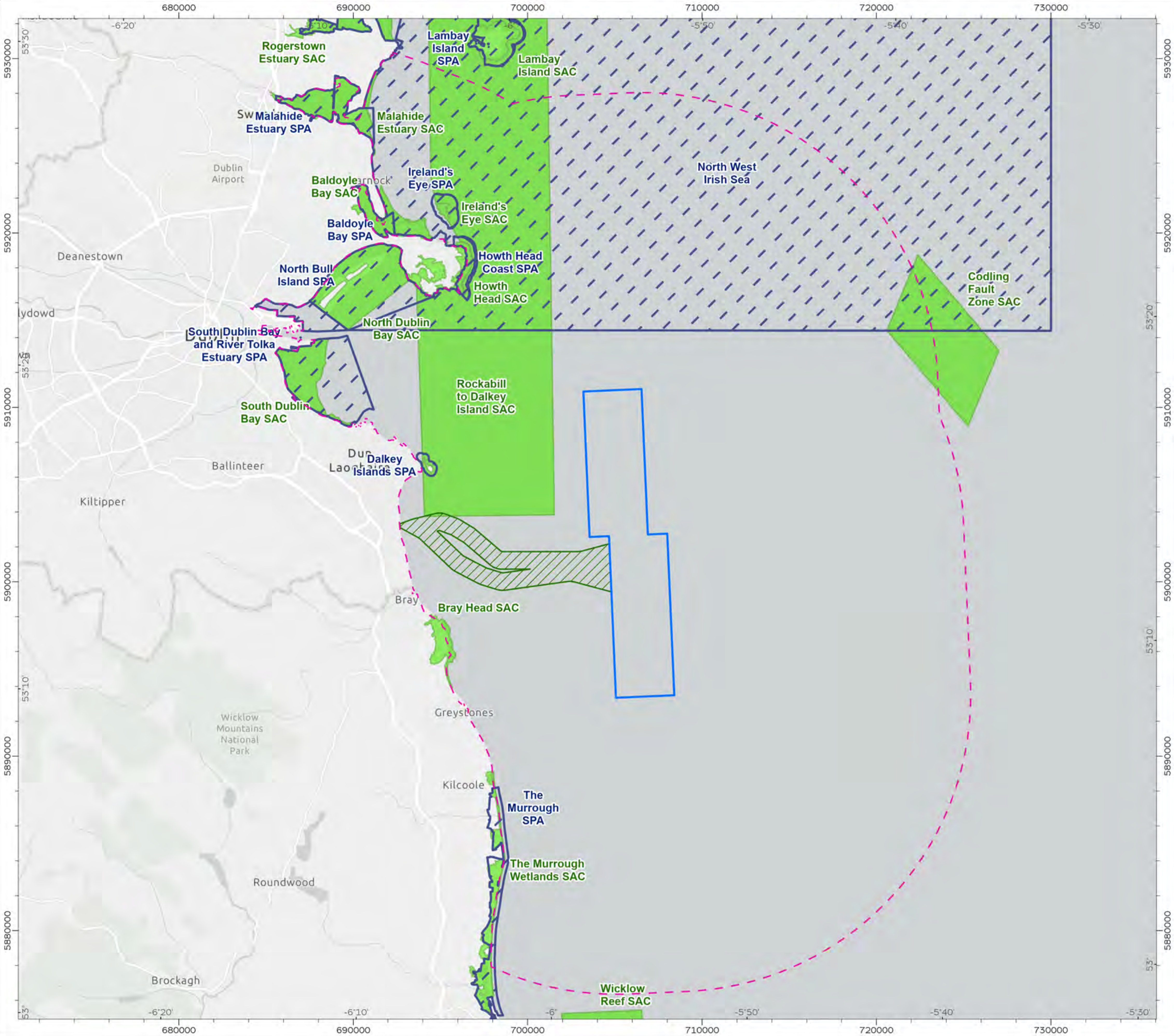
Table 8 All European sites within the ZoI of the proposed wind farm site[14].

Site code	Site name	Relative location to offshore ECC	Relative location to array area site	Benthic Feature of interest for which the site is selected
Special Areas of Conservation (SACs)				
003000	Rockabill to Dalkey Island SAC	Offshore ECC slightly overlaps the south western edge of the SAC	1.7 km west of Kish Bank site	Reefs (geogenic)
000210	South Dublin Bay SAC	8.5m north	14.9 km west of Kish Bank site	Mudflats and sandflats not covered by seawater at low tide
000206	North Dublin Bay SAC	12 km north	12 km north-west of Kish Bank site	Mudflats and sandflats not covered by seawater at low tide
000999	Baldoyle Bay SAC	16 km north	14 km north-west of Kish Bank site	Mudflats and sandflats not covered by seawater at low tide
000205	Malahide Estuary SAC	23 km north	18 km north-west of Kish Bank site	Mudflats and sandflats not covered by seawater at low tide
003015	Codling Fault Zone SAC	20 km east	14.5 km east of Kish Bank site	Submarine structures made by leaking gases
Special Protection Areas (SPAs)				
004172	Dalkey Islands SPA	2.5 km north	8.5 km west of Kish Bank site	These sites have been designated to protect internationally important birds, however the subtidal and intertidal habitats will provide important food resources for many bird species that use the site.
004024	South Dublin Bay and River Tolka Estuary SPA	7 km north west	11.9 km west of Kish Bank site	
004006	North Bull Island SPA	11.5 km north	10 km north-west of Kish Bank site	
004113	Howth Island SPA	12 km north	8.8 km north-west of Kish Bank site	
004016	Baldoyle Bay SPA	16 km north	14 km north-west of Kish Bank site	
004025	Malahide Estuary SPA	23 km north	18.5 km north-west of Kish Bank site	

[14] Distances provided are straight line (geodesic) as calculated using GIS from the outer point of offshore works to closest point of the designated site and as such are precautionary in nature.

Site code	Site name	Relative location to offshore ECC	Relative location to array area site	Benthic Feature of interest for which the site is selected
004186	The Murrough SPA	10 km south	8 km south-west of Bray Bank site	
004326	North West Irish Sea SPA	10.5 km north	3 km north of Kish Bank site	



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PROJECT TITLE

Dublin Array

DRAWING TITLE

Natura 2000 Sites within the Benthic Ecology Study Area

DRAWING NUMBER: 7

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-24	For Issue	GB	BB	SS

0 2 4 6 8 km
0 1 2 3 4 nm

N

GRID NORTH

SCALE	1:225,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

3.8 Features of conservation interest

3.8.1 As part of this report a review has been undertaken to identify benthic features of conservation interest within the Dublin Array subtidal and intertidal study areas. It should be noted that any potential effects on qualifying interests within designated sites have been considered in the NIS (Habitats Directive Assessments, Volume 4: NIS). Any features of conservation importance that lie outside the boundaries of these designated sites are identified within this section of the report, and any potential effects on these features considered in Section 3.16 *et seq*.

3.8.2 As discussed above some seabed morphological features of the Kish and Bray Banks are consistent with the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time', due to the following observed characteristics:

- The feature is permanently submerged;
- Water depths are seldom greater than 20 m; and
- Seabed sediments are predominately composed of sand.

3.8.3 Reef habitat category includes bedrock, stony and biogenic variants. Stony reefs may comprise areas of boulders or cobble (cobbles are generally considered as being between 64 mm and 256 mm in diameter, and boulders as being greater than 256 mm in diameter) which arise from the seafloor and provide a suitable substratum for the attachment of benthic communities of algae (when shallow enough) and animal species (Irving, 2009). It should be noted that geogenic reef features are a qualifying interest of the Rockabill to Dalkey Island SAC. While there is a small overlap (0.16 km^2) between the Offshore ECC and Rockabill to Dalkey Island SAC, this overlap area does not encompass any Annex I reef habitat as mapped by NPWS (2013).

3.8.4 Biogenic reefs are solid, massive structures created by accumulations of organisms, usually rising from the seabed, or at least clearly forming a substantial, discrete community or habitat which is very different from the surrounding seabed. The structure of the reef may be composed almost entirely of the reef building organism and its tubes or shells, or it may to some degree be composed of sediments, stones and shells bound together by the organisms (Holt *et al*., 1998).

3.8.5 The extent in Irish waters of geogenic and biogenic reef habitats combined is calculated as being 9,474 km^2 (West *et al*., 2024).

3.8.6 Site-specific surveys (Fugro, 2021) identified areas of cobbles and boulders in the nearshore section of the Offshore ECC (station ST12). This area was classified as the biotope 'Atlantic and Mediterranean high energy infralittoral rock' (IR.HIR). These areas were assessed for potential resemblance to stony reef habitats in accordance with the criteria outlined in Irving (2009) and Golding *et al.* (2020). Stony reefs are ecologically important for increasing the seabed complexity and providing habitats to organisms that would not otherwise occur, thus enhancing biological diversity.

3.8.7 Three main characteristic of a habitat are considered when determining whether an area of the seabed should be considered as a stony reef: composition, elevation and extent. The resulting measure of 'reefiness' is divided into four scores of low, medium and high 'reefiness' and not a reef (Irving, 2009).

3.8.8 Stony reef habitats are classified as an Annex I habitat within the Interpretation Manual of European Union Habitats - EUR28 (EEA, 2013). When determining whether an area of the seabed could be considered as Annex I stony reef, if a habitat is scored as medium or high then it can be considered as contributing to the Natura 2000 network of qualifying reefs in terms of the EU Habitats Directive. However, if a 'low' is scored in any of the three characteristics considered in determining 'reefiness', then a strong justification is required for this area to be considered as contributing to the Natura 2000 network of qualifying reefs in terms of the EU Habitats Directive (Irving, 2009).

3.8.9 Two areas were identified to be of 'medium' resemblance to a stony reef during the Fugro (2021) survey.

3.8.10 This area of cobbles and boulders in the nearshore section of the Offshore ECC corresponds with the Broad Scale Predictive Habitat Map (EUSeaMap, 2019) which indicates a band of sublittoral geogenic reef extending along the inshore section of the Offshore ECC between Killiney and Bray. This band, which is approximately 200 and 400 m wide in sections, occurs approximately 500 m from the shore. Three geogenic reef habitats are described from this area which include 'High energy circalittoral rock' (CR.HCR), 'High energy infralittoral rock' (IR.HIR) and 'Low energy infralittoral rock' (IR.LIR), all of which represent geogenic reef habitats classified as Annex I habitat (EEA, 2013).

3.8.11 A further study in the nearshore area mapped an area of 206ha of shallow reef habitat extending approximately 5km from Killiney in the north to Bray in the south (MERC Consultants, 2022). The area encompasses the inshore portion of the ECC from which the biotopes 'Kelp and seaweed communities on sediment-affected or disturbed Atlantic infralittoral rock' (LR.HIR.Ksed/EUNIS Code MB123) and Echinoderms and crustose communities on Atlantic circalittoral rock' (CR.MCR.EcCr/EUNIS Code MC122) were identified. It was concluded that the reef area represents a potentially significant area of sensitive reef habitat, especially in the context of the relatively low extent of this habitat on the east coast of Ireland.

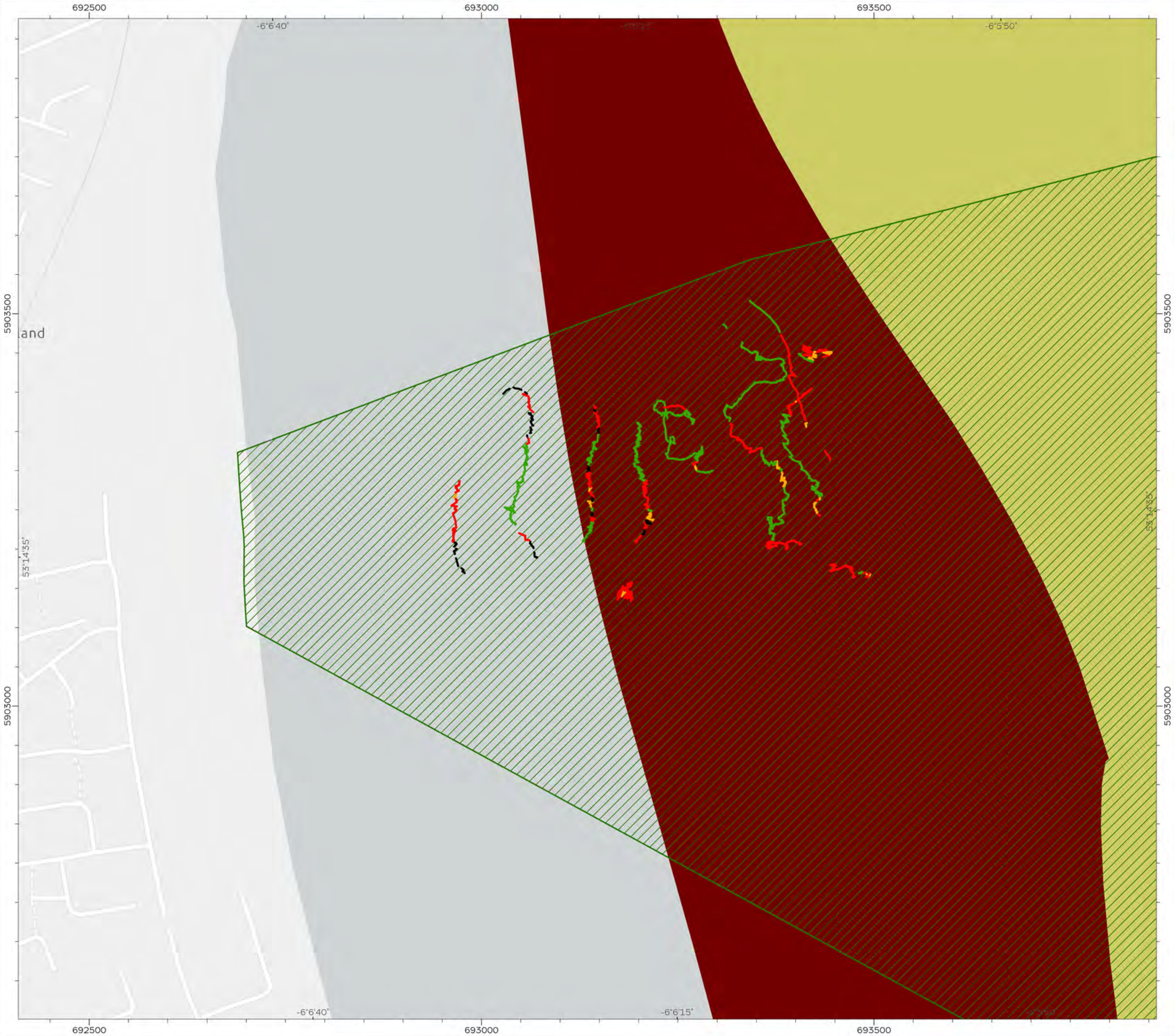
3.8.12 As the seaward punch out (i.e. the location where the drilling bit associated with where the cable exits out of the pilot hole on the seabed – see Volume 2, Chapter 6: Project Description [hereafter referred to as the Project Description Chapter) is to be located within this area characterised by reef habitat further studies were conducted in spring 2024 to better inform the extent and characteristics of the reef habitat (APEM, 2024). The survey included seven transects of between 120 and 325 m running parallel to the shore at distances of between 300 and 750 m from the shoreline along which still and video imagery was captured. The survey area corresponded to rock and boulder habitat identified by broad-scale seabed habitat map of Europe (EUSeaMap, 2021) (Figure 8).

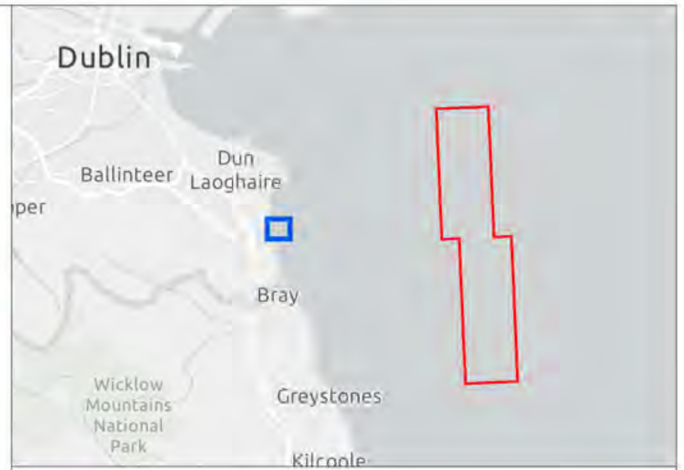
3.8.13 Analysis of the images indicated the presence of five biotopes or biotope complexes. The most widespread habitat complex recorded in the survey area was ‘Circalittoral fine mud’ SS.SMu.CFiMu / EUNIS Code MC611), followed by ‘Dense foliose red seaweeds on moderately exposed Atlantic infralittoral silty rock’ (IR.MIR.KR.XFoR / EUNIS Code MB121B) in the central and western extent. ‘Faunal communities of Atlantic circalittoral mixed sediment’ (SS.SMx.CMx / EUNIS Code MC421) were recorded on six of the transects, but was most prevalent in the east of the survey area (Figure 8). The eastern area also included larger boulders that were classified as ‘Faunal turf communities on Atlantic circalittoral rock’ (CR.HCR.FaT / EUNIS Code MC121). The least frequently recorded habitat was ‘Kelp and seaweed communities on Atlantic infralittoral rock’ (IR.HIR.KFaR / EUNIS Code MB121), which was restricted to the western most transects, which were closest to the shore.

3.8.14 Geogenic reef, in the form of stony reef as characterised in Irving (2009), was identified on all seven of the transects surveyed by APEM (2024). Overall, 40% of images contained habitat considered to be medium resemblance stony reef, while 9% contained habitat which met the criteria for low resemblance stony reef. As shown in Figure 8 the remaining 51% was categorised as 'Not Reef'.

3.8.15 This confirmed the observations reported previously concerning the presence and relative importance of a significant area of reef features in the nearshore portion of the ECC characterised by biotopes that 'may occur within', be 'contained within' or are 'typical of' Annex I reef habitats.

3.8.16 No biogenic reef habitat was identified during the survey.





Export Cable Corridor

Stony Reef Assessment

- Low Resemblance Stony Reef
- Medium Resemblance Stony Reef
- Not Reef
- Obstructed View of Substrate

EMODnet Seabed Substrate (Folk 7)

- 3. Coarse substrate
- 5. Rock and boulders

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Stony Reef Assessment of Nearshore Section of Offshore ECC

DRAWING NUMBER: 8

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-24	For Issue	GB	BB	SS

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0 0 0 0 0 nm

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SCALE	1:5,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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3.8.17 Site-specific surveys (Aquafact, 2021) across the intertidal study area reported the presence of reef habitats in the landfall characterised by the biotopes ‘Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata’ (LR.FLR.Eph.EphX/EUNIS Code MA4211) and ‘*Fucus serratus* and red seaweed on moderately exposed lower eulittoral rock’ (LR.MLR.BF.Fser.R/EUNIS Code MA12441). While these hard compact substrata are not located within a designated site they ‘may occur within', be 'contained within' or are 'typical of' Annex I habitats and are considered as examples of potential Annex I habitat.

3.8.18 Intertidal reefs are also present to the north of the intertidal study area between Dalkey Island and Dun Laoghaire harbour where 12ha of bedrock, boulders and cobbles were reported by MERC Consultants (2022). Two dominant habitat complexes were present, ‘Low energy littoral rock’ (LR.LLR) and ‘Moderate energy littoral rock’ (LR.LMR). The most commonly identified biotopes were: ‘*Ascophyllum nodosum* on full salinity mid eulittoral rock’ (LR.LLR.F.Asc.FS/EUNIS Code MA123E1);. ‘*Ascophyllum nodosum* on very sheltered mid eulittoral rock’ (LR.LLR.F.Asc/EUNIS Code MA123E); ‘*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock’ (LR.MLR.BF.FvesB/EUNIS Code MA1243); and ‘*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock’ (LR.MLR.BF.Fser.R/EUNIS Code MA12441). All areas of intertidal reef recorded in the area conform to the EU Annex I habitat “Reefs”.

3.8.19 During the Ecoserve (2008) survey a significant number of the horse mussel *Modiolus modiolus* were recorded at a station to the south of the array area, outside the current project boundary. This community was recorded as the biotope ‘*Modiolus modiolus* beds on open coast circalittoral mixed sediment’ (SS.SBR.SMus.ModMx/EUNIS Code MC2232). *Modiolus modiolus* beds are considered a type of Annex I biogenic reef habitat and an OSPAR listed habitat. However, this station was resampled during the Aquafact (2017) re-characterisation campaign and no beds of *Modiolus modiolus* were identified, with the station classified as ‘*Mediomastus fragilis, Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel’ (SS.SCS.CCS.MedLumVen/EUNIS Code MC3212). However, due to the natural spatial variablity of benthic communities and the limited coverage of the seabed by benthic sampling techniques, the presence of *Modiolus* and associated biogenic reefs cannot be discounted, although any extent is likely to be limited. Biogenic reef habitats are classified as an Annex I habitat (EEA, 2013). It should be noted that during the 2024 survey of the near shore portion of the EEC no biogenic reef features were identified (APEM, 2024).

3.8.20 Intertidal eelgrass beds have been recorded in south Dublin Bay, outside the current project boundary with the biotope '*Zostera noltei* beds in littoral muddy sand' (LS.LMp.LSgr.Znol / EUNIS Code MA6231) recorded. This habitat is included in the OSPAR List of Threatened and/or declining species and habitats[15]. The purpose of the list is to guide the OSPAR Commission in setting priorities for further work on the conservation and protection of marine biodiversity.

3.8.21 The dogwhelk *Nucella lapillus* is an intertidal gastropod commonly found on rocky coasts around Ireland[16] (although this species was not recorded during the site-specific intertidal surveys at Shanganagh). This species is included in the OSPAR List of Threatened and/or Declining Species and Habitats and is also included in a list of features selected for inclusion for spatial protection of conservation objectives of potential Marine Protected Areas (MPA)[17] in the western Irish Sea (Department of Housing, Planning and Local Government, 2023).

3.8.22 No other features of conservation importance have been recorded across the Dublin Array subtidal or intertidal study areas, following a detailed review of existing datasets.

3.9 Future receiving environment

3.9.1 An assessment of the future receiving environment (without the proposed development) has been carried out and is described in this section. The receiving environment is not static and is expected to exhibit some degree of natural change over time related 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.

3.9.2 Further to potential change associated with existing cycles and processes, it is necessary to take account of the potential effects of climate change on the marine environment. The quality of the marine environment, in particular, the integrity of marine ecosystems, is at risk from the impact of global climate change, especially rising sea temperatures with an increase in sea surface temperature of 0.6°C per decade observed in Irish waters since 1994 (EPA, 2024). Marine ecosystems are impacted by warming temperatures, changing wind patterns, shifting oceanic circulation patterns, increasing acidification and altering precipitation rates and hence salinity. These changes have the potential to change the distribution, abundance, size and behaviour of aquatic organisms (NPWS, 2019). Climate change impacts will change species distribution, reproduction, growth, migration and interactions. Studies of the benthic ecology over the last three decades have shown that biomass has increased by at least 250 to 400%, opportunistic and short-lived species have increased and the abundance of long-living sessile animals has decreased (Krönke, 1995; Krönke, 2011).

[15] OSPAR List of Threatened and/or Declining Species and Habitats is a list of species and habitats identified as being in need of protection under the OSPAR Strategy for the Protection and Conservation of Ecosystems and Biological Diversity: https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats

[16] https://www.marlin.ac.uk/species/detail/1501

[17] Marine Protected Areas (MPA) are geographically defined maritime areas designated under the Marine Protected Araes Bill which are designed to maintain, conserve and restore coastal and marine ecosystems.

3.9.3 Sea surface temperatures in Irish waters have shown a progressive warming from the mid-1990s (Cámaro García and Dwyer, 2020). The warming observed between 1983 and 2012 was particularly strong in parts of the north-east Atlantic, with the sea surface around Ireland warming at rates up to six times greater than the global average (Dye *et al.,* 2013).

3.9.4 To date, most literature has focused specifically on temperature, with regards to the effects of climate change on marine habitats. Climatic warming also causes deoxygenation within the water column. Over decadal timescales, there has been a measurable decline in dissolved oxygen content in the global ocean in response to ocean warming (Mahaffey *et al*., 2020), with a further 7% decrease predicted for the year 2100 (IPCC, 2013). It was concluded from 26 years of monitoring a benthic community within the Firth of Clyde on the west coast of Scotland that benthic communities had been affected by the decreasing levels of oxygen. This finding agreed with other short-term studies (Breitburg *et al*., 2018, Levin *et al*., 2009). Specific changes included changes in morphology, burrow depth, bioturbation and feeding mode (Caswell *et al*., 2018).

3.9.5 As such, the baseline in the Dublin Array study area described in Section 3.1 is a 'snapshot' of the present benthic ecosystem within a gradually yet continuously changing environment. Any changes that may occur during the 35-year design life span of Dublin Array should be considered in the context of both greater variability and sustained trends occurring on national and international scales in the marine environment.

3.10 Do-nothing environment

3.10.1 In the event that the development of the Dublin Array did not proceed, no alterations to the receiving environment are anticipated in addition to those that would be expected to occur in the absence of the project, either naturally or driven by other anthropogenic factors.

3.11 Defining the sensitivity of the baseline

3.11.1 The sensitivity of the receptors for each potential effect, using the criteria outlined in Section 3.5, are presented in Sections 3.16 (construction phase of development) 3.17 (O&M phase) and 3.18 (decommissioning phase).

3.12 Uncertainties and technical difficulties encountered

3.12.1 Some data sources or assumptions are less well studied and/or quantified for the study area. This section seeks to identify areas of uncertainty and potential data gaps.

3.12.2 Grab sampling and video surveys, while providing detailed information on the sediment types (and fauna) present, represent point samples that must be interpreted in combination with the other appropriate datasets. As noted, several surveys undertaking grab samples have been conducted in the area which show good validation against the regional data. Therefore, the regional data are considered sufficient to characterise the study (and wider) area. A number of surveys have been conducted on the seabed in the benthic study area which provide an adequate amount of information to enable the robust characterisation of the marine physical environment which is often strongly correlated with the biological communities present (Cooper *et al*., 2018; Rhoads, 1974).

3.12.3 Classification of survey data into benthic habitats/biotopes, while highly useful for assessment purposes, has two main limitations:

- Difficulties in defining the precise extents of each biotope, even when using site-specific geophysical survey data to characterise the seabed; and
- There is generally a transition from one biotope to another, rather than fixed limits and therefore, the boundaries of where one biotope ends and another starts often cannot be precisely defined.

3.12.4 Consequently, the biotopes presented in the technical report which underpin this assessment should not be considered as definitive, nor should habitat boundaries be considered to be fixed; they do however represent a robust characterisation of the receiving environment.

3.12.5 There is some uncertainty associated with the assessment of sediment plumes and accompanying changes to seabed levels due to construction related activities. This arises due to uncertainty regarding how the seabed geology will respond to construction activities such as drilling and jetting. The exact volume of material released into the water column will be dependent upon several factors including the type of drilling/ cable installation equipment used and the mechanical properties of the geological units and the metocean conditions at the time of the works. In the absence of detailed installation and construction methodologies from the appointed contractor, a series of potential release scenarios have been considered. Together, these scenarios capture the worst-case impacts in terms of SSC, duration of sediment plumes and the spatial extent of changes in seabed level, thus accounting for any uncertainties in relation to the data. Consequently, it is considered that the available evidence base is sufficiently robust to underpin the assessment presented here, leading to an overall high confidence being placed on the assessment.

3.13 Scope of the assessment

3.13.1 The following impacts have been assessed:

Table 9 Potential impacts/changes identified considered within the benthic subtidal and intertidal ecology assessment.

Potential impact/ change	Impact
Construction	
Temporary increase in SSC and sediment deposition in the array area, and Offshore ECC from construction activities	Impact 1
Temporary increase in SSC and sediment deposition in the intertidal area from construction activities	Impact 2
Temporary habitat loss/disturbance in the array area, and Offshore ECC from construction activities	Impact 3
Temporary habitat loss/disturbance in the intertidal area from construction activities	Impact 4
Seabed disturbances from construction activities leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology	Impact 5
Increased risk of introduction or spread of Marine Invasive Non-Native Species (IAS) due to presence of subsea infrastructure and vessel movements (e.g. ballast water)	Impact 6
Operation and Maintenance (O&M)	
Long-term habitat loss / change from the presence of foundations, scour and cable protection in the array area and Offshore ECC	Impact 7
Habitat disturbance in the array area and Offshore ECC from O&M activities	Impact 8
Seabed disturbances from maintenance activities leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology	Impact 9
Colonisation of the WTGs and scour/ cable protection by benthic epibiota which may affect benthic subtidal ecology and biodiversity	Impact 10
Increased risk of introduction or spread of IAS due to vessel movements (e.g. ballast water)	Impact 11
Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic subtidal and intertidal communities	Impact 12
Indirect disturbance arising from electromagnetic field (EMF) generated by the current flowing through cables	Impact 13
Decommissioning	
Temporary habitat disturbance from decommissioning of foundations, cables and rock protection	Impact 14
Increased SSC and sediment deposition from removal of foundations, cables and rock protection	Impact 15
Loss of introduced habitat from the removal of foundations and rock protection	Impact 16

Potential impact/ change	Impact
Seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology	Impact 17

3.14 Key parameters for assessment

3.14.1 As set out in the Application for Opinion under Section 287B of the Planning and Development Act 2000, flexibility is being sought where details or groups of details may not be confirmed at the time of the Planning Application. In summary, and as subsequently set out in the ABP Opinion on Flexibility (detailed within the EIA Methodology Chapter) the flexibility being sought relates to those details or groups of details associated with the following components (in summary - see further detail in see the Project Description Chapter):

- WTG (model – dimensions and number);
- OSP (dimensions);
- Array layout;
- Foundation type (WTG and OSP; types and dimensions and scour protection techniques); and
- Offshore cables (IAC and ECC; length and layout).

3.14.2 To ensure a robust, coherent, and transparent assessment of the proposed Dublin Array project for which development consent is being sought under section 291 of the Planning Act, the Applicant has identified and defined a Maximum Design Option (MDO) and Alternative Design Option(s) (ADO) for each environmental topic/receptor. The MDO and ADO have been assessed in the EIAR to determine the full range and magnitude of effects, providing certainty that any option within the specified parameters will not give rise to environmental effects more significant than that which could occur from the MDO. The extent of significant effects is therefore defined and certain, notwithstanding that not all details of the proposed development are confirmed in the application.

3.14.3 The range of parameters relating to the infrastructure and technology design allow for a range of options in terms of construction methods and practices, which are fully assessed in the EIAR. These options are described in the project description and are detailed in the MDO and ADO tables within each offshore chapter of the EIAR. This ensures that all aspects of the proposed Dublin Array project are appropriately identified, described and comprehensively environmentally assessed.

3.14.4 In addition to the details or groups of details associated with the components listed above (where flexibility is being sought), the confirmed design details and the range of normal construction practises are also assessed within the EIAR (see the Project Description Chapter). Whilst flexibility is not being sought for these elements (for which plans and particulars are not required under the Planning Regulations), the relevant parameters are also incorporated into the MDO and alternative option(s) table (Table 10) to ensure that all elements of the project details are fully considered and assessed.

3.14.5 With respect to project design features where flexibility is not being sought, such as trenchless cable installation methodology at the landfall, the MDO and alternative design option(s) are the same (as there is no alternative). With respect to the range of normal construction practises that are intrinsic to installation of the development, such as the nature and extent of protection for offshore cables and the design of cable crossings, but which cannot be finally determined until after consent has been secured and detailed design is completed, the parameters relevant to the receptor being assessed are quantified, assigned and assessed as a maximum and alternative, as informed by the potential for impact upon that receptor. In the event of a favourable decision on the application they will be agreed prior to the commencement of the relevant part of the development by way of compliance with a standard 'matters of detail' planning condition (see the Policy Chapter). Throughout, an explanation and justification is provided for the MDO and alternative(s) within the relevant tables, as it relates the details or groups of details where statutory design flexibility is being sought, and wider construction practises where flexibility is provided by way of planning compliance condition.

3.14.6 See the Physical Processes Chapter for full supporting calculations and volumes disturbed.

Table 10 Maximum and Alternative Design Options assessed

Maximum design option	Alternative design options	Justification
Construction		
Impact 1: Temporary increase in suspended sediment concentrations (SSC) and sediment deposition in the array area and Offshore ECC from construction activities		
Dredging prior to foundation installation: Trailer suction hopper dredger (TSHD). - Option B: 45 WTGs - One Offshore Substation Platform (OSP) requiring seabed preparation	**Dredging prior to foundation installation:** Alternative options include the potential for fewer locations requiring seabed preparation. All seabed preparation operations of this type will take place using TSHD. Preparation for alternative foundation types and WTG options may also give rise to varying areas of seabed affected and volumes of sediment disturbed, all less than those which arise from the maximum design option	The MDO for seabed preparation prior to foundation installation would result in the largest seabed footprint thus greatest volumes of SSC generated from construction activities. For drilling of foundation piles which produce drill cuttings, the realistic worst-case is represented by the largest volume of fine sediments released into the water column over the shortest interval which then has the potential to greatest SSC within a plume that advects away from the point of discharge. For both Inter-array cable installation and Export cable installation Mass Flow Excavation (MFE) will produce both a wide trench and also have the greatest potential to fluidise and raise fine sediments into suspension and is therefore considered as the realistic worst-case option for cable installation. With regards to increases in turbidity due to release of drilling fluid from Horizontal Directional Drilling (HDD), this scenario represents the maximum volumes of drilling mud discharges (bentonite) into the marine environment for HDD works. Alternative foundation types and WTG options will give rise to varying volumes of drill arisings, all less than the maximum design option.
100% of WTGs requiring seabed preparation	Alternative options include the potential for varying percentages of locations requiring seabed preparation. All seabed preparation operations of this type will take place using TSHD. Preparation for alternative foundation types and WTG options may also give rise to varying areas of seabed affected and volumes of sediment disturbed, all generating less SSC than the maximum design option.	
Disposal: For all options where seabed preparation prior to foundation installation will take place, the material is dredged by a TSHD.	**Disposal:** For all options where seabed preparation prior to foundation installation will take place, the material is dredged by a TSHD with drilling spoil released at, or above the water surface.	
Foundation installation Option C: 39 WTGs with four-legged jacket foundations; Jacket pin-piles foundations for one OSP	**Foundation installation** There will be no drill arisings generated with foundation installation using driven piles and vibro-piles. This approach would not result in the creation of any SSC plumes and would therefore represent the minimum scale of effect.	
Drilling required at 100% of foundations	Alternative options include the potential for varying percentages, less than 50%, of foundation locations requiring drilling.	

Maximum design option	Alternative design options	Justification
IAC - Cable Installation: - Inter-array cable: 120 km maximum total length. Although the total length may be less than this, depending on final routeing options yet to be decided, the total value will not exceed 120 km. **- Method**: ploughing of a V shaped trench 12m width x 3m depth; -Controlled displacement of sediment onto the seabed with approximately 15% of sediment ejected from trench; - **Method**: mass flow excavator (MFE); Assumes up to 100% of material elevated above the seabed with up to two backfill passes expected (for spoil mounds either side of the trenches).	**IAC - Cable installation:** Alternative options for cable installation involve the use of different cable installation methodologies including jet trenching, rock cutting and mechanical chain excavating in addition to ploughing and MFE (which are outlined within the maximum design option). **Method**: The alternative option will result in the smallest volume of fine sediment release into the water column is simultaneous lay and burial (ploughing).	(See previous page)
IAC - Sandwave Clearance (excluding Sandbank Crossing): - Method: TSHD - Maximum total length of IAC = 120 km, - Up to 50% requiring seabed preparation; - 40 m (maximum width of disturbance); **IAC - Sandbank Crossing** Method: TSHD Dredging to be undertaken for sandwave clearance across the Kish and Bray sandbanks at two locations with three cables at each site, to allow the IAC cables to cross the sandbank. 6 X 1000 m crossings with 100% requiring seabed preparation Export Cables Dredging using TSHD to undertake sandwave clearance and disposal - Two cables; - Maximum total length of one export cable = 18.35 km; - up to 70% requiring seabed preparation.	IAC (excluding Sandbank Crossing) -Method: TSHD - Maximum total length of IAC = 120 km, - Up to 25% requiring seabed preparation; - 40 m (maximum width of disturbance) **IAC: Sandbank Crossing** No alternative options have been considered for this operation, as the methodology described as the maximum design option is considered the most appropriate option. Export Cables Dredging using TSHD to undertake sandwave clearance and disposal - Two cables; - Maximum total length of one export cable = 18.35 km; - Up to 25% requiring seabed preparation.	
Landfall methodology: Trenchless installation (via HDD or direct pipe) beneath the beach, cliffs and intertidal area to be undertaken at Shanganagh. Excavation pits to be excavated and reinstated using back hoe dredge. Material will be stored to minimise loss of sediment as far as is reasonably practicable.	No alternative options have been considered for this operation, as the methodology described as the maximum design option is considered the most appropriate option.	
- Drilling punch-out location: Subtidal; - One per cable (2); - Excavation pits: Up to one per cable (2); - Maximum excavation pit dimensions: 30 m (long) x 5 m (wide) x 2.5 m (depth); - Estimated maximum excavated volume = 375 m3 x 2 (number of cables) = **750 m3;** - Maximum length of drill = 856 m; and	No alternative options have been considered for this operation, as the methodology described as the maximum design option is considered the most appropriate option.	

Maximum design option	Alternative design options	Justification
- Maximum installation period: 40 weeks subject to suitable weather conditions, inclusive of site mobilisation and demobilisation.		
Use of drilling fluid (landfall): Trenchless installation The drilling fluid is anticipated to be a low concentration bentonite/water mixture. Drill exit head to will stop short of punch out, flush bentonite, and complete the final 10 m in order to mitigate bentonite release on punch out. For the purposes of the assessment this is assumed to be an instantaneous release as this is the most conservative assumption for the purposes of the study/assessment model.	No alternative options have been considered for this operation, as the methodology described as the maximum design option is considered the most appropriate option.	
Impact 2: Temporary increase in Suspended Sediment Concentration and sediment deposition in the intertidal area from construction activities		
The installation of the offshore export cables from land will use a trenchless (below ground) technology to install two ducts, with the offshore export cables subsequently pulled through using a winch (a device used to pull cables). Using trenchless technology will safeguard the cliff stability and integrity as the installation will be deep below ground impacting the intertidal area.	No works will be undertaken within the landfall with the use of trenchless (below ground) technology and punch out within the subtidal	At the landfall cables will be installed beneath the beach, cliffs and intertidal area by means of trenchless drilling technique and punch out will be in the subtidal; consequently, no impact to the intertidal is anticipated in relation to temporary increase in SSC and sediment deposition.
Impact 3: Temporary habitat loss/disturbance in the array area and Offshore ECC from construction activities		
Seabed preparation prior to foundation installation: - Option B: 45 WTGS - 100% requiring seabed preparation - One OSP	**Dredging prior to foundation installation:** Seabed preparation in advance of foundation installation may not be required at any location. Foundations would be installed onto the seabed in its existing condition and so no dredging or similar methodologies would be employed, therefore resulting in the creation of no SSC plumes. This approach would represent the design option with the minimum scale of effect, i.e. 0 m^2 of seabed. Alternative options include the potential for varying percentages of locations between 0% and 100% requiring seabed preparation. All seabed preparation operations of this type will take place using TSHD.	The temporary disturbance relates to seabed preparation for foundations and cables, jack up and anchoring operations, and cable installation. The footprint of permanent infrastructure is assessed as a permanent impact in operation and maintenance.

Maximum design option	Alternative design options	Justification
Jack up and anchoring operations: - Option A: 50 WTGs - WTG/OSP installation jack up vessel (JUV) footprint - 6 jack-up operations required per turbine - WTG/OSP installation of foundation vessel anchor footprints IAC Sandwave Clearance (excluding Sandbank Crossing): Dredging using TSHD to undertake sandwave clearance - Maximum total length of IAC = 120 km, up to 50% requiring seabed preparation; - 40 m (maximum width of disturbance) IAC Sandbank Crossing Dredging using TSHD to undertake sandwave clearance, in two locations with three cables at each site, to allow the IAC cables to cross the sandbank. Maximum area of seabed affected: 6 x 1,000 m crossings, 100% of which requiring seabed preparation; **IAC Pre-Lay Grapnel Run (PLGR):** - 50 m (maximum width pre-sweeping disturbance) - 120 km (maximum total length of IAC) **IAC Seabed preparation:** - 40 m (maximum width of disturbance) - 120 km (maximum total length of IAC) - 50% (proportion of array cable length subject to seabed preparation **IAC Cable installation - Ploughing:** - 12 m (width of seabed disturbance) - 95% of 120 km maximum total length of IAC **IAC Cable installation MFE:** - 15 m (width of seabed disturbance) - 5% of 120 km maximum total length of IAC **Export Pre-Lay Grapnel Run:** - 50 m (maximum width seabed disturbance) - 18.35 km (Maximum total length of one export cable; cable route B)	**Jack up and anchoring operations:** No alternative options have been considered for this operation, as the methodology described as the maximum design option is considered the most appropriate option. However, lower number of WTGs will reduce the number of operations and reduce the level of seabed disturbance. **IAC Sandwave Clearance (excluding Sandbank Crossing):** Alternative options for cable installation involve the potential for varying percentages of total cable lengths requiring sandwave clearance than the MDO resulting in lower area of seabed disturbance. Similarly, lower number of WTGs will have concomitantly reduced overall length of IAC cable. **IAC sandbank crossing** No alternative options have been considered for this operation, as the methodology described as the maximum design option is considered the most appropriate option. As for the MDO Alternative options for cable installation involve the potential for varying percentages of total cable lengths requiring seabed preparation than the MDO resulting in lower area of seabed disturbance. **IAC - Cable installation:** Alternative options for cable installation involve the use of different cable installation methodologies including jet trenching, rock cutting and mechanical chain excavating in addition to ploughing and MFE (which are outlined within the maximum design option). **Method**: The alternative option will result in the smallest are of disturbance with simultaneous lay and burial (ploughing). As for the MDO	(See previous page)

Maximum design option	Alternative design options	Justification
Export cable seabed preparation: - 40 m (maximum width of seabed disturbance - 18.35 km (Maximum total length of one export cable; cable route B) - 70% subject to seabed preparation) Export Cables Dredging using TSHD to undertake sandwave clearance - Two cables; - Maximum total length of one export cable = 18.35 km - up to 70% requiring seabed preparation. **Landfall methodology:** Trenchless techniques will be used beneath the beach, cliffs and intertidal area to be undertaken at Shanganagh. - Drilling punch-out location: Subtidal; - Up to one per cable; - Excavation pits: Up to one per cable; - Maximum excavation pit dimensions: 25 m (long) x 5 m (wide)	**Export cable seabed preparation** Alternative options for cable installation involve the potential for varying percentages of total cable lengths requiring seabed preparation than the MDO resulting in lower area of seabed disturbance. Export Cables Dredging using TSHD to undertake sandwave clearance - Two cables - Maximum total length of export cable = 18.35 km - up to 25% requiring seabed preparation **Landfall methodology:** No alternative options have been considered for this operation, as trenchless techniques are considered the most appropriate option.	
Impact 4: Temporary habitat loss/disturbance in the intertidal area from construction activities		
The installation of the offshore export cables from land will use a trenchless (below ground) technology to install two ducts, with the offshore export cables subsequently pulled through using a winch (a device used to pull cables). Using trenchless technology will safeguard the cliff stability and integrity as the installation will be deep below ground impacting the intertidal area.	No works will be undertaken within the landfall with the use of trenchless (below ground) technology and punch out within the subtidal	At the landfall cables will be installed beneath the beach, cliffs and intertidal area by means of trenchless drilling technique and punch out will be in the subtidal; consequently, no impact to the intertidal is anticipated in relation to temporary increase in SSC and sediment deposition from construction activities.
Impact 5: Seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology in the array area and Offshore ECC		
The MDO for seabed disturbance are presented in Impact 1 and 2.	The alternative design options for seabed disturbance are presented in Impact 1 and 2.	This option represents the maximum total seabed disturbance and therefore the maximum amount of contaminated sediment that may be released into the water column during construction activities.
Impact 6: Increased risk of introduction or spread of IAS due to presence of subsea infrastructure and vessel movements (e.g. ballast water)		
Up to 813 round trips to port from construction vessels and an additional 1825 round trips from small vessels such as CTVs during construction period.	Up to 774 round trips to port from construction vessels and an additional 538 round trips from small vessels such as CTVs during construction period	MDO with regards to maximum number of vessel movements during construction activities. The presence of infrastructure is covered in the operation and maintenance phase.

Maximum design option	Alternative design options	Justification
Operation and Maintenance		
Impact 7: Long term habitat loss from the presence of foundations, scour and cable protection		
Lifetime of the proposed development: 35 years (operating life) **The WTG/OSP foundation and scour protection:** - Option B: 45 foundations with 4 suction feet multileg WTGs presents the largest turbine foundation footprint with scour protection; - OSP maximum scour protection area for site **IAC cable protection** Cable protection measures secured to the seabed if considered necessary and subject to license approval; - Length of IAC cable requiring additional protection where optimum burial is not achieved = 24.6 km; - Total footprint of all IAC cable crossings includes footprint of the berm and mattresses x two crossings. **Export cable protection:** - Maximum footprint of cable protection = 12 km (up to 6km per cable) - Total footprint of all export cable crossings includes footprint of the berm and mattresses x six crossings **Cable crossings** - Assumes a maximum of two cable crossings of Dublin Array cables; - Assumed to be constructed of both concrete mattresses (six per crossing) and rock berm **Permanent vessel moorings** Two moorings permanently moored to the seabed	**Lifetime of the proposed development:** 35 years (operating life) **WTG/OSP foundation and scour protection:** Alternative foundation types and WTG options will give rise to varying areas of scour protection, all less than the maximum design option. Option C: 39 WTGs with monopile foundations presents the minimum scour protection area **IAC Cable protection:** Cable protection measures may not be required at any location, if the desired burial depth is achieved at all points. This approach would represent the design option with the minimum scale of effect. Alternative options include the potential for varying percentages of the cable routes to require cable protection, ranging from 0% up to that assessed as the maximum design option. Alternative options for cable crossings include the use of concrete mattresses placed in isolation, rather than in addition to rock berms as in the maximum design option. **Export cable protection:** The alternative option involves no cable protection required; Cable protection measures may not be required at any location, if the desired depth of cover is achieved at all points. This approach would represent the design option with the minimum scale of effect. Alternative options include the potential for varying percentages of the cable routes to require cable protection, ranging from 0% up to that assessed as the maximum design option **Cable crossings:** Alternative options for cable crossings include the use of concrete mattresses placed in isolation, rather than in addition to rock berms as in the maximum design option. **Permanent vessel moorings** No alternative options have been considered for this operation, as the methodology described as the maximum design option is considered the most appropriate option.	The MDO is defined by the maximum area of seabed lost as a result of the placement of structures, scour protection, cable protection and cable crossings. Habitat loss from drilling is of a smaller magnitude than presence of project infrastructure.

Maximum design option	Alternative design options	Justification
Impact 8: Habitat disturbance in the array area and Offshore ECC from operation and maintenance activities		
WTG/OSP operation and maintenance activities - Option A: 50 WTGs - maintenance jack up vessel (JUV) footprint - 3 jack-up operations per WTG and 1 OSP	Alternative options for the use of jack-up vessels and maintenance activities involve the requirement for fewer maintenance events to be required over the lifetime of the Project. Details of the parameters that inform these alternative design options are provided in Annex B: Physical Processes Design Options Annex (hereafter referred to as the Physical Processes Design Options Annex).	Defined by the maximum number of jack-up vessel operations and maintenance activities that could have an interaction with the seabed anticipated during operation.
Cable Repairs: - Methodology: remedial burial of cables including rock dumping and / or concrete mattress installation/rock bags installation; - Array and ECC cable repairs 600m (length repaired) x 10 m (trench width) x - 7 (events/lifetime) Array and ECC cable remedial reburial 10 km (length reburied) - x 5 (reburial events/lifetime) Array and ECC cable repairs will be 2000m x 10 m (trench width) - x7 (repairs/lifetime)	**Cable repairs:** Method: Jetting tools potentially followed by rock dumping and / or concrete mattress installation Remedial burial of cables: 10 km per event ; x 3 reburial events assumed over the project lifetime; Array and ECC cable repairs will be 600 m (cable length of repair) x 10 m (trench width) -x4 (repairs/lifetime)	
Impact 9: Seabed disturbances from maintenance activities leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology		
Cable Repairs: - Methodology: remedial burial of cables including rock dumping and / or concrete mattress installation/rock bags installation; - Array and ECC cable repairs 600m (length repaired) x 10 m (trench width) x - 7 (events/lifetime) Array and ECC cable remedial reburial 10 km (length reburied) - x 5 (reburial events/lifetime) Array and ECC cable repairs will be 2000m x 10 m (trench width) - x7 (repairs/lifetime)	**Cable repairs:** Method: Jetting tools potentially followed by rock dumping and / or concrete mattress installation Remedial burial of cables: 10 km per event; x 3 reburial events assumed over the project lifetime; Array and ECC cable repairs will be 600 m (cable length of repair) x 10 m (trench width) -x4 (repairs/lifetime)	This scenario represents the maximum total seabed disturbance and therefore the maximum amount of contaminated sediment that may be released into the water column during operation and maintenance activities.
Impact 10: Colonisation of the WTGs and scour/ cable protection may affect benthic subtidal ecology and biodiversity		
Presence of foundations and scour protection: - Option B: 45 WTGs on monopile foundations (diameter of up to 13 m) plus scour protection; and - One OSP on 4-legged multi-leg foundations plus scour protection. - **46 structures in total** within the array area.	**Presence of foundations and scour protection:** Alternative options include the use of different foundation types for the range of WTG Options. These will result in different scour areas with the minimum areas affected by scour occurring from the following - Option A: 50 WTGs on 3-leg multi-leg foundations with pin-piles (pile diameter of up to 4.75 m); and - One OSP on monopile foundations. - **51 total structures** within the array area.	The MDO is defined by the maximum area of structures, scour protection, cable protection and cable crossings introduced to the water column, including surface area of vertical structures.

Maximum design option	Alternative design options	Justification
Impact 11: Increased risk of introduction or spread of IAS due to presence of subsea infrastructure and vessel movements (e.g. ballast water)		
Option B: 45 WTGs on monopile foundations (diameter of up to 13 m) plus scour protection; and One OSP on 4-legged multi-leg foundations plus scour protection. **46 total structures within the array area**. 3 daily CTV trips with the addition of up to 100 vessels trips to support scheduled routine and non-routine maintenance per year.	Alternative options include the use of different foundation types for the range of WTG layout options as above for Impact 10. 2 daily CTV trips with the addition of up to 75 vessels trips to support scheduled routine and non-routine maintenance.	Defined by the maximum surface area introduced into the water column as described in Impact 10. MDO with regards to maximum number of vessel movements during operation and maintenance activities.
Impact 12: Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities		
Lifetime of the proposed development: 35 years (operating life) **Presence of foundations:** - Option B: 45 WTGs on 4-legged suction bucket foundations (with stiffeners); - One OSP on 4-legged multi-leg foundations; **Cable protection** Cable protection measures may be required, where the desired burial depth is not achieved. **IAC:** Cable protection measures may be placed alone or in combination, and may be secured to the seabed if considered necessary and subject to license approval; maximum footprint of cable protection = 34.8 km (total length requiring protection) x 6 m (width at base) **Export cables:** Cable protection measures may be placed alone or in combination and may be secured to the seabed where appropriate; Up to 6 km per cable x 2 **Cable crossings** The MDO considered cable crossings in addition to rock berms.	**Lifetime of the proposed development:** 35 years (operating life) **Presence of foundations:** - Option C: 39 WTGs on monopile foundations; - One OSP on 4-legged multi-leg foundations; **Cable protection** Cable protection measures may not be required at any location, if the desired burial depth is achieved at all points. This approach would represent the design option with the minimum scale of effect. Alternative options include the potential for varying percentages of the cable routes to require cable protection, ranging from 0% up to that assessed as the maximum design option. **IAC:** No cable protection required. **Export cables:** No cable protection required. **Cable crossings** Alternative options for cable crossings include the use of alternative materials, namely that of concrete mattresses placed in isolation, rather than in addition to rock berms as in the maximum design option.	This impact is defined by any anticipated changes to physical processes as defined in Chapter 3.1: Physical Processes.

Maximum design option	Alternative design options	Justification
IACs: Assumes a maximum of two cable crossings of Dublin Array cables; Assumed to be constructed of both concrete mattresses (six per crossing) and rock berm; **Export cables:** Assumes a maximum of 6 cable crossings for all of the export cable **Foundation scour protection:** Maximum scour protection area for WTG foundations (50 WTGs (Option A) with 4-legged multi-leg foundations with suction buckets) and Maximum scour protection volume for WTG foundations (45 WTGs (Option B) with 3-legged multi-leg foundations with suction buckets **OSPs** Maximum scour protection area for the OSP foundation (jacket with suction bucket)	**IACs:** - Assumes a maximum of two cable crossings of Dublin Array cables; - Assumed to be constructed of concrete mattresses (18 per crossing); **Export cables:** Assumes a maximum of 6 cable crossings for all of the export cable; **Foundation scour protection:** Alternative foundation types and WTG options will give rise to varying areas and volumes of scour protection, all less than the maximum design option. Minimum scour protection area for WTG foundations (39 WTGs (Option C) with monopile foundations Minimum scour protection area for the OSP foundation (monopile): 1	
Impact 13: Indirect disturbance arising from EMF generated by the current flowing through buried cables		
Cable burial depths: Inter array cables: 0.6 m Export cables: 0.6 m	**Cable burial depths:** Inter array cables: 0.6 – 3 m Export cables: 0.6– 3 m	The impact is defined by the depth of cable burial. The MDO for impacts from EMF is assumed to be 0 m in the event that cables cannot be buried. Areas and volumes of disturbed sediment have been calculated based on the assumption of 3 m burial depth in standard conditions. In some areas higher burial depths may be required, however, the assumption of these depths along the entire length of the cable is not considered to provide a realistic MDO.
Decommissioning		
Impact 14: Temporary habitat disturbance from decommissioning of foundations, cables and rock protection		
Removal of structures is expected to be undertaken as an approximate reverse of the installation process; - It is anticipated that piled foundations will be cut at a level just below the seabed; - Buried cables to be cut and left in situ (but to be determined in consultation with key stakeholders as part of the decommissioning plan and following best practice at the time of decommissioning); - Scour and cable protection left in situ; and - Decommissioning activities lasting approximately three years for both onshore and offshore works.	Decommissioning activities are expected to be the same for all design options. Alternative design options are represented by varying numbers of total structures within the array area (represented by different WTG options), as shown below.	The MDO is the option with the greatest number of WTGs (Option A: 50 WTGs). All alternatives have lower potential for damage to assets and infrastructure during decommissioning.

<table>
<tr><th>Maximum design option</th><th>Alternative design options</th><th>Justification</th></tr>
<tr><td>Removal of foundations:
- Option A: 50 WTGs; and
- One OSP.

- Landfall infrastructure will be left in situ where considered appropriate. Any requirements for decommissioning at the landfall will be agreed with statutory consultees; and
- It is likely judged that cable removal will bring about further environmental impacts. At present it is therefore proposed that the cables will be left in situ, but this will be reviewed over the design life of the project.</td><td>Removal of foundations:
- Option C: 39 WTGs and Option B: 45 WTGs; and
- One OSP.

As for the MDO Landfall infrastructure will be left in situ where considered appropriate. Any requirements for decommissioning at the landfall will be agreed with statutory consultees; and
- It is likely judged that cable removal will bring about further environmental impacts. At present it is therefore proposed that the cables will be left in situ, but this will be reviewed over the design life of the project.</td><td></td></tr>
<tr><td colspan="3">Impact 15: Increased SSC and sediment deposition from removal of foundations, cables and rock protection</td></tr>
<tr><td colspan="3">As above. See Impact 14: Temporary habitat disturbance from decommissioning of foundations, cables and rock protection</td></tr>
<tr><td colspan="3">Impact 16: Loss of habitat from the removal of foundations and rock protection</td></tr>
<tr><td colspan="3">As above. See Impact 14: Temporary habitat disturbance from decommissioning of foundations, cables and rock protection</td></tr>
<tr><td colspan="3">Impact 17: Seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology</td></tr>
<tr><td colspan="3">As above. See Impact 14: Temporary habitat disturbance from decommissioning of foundations, cables and rock protection</td></tr>
</table>

3.15 Project Design Features and Avoidance and Preventative Measures

3.15.1 As outlined within the EIA Methodology Chapter and in accordance with the EPA Guidelines (2022), this EIAR describes the following:

- Project Design Features: These are features of the Dublin Array project that were selected as part of the iterative design process, which are demonstrated to avoid and prevent significant adverse effects on the environment in relation to benthic, subtidal and intertidal ecology. These are presented within Table 11.
- Other Avoidance and Preventative Measures: These are measures that were identified throughout the early development phase of the Dublin Array project, also to avoid and prevent likely significant effects, which go beyond design features. These measures were incorporated in as constituent elements of the project, they are referenced in the Project Description Chapter of this EIAR and they form part of the project for which development consent is being sought. These measures are distinct from design features and are found within our suite of management plans. These are also presented within Table 11.
- Additional Mitigation: These are measures that were introduced to the Dublin Array project after a likely significant effect was identified during the EIA assessment process. These measures either mitigate against the identified significant adverse effect or reduce the significance of the residual effect on the environment. The assessment of impacts is presented in Sections 3.16, 3.17 and 3.18 of this EIAR chapter.

3.15.2 All measures are secured within Volume 8, Chapter 2: Schedule of Commitments.

3.15.3 Where additional mitigation is identified as being required to reduce the significance of any residual effect in EIA terms, this is presented in Sections 3.16, 3.17 and 3.18.

Table 11 Project Design Features and Avoidance and Preventative Measures relating to benthic subtidal and intertidal ecology

Project Design Features / other avoidance and preventative measures	Where secured
Installation of cables to an optimum cable burial depth - offshore cables will, where possible, be buried in the seabed to the optimal performance burial depth for the specific ground conditions. Where optimum burial depth cannot be achieved secondary protection measure will be deployed e.g. concrete mattress, rock berm, grout bags or an equivalent in key areas	The Project Description Chapter details the requirement for a Cable Installation Plan (CIP) and Cable Burial Risk Assessment (CBRA) which will be developed upon award of consent and in advance of construction. The CIP and CBRA will provide information on the installation plan for subsea cables. The CBRA, will provide a risk assessment and evaluation for cable protection, unburied or shallow buried cables. The CIP will detail pertinent mitigation measures to be used during cable installation and will be applied throughout the construction phase. The CIP and CBRA will be submitted to the consenting authority in advance of construction phase. "
Use of trenchless technology at landfall, cables will be installed by trenchless installation technique beneath the intertidal zone and cliffs at landfall. Exit pits will be located within the offshore ECC seaward of the Mean Low Water (MLW) at a point/depth where cable installation vessels can operate. No cable protection will be used inshore of the exit pits. During excavation of the exit pits, material will be stored to minimise loss of sediment as far as is reasonably practicable.	Outlined within the Project Description Chapter
Applicant will implement the following, in line with the Sea Pollution Act 1991 and MARPOL convention and other similar binding rules and obligations imposed on ship owners and operators by inter alia the International Maritime Organisation as relevant: : Marine Pollution Contingency Plan to cover accidental spills, potential contaminant release and include key emergency contact details (e.g., the Irish Coast Guard (IRCG) and will comply with the National Maritime Oil/ HNS Spill Contingency Plan (IRCG, 2020) . Measures include Storage of all chemicals in secure designated areas with impermeable bunding (up to 110% of the volume); and double skinning of pipes and tanks containing hazardous materials to avoid contamination.	The PEMP includes measures outlined within the Marine Pollution Contingency Plan compliant with relevant legal obligations and frameworks
During the lifetime of the project the Applicant and its contractors will comply with all measures outlined in the Marine Biosecurity Plan to include:	The PEMP includes details of the Marine Biosecurity plan that

Project Design Features / other avoidance and preventative measures	Where secured
▪ All vessels of 400 gross tonnage (gt) and above to be in possession of a current international Anti-fouling System (AFS) certificate; ▪ Details of all ship hull inspections and biofouling management measures be documented by the Contractor; and ▪ All vessels to be compliant (where applicable) with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention, developed and adopted by the International Maritime Organisation (IMO).	details requirements and relevant legislation.
Waste management and disposal arrangements - the developer will dispose of sewage and other waste in a manner which complies with all regulatory requirements, including but not limited to the IMO MARPOL requirements	The PEMP includes provision for waste management and disposal arrangements compliant with relevant legal obligations.
Scour protection measures, options include rock protection or concentrated mattresses, flow energy dissipation devices, protective aprons or bagged solutions	The Project Description Chapter sets out the methods for scour protection and outlines the requirement for a Scour Protection Management Plan (SPMP) developed prior to construction for all offshore infrastructure which will include details of the need, location, type, quantity and installation methods for scour protection which will be undertaken in accordance with the design options, quantities & methods outlined in the Project Description Chapter.

3.16 Environmental Assessment: Construction phase

3.16.1 The effects of the construction of Dublin Array have been assessed within the benthic subtidal ecology and intertidal ecology study areas as defined in Section 3.4. The environmental impacts arising from construction are listed in Table 10 , along with MDO and ADO against which each construction phase impact has been assessed.

3.16.2 A description of the significance of effects upon benthic and intertidal receptors likely to be caused by each identified impact is provided below.

3.16.3 The Kish and Bray Banks encompass areas of the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time'[18], but are not designated sites. However, any likely significant impacts on ecological features of the sandbanks are assessed in this chapter. Any impacts on the physical marine environment have been assessed in Physical Processes chapter.

Impact 1: Temporary increase in Suspended Sediment Concentration and sediment deposition in the array area and Offshore ECC from construction activities

3.16.4 Temporary localised increases in SSC and associated sediment deposition are expected from seabed preparation works in addition to foundation and cable installation. This assessment should be read in conjunction with the Physical Processes Chapter and the Physical Processes Technical Baseline which provide a full description of the offshore physical environment assessment (including project specific modelling of sediment plume dynamics).

3.16.5 Maximum sediment plume distances and peak increases in SSC and deposition that could occur because of construction activities, are presented in the Marine Water and Sediment Quality Chapter. As detailed in the sediment Physical Processes Modelling Report, sediment plumes caused by seabed preparation and installation activities will be restricted to well-within a single spring tidal excursion, with plumes expected to occur over a maximum distance of 10 km from the source. The modelling indicates that sediment plumes, particularly those containing coarser sediment fractions, are expected to quickly dissipate after cessation of the activities, due to settling and wider dispersion with the concentrations reducing quickly over time to background levels. Deposition of resuspended material will consist of the coarser sandy fraction being deposited close to the source, while finer silty material is dispersed further afield before settling with amounts of deposited material reducing exponentially with distance from source.

3.16.6 The magnitude of the impact (temporary increase in SSC and sediment deposition) is assessed in Table 12 based on the methodology outlined in Section 3.5. For the identified benthic biotope receptors, the sensitivity of the receptor to the effect is assessed in Table 13. Biotope receptors identified across the sandbanks, and therefore associated with the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' are also assessed in Table 13 below, as are those biotopes typical of Annex I habitat 'Reefs'. Physical impacts on the sandbanks in the context of marine geology, oceanography and physical processes are assessed in the Physical Processes Chapter.

[18] https://www.npws.ie/marine/marine-habitats/sandbanks

Table 12 Determination of magnitude of temporary increase in SSC and sediment deposition

Definition	Maximum design option	Alternative design options
Extent	The temporary impact of increased SSC and deposition from construction activities is expected to be restricted to the near field and the adjacent areas of the far-field (within one spring tidal cycle).	In line with the maximum design option, impacts restricted to the near field and adjacent areas of the far field, although the increase in SSC will be less.
Duration	The impact will be restricted to the construction phase of the project and will therefore be short-term (maximum of 30 months), although works in any given discrete location within the project boundary will be temporary (less than one year).	In line with the maximum design option impacts will be short term with a minimum construction period of 18 month and a mean of 24 months.
Frequency	The impact will occur frequently in discrete areas throughout the 30 month construction phase of the development with periodicity and magnitude being related to construction activity.	The impact will occur frequently in discrete areas throughout 30 month the construction phase of the development with periodicity and magnitude being related to construction activity.
Probability	The impact upon the subtidal benthic habitats can reasonably be expected to occur.	The impact upon the subtidal benthic habitats can reasonably be expected to occur.
Consequence	Sediment plumes are expected to quickly dissipate after cessation (i.e. lasting less than a day) of the activities, due to settling and wider dispersion with the concentrations reducing quickly over time to background levels. Sediment deposition will consist primarily of coarser sediments deposited close to the source, with a small proportion of silt deposition (reducing exponentially from source). Therefore, the consequence will be barely discernible to noticeable change in SCC concentrations and deposition occurring during the construction phase within the near-field and the adjacent areas of the far-field.	Similar to the MDO with impacts restricted to the near field and adjacent areas of the far field, although the increase in SSC will be less.
Overall magnitude	*The potential magnitude of the predicted changes is rated as **Low.***	*The potential magnitude of the predicted changes is rated as **Low.***

Table 13 MarESA assessment for the benthic subtidal biotopes for temporary increase in SSC and sediment deposition (changes in suspended solids, smothering and siltation rate) with X denoting presence of biotope. (Sensitivity rating: Red = High; Pink = High (not assessed in MarESA therefore determined to be High as a worst-case precaution'; Amber = Medium; Green = Low/not sensitive)

Biotope code (JNCC and EUNIS 2022)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field[19]
Biotopes identified across the subtidal study area that 'may occur within', are 'contained within' or that are 'typical of' Annex I Habitats					
IR.HIR – Atlantic and Mediterranean high energy infralittoral rock	▪ For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	▪ Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.		X	
IR.LIR – Low energy infralittoral rock	▪ For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	▪ Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.		X	
CR.HCR – High energy circalittoral rock	▪ For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	▪ Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.		X	

[19] As per the criteria set out in Section 1.5 far-field has been defined as extending beyond the limits of the offshore infrastructure but within the defined ZoI.

Biotope code (JNCC and EUNIS 2022)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field[19]
SS.SMx.CMx / EUNIS Code MC421 - Faunal communities of Atlantic circalittoral mixed sediment	▪ For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	▪ Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.		X	
CR.HCR.FaT / EUNIS Code MC121 - Faunal turf communities on Atlantic circalittoral rock	▪ For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	▪ Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.		X	
IR.HIR.KFaR / EUNIS Code MB121 - Kelp and seaweed communities on Atlantic infralittoral rock	▪ For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	▪ Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.		X	
SS.SMu.CFiMu / EUNIS Code MC611 - Circalittoral fine mud	▪ For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	▪ Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.		X	
IR.MIR.KR.XFoR / EUNIS Code MB121B - Dense foliose red	▪ Not sensitive to changes in SSC; ▪ Not sensitive to changes to light smothering (< 5 cm); and	▪ Confidence is high for changes in SSC.		X	

Biotope code (JNCC and EUNIS 2022)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field[19]
seaweeds on moderately exposed Atlantic infralittoral silty rock	▪ Low sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is high for light smothering. ▪ Confidence is low for heavy smothering because assessment base on a similar proxy biotope.			
SS.SBR.Smus.ModMx / EUNIS Code MC2232 – *Modiolus modiolus* beds on open coast circalittoral mixed sediment	▪ Not sensitive to changes in SSC; ▪ High sensitivity to light smothering (< 5 cm); and ▪ High sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is high for changes in SSC. ▪ Confidence is high for light smothering and heavy smothering, with the agreement of the evidence and applicability of the evidence also high.			X
SS.SCS.CCS.MedLumVen / EUNIS Code MC3212 - *Mediomastus fragilis, Lumbrineris spp.* And venerid bivalves in circalittoral coarse sand or gravel	▪ Low sensitivity to changes in SSC; ▪ Low sensitivity to light smothering (< 5 cm); and ▪ Medium sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is low for changes in SSC. ▪ Confidence is medium for light smothering. ▪ Confidence is low for heavy smothering because the peer reviewed papers are based on a proxy for the pressure.			X
Additional biotopes identified across the subtidal study area					
SS.SMx.CMx.MysThyMx / EUNIS Code MC4213 - *Kurtiella bidentata* and *Thyasira* spp. In	▪ Not sensitive to changes in SSC; ▪ Not sensitive to light smothering (< 5 cm); and ▪ Low sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is low for changes in SSC. ▪ Confidence is low for light smothering and heavy smothering because the peer reviewed papers are	X	X	

Biotope code (JNCC and EUNIS 2022)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field[19]
circalittoral muddy mixed sediment[20]		based on a proxy for the pressure.			
SS.Ssa.IfiSa.ImoSa / EUNIS Code MB5231 – Infralittoral mobile clean sand with sparse fauna[21]	▪ Low sensitivity to changes in SSC; ▪ Not sensitive to light smothering (< 5 cm); and ▪ Low sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is low for changes in SSC. ▪ Confidence is high for light smothering and heavy smothering because the evidence is based on peer reviewed papers.	X		
SS.SCS.ICS.Glap / EUNIS Code MB3235 – *Glycera lapidum* in impoverished infralittoral mobile gravel and sand[22]	▪ Not sensitive to changes in SSC; ▪ Low sensitivity to light smothering (< 5 cm); and ▪ Medium sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is low for changes in SSC. ▪ Confidence is medium for light smothering. ▪ Confidence is low of heavy smothering because the peer reviewed papers are based on a proxy for the pressure.	X		X
SS.SSA.CfiSa.ApriBatPo / EUNIS Code MC5212 – *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand[23]	▪ Low sensitivity to changes in SSC; ▪ Low sensitivity to light smothering (< 5 cm); and ▪ Medium sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is low for changes in SSC. ▪ Confidence is medium for light smothering. ▪ Confidence is low of heavy smothering because the peer reviewed papers are based on a proxy for the pressure.	X		X

[20] https://www.marlin.ac.uk/habitats/detail/374
[21] https://www.marlin.ac.uk/habitats/detail/262
[22] https://www.marlin.ac.uk/habitats/detail/1137
[23] https://www.marlin.ac.uk/habitats/detail/1133

Biotope code (JNCC and EUNIS 2022)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field[19]
SS.SSA.IfiSa.NcirBat / EUNIS Code MB5233 – *Nephtys cirirrosa* and *Bathyporeia* spp. In infralittoral sand[24]	▪ Low sensitivity to changes in SSC; ▪ Not sensitive to light smothering (< 5 cm); and ▪ Low sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is low for changes in SSC. ▪ Confidence is high for light smothering and heavy smothering because the evidence is based on peer reviewed papers.	X		
SS.SSA.CmuSa.AalbNuc / MC5214 – *Abra alba* and *Nucula Nitidosa* in circalittoral muddy sand or slightly mixed sediment[25]	▪ Low sensitivity to changes in SSC; ▪ Low sensitivity to light smothering (< 5 cm); and ▪ Medium sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is low for changes in SSC. ▪ Confidence is medium for light smothering. ▪ Confidence is low of heavy smothering because the peer reviewed papers are based on a proxy for the pressure.	X	X	X
SS.SMx.CMx.OphMx / MC4215 – *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment[26]	▪ Low sensitivity to changes in SSC; ▪ Low sensitivity to light smothering (< 5 cm); and ▪ Medium sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is medium for changes in SSC, light smothering and heavy smothering, with the agreement of the evidence and applicability of the evidence also medium.		X	
SS.SCS.CCS.PomB / EUNIS Code MC3211 – *Spirobranchus triqueter* with	▪ Not sensitive to changes in SSC; ▪ Not sensitive to light smothering (< 5 cm); and	▪ Confidence is high for changes in SSC. ▪ Confidence is medium for light smothering and heavy			X

[24] https://www.marlin.ac.uk/habitats/detail/154
[25] https://www.marlin.ac.uk/habitats/detail/62
[26] https://www.marlin.ac.uk/habitats/detail/1068

Biotope code (JNCC and EUNIS 2022)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field[19]
barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles[27]	▪ Low sensitivity to heavy smothering (5 – 30 cm)	smothering, with the agreement of the evidence and applicability of the evidence also medium.			
SS.Ssa.ImuSa.FfabMag / EUNIS Code MB5236 – *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	▪ Low sensitivity to changes in SSC; ▪ Low sensitivity to light smothering (< 5 cm); and ▪ Medium sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is low for changes in SSC. ▪ Confidence is medium for light smothering. ▪ Confidence in the quality of the evidence is medium for heavy smothering due to low evidence base.			X
SS.SCS.ICS / EUNIS Code MB32 – Infralittoral coarse sediment	▪ For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst- case precaution).	▪ Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.	X		
SS.Smu.CsaMu.AfilMysAnit / EUNIS Code MC6211 – *Amphiura filiformis, Mysella bidentata* and *Abra*	▪ Not sensitive to changes in SSC; ▪ Not sensitive to light smothering (< 5 cm); and ▪ Medium sensitivity to heavy smothering (5 – 30 cm)	▪ Confidence is low for changes in SSC. ▪ Confidence in the quality of the evidence and the agreement of the evidence is medium and the		X	

[27] https://www.marlin.ac.uk/habitats/detail/177

Biotope code (JNCC and EUNIS 2022)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field[19]
nitida in circalittoral sandy mud		applicability of the evidence is medium for smothering.			
Overall sensitivity	*The worst-case sensitivity for benthic subtidal ecology receptors is rated as **High** (range: low to high - nine biotopes high sensitivity; seven biotopes medium sensitivity; and five biotopes low sensitivity).*				

3.16.7 All biotopes present within the study area have been assessed according to the MarESA criteria as presented in Table 4. The sensitivity of biotopes range from 'not sensitive' to having a 'high' sensitivity to a disturbance of this nature. All biotopes identified across the benthic subtidal ecology study area are acclimated to high levels of SSC that occur naturally within this region and consequently, are naturally subject to and able to tolerate variations in SSC and some degree of sediment deposition.

3.16.8 In relation to reef habitats, sedimentation and increased SSC have been shown to have a detrimental impact on local kelp beds by reducing the light available for photosynthesis (Birkett *et al*., 1998), leading to change in the structure of geogenic reef by reducing habitat complexity. Light penetration determines the lower limit at which algal species can grow and increased turbidity will likely alter reef distribution and as primary producers which utilise daylight for energy through photosynthesis, recovery of geogenic reef from any decreases in water clarity may be prolonged. However, due to the short-term nature of the sediment plumes associated with construction activities no significant impact is anticipated on seaweed dominated inshore reef habitats.

3.16.9 The magnitude of the impact to biotopes identified within the region has been assessed as **Low Adverse**, with the maximum sensitivity of the receptors (including Annex I habitats) being **High** (range: low to high). Therefore, the maximum significance of effect from SSC and deposition occurring as a result of construction activities in the benthic subtidal ecology study area is **Moderate Adverse** (but lower for a number of the biotopes recorded – range: slight to moderate adverse), which is not significant in EIA terms. Table 13 identifies that the confidence for the sensitivity of the specified habitats to temporary increase in SSC and sediment deposition is low in some instances. For all habitats, the low confidence is associated with the resistance measure, with high confidence associated with the recovery (resilience) of the habitats. Since the evidence agrees in terms of direction and magnitude of the impact the assessment is considered a conservative and robust assessment.

3.16.10 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effect

The impacts associated with temporary SSC and sediment deposition as a result of the Dublin Array development have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 11) is considered necessary. No ecologically significant adverse residual effects on benthic subtidal ecology have therefore been predicted.

Impact 2: Temporary increase in Suspended Sediment Concentration and sediment deposition in the intertidal area from construction activities

3.16.11 At the landfall cables will be installed beneath the beach, cliffs and intertidal area by means of trenchless technique and punch out will be in the subtidal; consequently, no impact to the intertidal is anticipated in relation to temporary increase in SSC and sediment deposition and no further assessment is considered.

Impact 3: Temporary habitat loss/disturbance in the array area and Offshore ECC from construction activities

3.16.12 Direct temporary habitat loss/disturbance is expected to occur as a result of seabed preparation prior to foundation installation, jack up and anchoring operations and the installation of inter-array and export cables. Temporary loss/disturbance of benthic habitats will be restricted to discrete areas only within the array area and Offshore ECC with no pathway of effect beyond the project infrastructure. Table 8 presents the MDO associated with temporary subtidal habitat loss/disturbance due to construction activities.

3.16.13 The magnitude of the impact (temporary habitat loss/ disturbance) is assessed in Table 14 based on the methodology outlined in Section 3.5. For the identified benthic biotope receptors, the sensitivity of the receptor to the potential effect is assessed in Table 15 . Biotope receptors identified across the sandbanks, and therefore associated with the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' are also assessed in Table 15 below, as are those biotopes typical of Annex I habitat 'Reefs'. Physical impacts on the sandbanks in the context of marine geology, oceanography and physical processes are assessed in the Physical Processes chapter.

Table 14 Determination of magnitude of temporary habitat disturbance to benthic subtidal habitats.

Definition	Maximum design option	Alternative design option
Extent	Habitat loss/disturbance would be restricted to discrete areas within the project boundary and is therefore regarded as near field.	In line with the maximum design option, impacts restricted to the near field and adjacent areas of the far field, although the total area of seabed disturbed will be less.
Duration	The impact will be restricted to the construction phase of the project and will therefore be short-term (maximum of 30 months), although works in any given discrete location within the project boundary will be temporary (less than one year).	In line with the maximum design option impacts will be short term with a minimum construction period of 18 month and a mean of 24 months.
Frequency	The impact will occur frequently in discrete areas throughout the construction phase of the development.	In line with the maximum design option.

Definition	Maximum design option	Alternative design option
Probability	The impact upon the subtidal habitats can reasonably be expected to occur.	In line with the maximum design option.
Consequence	Construction activities will result in the temporary loss and/or disturbance of discrete areas of subtidal benthic habitat within the immediate vicinity of the works; regarded as a discernible change within the near field.	As the maximum design option, although the total area of seabed will be less.
Overall magnitude	*The potential magnitude of the predicted changes is rated as* ***Low.***	*The potential magnitude of the predicted changes is rated as* ***Low.***

Table 15 MarESA assessment for the benthic subtidal habitats to temporary habitat loss/disturbance (abrasion / disturbance). (Sensitivity rating: Red = High; Pink = High (not assessed in MarESA therefore determined to be High as a worst-case precaution'; Amber = Medium; Green = Low/not sensitive)

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field
Biotopes identified across the subtidal study area that 'may occur within', are 'contained within' or that are 'typical of' Annex I Habitats					
IR.HIR - Atlantic and Mediterranean high energy infralittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.		X	
IR.LIR - Low energy infralittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.		X	
CR.HCR - High energy circalittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.		X	
SS.SMx.CMx / EUNIS Code MC421 - Faunal communities of Atlantic circalittoral mixed sediment	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity	Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.		X	

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field
	of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).				
CR.HCR.FaT / EUNIS Code MC121 - Faunal turf communities on Atlantic circalittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.		X	
IR.HIR.KFaR / EUNIS Code MB121 - Kelp and seaweed communities on Atlantic infralittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.		X	
SS.SMu.CFiMu / EUNIS Code MC611 - Circalittoral fine mud	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not included in MarESA sensitivity assessment.		X	
IR.MIR.KR.XFoR / EUNIS Code MB121B - Dense foliose red seaweeds on moderately exposed Atlantic infralittoral silty rock	Low (based on medium resistance and high resilience	Confidence is low because the peer reviewed papers are based on a proxy and expert judgement for the assessment of pressure.		X	

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field
SS.SBR.Smus.ModMx / EUNIS Code MC2232 – *Modiolus modiolus* beds on open coast circalittoral mixed sediment	High (based on low resistance and low resilience)	Confidence is medium as the assessment is based on some peer reviewed papers but relies on grey literature[28] and expert judgement.			X
SS.SCS.CCS.MedLumVen / EUNIS Code MC3212 - *Mediomastus fragilis, Lumbrineris spp*. And venerid bivalves in circalittoral coarse sand or gravel	Low (based on medium resistance and high resilience	Confidence is low because the peer reviewed papers are based on a proxy and expert judgement for the assessment of pressure.			X
Additional biotopes identified across the subtidal study area					
SS.SMx.CMx.MysThyMx / EUNIS Code MC4213 - *Kurtiella bidentata* and *Thyasira* spp. In circalittoral muddy mixed sediment	Low (based on medium resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.	X	X	
SS.Ssa.IfiSa.ImoSa / EUNIS Code MB5231 – Infralittoral mobile clean sand with sparse fauna	Low (based on low resistance and high resilience)	Confidence is high as the assessment is based on peer reviewed papers (observational or experimental), although the assessment was based on similar pressures on the feature.	X		
SS.SCS.ICS.Glap / EUNIS Code MB3235 – *Glycera lapidum* in impoverished infralittoral mobile gravel and sand	Low (based on medium resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.	X		X

[28] Grey literature is any information that is not produced by commercial publishers including research reports, working papers, conference proceedings, theses and reports produced by government departments, academics, business and industry.

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field
SS.SSA.CFiSa.ApriBatPo / EUNIS Code MC5212 – *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	Low (based on medium resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.	X		X
SS.SSA.IfiSa.NcirBat / EUNIS Code MB5233 – *Nephtys cirirrosa* and *Bathyporeia* spp. In infralittoral sand	Low (based on low resistance and high resilience)	Confidence is high as the assessment is based on peer reviewed papers (observational or experimental), although the assessment was based on similar pressures on the feature.	X		
SS.SSA.CmuSa.AalbNuc / EUNIS Code MC5214 – *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Low (based on medium resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.	X	X	X
SS.SMx.CMx.OphMx / EUNIS Code MC4215 – *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment	Medium (based on low resistance and medium resilience)	Confidence is high as the assessment is based on peer reviewed papers (observational or experimental), although the assessment was based on similar pressures on the feature.		X	
SS.SCS.CCS.PomB / EUNIS Code MC3211 – *Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Low (based on medium resistance and high resilience)	Confidence is high as the assessment is based on peer reviewed papers (observational or experimental), although the assessment was based on similar pressures on the feature.			X
SS.Ssa.ImuSa.FfabMag / EUNIS Code MB5236 – *Fabulina fabula* and	Low (based on medium resistance and high resilience)	Confidence is low as the assessment is based on expert			X

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence	Location		
			Array	ECC	Far-field
Magelona mirabilis with venerid bivalves and amphipods in infralittoral compacted fine muddy sand		judgement and therefore a baseline is not available.			
SS.SCS.ICS / EUNIS Code MB32 – Infralittoral coarse sediment	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.	X		
SS.Smu.CsaMu.AfilMysAnit / EUNIS Code MC6211 – *Amphiura filiformis, Mysella bidentata* and *Abra nitida* in circalittoral sandy mud	Medium (based on low resistance and medium resilience)	Confidence is high as the assessment is based on peer reviewed papers (observational or experimental), although the assessment was based on similar pressures on the feature.		X	
Overall sensitivity	*The worst-case sensitivity for benthic subtidal ecology receptors is rated as **High** (range: low to high - nine biotopes high sensitivity; two biotopes medium sensitivity; and ten biotopes low).*				

3.16.14 As demonstrated in Table 15 , the majority of sedimentary benthic biotopes have been determined as having a low sensitivity to physical disturbance. These biotopes are typical of high energy environments and are therefore naturally subject to, and tolerant of, high levels of physical disturbance. The faunal communities are characterised by mobile species such as polychaetes and amphipods, as well as burrowing bivalve species which can re-enter the substratum following temporary habitat disturbance. The recovery of such communities is therefore likely to occur rapidly following cessation of the pressure (<2 years (MarESA)) predominantly as a result of adult migration from surrounding unaffected areas, as well as via larval settlement.

3.16.15 Based on parameters given in Table 10, and assuming 100% seabed clearance and a maximum width of rocky reef habitat of 590 m (based EMODnet seabed substrate data), within the nearshore portion of the ECC a maximum of 4.51 ha of potential rocky reef habitat may be temporarily disturbed during construction, representing 2.59% of habitat off the coast between Killiney and Bray as mapped by MERC Consultants (2022). The estimated area of reef is a precautionary figure as reef features are not contiguous across the identified habitat as indicated in Figure 8. To put this temporary disturbance to Annex I stony reef into the national context, 9,474 km^2 of Annex I reef is present in Irish waters (West *et al*., 2024). Assuming that as a worst case 100% of works within the potential rocky reef habitat was directly to reef features, the area of reef temporarily affected represents 0.0005% of the total area of reef habitat in Irish waters.

3.16.16 It is anticipated that disturbance of geogenic reef habitat will be short-term resulting in some direct temporary losses to epifaunal species, which in turn may temporarily affect other species at a local level in relation to reduced availability of prey species in these areas until recovery and recolonisation occurs. Encrusting species are known to become completely lost through winter storms, although, where there is high recruitment potential, recolonisation is rapid, often occurring within a year (Holt *et al*. 1998). Consequently, this habitat is considered to have a high recoverability and recolonisation of rocky reef communities is expected following temporary disturbance. Furthermore, as detailed in the Project Description Chapter, material excavated in relation to cable installation and HDD activities will be utilised to backfill excavations, much of the biota will not be removed from the area thus enabling biotope recovery and minimising impacts.

3.16.17 As discussed the proportion of geogenic reef likely to be affected will be relatively low compared with the total area of this habitat within the local area. Consequently, it is anticipated that any temporary loss or disturbance will result in no significant impact to the ecological function of these habitats.

3.16.18 Of the three reef biotopes identified from this area in site specific surveys (APEM, 2024) 'Faunal turf communities on Atlantic circalittoral rock' (CR.HCR.FaT / EUNIS Code MC121) and 'Kelp and seaweed communities on Atlantic infralittoral rock' (IR.HIR.KFaR / EUNIS Code MB121) were not assessed within the Marlin MarESA sensitivity assessment so as the sensitivity to physical disturbance is determined to be high as a precautionary approach.

3.16.19 The third potential reef biotope, ‘Dense foliose red seaweeds on moderately exposed Atlantic infralittoral silty rock’ (IR.MIR.KR.XFoR / EUNIS Code MB121B) is assessed within Marlin MarESA sensitivity assessment to have low sensitivity to this pressure. This biotope was the most frequently recorded potential ref habitat recorded during three, being present in the central and western parts of the survey area. There is considerable evidence worldwide that the communities of geogenic reef habitats can demonstrate signs of recovery and potentially be considered to be restored towards a natural state if pressures are removed (Johnston and Mousley, 2021). Consequently, as this biotope is assessed as being of high resilience to physical disturbance, associated communities are expected to recover rapidly.

3.16.20 Some biotopes have been assigned a sensitivity of medium or high. Those of medium sensitivity generally have low resistance and medium resilience to the impact. Those assigned a high sensitivity rating, have been done so on a precautionary basis, due to the lack of MarESA sensitivity assessment for the biotope.

3.16.21 Table 15 identifies that the confidence for the sensitivity of the specified habitats to habitat loss/ disturbance of the surface is low in some instances. For all habitats the low confidence is associated with the resistance measure, with high confidence associated with the recovery (resilience) of the habitats. Since the evidence agrees in terms of direction and magnitude of the impact the assessment is considered a conservative and robust assessment.

3.16.22 The magnitude of the impact on both sedimentary and potential reef habitats has been assessed as **Low Adverse for both the MDO and the alternative design options**, with the maximum sensitivity of the receptors being **High** (range: low to high). For all receptors identified, the significance of effect from temporary habitat loss/disturbance as a result of Dublin Array is **Moderate Adverse** (but lower for a number of the biotopes recorded – range: slight to moderate adverse) which is not significant in EIA terms.

3.16.23 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effect

The impacts associated with temporary habitat loss/disturbance as a result of the Dublin Array development have been assessed as ‘not significant’ in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 11) is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal and intertidal ecology have therefore been predicted.*

Impact 4: Temporary habitat loss/disturbance in the intertidal area from construction activities

3.16.24 At the landfall cables will be installed by trenchless technique beneath the beach, cliffs and intertidal area and punch out will be in the subtidal; consequently, no impact to the intertidal is anticipated in relation to temporary habitat loss/disturbance in the intertidal area and no further assessment is considered.

Impact 5: Seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology in the array area and Offshore ECC

3.16.25 There is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants, to be released into the water column and effect the benthic subtidal and intertidal ecology receptors as a result of construction activities and sediment mobilisation.

3.16.26 Site-specific contaminants sampling provided confirmation that the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC. One sample located to the south of the Kish and Bray Banks exceeded the Lower Limit for arsenic, while relatively high levels of aluminium were recorded at two sites in the ECC, although these were comparable with concentration reported previously from Dublin Bay (Cunningham, 2018) and the samples align with expected contaminant levels (pers.comm, Cronin, 2021). No samples exhibited PAH levels in exceedance of the Irish Sediment Quality Guidelines. No elevated levels of THC and n-Alkanes were detected and levels of DHT and TBT were well below the Irish Sediment Quality Lower Level.

3.16.27 Anticipated disturbance expected as a result of construction activities, the majority of re-suspended sediments are expected to be deposited in the immediate vicinity of the works. The release of contaminants from the small proportion of fine sediments is likely to be rapidly dispersed with the tide and/ or currents and therefore increased bioavailability resulting in adverse eco-toxicological effects are not expected.

3.16.28 With respect to accidental pollution, good construction practice standards will be adhered to and control measures will be adopted to ensure necessary levels of environmental performance are being met and environmental risks are appropriately managed. Protocols will be put in place to ensure that there is a timely, measured, and effective response to all marine pollution incidents in the marine environment arising from any activities associated with construction and operation. Those protocols and standards will be compliant with relevant legislation (including MARPOL and the Sea Pollution Act). All project and contractor vessels shall comply with MARPOL and the Sea Pollution Act and associated regulations.

3.16.29 Whilst substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment, no discharges (continuous or intermittent) of chemicals or materials, which may be toxic or persistent within the marine environment, will be used during any phase of Dublin Array (see Project Description Chapter).

3.16.30 A full assessment of the impacts to water quality from accidental spills, accidental releases and releases of contaminated sediments is presented in the Marine Water and Sediment Quality chapter.

3.16.31 The magnitude of the impact on benthic ecology is assessed in Table 16 based on the methodology outlined in Section 3.5. For the identified benthic biotope receptors (inclusive of those across the Kish and Bray Banks), the sensitivity of the receptor is not assessed on a biotope basis because there is lack of research, and the pressures are not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the toxic pollutants that may be disturbed is therefore determined to be **High** (as a worst-case precaution).

Table 16 Determination of magnitude of Seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology

Definition	Maximum design option	Alternative design option
Extent	Following disturbance as a result of construction activities, the majority of re-suspended sediments are expected to be deposited in the immediate vicinity of the works (near-field). The release of contaminants from fine sediments is likely to be rapidly diluted with the tide and/ or currents and therefore increased bioavailability resulting in adverse eco-toxicological effects are not expected. The extent of an accidental spill is not considered further as the likelihood of a spill incident will be reduced by the implementation of mitigation (Table 11).	In line with the maximum design option, impacts restricted to the near field and adjacent areas of the far field, although the increase in disturbed sediment will be less.
Duration	The impact will be restricted to the construction phase of the project and will therefore be short-term (maximum of 30 months), although works in any given discrete location within the project boundary will be temporary (less than one year).	In line with the maximum design option impacts will be short term with a minimum construction period of 18 month and a mean of 24 months.
Frequency	The impact will occur intermittently in discrete areas throughout the construction phase of the development.	The impact will occur intermittently in discrete areas throughout the construction phase of the development
Probability	The release of contaminants from fine sediments is likely to be rapidly disturbed with the tide and/ or currents and therefore increased bioavailability resulting in adverse eco-toxicological effects is not expected to occur.	The release of contaminants from fine sediments is likely to be rapidly disturbed with the tide and/ or currents and therefore increased bioavailability resulting in adverse eco-toxicological effects is not expected to occur.

Definition	Maximum design option	Alternative design option
Consequence	Construction activities are not expected to cause any discernible change through the construction phase within the near-field and the adjacent of the far-field, to benthic subtidal and intertidal ecology features from the release of sediment contaminants and /or accidental contamination.	In line with the maximum design option, although the increase in disturbed sediment will be less.
Overall magnitude	*The potential magnitude of the predicted changes is rated as **Negligible.***	*The potential magnitude of the predicted changes is rated as **Negligible.***

3.16.32 The magnitude of the impact has been assessed as **Negligible for both the MDO and alternative design options**, with the maximum sensitivity of the receptors being **High.** Therefore, the significance of effect from temporary habitat loss/disturbance is a **Neutral Effect** which is **Not Significant.**

3.16.33 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effect

The significance of effect associated with seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal ecology receptors have therefore been predicted.*

Impact 6: Increased risk of introduction or spread of IAS due to presence of subsea infrastructure and vessel movements (e.g. ballast water)

3.16.34 The movement of construction vessels has the potential to impact upon benthic subtidal ecology and biodiversity by contributing to the risk of introduction or spread of IAS through ballast water discharge. There will be up to 813 round trips to port from construction vessels and an additional 1825 round trips from small vessels such as CTVs during construction However, the movement of commercial vessels is common throughout the region (Volume 3, Chapter 10: Shipping and Navigation [hereafter referred to as the Shipping and Navigation Chapter) and this provides an existing and potentially more likely method of transport for IAS species (due to the higher variety of ports and passage routes). Therefore, any contribution of construction vessels would be negligible in comparison to the impacts of other marine users.

3.16.35 Project Design Features and Avoidance and Preventative Measures will be implemented, detailed within a marine biosecurity plan detailing how the risk of introduction and spread of invasive non-native species will be minimised to ensure that the risk of potential introduction and spread of IAS will be minimised as far as is reasonably practicable.

3.16.36 The magnitude of the impact is assessed in Table 17 based on the methodology outlined in Section 3.5. For the identified benthic biotope receptors, the sensitivity of the receptor to the potential effect is assessed in Table 18. The worst-case sensitivity for benthic subtidal ecology is rated as **High** to an impact of this nature.

Table 17 Determination of magnitude of risk of introduction of IAS

Definition	Maximum design option	Alternative design option
Extent	The extent of the impact will be restricted the near-field where construction vessel movement will occur.	In line with the maximum design option, impacts restricted to the near field, although the number of vessel transits will be less and thus the likelihood of any impacts reduced.
Duration	The impact will be restricted to the construction phase of the project and will therefore be short-term (maximum of 30 months), although works in any given discrete location within the project boundary will be temporary (less than one year).	In line with the maximum design option impacts will be short term with a minimum construction period of 18 month and a mid of 24 months.
Frequency	The impact will occur intermittently throughout the construction phase of the development.	In line with the maximum design option, although the number of vessel transits will be less.
Probability	Project Design Features and Avoidance and Preventative Measures which include a marine biosecurity plan (Table 11) will ensure that the risk of potential introduction and spread of IAS will be minimized.	Project Design Features and Avoidance and Preventative Measures which include a marine biosecurity plan (Table 11) will ensure that the risk of potential introduction and spread of IAS will be minimized.
Consequence	Vessel movements may result in the introduction or spread of IAS through ballast water discharge.	In line with the maximum design option.
Overall magnitude	*The potential magnitude of the predicted changes is rated as **Low**.*	*The potential magnitude of the predicted changes is rated as **Low**.*

Table 18 MarESA assessment for the benthic subtidal habitats for of introduction of IAS. (Sensitivity rating: Red = High; Pink = High (not assessed in MarESA therefore determined to be High as a worst-case precaution'; Amber = Medium; Green = Low/not sensitive)

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence
Biotopes identified across the subtidal study area that 'may occur within', are 'contained within' or that are 'typical of' Annex I Habitats		
IR.HIR - Atlantic and Mediterranean high energy infralittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
IR.LIR - Low energy infralittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
CR.HCR - High energy circalittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
SS.SMx.CMx / EUNIS Code MC421 - Faunal communities of Atlantic circalittoral mixed sediment	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
CR.HCR.FaT / EUNIS Code MC121 - Faunal turf communities on Atlantic circalittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence
IR.HIR.KFaR / EUNIS Code MB121 - Kelp and seaweed communities on Atlantic infralittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
SS.SMu.CFiMu / EUNIS Code MC611 - Circalittoral fine mud	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
IR.MIR.KR.XFoR / EUNIS Code MB121B - Dense foliose red seaweeds on moderately exposed Atlantic infralittoral silty rock	Not sensitive (based on high resistance and high resilience).	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SBR.SMus.ModMx / EUNIS Code MC2232 – *Modiolus modiolus* beds on open coast circalittoral mixed sediment	No evidence on Marlin MarESA assessment, so a High sensitivity has been adopted.	No evidence on Marlin MarESA assessment, so a Low confidence has been adopted.
SS.SCS.CCS.MedLumVen / EUNIS Code MC3212 - *Mediomastus fragilis, Lumbrineris spp*. and venerid bivalves in circalittoral coarse sand or gravel	High sensitivity (based on no resistance and very low resilience).	Confidence is high as the assessment is based on peer reviewed papers (observational or experimental), although the assessment was based on similar pressures on the feature..
Additional biotopes identified across the subtidal study area		
Fine sands with *Angulus tenuis* community complex and **S.LSa.FiSa.Po.Aten / EUNIS Code MA52412** – Polychaetes and *Angulus tenuis* in littoral fine sand	High (based on low resistance and very low resilience).	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SMx.CMx.MysThyMx / EUNIS Code MC4213 –*Kurtiella bidentata* and	High (based on no resistance and very low resilience).	Confidence is high as the assessment is based on peer reviewed papers (observational or

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence
Thyasira spp. in circalittoral muddy mixed		experimental), although the assessment was based on similar pressures on the feature.
SS.SSa.IFiSa.IMoSa / EUNIS Code MB5231 – Infralittoral mobile clean sand with sparse fauna	Not sensitive (based on high resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SCS.ICS.Glap / EUNIS Code MB3235 – *Glycera lapidum* in impoverished infralittoral mobile gravel and sand	High (based on no resistance and very low resilience).	Confidence is high as the assessment is based on peer reviewed papers (observational or experimental), although the assessment was based on similar pressures on the feature.
SS.SSA.CFiSa.ApriBatPo / EUNIS Code MC5212 – *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	High (based on no resistance and very low resilience).	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SSA.IFiSa.NcirBat / EUNIS Code MB5233 – *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand	Not sensitive (based on high resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available
SS.SSA.CMuSa.AalbNuc / EUNIS Code MC5214 – *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	High (based on no resistance and very low resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available
SS.SMx.CMx.OphMx / EUNIS Code MC4215 **–** *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment	No evidence on Marlin MarESA assessment, so a High sensitivity has been adopted.	No evidence on Marlin MarESA assessment, so a Low confidence has been adopted.
SS.SCS.CCS.PomB / EUNIS Code MC3211 – *Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Not sensitive (based on high resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available
SS.SSa.IMuSa.FfabMag / EUNIS Code MB5236 – *Fabulina fabula* and	High (based on no resistance and very low resilience)	Confidence is high as the assessment is based on peer reviewed papers (observational or

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence
Magelona mirabilis with venerid bivalves and amphipods in infralittoral compacted fine muddy sand		experimental), although the assessment was based on similar pressures on the feature
SS.SCS.ICS / EUNIS Code MB32 – Infralittoral coarse sediment	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst- case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
SS.Smu.CsaMu.AfilMysAnit / EUNIS Code MC6211 – *Amphiura filiformis, Mysella bidentata* and *Abra nitida* in circalittoral sandy mud	No evidence on Marlin MarESA assessment, so a High sensitivity has been adopted.	No evidence on Marlin MarESA assessment, so a Low confidence has been adopted.
Overall sensitivity	*The worst-case sensitivity for benthic subtidal ecology receptors is rated as **High** (range: not sensitive to high - eighteen biotopes high sensitivity and four biotopes not sensitive).*	

3.16.37 The magnitude of the impact has been assessed as **Low Adverse**, with the maximum sensitivity of the receptors being **High** (range not sensitive to high). Therefore, the significance of effect from increased risk of introduction or spread of IAS as a result of the Dublin Array is **Moderate Adverse** (but imperceptible for two of the 17 biotopes recorded – range: imperceptible to moderate adverse) for both the MDO and ADO which is not significant in EIA terms.

3.16.38 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

3.16.39 The MarESA assessments (Table 18) identifies that the confidence for the sensitivity of the specified habitats to introduction of IAS is low in some instances. This low confidence is associated with a lack of direct evidence for either recoverability or resilience. However, as the assessment has been based on the worst-case high sensitivity, the assessment can be considered both conservative and robust.

Residual effect

*The significance of effect associated with the introduction or spread of IAS as a result of construction vessel movement is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary**. No ecologically significant adverse residual effects** on benthic subtidal ecology receptors have therefore been predicted.*

3.17 Environmental assessment: Operational phase

3.17.1 The effects of operation and maintenance of Dublin Array offshore infrastructure have been assessed on the benthic subtidal ecology and intertidal ecology study areas as defined in Section 3.1. The environmental impacts arising from operation and maintenance of Dublin Array are listed in Table 10 , along with the MDO and ADO against which each O&M phase impact has been assessed.

3.17.2 A description of the significance of effect upon benthic and intertidal receptors caused by each identified impact is provided below.

Impact 7: Long term habitat loss from the presence of foundations, scour and cable protection

3.17.3 The presence of the WTG and OSP foundations and the associated scour protection (if installed), along with the cable protection measures used at cable crossings and areas where cable burial is not possible, will lead to a change from a sedimentary habitat to one characterised by hard substrate. The magnitude of the impact and sensitivities of the benthic habitats to habitat loss are as described in Table 19 below.

Table 19 Determination of magnitude of long term habitat loss resulting in potential effects on benthic ecology

Definition	Maximum design option	Alternative design option
Extent	Habitat loss/disturbance would be localised, restricted to discrete areas within the project boundary and is therefore regarded as near field.	In line with the maximum design option, impacts restricted to the near field and adjacent areas of the far field, although total area of seabed disturbed will be less.
Duration	The impact is anticipated to persist for the operating lifetime of the Dublin Array Wind Farm (35 years) and therefore is considered to be long-lasting (15 – 60 years).	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).
Frequency	The impact will occur within the footprint of the structures and scour and cable protection.	In line with the maximum design option.
Probability	The impact upon the subtidal habitats can reasonably be expected to occur.	In line with the maximum design option.
Consequence	O&M activities will result in the loss of discrete areas of subtidal benthic habitat within the immediate vicinity of the works; regarded as a permanent but localised change	As the maximum design option, although the total area of seabed will be less.
Overall magnitude	*The potential magnitude of the predicted changes is rated as **Low.***	*The potential magnitude of the predicted changes is rated as **Low.***

3.17.4 The change from a sedimentary habitat to one characterised by hard substrate will be considered as either a long-term habitat loss or a permanent change and is therefore considered an impact of the operational phase of the development and potentially beyond. It is assessed here as long-term/permanent habitat loss.

3.17.5 While the impact will be locally significant and comprise a permanent change in seabed habitat within the footprint of the structures and scour and cable protection, the footprint of the area affected is highly localised. A change of subtidal sediment biotopes to rock or artificial hard substratum would alter the character of the biotope leading to reclassification and the loss of the sedimentary community. Furthermore, as the habitats and characterising biotopes are common and widespread throughout the wider region the loss of these habitats would be discernible but slight (see Table 13). The magnitude is therefore assessed as low.

3.17.6 As demonstrated in Table 14, the majority of the benthic biotopes have been determined as having a low sensitivity to physical disturbance. These biotopes are typical of high energy environments and are therefore naturally subject to, and tolerant of, high levels of physical disturbance. The faunal communities are characterised by mobile species such as polychaetes and amphipods, as well as burrowing bivalve species which can re-enter the substratum following temporary habitat disturbance. The recoverability of such communities is therefore likely to occur rapidly (<2 years (MarESA)) predominantly as a result of adult migration from surrounding unaffected areas, as well as via larval settlement.

3.17.7 Some biotopes have been assigned a sensitivity of medium or high. Those of medium sensitivity generally have low resistance and medium resilience to the impact. Those assigned a high sensitivity rating, have been done so on a precautionary basis, due to the lack of MarESA sensitivity assessment for the biotope.

3.17.8 Table 14 identifies that the confidence for the sensitivity of the specified habitats to habitat loss/ disturbance of the surface is low in some instances. For all habitats the low confidence is associated with the resistance measure, with high confidence associated with the recovery (resilience) of the habitats. Since the evidence agrees in terms of direction and magnitude of the impact the assessment is considered a conservative and robust assessment.

3.17.9 The magnitude of the impact has been assessed as Low Adverse, with the maximum sensitivity of the receptors being **High** (range: low to high). For all receptors identified, the significance of effect from temporary habitat loss/disturbance as a result of Dublin Array is **Moderate Adverse** (but lower for a number of the biotopes recorded – range: slight to moderate adverse) which is not significant in EIA terms.

3.17.10 Based on the assessment undertaken it is predicted that the maximum sensitivity of the receptors in the subtidal is **High**, and the magnitude for impacts in the subtidal is **Low Adverse for both the MDO and alternative design options**. Therefore, the significance of effect from habitat loss as a result of Dublin offshore infrastructure is **Moderate Adverse** within the subtidal and intertidal regions, which is not significant in EIA terms. The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effect

The significance of effect associated with loss of benthic habitats is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal ecology receptors have therefore been predicted as a result of long-term habitat loss.*

Impact 8: Habitat disturbance in the array area and Offshore ECC from operation and maintenance activities

3.17.11 The total maximum area of temporary subtidal habitat disturbance will arise from the use of jack-up vessels for operational and maintenance activities as well as from cable maintenance and cable repair. Cable replacement works will require de-burial and re-burial of a cable or cable sections and along with cable preventative maintenance, including re-burial, will consequently result in increases in SSC and sediment deposition. However, the impacts from these works will be limited to discrete areas and spread over the life span of O&M activities with only a limited number of activities occurring within any one year. Table 10 presents the MDO associated with habitat disturbance from O&M activities with Table 20 presenting the magnitude of the effect.

Table 20 Determination of magnitude of habitat disturbance resulting in potential effects on benthic ecology

Definition	Maximum design option	Alternative design option
Extent	Habitat disturbance would be localised, restricted to discrete areas within the project boundary and is therefore regarded as near field.	In line with the maximum design option, impacts restricted to the near field and adjacent areas of the far field, although total area of seabed disturbed will be less.
Duration	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).
Frequency	Impacts will be restricted to limited number of activities occurring within any one year.	In line with the maximum design option but will involve the requirement for fewer maintenance events to be required over the lifetime of the Project.
Probability	The impact upon the subtidal habitats can reasonably be expected to occur.	In line with the maximum design option.
Consequence	O&M activities will result in the disturbance of discrete areas of subtidal benthic habitat within the immediate vicinity of the works.	As the maximum design option, although the total area of seabed disturbed will be less.
Overall magnitude	*The potential magnitude of the predicted changes is rated as **Low.***	*The potential magnitude of the predicted changes is rated as **Low.***

3.17.12 While the impact will be locally significant and comprise a permanent change in seabed habitat within the footprint of the structures and scour and cable protection, the footprint of the area affected is highly localised. A change of subtidal sediment biotopes to rock or artificial hard substratum would alter the character of the biotope leading to reclassification and the loss of the sedimentary community. Furthermore, as the habitats and characterising biotopes are common and widespread throughout the wider region the loss of these habitats would be discernible but slight (see Table 15). The magnitude is therefore assessed as low.

3.17.13 Given that the habitats are common and widespread throughout the wider region the temporary habitat disturbance during O&M activities would have an impact on a very limited footprint compared to their overall extent. As detailed in Table 15 the habitats directly affected by habitat loss/disturbance have a worst-case sensitivity of high to a disturbance of this nature, with the MarESA assessment also presented in detail.

3.17.14 Based on the assessment undertaken, it is predicted that the maximum sensitivity of the receptors in the subtidal and intertidal is **High**, and the magnitude for impacts in the subtidal and intertidal is **Low Adverse for both the MDO and alternative design options**. Therefore, the significance of effect from habitat disturbance as a result of Dublin Array is **Moderate Adverse** within the subtidal and intertidal regions, which is not significant in EIA terms.

3.17.15 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effect

The significance of the effect associated with from temporary habitat disturbance during the O&M phase is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal ecology receptors have therefore been predicted as a result of temporary habitat disturbance.*

Impact 9: Seabed disturbances from maintenance activities leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology

3.17.16 As described for Impact 4: Temporary habitat loss/disturbance in the intertidal area from construction activities there is potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants, to be released into the water column and lead to an effect on benthic subtidal and intertidal ecology receptors following O&M activities.

Table 21 Determination of magnitude of the potential for contamination resulting in potential effects on benthic ecology

Definition	Maximum design option	Alternative design option
Extent	Following disturbance as a result of O&M activities, the majority of re-suspended sediments are expected to be deposited in the immediate vicinity of the works (near-field). The release of contaminants from fine sediments is likely to be rapidly disturbed with the tide and/ or currents and therefore increased bioavailability resulting in adverse eco-toxicological effects are not expected. The extent of an accidental spill is not considered further as the likelihood of a spill incident will be reduced by the implementation of Project Design Features and Avoidance and Preventative Measures with resultant negligible extent (Table 11).	In line with the maximum design option, impacts restricted to the near field and adjacent areas of the far field, although the extent of disturbed sediment will be less.
Duration	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).
Frequency	Impacts will be restricted to limited number of activities occurring within any one year which themselves are limited.	As the maximum design option, although the impact will occur less frequently with a reduced number of maintenance activities required.
Probability	Adverse eco-toxicological effects are not expected as the release of contaminants from fine sediments is likely to be rapidly disturbed with the tide and/ or currents and therefore increased bio-availability unlikely to occur.	In line with the maximum design option
Consequence	O&M activities are not expected to cause any discernible change over the lifetime of the project to benthic subtidal and intertidal ecology features as no adverse eco-toxicological effects are not expected from the release of	O&M activities are not expected to cause any discernible change over the lifetime of the project to benthic subtidal and intertidal ecology features as no adverse eco-toxicological effects are not expected from the release of

Definition	Maximum design option	Alternative design option
	sediment contaminants and /or accidental contamination.	sediment contaminants and /or accidental contamination.
Overall magnitude	*The potential magnitude of the predicted changes is rated as **Negligible.***	*The potential magnitude of the predicted changes is rated as **Negligible.***

3.17.17 There are limited O&M activities that would result in the re-suspension of sediments. Cable reburial would be one of those impacts, although most re-suspended sediments are expected to be deposited in the immediate vicinity of the works. The release of contaminants from the small proportion of fine sediments is likely to be rapidly dispersed with the tide and/ or currents and therefore increased bioavailability resulting in adverse eco-toxicological effects are not expected.

3.17.18 With respect to accidental pollution, good practice standards will be adhered to and control measures will be adopted to ensure necessary levels of environmental performance are being met and environmental risks are appropriately managed. Protocols will be put in place to ensure that there is a timely, measured, and effective response to all marine pollution incidents in the marine environment arising from any activities associated with operation and maintenance. As detailed in Table 11, the PEMP includes measures outlined within the Marine Pollution Contingency Plan compliant with relevant legal obligations and frameworks designed to ensure that the risk of potential impacts of the release of sediment contaminants and /or accidental contamination on benthic ecology will be minimised as far as is reasonably practicable.

3.17.19 The impacts from the release of sediment bound contaminants on benthic habitats from the O&M phase are expected to be less than that for construction due to lower level of proposed works and are therefore of a reduced magnitude. The magnitude of the impact and sensitivities of the benthic habitats to the release of contaminants are described in Table 20.

3.17.20 Based on the assessment undertaken, which would be considered to be a very precautionary MDO for the O&M process, it is predicted that the maximum sensitivity of the receptors is **High Adverse**, and the magnitude of the impacts **is Negligible for both the MDO and alternative design options. Therefore**, the significance of effect from habitat disturbance is a **Neutral Effect** as a result of Dublin offshore infrastructure which is **Not Significant** in EIA terms.

3.17.21 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effect

The significance of effect associated with seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology during the O&M phase is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal ecology receptors have therefore been predicted.*

Impact 10: Colonisation of the WTGs and scour/ cable protection which may affect benthic subtidal ecology and biodiversity.

3.17.22 The introduction of hard substrate will change the type of available habitats within the benthic subtidal ecology study area. Table 10 presents the MDO associated with colonisation of the WTGs and scour/cable protection for benthic subtidal ecology.

3.17.23 Hard substrate habitats are comparatively rare across Dublin Array which is dominated by sedimentary habitats. The introduction of hard substrate, and associated increases in biodiversity, will locally alter the biotopes that characterise the area at the location of the infrastructure and will be long term, lasting for the duration of the development. Any effects on benthic subtidal ecology, arising from the introduction of hard substrates will be localised to the array area and Offshore ECC, and sections of offshore and inter-array cables where protection is laid.

3.17.24 The magnitude of the impact is assessed in Table 22 based on the methodology outlined in Section 3.5. No Marlin MarESA sensitivity assessment exists for an impact of this nature, however the soft sediment biotopes likely to be affected are deemed to be of low vulnerability, high recoverability (following removal of the infrastructure) and of local to regional value. The sensitivity of these receptors is therefore, considered to be **Low**.

3.17.25 Any beneficial effects associated with an increase in biodiversity (Lindeboom *et al.*, 2011) will be highly localised in nature and is not regarded as mitigation for the loss of sedimentary habitat associated with the installation of these structures.

Table 22 Determination of magnitude from the colonisation of the WTGs and scour/ cable protection and the associated impacts on benthic subtidal ecology and biodiversity

Definition	Maximum design option	Alternative design option
Extent	The extent of the impact will be largely restricted to the placement of infrastructure which will be within the near-field, with only de-minimis potential impacts within adjacent far-field areas.	In line with the maximum design option, impacts restricted to the near field with only de-minimis potential impacts within adjacent far-field areas. However, total area of seabed disturbed will be less.
Duration	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).
Frequency	The impact will occur constantly throughout the operational phase of the development.	In line with the maximum design option.
Probability	The impact can reasonably be expected to occur.	In line with the maximum design option
Consequence	The placement of infrastructure will provide hard substrate within an area of seabed which would otherwise be characterised by sedimentary habitat with any associated increase in biodiversity representing a potential shift in the receiving environment.	As the maximum design option however the total area of seabed will be less.
Overall magnitude	*The potential magnitude of the predicted changes is rated as **Low**.*	*The potential magnitude of the predicted changes is rated as **Low***

3.17.26 The magnitude of the impact has been assessed as **Low Adverse for both the MDO and alternative design option**, with the maximum sensitivity of the receptors being **Low**. Therefore, the significance of effect from colonisation of the WTGs and scour/ cable protection as a result of the Dublin Array is **Slight Adverse**, which is not significant in EIA terms.

3.17.27 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effects

*The significance of effect associated with the colonisation of the WTGs and scour/ cable protection and the associated impacts on benthic subtidal ecology and biodiversity is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. **No ecologically significant adverse residual effects** on benthic subtidal ecology receptors have therefore been predicted.*

Impact 11: Increased risk of introduction or spread of IAS due to presence of subsea infrastructure and vessel movements (e.g. ballast water)

3.17.28 There is a risk that the introduction of hard substrate into a sedimentary habitat will enable the colonisation of the introduced substrate by IAS that otherwise may not have had a suitable habitat available. The colonisation of structures may also serve as 'stepping-stones' and extend the impact beyond a local scale; based on current scientific knowledge it is not possible to predict whether such a spread will occur and to what extent and which species, if any, this may involve. Consequently, as a precautionary approach the impact is included in the assessment.

3.17.29 No hard substrate will be placed within the intertidal area of the Offshore ECC, however, the infrastructure within the array area and cable protection on the Offshore ECC, inter-array cables and inter OSP cables will provide an area of additional hard substrate which could be considered to provide a ‘stepping-stone’ for IAS. While there is the potential that Dublin Array offshore infrastructure may act as a stepping-stone for IAS, subtidal rock outcroppings as well as intertidal rock are known to occur throughout the region, the introduction of hard substrate will not fundamentally change the type of habitats available within the nearshore regional area. Although, the introduction of hard substrates on Kish and Bray Banks will result in habitat change.

3.17.30 The Biosecurity Plan within the PEMP measures included in will ensure that the risk of potential introduction and spread of IAS will be minimised as far as is reasonably practicable are outlined above in Section 3.15.

3.17.31 Table 10 presents the MDO associated with new hard substrate habitat introduced across the array area and Offshore ECC. While impacts will be long-lasting, the total area of the footprint of the foundations and rock protection equates to approximately 1.12% of the subtidal environment within the array area and Offshore ECC, which is regarded as negligible on a western Irish Sea regional scale.

3.17.32 The movement of vessels in and out of ECC and array area during the O&M phase of the development has the potential to impact upon benthic subtidal ecology and biodiversity by contributing to the risk of introduction or spread of IAS through ballast water discharge. However, the movement of vessels will be localised with transits from the O&M base to the offshore infrastructure and with vessel type restricted to small O&M vessels and lift vessels that would not require the use of ballast water, significantly reducing the potential for vessels to be vectors for IAS. There will be up to 3 daily CTV trips with the addition of up to 100 vessels trips to support scheduled routine and non-routine maintenance per year. In the wider context, the movement of commercial vessels is common through the region (Shipping and Navigation Chapter) and this provides an existing and potentially more likely method of transport for IAS species (due to the higher variety of ports and passage routes). Therefore, any contribution of from O&M vessels would be negligible in comparison to the impacts of other marine users.

3.17.33 Project Design Features and Avoidance and Preventative Measures, including measures within a marine biosecurity plan (Table 11) will, however, ensure that the risk of potential introduction and spread of IAS will be minimised.

3.17.34 The magnitude of the impact is assessed in Table 23 based on the methodology outlined in Section 3.5. For the e identified benthic biotope receptors, sensitivity of receptor to the potential effect is assessed in Table 18. The worst-case sensitivity for benthic subtidal ecology is rated as **High** to an impact of this nature.

Table 23 Determination of magnitude of risk of introduction of IAS during O&M

Definition	Maximum design option	Alternative design option
Extent	The extent of the impact will be largely restricted to introduced infrastructure within the near-field, with only de-minimis potential impacts within adjacent far-field areas.	In line with the maximum design option, impacts restricted to the near field however the number of vessel transits will be less.
Duration	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).
Frequency	The impact will occur constantly throughout the operational phase of the development.	In line with the maximum design option, although the number of vessel transits will be less.
Probability	The introduction of IAS is not anticipated to occur given the size and local nature of O&M vessels and the controls in place through a Biosecurity Plan.	The introduction of IAS is not anticipated to occur given the nature size and local nature of O&M vessels and the controls in place through a Biosecurity Plan.
Consequence	The placement of infrastructure will provide hard substrate within an area of seabed which is, locally, largely characterised by sedimentary habitat. However, areas of outcropping rock throughout the study area and wider region do occur.	In line with the MDO.
Overall magnitude	*The potential magnitude of the predicted changes is rated as* ***Negligible.***	*The potential magnitude of the predicted changes is rated as* ***Negligible.***

3.17.35 The magnitude of the impact has been assessed as **Negligible for both MDO and alternative design options**, with the maximum sensitivity of the receptors being **High**. Therefore, the significance of effect from increased risk of introduction or spread of IAS as a result of Dublin Array is a **Neutral Effect** which is **Not Significant** in EIA terms.

3.17.36 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effects

The significance of effect associated with the introduction or spread of IAS as a result of the proposed development is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal ecology receptors have therefore been predicted.*

Impact 12: Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic subtidal and intertidal communities

3.17.37 The presence of foundations, scour protection and cable protection material may introduce changes to the local hydrodynamic and wave regime, resulting in changes to the sediment transport pathways and associated effects on benthic subtidal and intertidal ecology. Scour and increases in flow rates can change the characteristics of the sediment potentially making the habitat less suitable for some species.

3.17.38 It has determined that the impacts on hydrodynamic and wave regimes, changes to sediment transport and sediment transport pathways and scour of seabed sediments will be not significant and would therefore not have any significant impacts on benthic subtidal and intertidal ecology (see Physical Processes Chapter).

3.17.39 The magnitude of the impact is assessed in Table 24 based on the methodology outlined in Section 3.5. For the identified benthic biotope receptors, sensitivity of receptor to the potential effect is assessed in Table 25. Biotope receptors identified across the sandbanks, and therefore associated with the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' are also assessed in Table 13 above, as are those biotopes typical of Annex I habitat 'Reefs'. Physical impacts on the sandbanks in the context of marine geology, oceanography and physical processes are assessed in the Physical Processes Chapter.

Table 24 Determination of magnitude of risk of changes to benthic subtidal and intertidal habitats arising from effects on physical processes during O&M

Definition	Maximum design option	Alternative design option
Extent	The extent of the impact will be largely restricted to the placement of introduced infrastructure which will be within the near-field, with only de-minimis potential impacts within adjacent far-field areas.	In line with the maximum design option.
Duration	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).
Frequency	The impact will occur constantly throughout the both the operational phases of the development.	In line with the maximum design option.
Probability	The impact can reasonably be expected to occur.	In line with the maximum design option.
Consequence	No discernible change in the tidal regime, wave regime and therefore changes to sediment transport and sediment transport pathways and scour of seabed sediments throughout the operation of Dublin Array, will be encountered within the near-field and the adjacent far-field.	No discernible change in the tidal regime, wave regime and therefore changes to sediment transport and sediment transport pathways and scour of seabed sediments throughout the operation of Dublin Array, will be encountered within the near-field and the adjacent far-field.
Overall magnitude	*The potential magnitude of the predicted changes is rated as **Negligible**.*	*The potential magnitude of the predicted changes is rated as **Negligible.***

Table 25 MarESA assessment for the benthic subtidal and intertidal habitats for changes to seabed habitats arising from effects on physical processes (water flow (tidal current) changes (local)/ wave exposure changes (local)). (Sensitivity rating: Red = High; Pink = High (not assessed in MarESA therefore determined to be High as a worst-case precaution'; Amber = Medium; Green = Low/not sensitive)

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence
Biotopes identified across the subtidal and intertidal study areas that 'may occur within', are 'contained within' or that are 'typical of' Annex I Habitats		
IR.HIR - Atlantic and Mediterranean high energy infralittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
IR.LIR - Low energy infralittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
LR.HLR - High energy littoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
CR.HCR - High energy circalittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
SS.SMx.CMx / EUNIS Code MC421 - Faunal communities of Atlantic circalittoral mixed sediment	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence
CR.HCR.FaT / EUNIS Code MC121 - Faunal turf communities on Atlantic circalittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
IR.HIR.KFaR / EUNIS Code MB121 - Kelp and seaweed communities on Atlantic infralittoral rock	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
SS.SMu.CFiMu / EUNIS Code MC611 - Circalittoral fine mud	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
IR.MIR.KR.XFoR / EUNIS Code MB121B - Dense foliose red seaweeds on moderately exposed Atlantic infralittoral silty rock	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is medium for both pressures assessed as the assessment is based on some peer reviewed papers but relies heavily on grey literature or expert judgement on feature.
LR.FLR.Eph.EphX / EUNIS Code MA4211 - Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata	Water flow (tidal current) changes: Low Wave exposure changes: not sensitive.	Confidence is low for both pressures assessed as the assessment is based on expert judgement and therefore a baseline is not available.
LR.MLR.BF.Fser.R / EUNIS Code MA12441 - *Fucus serratus* and red seaweed on moderately exposed lower eulittoral rock	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is medium for both pressures assessed as the assessment is based on some peer reviewed papers but relies heavily on grey literature or expert judgement on feature.

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence
SS.SBR.SMus.ModMx / EUNIS Code MC2232 – *Modiolus modiolus* beds on open coast circalittoral mixed sediment	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is high for both pressures assessed because the evidence is based on peer reviewed papers.
SS.SCS.CCS.MedLumVen/ EUNIS Code MC3212 - *Mediomastus fragilis*, Lumbrineris *spp. and* venerid bivalves in circalittoral coarse sand or gravel	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is high for water flow changes; Confidence is low for wave exposure changes as the assessment is based on expert judgement and therefore a baseline is not available.
LR.HLR.MusB.Sem / EUNIS Code MA1223 - *Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is high for both pressures assessed because the evidence is based on peer reviewed papers.
IR.MIR.KR.Ldig.Bo EUNIS Code MB12172 - *Laminaria digitata* forest on boulders	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is high for both pressures assessed because the evidence is based on peer reviewed papers.
LS.Lsa.MuSa.Lan / EUNIS Code MB12172 - *Lanice conchilega* in littoral sand	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is high for both pressures assessed because the evidence is based on peer reviewed papers.
LS.LMp.LSgr.Znol / EUNIS Code MA6231 - *Zostera (Zosterella) noltei* beds in littoral muddy sand	Water flow (tidal current) changes: medium sensitivity Wave exposure changes: medium sensitivity.	Confidence is high for both pressures assessed because the evidence is based on peer reviewed papers.

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence
Additional Biotopes Identified Across the subtidal and intertidal study areas		
LS.LCS.Sh.BarSh / EUNIS Code MA3211 Barren littoral shingle	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is low for both pressures assessed as the assessment is based on expert judgement and therefore a baseline is not available.
LS.LSa.St.Tal / EUNIS Code MA5211 - Talitrids on the upper shore and strand-line.	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is low wave exposure changes as the assessment is based on expert judgement and therefore a baseline is not available.
LS.LSa.FiSa.Po.Aten / EUNIS Code MA52412 - Polychaetes and *Angulus tenuis* in littoral fine sand	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is low for both pressures assessed as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SMx.CMx.MysThyMx / EUNIS Code MC4213 - *Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is high for both pressures assessed because the evidence is based on peer reviewed papers.
SS.SSa.IFiSa.IMoSa / EUNIS Code MB5231 – Infralittoral mobile clean sand with sparse fauna	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is low for water flow changes; Confidence is high for wave exposure changes as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SCS.ICS.Glap / EUNIS Code MB3235 – *Glycera lapidum* in impoverished infralittoral mobile gravel and sand	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is high for water flow changes; Confidence is low for wave exposure changes as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SSA.CFiSa.ApriBatPo / EUNIS Code MC5212 – *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is low for both pressures assessed as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SSA.IFiSa.NcirBat/ EUNIS Code MB5233 – *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is low for water flow changes; Confidence is high for wave exposure changes as the assessment is based on expert judgement and therefore a baseline is not available.

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence
SS.SSA.CMuSa.AalbNuc/ EUNIS Code MC5214 – *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is low for both pressures assessed as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SMx.CMx.OphMx / EUNIS Code MC4215 – *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is high for water flow changes; Confidence is low for wave exposure changes as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SCS.CCS.PomB / EUNIS Code MC3211 – *Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is high for water flow changes; Confidence is low for wave exposure changes as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SSa.IMuSa.FfabMag / EUNIS Code MB5236 – *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is high for water flow changes; Confidence is low for wave exposure changes as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SCS.ICS / EUNIS Code MB32 – Infralittoral coarse sediment	For this identified benthic biotope receptor, the sensitivity is not assessed within the Marlin MarESA sensitivity assessment. The sensitivity of benthic species to the pressure is therefore determined to be High (as a worst-case precaution).	Not applicable as the sensitivity of this biotope was not assessed.
SS.Smu.CsaMu.AfilMysAnit - / EUNIS Code MC6211 – *Amphiura filiformis, Mysella bidentata* and *Abra nitida* in circalittoral sandy mud	Water flow (tidal current) changes: not sensitive Wave exposure changes: not sensitive.	Confidence is high for both pressures assessed because the evidence is based on peer reviewed papers.

Biotope code (JNCC and EUNIS 2011)	MarESA sensitivity assessment	Assessment confidence
Overall sensitivity	*The worst-case sensitivity for benthic subtidal and intertidal ecology is **High** (range: not sensitive to high – nine biotopes high sensitivity; one biotope medium sensitivity; and 21 biotopes not sensitive)*	

3.17.40 The magnitude of the impact has been assessed as **Negligible for both the MDO and alternative design options**, with the maximum sensitivity of the receptors being **High** (including those that fall within protected sites). Therefore, the significance of effect from changes to seabed habitats arising from effects on physical processes as a result of the Dublin Array is a **Neutral Effect** which is **Not Significant** in EIA terms.

3.17.41 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effects

The significance of effect associated with changes to seabed habitats arising from effects on physical processes as a result of the proposed development is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal ecology receptors have therefore been predicted.*

Impact 13: Indirect disturbance arising from electromagnetic fields (EMF) generated by the current flowing through buried cables

3.17.42 EMF are generated by the current that passes through an electric cable. It is known that EMF can be detected by fish and elasmobranchs (assessed in Fish and Shellfish Ecology Chapter), and it is thought that any benthic invertebrates can also detect EMF. Three types of fields are generated by underwater electric cables: Electric fields (E-fields), magnetic fields (B-fields) and induced electric fields (iE-fields). As per standard industry practice, the types of cables that will be installed at Dublin Array are designed with shielding surrounding the cores which are impervious to electric fields (E fields) and so there is no further consideration of E fields herein as there is no prospect of those fields entering the marine environment (Table 11). Shielding and/or burial does not reduce the B-fields and it is these fields that allow the formation of iE-fields. As such, further reference here to EMF is limited to B-fields and associated iE-fields.

3.17.43 Impacts from changes in EMFs arising from cables, are not considered to result in a significant effect on benthic subtidal and intertidal receptors. EMFs are likely to be generated by subsea cables and detectable above background levels in close proximity to the cables. Although burial does not mask EMFs it increases the distance between species that may be affected by EMFs and the source.

3.17.44 The MarESA sensitivity assessments do not consider there to be sufficient evidence to support assessments of impacts of EMF on benthic and intertidal habitats; therefore, a desktop study has been undertaken to describe the typical responses of benthic invertebrates and inform the sensitivity assessment of benthic receptors.

3.17.45 Typically, the impacts of EMF on marine organisms have focused on electrically sensitive fish and elasmobranchs, with little research focusing on benthic invertebrates, with the few studies using invertebrates focusing on crustaceans (for example Woodruff *et al*., 2012). Furthermore, many studies contradict each other or provide inconclusive results (Switzer and Meggitt, 2010), further reducing the available evidence.

3.17.46 However, evidence of sensing, responding to, or orienting to natural magnetic field cues has been shown for invertebrates including molluscs and arthropods (Lohman and Willows, 1987; Ugolini and Pezzani, 1995; Ugolini, 2006; Boles and Lohmann, 2003). Scott *et al*. (2021) investigated the effects of EMF (strengths 250µT, 500µT and 1000µT) from submarine power cables on edible crab which showed limited physiological and behavioural effects on the crabs exposed to EMF of 250µT. EMF of 500µT or above showed physiological stress in crabs, and changes to behavioural trends, specifically an attraction to EMF. It is to be noted however, that these studies investigated EMF strengths significantly higher than those that receptors will typically be exposed to as a result of offshore wind cables in the marine environment (see Gill and Bartlett, 2010). Specifically, the lowest experimental EMF used in Scott *et al*. (2021) was more than eight times higher than that expected for Dublin Array (predicted to be up to 30 µT assuming a power (current) of 1,200 A and cable buried to 1m) at 1m from the cable, with no impacts identified at this EMF strength. Effects were only noted in these studies using EMF strengths 17 times higher than those expected from the Dublin Array cables. Taking this into consideration, any effects on marine invertebrates are anticipated to only occur in the immediate vicinity of the cable, i.e., within < 10 m each side of the cables. Therefore, it is considered that it is unlikely that there would be any impacts to crustaceans from EMF resulting from cables associated with Dublin Array.

3.17.47 A laboratory study assessing the effects of environmentally realistic, low-frequency B-field exposure on the behaviour and physiology of the common ragworm (*Hediste diversicolo*r) did not find any evidence of avoidance or attraction behaviours (Jakubowska *et al*., 2019). However, the worms did exhibit enhanced burrowing activity when exposed to the B-field, with plausible consequences for their metabolism; however, knowledge about the biological relevance of this response is currently absent (Jakubowska *et al*., 2019).

3.17.48 A study examining the difference in invertebrate communities along an energised and nearby unenergised surface laid cables identified that there were no functional differences between the communities on and around the cables up to three years after installation (Love *et al*., 2016). This study also identified that the EMF levels reduce to background levels generally within one metre of the cable. Similar evidence was collected from wind farm in Denmark determined that there was no change in the overall faunal distribution that could be attributed to the presence of the cables (Hvidt *et al*.,2004).

3.17.49 For invertebrate receptor species, it is difficult to translate the patchwork of knowledge about individual-level EMF effects into assessments of biologically or ecologically significant impacts on populations (Boehlert and Gill, 2010). However, given the evidence presented, it is predicted that EMFs have no significant impact on mobile or sessile benthic invertebrates, including if the cable is surface laid.

3.17.50 The Project Design Features and Preventative Measures (as shown in Table 11) include measures to bury or protect cables, any behavioural responses of benthic receptors are likely to be mitigated. Export and inter-array cables will have sufficient shielding to contain any E-fields generated. In addition, export and inter-array cables will be buried where possible, typically to a target cable burial depth of up to 3 m. Although burial does not entirely mask EMFs, it increases the distance between the EMF source and species that may be affected by EMFs with few infaunal species burrowing deeper than 10 cm in sand (Hines and Comtois, 1985). As the cables will be buried or protected, any behavioural responses are likely to be mitigated due to the increased distance from the surface of the cable.

Table 26 Determination of magnitude of risk of changes to benthic subtidal and intertidal habitats arising from effects from EMF

Definition	Maximum design option	Alternative design option
Extent	The extent of the impact will be limited to immediate vicinity of cable being largely restricted by shielding in-built into cable design and the burial of the cables (up to 3 m in mobile sediment areas).	In line with the maximum design option.
Duration	The impact is anticipated to persist for the operating lifetime of the project (35 years) and therefore is considered to be long-lasting (15 – 60 years).	The impact is anticipated to persist for the operating lifetime of the project (30 years) and therefore is considered to be long-lasting (15 – 60 years).
Frequency	The impact will occur constantly throughout the operational phase of the development.	In line with the maximum design option.
Probability	The impact can reasonably be expected to occur.	In line with the maximum design option
Consequence	Operational cables will emit EMF, which could affect benthic subtidal and intertidal benthic receptors. However, it is unlikely that EMFs will result in significant behavioural responses that will cause a change in benthic communities. Any potential negative effects will be confirmed to a localised area surrounding the cables.	Operational cables will emit EMF, which could affect benthic subtidal and intertidal benthic receptors. However, it is unlikely that EMFs will result in significant behavioural responses that will cause a change in benthic communities. Any potential negative effects will be confirmed to a localised area surrounding the cables.
Overall magnitude	*The potential magnitude of the predicted changes is rated as **Negligible**.*	*The potential magnitude of the predicted changes is rated as **Negligible**.*

3.17.51 The magnitude of the impact has been assessed as **Negligible for both the MDO and alternative design options.** The pressure has been included within the MarESA assessment, however there is no strong evidence and research to support the sensitivity of the biotopes across the array and Offshore ECC. The sensitivity of benthic species to the effects of EMF is therefore determined to be **High** (as a worst-case precaution). Therefore, the significance of effect associated from EMFs arising from cables on benthic ecology as a result of the Dublin Array is a **Neutral Effect** which is **Not Significant** in EIA terms.

3.17.52 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effects

The significance of effect associated from EMFs arising from cables on benthic ecology as a result of the proposed development is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal ecology receptors have therefore been predicted.*

3.18 Environmental assessment: decommissioning phase

3.18.1 As referenced in the Project Description, the Decommissioning and Restoration Plan (Volume 7, Appendix 2), including the three rehabilitation schedules attached thereto, describes how the Applicant proposes to rehabilitate that part of the maritime area, and any other part of the maritime area, adversely affected by the permitted maritime usages that are the subject of the MACs (Reference Nos. 2022-MAC-003 and 004 / 20230012 and 240020).

3.18.2 It is based on the best scientific and technical knowledge available at the time of submission of this Planning Application. However, the lengthy passage of time between submission of the Planning Application and the carrying out of decommissioning works (expected to be in the region of 35 years as defined in the MDO) gives rise to knowledge limitations and technical difficulties. Accordingly, the Decommissioning and Restoration Plan will be kept under review by the Applicant as the project progresses, and an alteration application will be submitted if necessary. In particular, it will be reviewed having regard to the following:

- The baseline environment at the time rehabilitation works are proposed to be carried out;
- What, if any, adverse effects have occurred that require rehabilitation;
- Technological developments relating to the rehabilitation of marine environments;
- Changes in what is accepted as best practice relating to the rehabilitation of marine environments;
- Submissions or recommendations made to the Applicant by interested parties, organisations and other bodies concerned with the rehabilitation of marine environments; and/or

- Any new relevant regulatory requirements.

3.18.3 The Decommissioning and Restoration Plan outlines the process for decommissioning of the WTG, foundations, scour protection, OSP, inter array cables and Offshore ECC. The plan outlines the assumption that the most practicable environmental option is to leave certain structures in situ. All surface structures to be removed and it is assumed that the wind turbine generators (WTG's) will be dismantled and completely removed to shore. Piled foundations will be cut at a level below the seabed, buried cables and scour and cable protection left in situ.

Impact 14: Temporary habitat disturbance from decommissioning of foundations, cables and rock protection

3.18.4 It is anticipated that the piled foundations, will be cut at a level below the seabed, buried cables and scour and cable protection left in situ. Where the cables have been buried, over the lifetime of the project, the seabed is likely to have recovered to its condition prior to work starting.

3.18.5 Should there be a requirement for additional infrastructure to be removed, the nature and extent of temporary habitat loss/disturbance during decommissioning is assumed (for the purposes of this assessment) to be similar or less to that described for the equivalent activities during the construction phase given the lack of seabed preparation required under Impact 3 (paragraphs 3.16.12 *et seq*.). Any such impacts will be related primarily to the removal of export and array cables and associated cable protection should this be required. Turbines will be removed in reverse to the construction methodology although, there is no requirement for seabed preparation prior to decommissioning with the potential for some buried assets to left in situ.

3.18.6 The MDO has assumed the same quantitative requirements for seabed preparation, as it forms a proxy for disturbance. However, as seabed preparation works would not be required, the magnitude of this impact will be lower than during the construction phase.

3.18.7 The details of the proposed decommissioning process are included within the Decommissioning and Restoration Plan which will be submitted as part of the Planning Application.

3.18.8 Based on the assessment undertaken for construction, which would be considered to be a very precautionary MDO for the decommissioning process given the absence of seabed preparation, it is predicted that the maximum sensitivity of the receptors is **High** and the magnitude is **Low Adverse for the MDO and alternative design options** (Table 14). Therefore, the significance of effect from temporary habitat disturbance as a result of Dublin Array is **Moderate Adverse**, which is not significant in EIA terms.

3.18.9 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effects

The significance of effect associated with temporary habitat loss/disturbance as a result of the Dublin Array decommissioning is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal ecology receptors have therefore been predicted.*

Impact 15: Increased Suspended Sediment Concentration and sediment deposition from removal of foundations, cables and rock protection

3.18.10 Increases in SSC and sediment deposition from the decommissioning works associated with removal of the WTGs will be less than that for construction. Should additional infrastructure be required to be removed, the magnitude of the impact and the sensitivities of the benthic habitats to SSC and sediment deposition are as described for the construction phase under Impact 1 (subtidal; paragraphs 3.16.4 *et sq.)*.

3.18.11 Based on the assessment undertaken for construction, which would be considered to be a very precautionary MDO for the decommissioning process as structures are likely to remain in-situ, it is predicted that the maximum sensitivity of the receptors in the subtidal and intertidal is **Medium**. The magnitude for the subtidal is **Low** and **Negligible** for the intertidal on account of the HDD works. Therefore, the significance of effect from temporary habitat disturbance as a result of Dublin Array is **Slight adverse** within the subtidal region which is not significant in EIA terms and **Imperceptible** (not significant) across the intertidal.

3.18.12 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effects

The significance of effect associated with increased SSC and sediment deposition from removal of foundations, cables and rock protection as a result of the Dublin Array decommissioning is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal ecology receptors have therefore been predicted.*

Impact 16: Loss of habitat from the removal of foundations and rock protection

3.18.13 As detailed in Impact 6, hard substrate introduced into Dublin Array is likely to become colonised by epifauna. The removal of any infrastructure during decommissioning would therefore remove these species and associated habitats they had created. In line with the Decommissioning and Restoration Plan it is expected that this be limited to the WTGs and foundations where they will be cut just below the seabed.

3.18.14 The removal of any hard substrate will result in localised declines in biodiversity and areas of bare habitat lost during construction will be exposed and will be open to recolonization by the original soft benthic species. It is expected that the baseline benthic communities will recover in these areas to their pre-construction state based on the recovery rates for disturbed sediment, which would equate to a maximum sensitivity for the baseline habitats of **Medium**.

3.18.15 The magnitude of the impact has been assessed as **Low Adverse**, with the maximum sensitivity of the receptors being **Medium**. Therefore, the significance of effect from risk of changes to seabed habitats arising from loss of introduced habitat from the removal of structures during decommissioning of Dublin Array is **Slight Adverse**, which is not significant in EIA terms.

3.18.16 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effects

The significance of effect associated with the loss of introduced habitat from the removal of foundations and rock protection as a result of the Dublin Array decommissioning is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal ecology receptors have therefore been predicted.*

Impact 17: Seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology

3.18.17 As detailed in Impact 4, there is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants, to be released into the water column and lead to an effect on benthic subtidal ecology receptors. The details of the proposed decommissioning process will be included within the Decommissioning and Restoration Plan (Table 11) which will identify the potential risk of pollutants entering the environment as a result of the decommissioning of offshore infrastructure and suitable measures for mitigating these.

3.18.18 There is likely to be less mobilisation of sediments during the decommissioning phase of the development than that for construction and therefore a reduced magnitude is expected. The magnitude of the impact and the sensitivities of the benthic habitats to SSC and sediment deposition are as described for the construction phase under Impact 4 (described in detail in paragraph 3.16.25 *et seq*.).

3.18.19 As for construction and operation phases and detailed in Table 11, The PEMP includes measures outlined within the Marine Pollution Contingency Plan compliant with relevant legal obligations and frameworks designed ensure the risk of potential impacts of the release of accidental contamination on benthic ecology will be minimised as far as is reasonably practicable.

3.18.20 Based on the assessment undertaken for construction, which would be considered to be a very precautionary MDO for the decommissioning process, the sensitivity of benthic species to the toxic pollutants that may be disturbed is determined to be **High** (Table 15). The magnitude is considered to be **Negligible** (Table 16). Therefore, the significance of effect from temporary habitat disturbance as a result of Dublin Array decommissioning is a **Neutral Effect** which is **Not Significant** in EIA terms.

3.18.21 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual effects

The significance of effect associated with the release of sediment contaminants as a result of the Dublin Array decommissioning is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 11 is considered necessary. ***No ecologically significant adverse residual effects*** *on benthic subtidal ecology receptors have therefore been predicted.*

3.19 Environmental assessment: cumulative effects

Methodology

3.19.1 This section outlines the Cumulative Effects Assessment on subtidal and intertidal benthic ecology and takes in account the impacts of the proposed development alone, together with other plans and projects. As outlined in the Cumulative Effects Assessment Methodology Chapter (Volume 2, Chapter 4) (hereafter referred to as the Cumulative Effects Assessment Methodology Chapter), the screening process involved determination of appropriate search areas for projects, plans and activities and ZoIs for potential cumulative effects. These were then screened according to the level of detail publicly available and the potential for interactions with regard to the presence of an impact pathway as well as spatial and temporal overlap.

3.19.2 The cumulative effects assessment CEA long list of projects, plans and activities with which offshore infrastructure has the potential to interact with to produce a cumulative impact is presented within the Cumulative Effects Assessment Methodology Chapter. Each plan and project has been considered on case by case basis with the maximum suite of projects identified from a long list (Volume 2, Chapter 4, Annex A: Offshore Long-list) within a search area defined as the ICES Ecoregion subsection 7a[29] which broadly covers the Irish Sea, and as such is considered appropriate for this exercise in relation to benthic subtidal and intertidal receptors as it will fully encompass all projects and plans with the potential to have spatial overlap with the effects of the offshore works associated with Dublin Array.

[29]Ecoregions are used to provide regional advice, steer regional integrated approaches and are the primary geographical units for ICES to develop science, new techniques and monitoring programmes. They provide the broad-scale spatial framework for the knowledge base to address management challenges and monitor the changing ecology of the North-East Atlantic. Division 7a is part of the Celtic Sea Ecoregion and broadly covers the Irish Sea

3.19.3 The zone of influence for subtidal and intertidal benthic receptors for the purposes of this assessment has been defined as 17 km from Dublin Array, i.e. the maximum distance that a sediment plume will travel from Dublin Array (equal to a single tidal ellipse in addition to a 1 km buffer). On the basis that these tidal ellipses will be regionally similar, it is considered that sediment plumes from nearby projects and plans will travel a similar distance. Due to the nature of tidal streams, any suspended sediment plumes will travel in the direction of the tidal transport, therefore, adjacent plumes will remain equidistant from one another as they are transported laterally. In addition, as presented in Physical Processes Modelling Report, the plumes associated with the proposed activities for Dublin Array are typically constrained to immediate far field and would be undetectable at the boundaries of the 17 km ZoI. Therefore, any marine operations that are located over 17 km from the Dublin Array offshore works area will therefore not result in an additive cumulative effect. The potential spatial overlap will therefore be considered within 17 km from the offshore works area, which is consistent with the Physical Processes ZoI.

3.19.4 Plans and projects screened in, together with their allocated tier as defined in the Cumulative Effects Assessment Methodology Chapter that reflects their current stage within the planning and development process are presented in Table 23.

3.19.5 The full list of plans and projects considered, including those screened out, are presented in (Volume 2 Chapter 4 Annex A Offshore long-list). For the purposes of the cumulative impact assessment, a precautionary construction period has been assumed between the years 2029 to 2032, with offshore construction (excluding preparation works) lasting up 30 months as a continuous phase within this period (refer to the Project Description chapter). After construction, Dublin Array will be operational for 35 years.

Projects screened out

3.19.6 The following types of developments have been scoped out from this cumulative assessment on benthic subtidal and intertidal receptors based on a lack of a spatial overlap:

- Aggregate production;
- Transboundary disposal sites (i.e. equivalent to Dumping at Sea licences outside of Irish waters);
- Oil and gas pipelines and infrastructure;
- Wave and tidal energy projects;
- Aquaculture; and
- Carbon Capture storage.

3.19.7 Marine surveys were screened out from a cumulative effects assessment for benthic subtidal and intertidal receptors on the basis of a lack of pathway which could result in significant effects in EIA terms. Activities undertaken within the temporary works area, namely the use of jack-up vessels and anchors during the construction, O&M, and decommissioning phases have also been screened out within the Physical Processes Chapter for suspended sediment and deposition with their use not resulting in notable changes in SSC and associated sediment deposition.

Projects for cumulative assessment

3.19.8 The specific projects scoped into this Cumulative Effects Assessment, and the tiers into which they have been allocated are presented in Table 27 below.

3.19.9 The rationale and MDO for the projects selected which have a potential to give rise to cumulative effects for sediment deposition is presented in the Physical Processes Chapter.

Table 27 Projects for cumulative assessment

Development type	Project Name	Current Status of Development	Data confidence assessment / phase	Planned programme
Tier 1				
Jetty construction and dredging	Dublin Port Company MP2 Project	Consented	High – Consented Licence FS006893 Permit S0024-02 (2022-2032) Permit S0024-03 (2022-2029)	Construction activities in Dublin Harbour scheduled to take place 2022-2032; works include dredging within Dublin Harbour and the release of dredged material from vessels west of Burford Bank in outer Dublin Bay. Various activities in Dublin Port including construction of passenger building a new jetty.
Dredging	Dublin Port Company Maintenance Dredging	Consented	High – Consented Licence FS007132	Maintenance dredging at various locations in Dublin Port for the years 2022-2029 (four to six weeks each year).
Subsea cable	EXA Atlantic	Operational	High – Operational	Active telecommunication cable. Unknown O&M works as required.
Subsea cable	Aqua Comms CeltixConnect 1 (CC-1)	Operational	High – Operational	Active telecommunication cable. Unknown O&M works as required.
Subsea cable	ESB ZAYO Emerald Bridge Fibres	Operational	High – Operational	Active telecommunication cable. Unknown O&M works as required.
Tier 2				
No screened projects classed at Tier 2				
Tier 3				
Terminal construction and dredging	Dublin port Company 3FM Project	Pre-consent	Medium – EIA available (submitted July 2024)	2026 – 2040
Subsea cable	Mares Connect	Pre-application	Low - Proposed Environmental assessments ongoing Foreshore licence application (2023) in consultation	Subsea HVED electricity cable between Wales and Ireland. Construction period may overlap with offshore construction at Dublin Array (construction is scheduled for 2026 to 2029).

Development type	Project Name	Current Status of Development	Data confidence assessment / phase	Planned programme
Offshore Wind Farm	Fred. Olsen Seawind, EDF Energies – Codling Wind Park	Pre-consent	High – Phase 1 project (MAC awarded). Pre-consent. Scoping report and EIA available (EIA submitted Q2 2024). Initial foreshore licence granted in 2005, more recently in 2021. Reference FS007045.	Installation of up to 75 WTGs, three export cables and three OSPs. Commencement in 2027 with offshore construction lasting 2-3 years.

3.19.10 The impacts that have been considered in the CEA are as follows:

- Construction phase:
  - Impact 18: Cumulative temporary habitat loss as a result of construction activities; and
  - Impact 19: Cumulative increases in SSC and associated sediment deposition.
- O&M phase:
  - Impact 20: Cumulative long-term habitat loss / change from the presence of foundations, scour protection and cable protection; and
  - Impact 21: Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities.

3.19.11 As for the project alone assessment, in line with the process for decommissioning set out in the Decommissioning and Restoration Plan, it is concluded that potential impacts associated with the decommissioning phase would be no greater than that assessed during construction. It is likely that the types of plans or projects requiring assessment in the future would be similar in type and nature to those being progressed during the construction and operational phases, therefore it is reasonable to assume that the impacts associated with decommissioning would also be no greater than construction from a cumulative perspective.

3.19.12 Certain impacts assessed for Dublin Array alone are not considered in the Cumulative Effects Assessment due to:

- The highly localised nature of the impacts;
- Management and mitigation measures in place for Dublin Array and other projects will reduce the risk of the impact occurring; and
- Where the potential significance of effects from the offshore infrastructure of Dublin Array alone has been assessed as Imperceptible or Not significant (as defined in Table 6).

3.19.13 The impacts excluded from the benthic Cumulative Effects Assessment for these reasons are:

- Reduction in water and sediment quality through the release of contaminated sediments and/or accidental contamination during construction, O&M and decommissioning (Impacts 5, 9 and 17): Potential effects on benthic receptors through the release of contaminated sediments have been assessed as 'Not significant'. Furthermore, it is expected that all offshore projects will employ a vessel management plan or follow best practice guidelines to reduce the risk of accidental contamination;
- Habitat disturbance during operation and maintenance activities (Impact 6): This impact will result in highly localised effects on benthic receptors, which have been assessed as being 'Not significant'; and

- Introduction of IAS during construction and O&M (Impacts 6 and 11): no potential for cumulative impacts as pathways minimised by introduction of mitigation measures.

3.19.14 The cumulative maximum design option for each assessed impact is described in Table 28 below.

Table 28 Cumulative MDO for benthic subtidal and intertidal ecology

Impact	Projects to be assessed	Maximum Design Option assessed	Justification for scoping in
Impact 18: Cumulative temporary habitat loss as a result of construction activities (construction phase)	**Tier 1:** ▪ EXA Atlantic ▪ Aqua Comms CeltixConnect 1 (CC-1) ▪ ESB ZAYO Emerald Bridge Fibres	Routine planned and unplanned cable maintenance over the lifetime of the cables. Exact details and programmes are unknown and so there is a high uncertainty.	Due to the close proximity of the cables to the Dublin Array and the potential for temporal overlap during O&M activities and Dublin Array construction there is potential for the effects of temporary habitat loss to act cumulatively. These assumptions are considered to be precautionary and an appropriate estimation in the absence of further information.
	Tier 3: ▪ Mares Connect	**Mares Connect** ▪ Two HVDC subsea cables with construction anticipated between 2026 to 2029. ▪ Landfall in the Greater Dublin area. ▪ Installation methodologies and exact route is unknown at the time of writing. ▪ Routine planned and unplanned cable maintenance over the lifetime of the cables.	Due to the close proximity of the cable route to the Dublin Array and the potential for temporal overlap during construction and O&M activities there is potential for the effects of temporary habitat loss to act cumulatively. These assumptions are considered to be precautionary and an appropriate estimation in the absence of further information.
	Tier 3: ▪ Codling Wind Park	Maximum design option for Dublin Array plus the area of seabed potentially damaged and disturbed during the construction or operation of the identified projects. **Codling Wind Park** ▪ 12,088,840 m^2 of temporary habitat loss/disturbance due to offshore and landfall construction activities.	Due to the close proximity of Codling Wind Park to the Dublin Array and the potential for temporal overlap during construction of the projects, there is potential for the effects of temporary habitat loss to act cumulatively. These assumptions are considered to be precautionary and an appropriate estimation in the absence of further information.

Impact	Projects to be assessed	Maximum Design Option assessed	Justification for scoping in
Impact 19: Cumulative increases in SSC and associated sediment deposition (construction phase)	**Tier 1:** ▪ Dublin Port Company MP2 Project ▪ Dublin Port Company Maintenance Dredging	Maximum design option for Dublin Array plus the release of sediments and sediment deposition associated with the identified projects. **Dublin Port Company MP2 Project** ▪ Capital dredging and disposal will cause temporary localised sediment plumes both at the loading and licensed disposal sites. ▪ Total volume to be dredged: 424,644 m^3. **Dublin Port Company** (Licence: FS007132) ▪ 300,000 m^3 of material to be dredged per annum using TSHD. ▪ Disposal of material into a licensed Dumping at Sea (DAS) site (west of Burford Bank). ▪ Dredged sediment consists mostly of silt and sand with elements of clay, gravel, and cobbles. **Dublin Port Company** (DAS permit: S0004-03) ▪ The activities involve the loading and dumping of a maximum of 3,960,000 tonnes (wet weight) of dredged material during the months of April to September from 2022-2029. ▪ A maximum quantity of 495,000 tonnes (wet weight) per annum. ▪ Disposal of material into a licensed DAS site (west of Burford Bank).	If these intermittent activities overlap temporally with either the construction or maintenance of Dublin Array, there is potential for cumulative SSC and sediment deposition to occur.

Impact	Projects to be assessed	Maximum Design Option assessed	Justification for scoping in
		Dublin Port Company (DAS permit: S0024-02) ▪ Material arising from the MP2 project, which involves the loading and dumping of a maximum of 1,102,723 tonnes (wet weight) of dredged material. ▪ Disposal of material into a licenced DAS site (west of Burford Bank).	
	Tier 1: ▪ EXA Atlantic ▪ Aqua Comms CeltixConnect 1 (CC-1) ▪ ESB ZAYO Emerald Bridge Fibres	Routine planned and unplanned cable maintenance over the lifetime of the cables. Exact details and programmes are unknown and so there is a high uncertainty.	SSC plumes may be generated through cable installation, reburial and repair operations which has the potential to result in a cumulative deterioration in water quality and increase of deposition in benthic habitats.
	Tier 3: Dublin Port Company 3FM Project	**Dublin Port Company 3FM Project:** Capital dredging and disposal will cause temporary localised sediment plumes both at the loading and licensed disposal sites. Total dredge volume suitable for disposal at sea: 1,189,000 m^3 Dredging will consist of: ▪ Maritime Village – Capital Dredging	If these intermittent activities overlap temporally with offshore construction activities for Dublin Array, there is potential for spatial (and temporal) overlap of SSC plumes generated by the developments.

Impact	Projects to be assessed	Maximum Design Option assessed	Justification for scoping in
		3 m Chart Datum (CD) 197,000 m^3 ▪ Area K – Ro-Ro Terminal Scour Protection 12.5 m CD 13,000 m^3 ▪ Turning Circle – Capital Dredging 10 m CD 444,000 m^3 ▪ Area N – Lo-Lo Terminal – Capital Dredging 13 m CD 533,000 m^3 ▪ Area N – Lo-Lo Terminal – Capital Dredging 3 m CD 72,000 m^3 ▪ Total dredge volume: 1,259,000 m^3 (70,000 m^3 of which not suitable for disposal at sea)	
	Tier 3: ▪ Mares Connect	**Mares Connect:** ▪ Two HVDC subsea cables with construction anticipated between 2026 to 2029. ▪ Landfall in the Greater Dublin area. ▪ Installation methodologies and exact route is unknown at the time of writing. ▪ Routine planned and unplanned cable maintenance over the lifetime of the cables.	Due to the close proximity of the cable route to the Dublin Array and the potential for temporal overlap during construction and O&M activities there is potential for the effects of increases in SSC and sediment deposition to act cumulatively. These assumptions are considered to be precautionary and an appropriate estimation in the absence of further information.

Impact	Projects to be assessed	Maximum Design Option assessed	Justification for scoping in
	Tier 3: ▪ Codling Wind Park	**Codling Wind Park** ▪ Three export cables with landfall at Poolbeg. ▪ Cable corridor crossing the Offshore ECC of Dublin Array. ▪ Sediments to be released during pre-construction surveys, seabed preparation works, foundation and cable installation, landfall works, and maintenance activities. ▪ Total volume of 15,796,116 m^3 from seabed preparation, WTG and OSS construction and cable installation.	If these intermittent activities overlap temporally with either the construction or maintenance of Dublin Array, there is potential for cumulative SSC and sediment deposition to occur.
Impact 20: Cumulative long-term habitat loss / change from the presence of foundations, scour protection and cable protection (O&M phase).	**Tier 3:** ▪ Mares Connect	Installation methodologies and exact route is unknown at the time of writing.	If these impacts overlap with Dublin Array, there is potential for cumulative habitat loss to occur.
	Tier 3: ▪ Codling Wind Park	Maximum design option for Dublin Array plus the potential changes to seabed habitats from effects on local hydrodynamic and sediment transport processes from the identified projects. **Codling Wind Park** ▪ 599,320 m^2 total area of potential long-term habitat loss.	If these impacts overlap with Dublin Array, there is potential for cumulative habitat loss to occur. These assumptions are considered to be precautionary and an appropriate estimation in the absence of further information.
Impact 21: Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects	**Tier 3:** ▪ Codling Wind Park	Maximum design option for Dublin Array plus the potential changes to seabed habitats from effects on local hydrodynamic and sediment transport processes from the identified projects. **Codling Wind Park**	The largest structures proposed for installation at Phase 1 projects, given the locations of the developments, may have limited potential to create modifications to the wave and tidal regime of a scale large enough to allow interaction between them with resulting impacts in relation to

Impact	Projects to be assessed	Maximum Design Option assessed	Justification for scoping in
on benthic communities (O&M phase)		▪ 597,520 m^2 total seabed area take footprint of introduced hard structures.	sedimentary patterns unlikely to be affected.

Impact 18: Cumulative temporary habitat loss as a result of construction activities

3.19.15 The potential for significant cumulative effects, as a result of temporary habitat loss as a result of construction activities at Codling Wind Park, is presented in Table 29.

Table 29 Consideration of potential for cumulative temporary habitat loss as a result of construction activities with the Codling Wind Park project.

	Justification
Step 1: Drivers[30]	Seabed preparation works (including sandwave clearance), foundation and cable installation works.
Step 2: Pressures	Temporary habitat disturbance/loss
Step 3: States	Benthic subtidal ecology species and their supporting habitats
Step 4: Impacts	Plans for Codling Wind Farm indicate that the proposed development will comprise up to 75 WTGs, three OSPs and three export cable which will entail a temporary habitat loss of 12 km^2. Dates for offshore construction have been identified as 2027 to 2028, which indicate that work will be completed before overlap with the construction of Dublin Array commences (Q2 2029). Landfall has been identified at Poolbeg which will mean that the ECC will cross that for Dublin Array. The assessments of Impact 2 that short term habitat loss associated with from construction activities would be restricted to discrete areas within the project boundary and is therefore regarded as near field. Similar patterns are expected in relation to other Phase 1 projects. Consequently, with the exception of the location of Codling export cable corridor potentially encroaching on that for Dublin Array, there will be negligible overlap between footprints of this Phase 1 project. It should be noted that construction plans indicate that the majority of construction periods of other Phase 1 project will be prior to work commencing on Dublin Array. Consequently, any habitat loss during construction activities associated with the other Phase 1 projects are expected to be of local spatial extent, short-term duration, intermittent and reversible, with effects on benthic subtidal and intertidal receptors likely to be undiscernible or barely discernible from baseline conditions. The maximum magnitude of the cumulative damage and disturbance has therefore been assessed as **Low adverse**. The sensitivity of benthic habitats to temporary habitat loss/disturbance have been documented in Impact 3. The worst-case sensitivity for benthic subtidal ecology receptors is rated as **High**.
Step 5: Responses	No additional mitigation to that already identified in Table 11 are considered necessary to prevent significant effects.

[30] For description of Steps 1 – 5 see Volume 2, Chapter 4: Cumulative Effects Assessment Methodology chapter paragraph 4.3.29

	Justification
Conclusion	*The magnitude of the potential cumulative temporary habitat loss from simultaneous construction is concluded to be **Low**. The maximum sensitivity of receptors in the area is assessed as **High**; this could result in a **Moderate effect**, which is **not significant in EIA terms**.*

Impact 19: Cumulative increases in SSC and associated sediment deposition

3.19.16 The potential for significant cumulative effects as a result of simultaneous increases in SSC and associated sediment deposition is presented in Table 30 to Table 34 Particular regard has been given to the possibility of cumulative effects from works associated with the Dublin Port Company MP2 Project, the Codling Wind Park and Dublin Array occurring within the area surrounding Dublin Bay. However, given the project timelines are such that it is highly unlikely that the proposed construction programmes would overlap. Furthermore, constraints due to equipment availability (due to limited pool of appropriate construction related equipment) and space for the works to be safely undertaken also exist. Therefore, on this basis of these constraints it is not considered feasible for Dublin Array and Codling Wind Park to install cables or make landfall at the same time. However, the projects could undertake these activities sequentially to one another. Therefore, this assessment has not considered the possibility of the MP2 project, Dublin Array and Codling Wind Park undertaking activities at the same time in close proximity. Instead, Dublin Array has been assessed cumulatively with each project individually.

Table 30 Consideration of potential for cumulative increases in SSC and deposition within Dublin Bay.

	Justification
Step 1: Drivers	Capital and maintenance dredging and disposal in Dublin harbour and associated sediment disposal (Dublin Port Company MP2 Project and Dublin Port Company Maintenance Dredging).
Step 2: Pressures	Temporary increases in SSC and associated sediment deposition and smothering of the benthos.
Step 3: States	Benthic subtidal ecology species and their supporting habitats.
Step 4: Impacts	The capital dredging and disposal, associated with the MP2 project, will cause temporary localised sediment plumes both at the loading location and licensed disposal sites. Plume modelling (undertaken on behalf of Dublin Port Company) demonstrated that all plumes generated from dredging were typically less than 10 mg/l within 750 m of the dredging activities. The deposition of sediments was generally confined to the area being dredged and were generally less than 8 g/m^2 beyond the immediate area of the dredging operation. The plumes associated with disposal of material, in the greater Dublin Bay area, results in a plume less than 200 mg/l and is confined to 750 m from the location of disposal. The potential increases in SSC, when considered cumulatively, are still anticipated to be within natural variation within Dublin Bay. Furthermore, it should be noted that given the potential construction programme durations of the two projects, it is unlikely that a

	Justification
	temporal overlap would occur. Plumes generated from maintenance dredging are anticipated to dissipate quickly and be on a smaller geographical scale that the capital dredging associated with MP2. As demonstrated by the water quality monitoring undertaken for Dublin Port (Dublin Port Company, 2021), suspended sediment maxima resulting from seabed activities remain local to the works with background levels occurring elsewhere. Further and as previously stated, any increased SSC levels will immediately dissipate following the cessation of works removing the possibility for an additive process of these levels. Therefore, no additional potential impacts or receptors are identified than when considering Dublin Array in isolation. The magnitude (and so significance) of the effect on physical processes resulting from simultaneous cable installation activities would be no greater than those assessed in Impact 1. Consequently, the maximum magnitude of the impact for these receptors is assessed as being **Low adverse**. The sensitivity of benthic habitats to increased SSC and sediment deposition have been documented in Impact 1. The worst-case sensitivity for benthic subtidal ecology receptors is rated as **High**.
Step 5: Responses	No additional mitigation to that already identified in Table 11 are considered necessary to prevent significant effects.
Conclusion	*The magnitude of the potential cumulative increases in SSC and deposition from simultaneous operations is concluded to be **Low adverse**, i.e. the same as the project alone. The maximum sensitivity of receptors in the area is assessed as **High**; this could result in a **Moderate effect**, which is **not significant in EIA terms**.*

Table 31 Consideration of potential for cumulative increases in SSC and deposition with subsea cables.

	Justification
Step 1: Drivers	Maintenance work of subsea cables
Step 2: Pressures	Temporary increases in SSC and associated sediment deposition and smothering of the benthos.
Step 3: States	Benthic subtidal ecology species and their supporting habitats.
Step 4: Impacts	Cumulative effects may arise between the installation of the offshore components of Dublin Array and the planned and unplanned maintenance of operational subsea cables, and so could result in the potential for interaction of sediment plumes. Potential maintenance works could be both planned (routine) and unplanned works (where corrective action is needed) but at the time of writing it is unknown when these works could occur. However, there is the potential for a temporal overlap and so a potential interaction of sediment plumes and associated deposition. The lengths of cable to be replaced or reburied would be shorter, and the potential impacts will be more localised and occur over a shorter duration than those considered presented for the installation of the Dublin Array export cables. As increased SSC rapidly dissipate following the cessation of activities, it is not expected for there to be any measurable plume coalescence. The magnitude (and so significance) of the effect on physical processes resulting from these activities would be no greater than those assessed in Impacts 1. Consequently, the maximum magnitude of the impact for these receptors is assessed as being **Low adverse**. The sensitivity of benthic habitats to increased SSC and sediment deposition have been documented in Impact 1. The worst-case sensitivity for benthic subtidal ecology receptors is rated as **High**.
Step 5: Responses	No additional mitigation to that already identified in Table 11 are considered necessary to prevent significant effects.
Conclusion	*The magnitude of the potential cumulative increases in SSC and deposition from simultaneous operations is concluded to be **Low adverse**, i.e. the same as the project alone. The maximum sensitivity of receptors in the area is assessed as **High**; this could result in a **Moderate effect**, which is **not significant in EIA terms**.*

Table 32 Consideration of potential for cumulative increases in SSC and deposition with the Mares Connect project.

	Justification
Step 1: Drivers	Installation of the Mares Connect cable and landfall activities.
Step 2: Pressures	Temporary increases in SSC and associated sediment deposition and smothering of the benthos.
Step 3: States	Benthic subtidal ecology species and their supporting habitats.
Step 4: Impacts	Whilst there is the potential for the offshore components and Mares Connect to be constructed the project timelines are such that it is highly unlikely that the proposed construction programmes would be proposed to overlap. Furthermore, if Mares Connect is installed in close proximity to Dublin Array, then there will be additional construction constraints due to space for the works to be safely undertaken in practice. Therefore, on this basis of these constraints is not considered feasible for Dublin Array and Mares Connect to install cables or make landfall at the same time. However, the projects could undertake these activities sequentially to one another. As predicted in the Dublin Array modelling, the SSC plumes are anticipated to rapidly dissipate following the cessation of activities, and so it is not expected for there to be any measurable plume coalescence. The magnitude (and so significance) of the effect on physical processes resulting from these activities would be no greater than those assessed in Impacts 1. Consequently, the maximum magnitude of the impact for these receptors is assessed as being **Low adverse**. The sensitivity of benthic habitats to increased SSC and sediment deposition have been documented in Impact 1. The worst-case sensitivity for benthic subtidal ecology receptors is rated as **High**.
Step 5: Responses	No additional mitigation to that already identified in Table 11 are considered necessary to prevent significant effects.
Conclusion	*The magnitude of the potential cumulative increases in SSC and deposition from simultaneous operations is concluded to be **Low adverse**, i.e. the same as the project alone. The maximum sensitivity of receptors in the area is assessed as **High**; this could result in a **Moderate** effect, which is **not significant in EIA terms**.*

Table 33 Consideration of potential for cumulative increases in SSC and deposition with the Dublin Port Company 3FM Project.

	Justification
Step 1: Drivers	Capital dredging and disposal as part of the Dublin Port Company 3FM Project.
Step 2: Pressures	Temporary increases in SSC and associated sediment deposition.
Step 3: States	Benthic subtidal ecology species and their supporting habitats.
Step 4: Impacts	The capital dredging and disposal associated with the 3FM Project will cause temporary localised sediment plumes both at the loading location and licensed disposal sites. Modelling and monitoring data analysed from earlier works in Dublin Bay has shown that plumes from proposed dredging operations are confined to the immediate area of operation and do not impact the wider environment. Plumes associated with the disposal of material in the greater Dublin Bay area have been shown to settle rapidly and within 750 m from the location of disposal (Dublin Port Company, 2024). As predicted in the Dublin Array modelling, the SSC plumes are anticipated to rapidly dissipate following the cessation of activities, and so it is not expected for there to be any measurable plume coalescence. The magnitude (and so significance) of the effect on physical processes resulting from these activities would be no greater than those assessed in Impacts 1. Consequently, the maximum magnitude of the impact for these receptors is assessed as being **Low adverse**. The sensitivity of benthic habitats to increased SSC and sediment deposition have been documented in Impact 1. The worst-case sensitivity for benthic subtidal ecology receptors is rated as **High**.
Step 5: Responses	No additional mitigation to that already identified in Table 11 are considered necessary to prevent significant effects.
Conclusion	*The magnitude of the potential cumulative increases in SSC and deposition from simultaneous operations is concluded to be **Low adverse**, i.e. the same as the project alone. The maximum sensitivity of receptors in the area is assessed as **High**; this could result in a **Moderate** effect, which is **not significant in EIA terms**.*

Table 34 Consideration of potential for cumulative increases in SSC and deposition with the Codling Wind Park project.

	Justification
Step 1: Drivers	Simultaneous construction activities including export cable laying in Dublin Bay.
Step 2: Pressures	Temporary increases in SSC and associated sediment deposition and smothering of the benthos.
Step 3: States	Benthic subtidal ecology species and their supporting habitats.
Step 4: Impacts	Should the programmes change such that they are scheduled for the same period, the greatest likelihood is for the two project's installation periods to be sequenced to allow for the availability of installation equipment. However, the projects could undertake these activities sequentially to one another. As predicted in the Dublin Array modelling, the SSC plumes are anticipated to rapidly dissipate following the cessation of activities, and so it is not expected for there to be any measurable plume coalescence. The magnitude (and so significance) of the effect on physical processes resulting from these activities would be no greater than those assessed in Impacts 1. Consequently, the maximum magnitude of the impact for these receptors is assessed as being **Low adverse**. The sensitivity of benthic habitats to increased SSC and sediment deposition have been documented in Impact 1. The worst-case sensitivity for benthic subtidal ecology receptors is rated as **High**.
Step 5: Responses	No additional mitigation to that already identified in Table 11 are considered necessary to prevent significant effects.
Conclusion	*The magnitude of the potential cumulative increases in SSC and deposition from simultaneous operations is concluded to be* ***Low adverse****, i.e. the same as the project alone. The maximum sensitivity of receptors in the area is assessed as* ***High****; this could result in a* ***Moderate*** *effect, which is* ***not significant in EIA terms****.*

Impact 20: Cumulative long-term habitat loss / change from the presence of foundations, scour protection and cable protection

3.19.17 The presence of infrastructure in the marine environment, including turbine foundations, scour protection and cable protection, will cause long-term changes in the extent and distribution of sedimentary habitats which may affect benthic ecology. In addition, any infrastructure left in situ following decommissioning will represent a permanent loss of sedimentary habitat. The potential for significant cumulative effects on benthic ecology receptors as a result of simultaneous long-term or permanent loss of benthic habitats is assessed in the following sections.

3.19.18 The potential for significant cumulative long-term habitat loss / change effects, as a result in the presence of other OWFs infrastructure, is presented in Table 35.

Table 35 Determination of potential for cumulative long-term habitat loss / change from the presence of foundations, scour protection and cable protection

	Justification
Step 1: Drivers	Presence of OWF infrastructure in the marine environment, including foundations, scour protection and cable protection.
Step 2: Pressures	Long term changes in habitat through the presence of infrastructure in the marine environment.
Step 3: States	Benthic subtidal and intertidal ecology species and their supporting habitats.
Step 4: Impacts	Plans for Codling Wind Farm indicate that the proposed development will comprise up to 75 WTGs, three OSPs and three export cable which will entail a temporary habitat loss of 12 $km^{2.}$ Dates for offshore construction have been identified as 2027 to 2028, which indicate that work will be completed before overlap with the construction of Dublin Array commences (Q2 2029). It is predicted that under the maximum design option approximately 1.02 km^2 of seabed would be permanently lost due to the installation of Dublin Array. The loss of sedimentary habitats resulting from Codling Wind Farm is predicted to be slightly smaller. Long-term habitat loss relating to footprints of foundations including scour protection and areas of cable protection installations will be 0.6 km^2. Landfall has been identified at Poolbeg which will mean that the Codling ECC will cross the Offshore ECC for Dublin Array. It should be noted that in relation to all the development discussed here comparable habitats likely to be impacted are widely distributed in the Irish Sea, so long-term habitat loss at the scale predicted for Dublin Array is not predicted to diminish regional ecosystem functions. Consequently, the maximum magnitude of the cumulative impact is assessed as being **Low adverse**. The sensitivity of benthic habitats to long-term habitat loss is considered **High**, as there will be a complete loss of that habitat type.
Step 5: Responses	No additional mitigation to that already identified in Table 11 are considered necessary to prevent significant effects.
Conclusion	*The magnitude of the potential cumulative temporary habitat loss from simultaneous construction is concluded to be* ***Low adverse****. The maximum sensitivity of receptors in the area is assessed as* ***High****; this could result in a* ***Moderate*** *effect, which is* ***not significant in EIA terms****.*

Impact 21: Changes to seabed habitats arising from cumulative changes to the wave and tidal regimes as a result of the operational presence of other OWFs

3.19.19 The potential for significant cumulative effects, as a result in the presence of other OWFs on the tidal and wave regimes, is presented in Table 36.

Table 36 Determination of potential for cumulative effects on benthic receptors from changes to the wave and tidal regimes as a result of the operational presence of other OWFs

	Justification
Step 1: Drivers	Changes in the tidal and wave regimes through the presence of structures in the marine environment could potentially affect benthic receptors.
Step 2: Pressures	Scour effects and changes in the sediment transport and wave regimes.
Step 3: States	Benthic subtidal and intertidal ecology species and their supporting habitats.
Step 4: Impacts	The effects on the tidal and wave regimes from the project alone on benthic receptors were deemed to be of Negligible magnitude in the far-field for Dublin Array (Physical Processes Chapter) and that the influence on the regimes was highly localised. Therefore, no significant pathway of effect on benthic receptors were predicted for these aspects (Impact 12). Given the similar technologies, scales of development and analogous location of other Phase 1 projects, it is anticipated that similar magnitudes of effects would occur for these projects alone, i.e. localised and not significant in EIA terms. Therefore, despite being potentially additive, it is not anticipated that the cumulative changes arising from the developments would be discernible from baseline conditions. As such, it is expected that there would be no changes to the supporting habitats of benthic communities and the magnitude of the cumulative impact is consequently assessed as **Negligible**. Changes in seabed topography and flow patterns around the foundations of Dublin Array resulting from scour were predicted to be of Low magnitude given their highly localised nature (see Physical Process Chapter). Any effects on benthic receptors resulting from these changes were deemed to be Negligible based on the localised nature of the impact and given that the supporting benthic habitats are common and widespread throughout the study area and wider region. Given the similar technologies, scales of development and similar seabed environments of the other assessed projects, it is anticipated that similar magnitudes of effects would occur for these projects alone, i.e. localised and not significant in EIA terms. Therefore, despite being potentially additive, it is not anticipated that the cumulative changes in seabed conditions due to scour development would result in discernible changes in the distribution of sensitive benthic receptors, and the magnitude of the cumulative impact is consequently assessed as **Negligible**.

	Justification
	The sensitivity of benthic habitats to the wave and tidal regimes have been documented in Impact 11. The worst-case sensitivity for benthic subtidal ecology is **Not sensitive** and the worst-case for intertidal ecology is **Low**.
Step 5: Responses	No additional mitigation to that already identified in Table 11 are considered necessary to prevent significant effects.
Conclusion	*Despite being potentially additive, it is not anticipated that the cumulative changes arising from the developments would be measurable and therefore the magnitude is concluded to be **Negligible**. The maximum sensitivity of receptors in the area is assessed as **Low**; this would result in a **Not significant effect**.*

3.20 Interactions of the Environmental Factors

3.20.1 A matrix illustrating where interactions between effects on different factors have been addressed is provided in Volume 8, Chapter 1: Interactions of the Environmental Factors.

3.20.2 Interactions of the environmental factors are considered to be the effects and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the project (construction, O&M and decommissioning) to interact and potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project phases; and
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on benthic ecology such as direct habitat loss or disturbance, sediment plumes, scour, jack up vessel use etc., may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short-term, temporary or transient effects.

3.20.3 As indicated in the interactions matrix there are linkages between the topic-specific chapters presented within this EIAR, whereby the effects assessed in one chapter have either the potential to result in secondary effects on another receptor (e.g. effects on fish and shellfish ecology have the potential to result in secondary effects on marine mammals prey resources).

3.20.4 The different effects to benthic habitats studied are already inter-related. The potential effects on benthic subtidal and intertidal ecology during construction, operational and maintenance and decommissioning phases of the Project have been assessed in sections 1.17 – 1.19 above.

3.20.5 As effects on benthic, subtidal and intertidal ecology (i.e. from effects to habitats and effects resulting from impacts to prey species) also have the potential to have secondary effects on other receptors which have been fully assessed in the topic-specific chapters. These receptors are:

- Chapter 1: Physical Processes (see Section 1.16 therein);

- Chapter 5: Fish and Shellfish; and
- Chapter 7: Offshore and Intertidal Ornithology.

3.20.6 For Benthic Subtidal and Intertidal Ecology receptors, the following potential impacts have been considered within the interactions assessment:

- Temporary subtidal habitat loss/disturbance;
- Increased suspended sediment concentrations and associated deposition;
- Increased risk of introduction or spread of IAS due to presence of subsea infrastructure and vessel movements; and
- Indirect impacts to benthic ecology as a result of the release of contaminants from disturbed sediments and accidental pollution.

Project lifetime effects

3.20.7 Project lifetime effects consider impacts from the construction, operation or decommissioning of Dublin Array on the same receptor (or group). The potential inter-related effects that could arise in relation to benthic and intertidal ecology are presented in Table 37.

Table 37 Project lifetime effects assessment for potential inter-related effects on benthic and intertidal ecology.

Impact Type	Construction	O&M	Decommissioning	Interaction Assessment - Project lifetime effects
Temporary/long-term subtidal habitat loss/disturbance	Moderate Adverse (temporary loss)	Moderate Adverse (long-term loss)	Slight adverse (temporary loss)	When considering habitat loss or disturbance additively across all phases, it should be noted that the total area of individual habitat affected is low and that these habitats are common and widespread. While the introduction of hard substrate will alter the nature of predominantly sedimentary habitats on decommissioning all benthic habitats are predicted to recover to the baseline condition within two to ten years of removal of introduced hard infrastructure. Therefore, across the project lifetime, the effects on benthic ecology receptors are not anticipated to be such as to result in combined effects of greater significance than the assessments presented for each individual phase. There will therefore be no inter-related effects of greater significance compared to the impacts considered alone.
Indirect impacts to benthic ecology as a result of the temporary increase in SSC and sediment deposition. Increased suspended sediment concentrations and associated deposition	Imperceptible to Moderate Adverse	Neutral	Imperceptible to Slight adverse	The majority of the seabed disturbance (resulting in the highest SSC and sediment deposition) will occur during the construction and decommissioning phases, with any effects being short-lived. Due to this, and the recoverability of the species and habitats affected, the interaction of these impacts across all stages of the development is not predicted to result in an effect of any greater significance than those assessed in the individual project phases.

Impact Type	Construction	O&M	Decommissioning	Interaction Assessment - Project lifetime effects
Indirect impacts to benthic ecology as a result of the release of contaminants from disturbed sediments and accidental pollution.	Neutral	Neutral	Neutral	The likelihood of project lifetime effects arising is low given the factored-in measures that will be applied throughout the various project stages which will ensure that the risk of interaction of such effects through time is limited. Therefore, across the project lifetime, the effects on benthic subtidal and intertidal receptors are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual phase.
Increased risk of introduction or spread of IAS due to presence of subsea infrastructure and vessel movements	Moderate Adverse	Neutral	N/A	The pathways by which IAS may be introduced are primarily via vessel movement. Introduction of biosecurity measures outlined in the PEMP on vessels employed throughout all phases of the development will ensure the removal of the risk of the introduction of IAS. Furthermore, the O&M phase is likely to employ primarily local CTVs with only infrequent uses of JUVs which may be sourced from further afield. Due to this, and the limited space for colonisation represented by introduced infrastructure (and its removal on decommissioning) indicates that the interaction of these impacts across all phases of the development is not predicted to result in an effect of any greater significance than those assessed in the individual project.

Receptor led effects

3.20.8 There is the potential for spatial and temporal interactions between the effects arising from habitat loss/ disturbance and increases SSC and sediment deposition on benthic habitats during the project lifetime. Based on current understanding, and expert knowledge, the greatest potential for interactions between effects is predicted to occur through the interaction of both temporary and long-term or permanent habitat loss/ disturbance from foundation installation/ jack-up vessels/ anchor placement/ scour, indirect habitat disturbance due to sediment deposition and indirect effects resulting from changes in physical processes due the presence of infrastructure in the operational wind farm.

3.20.9 With respect to this interaction, these individual impacts were assigned a significance of negligible to moderate significance as standalone impacts and although potential combined impacts may arise (i.e. spatial and temporal overlap of direct habitat disturbance), it is predicted that this will not be any more significant than the individual impacts in isolation. This is because the combined amount of habitat potentially affected would be very limited, typically restricted to the array area and Offshore ECC, the biotopes affected are widespread across the Irish Sea, and where temporary disturbance occurs, full recovery of the benthos is predicted. In addition, any effects due to changes in the physical processes are likely to be limited (i.e. largely within near-field), both in extent and in magnitude, with receptors having low sensitivity to the scale of changes predicted. As such, these interactions are predicted to be no greater in significance than that for the individual effects assessed in isolation.

3.20.10 Overall, the interactions of the foregoing assessment does not identify any significant inter-related effects that were not already covered by the topic-specific assessment set out in the preceding sections. However, certain individual effects were identified that did interact with each other whilst not leading to any greater significance of effect.

3.21 Transboundary statement

3.21.1 No transboundary effects have been identified. This is because the predicted changes to the key physical process pathways (i.e. tides, waves, and sediment transport) are not anticipated to be sufficient to influence identified benthic receptors at this distance from Dublin Array.

3.21.2 Although the 17 km range around the proposed development encompasses UK territorial water (13.6 km north of the array) this does not overlap with a similar range around any identified project within UK waters. Consequently, there are no identified pathways for transboundary cumulative effects and therefore transboundary cumulative effects are screened out.

3.22 Summary of effects

3.22.1 A summary of the significant impacts assessed within this EIAR chapter, any mitigation (other than Project Design Features and Avoidance and Preventative Measures) and the residual effects. are presented in Table 38 .

Table 38 Summary of effects assessed for benthic subtidal and intertidal ecology

Description of Effect	Effect	Additional mitigation measures	Residual impact
Construction			
Impact 1	Temporary increase in SSC and sediment deposition in the array area and Offshore ECC from construction activities	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 2	Temporary increase in SSC and sediment deposition in the intertidal area from construction activities	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 3	Temporary habitat loss/disturbance in the array area and Offshore ECC from construction activities	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 4	Temporary habitat loss/disturbance in the intertidal from construction activities	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 5	Seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 6	Increased risk of introduction or spread of IAS due to presence of subsea infrastructure and vessel movements (e.g. ballast water)	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects

Description of Effect	Effect	Additional mitigation measures	Residual impact
Operation and maintenance			
Impact 7	Long-term habitat loss / change from the presence of foundations, scour and cable protection in the array area and Offshore ECC	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 8	Habitat disturbance in the array area and Offshore ECC from O&M activities	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 9	Seabed disturbances from maintenance activities leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 10	Colonisation of the WTGs and scour/ cable protection may affect benthic subtidal ecology and biodiversity	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 11	Increased risk of introduction or spread of IAS due to presence of subsea infrastructure and vessel movements (e.g. ballast water)	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 12	Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic subtidal and intertidal communities	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 13	Indirect disturbance arising from EMF generated by the current flowing through buried cables	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects

Description of Effect	Effect	Additional mitigation measures	Residual impact
Decommissioning			
Impact 14	Temporary habitat disturbance from decommissioning of foundations, cables and rock protection	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 15	Increased SSC and sediment deposition from removal of foundations, cables and rock protection	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 16	Loss of introduced habitat from the removal of foundations and rock protection	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 17	Seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Cumulative effects			
Impact 18	Cumulative temporary habitat loss as a result of construction activities	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 19	Cumulative increases in SSC and associated sediment deposition	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 10	Cumulative long-term habitat loss / change from the presence of foundations, scour protection and cable protection	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 21	Changes to seabed habitats arising from cumulative changes to the wave and tidal regimes as a result of the operational presence of other OWFs	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects

3.23 References

APEM (2024). Dublin Array Offshore Wind Farm. Underwater Image Analysis.

Aquafact International Services Ltd., 2017. JN1445 Marine ecology Baseline Chapter 1.

Aquatic International Services Unit., 2019. Dublin Port Company Maintenance Dredging. Assessment of Potential Benthic and Fisheries Impacts.

Aquafact International Services Ltd, 2021. Marine Intertidal Ecological Survey, Shanganagh & Poolbeg, Co.Dublin. Report for Kish Offshore Wind Ltd & Bray Offshore Wind Ltd.

Barnes M.D. (2017) Guidance on EIS and NIS Preparation for Offshore Renewable Energy Projects, Report for the Environmental Working Group of the Offshore Renewable Energy Steering Group and the Department of Communications, Climate Action and Environment, Dublin: Department of Communications, Climate Action and Environment, Available at: https://cieem.net/resource/guidance-on-eis-and-nis-preparation-for-offshore-renewable-energy-projects/

Birkett, D.A., Maggs, C.A., Dring, M.J. & Boaden, P.J.S. (1998). Infralittoral reef biotopes with kelp species (volume VII). An overview of dynamic and sensitivity characteristic for conservation management of marine SACs. Scottish Association of Marine Science. http://www.ukmarinesac.org.uk/pdfs/reefkelp.pdf
Boehlert GW and AB Gill. (2010). "Environmental and ecological effects of ocean renewable energy development – a current synthesis." Oceanography 23: 68–81.

Boles, L. C., & Lohmann, K. J. (2003). True navigation and magnetic maps in spiny lobsters. Nature, 421, 60–63.

Breitburg, D., Levin, L.A., Oschlies, A., Grégoire, M., Chavez, F.P., Conley, D.J., Garçon, V., Gilbert, D., Gutiérrez, D., Isensee, K., Jacinto, G.S., Limburg, K.E., Montes, I., Naqvi, S.W.A., Pitcher, G.C., Rabalais, N.N., Roman, M.R., Rose, K.A., Seibel, B.A., Telszewski, M., Yasuhara, M., Zhang, J., 2018. Declining oxygen in the global ocean and coastal waters. Science, 359, p.1–13. Available at: https://repository.si.edu/bitstream/handle/10088/34698/Breitburg_Denise-20171004-Breitburg_et_al_ocean_deoxygenation.pdf?sequence=1&isAllowed=y

Burdige, D.J. (2007). Preservation of Organic Matter in Marine Sediments: Controls, Mechanisms, and an Imbalance in Sediment Organic Carbon Budgets? Chemistry Review, 107(2), 467-485.

Cámaro García, W.C.A. and Dwyer, N. (2020). The Status of Ireland's Climate, 2020. Government of Ireland. Available at: https://www.epa.ie/publications/research/climate-change/research-386-the-status-of-irelands-climate-2020

Caswell, B., Paine, M. and Frid, C., 2018. Seafloor ecological functioning over two decades of organic enrichment. Marine Pollution Bulletin, 136, p.212-229. Available at: https://www-sciencedirect-com.plymouth.idm.oclc.org/science/article/pii/S0025326X18306052.

Cefas, 2004. Guidance note for EIA in respect of FEPA and CPA requirements. Prepared by the Centre

Cefas, 2012. Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects. Cefas contract report: ME5403 – Module 15. 89pp. Available at: https://tethys.pnnl.gov/sites/default/files/publications/CEFAS_2012_Eenvironmental_Assessment_Guidance.pdf

CIEEM, 2018. Guidelines for Ecological Impact Assessment in the UK And Ireland: Terrestrial, Freshwater, Coastal and Marine. Available at: https://cieem.net/wp-content/uploads/2019/02/Combined-EclA-guidelines-2018-compressed.pdf

Codling Wind Park (2024). Environmental Impact Assessment Repordavist. Available at: https://codlingwindparkplanningapplication.ie/environmental-impact-assessment-report-eiar/

Cooper, K., Bolam, S.G., Downie, A.L., Barry, J., 2018. Biological-based habitat classification approaches promote cost-efficient monitoring: An example using seabed assemblages. Journal of Applied Ecology, 56 (05), 1085-1098.

Cronin, M., McGovern, E., McMahon, T. & Boelins, R. (2006). Guidelines for the assessment of dredge material for disposal in Irish water. Marine Environment and Health Series, No. 24, 2006. Available at: https://oar.marine.ie/handle/10793/251

Cunningham, A., 2018. Distribution and sources of PAHs and trace metals in Bull Island, Dublin Bay. MSc Thesis, Dublin City University. Available at: https://doras.dcu.ie/22633/1/Final%20Thesis%20Aisling%20Cunningham%20for%20MSc%20Award%20PDF%20final.pdf

Dauwe, B., Middelburg, J.J. & Herman, P.M.J., 2001. Effect of oxygen on the degradability of organic matter in subtidal and intertidal sediments of the North Sea area. Marine Ecology Progress Series, 215, 13-22. Available at: https://www.jstor.org/stable/24864252

Davis, J.A., Kent D.B., 1990. Surface complexation modelling in aqueous geochemistry. Rev. Mineral. 23, 177-260. Available at: https://www.researchgate.net/publication/248728560_Surface_Complexation_Modeling_in_Aqueous_Geochemistry

DCCAE, 2017. Guidance on Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) Preparation for Offshore Renewable Energy Projects.

DCCAE, 2018. Guidance on Marine Baseline Ecological Assessments & Monitoring Activities for Offshore Renewable Energy Projects Parts 1 and 2. Available at: https://www.gov.ie/en/publication/3d6efb-guidance-documents-for-offshore-renewable-energy-developers/

Department of Housing, Planning and Local Government, 2018. 'Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment', Available online: https://www.housing.gov.ie/sites/default/files/publications/files/guidelines_for_planning_authorities_and_an_bord_pleanala_on_carrying_out_eia_-_august_2018.pdfn [Accessed November 2020]

Department of Housing, Planning and Local Government, 2023. Ecological sensitivity analysis of the Western Irish Sea to inform future designation of Marine Protected Areas (MPAs). Available at: https://www.gov.ie/en/publication/4bc80-ecological-sensitivity-analysis-of-irish-sea-main-report/

Dublin Port Company, 2012. Maintenance Dredging Programme 2022 – 2029. Application for Foreshore Licence. Water Quality Risk Assessment Dun Laoghaire Harbour Company (2011). Dun Laoghaire Harbour Masterplan - Environmental Report.

Dublin Port Company (2024), '3FM Project Environmental Impact Assessment Report – Chapter 20: Cumulative Effects & Environmental Interactions (Volume 2, Part 5)', https://dublinport3fm.ie/wp-content/uploads/2024/07/Chapter-20-Cumulative-Effects-Environmental-Interactions-Volume-2-Part-5.pdf.

Dye, S., Hughes, S., Tinker, J., & Berry, D., Holliday, N., Kent, E., Kennington, K., Inall, M., Smyth, T., Nolan, G., Lyons, K., Andres, O., Beszczynska-Moeller, A., 2013. Impacts of climate change on temperature (air and sea). MCCIP Science Review 2013. 1-12. 10.14465/2013.arc01.001-012.

Ecological Consulting Services (EcoServe), 2001. SensMap project.

Ecological Consulting Services (EcoServe), 2002. Benthic surveys of the Kish and Bray banks.

Ecological Consulting Services (EcoServe), 2002. A marine ecological study of the Kish and Bray Banks for a proposed offshore wind farm development - baseline survey.

Ecological Consulting Services (EcoServe), 2004. A marine ecological study of the Kish and Bray Banks for a proposed offshore wind farm development - baseline survey.

Ecological Consulting Services (EcoServe), 2008. A marine ecological study of the Kish and Bray banks for a proposed offshore wind farm development: Re-characterisation survey.

EEA (European Environment Agency), 2013. Interpretation Manual of European Union Habitats, version EUR 28. Available at: https://eunis.eea.europa.eu/references/2435

EEA (European Environment Agency), 2022. EUNIS habitat type hierarchical view. Available at: https://eunis.eea.europa.eu/habitats-code-browser-revised.jsp?expand=30000,31346,31348,31349,31361,31363,31364#level_31364

EUSeamap, 2019. Broadscale predictive habitat map. Created by the EMODnet Seabed Habitats project consortium. Available at https://atlas.marine.ie/#?c=53.2857:-6.1139:10. Accessed 19/11/2019

Environmental Protection Agency (2014). Biodiversity Action Plan 2014-2018. Aaviable at: https://www.epa.ie/publications/circular-economy/resources/epa-biodiversity-action-plan-2014-2018.php

Environmental Protection Agency, 2022. Guidelines on the Information to be contained in Environmental Impact Assessment reports, Available online: https://www.epa.ie/publications/monitoring--assessment/assessment/EIAR_Guidelines_2022_Web.pdf , [Accessed September 2023]

Environmental Protection Agency (2024). Ireland's State of the Environment Report 2024. Available at: https://www.epa.ie/publications/monitoring--assessment/assessment/state-of-the-environment/

Fay,D., Kramers, G., Zhang, C., McGrath, D. & Grennan, E., 2007. Soil Geochemical Atlas of Ireland. Published by Teagasc and the Environmental Protection Agency in 2007. Available at: https://www.teagasc.ie/media/website/publications/2011/Soil_Geochemical_AtlasofIreland.pdf

Fugro (2021). WPM1, WPM2 & WPM3 - Main Array & ECR - Benthic Ecology Monitoring Report. Report to Kish Offshore Wind Limited and Bray Offshore Wind Limited.

Gill, A.B. & Bartlett, M. (2010). Literature review on the potential effects of electromagnetic fields and subsea noise from marine renewable energy developments on Atlantic salmon, sea trout and European eel. Scottish Natural Heritage Commissioned Report No.401. Available at: https://dspace.lib.cranfield.ac.uk/server/api/core/bitstreams/dee1a7b3-e898-44b1-9974-a03a5c698fa5/content

Golding. N., Albrecht. J., McBreen. F. 2020. Refining criteria for defining areas with a 'low resemblance' to Annex I stony reef; Workshop Report. JNCC Report No. 656, JNCC, Peterborough, ISSN 0963-8091. Available at: https://data.jncc.gov.uk/data/4b60f435-727b-4a91-aa85-9c0f99b2c596/JNCC-Report-656-FINAL-WEB.pdf

Grant, A., and Middleton, R., 1998. Contaminants in sediments: Using robust regression for grain-size normalization. Estuaries, 21, 197–203.

Hagan & Dubsky, 2021. Short autumn Survey of seagrass *Zostera noltii* in Dublin Bay, October 2021. On behalf of Coastwatch for Dublin City Council.Hedges, J.I., Keil, R.G., 1995. Sedimentary organic matter preservation: an assessment and speculative synthesis. Mar. Chem., 49 (1995), pp. 81-115

Hines, A.H. and Comtois, K.L. (1985). Vertical distribution of infauna in sediments of a subestuary of central Chesapeake Bay. Estuaries, 8(3), 296-304. Avaialble at: https://repository.si.edu/bitstream/handle/10088/17784/serc_Hines_Comtois_1985_Estuaries_8_296_304.pdf

T.J. Holt, E.I. Rees, S.J. Hawkins, R. Seed. (1998). Biogenic Reefs (volume IX). An overview of dynamic and sensitivity characteristics for conservation management of marine SACs. Scottish Association for Marine Science (UK Marine SACs Project). Available at: http://ukmpa.marinebiodiversity.org/uk_sacs/pdfs/biogreef.pdf

Hvidt, C. B., L. Brünner, F.R. Knudsen and B.S. Jensen, 2004. Hydroacoustic Monitoring of Fish Communities at Foundations of Offshore Wind Turbines. Pilot project, Nysted Offshore Wind Farm at Rødsand, 2004. Prepared for ENERGI E2:1-29.

Hydrographic Surveys Ltd., 2013. Report of Survey: Dun Laoghaire Bathymetric Survey Sediment Samples & Analysis.

Hydrographic Services Ltd., 2015. Dun Laoghaire Harbour sediment samples analysis.

INFOMAR., 2016. Integrated Mapping for the Sustainable Development of Ireland's Marine Resource.

INFOMAR (2021). Integrated Mapping for the Sustainable Development of Ireland's Marine Resources. Available at: https://www.marine.ie/Home/site-area/areas-activity/seabed-mapping/infomar

IPCC (2013). Climate change 2013: the physical science basis. In: Working Group I Contribution to the IPCC Fifth Assessment Report of the Intergovernmental Panel on Climate Change, UK and New York, p. 1535.

Irving, R. (2009). The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. JNCC Report No. 432. Available at: https://data.jncc.gov.uk/data/21693da5-7f59-47ec-b0c1-a3a5ce5e3139/JNCC-Report-432-FINAL-WEB.pdf

Jakubowska, Magdalena & Urban-Malinga, Barbara & Otremba, Zbigniew & Andrulewicz, Eugeniusz. (2019). Effect of low frequency electromagnetic field on the behavior and bioenergetics of the polychaete *Hediste diversicolor*. Marine Environmental Research. 150. 104766. 10.1016/j.marenvres.2019.104766.

JNCC (2019), Guidance on Assigning Benthic Biotopes using EUNIS or the Marine Habitat Classification of Britain and Ireland (Revised 2019), Available at: https://data.jncc.gov.uk/data/f23a26d7-07ad-4291-a42d-b422dad82351/JNCC-Report-546-REVISED-WEB.pdf [Accessed: February 2022]

Johnston, C.and Mousley, S. (2021). Definition of Favourable Conservation Status for Reefs. Natural England.

Keil, R.G., Hedges, J.I., 1993. Sorption of organic matter to mineral surfaces and the preservation of organic matter in coastal marine sediments. Chem. Geol., 107, pp. 385-388.

Kröncke, I., 2011. Changes in Dogger Bank macrofauna communities in the 20th century caused by fishing and climate. Estuarine, Coastal and Shelf Science, 94, p.234-245.

Kröncke, I., 1995. Long-term changes in North Sea benthos. Senckenberg Marit, 26, p.73-80.

Laffoley, D.A., Connor, D.W., Tasker, M.L. & Bines, T., 2000. Nationally important seascapes, habitats and species. A recommended approach to their identification, conservation and protection, pp. 17. Peterborough: English Nature.

Levin, L.A., Ekau, W., Gooday, A.J., Jorissen, F., Middelburg, J.J., Naqvi, S.W.A., Neira, C., Rabalais, N.N., Zhang, J., 2009. Effects of natural and human-induced hypoxia on coastal benthos. Biogeosciences, 6, p. 2063–2098. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.715.8135&rep=rep1&type=pdf

Leppäkoski, E., 1975. Assessment of degree of pollution on the basis of macrozoobenthos in marine and brackish water environments. Acta Acadamiae Aboensis (B), 35, 1-89).

Lindeboom, H.J., Kouwenhoven, H.J., Bergman, M.J.N., Bouma, S., Brasseur, S., Daan, R., Fijn, R.C., Haan, De d.,Dirksen, S., Hal, R. van., Hille Ris Lambers, R., Hofsted, R ter., Krijgsveld, K.L., Leopold, M. and Scheidat, M., 2011. Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. Environmental Research Letters, 6 (3).

Lohmann, K.J., Willows, A.OD. (1987). "Lunar-modulated geomagnetic orientation by a marine mollusk." Science 235 :331–334

Love, M.S., Nishimoto, M.M, Clark, S. & Bull, A.S., 2016. Renewable Energy in situ Power Cable Observation. OCS Study BOEM 2016-008. Available at: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/BOEM-2016-008.pdf

Mahaffey, C., Palmer, M., Greenwood, N. and Sharples, J. (2020) Impacts of climate change on dissolved oxygen concentration relevant to the coastal and marine environment around the UK. MCCIP Science Review 2020, 31–53.

Marine Institute, 2014. Biological Effects and Chemical Measurements in Irish Marine Waters, Available from:

https://oar.marine.ie/bitstream/handle/10793/974/Biological%20Effects%20and%20Chemical%20Measurements%20in%20Irish%20Marine%20Waters%20Final%20Report.pdf?sequence=1&isAllowed=y [Accessed December 2020]

Marine Institute (2017). Benthos monitoring in the marine environment. Available at: https://data.gov.ie/dataset/benthos-monitoring-in-the-marine-environment

MERC Consultants (2022). Littoral and sublittoral Reef habitats of Dún Laoghaire Rathdown County Council area. Report to Dún Laoghaire Council https://www.dlrcoco.ie/sites/default/files/atoms/files/dlrd_reef_habitats_nov_2022_final_01.pdf

NISA, (2021). North Irish Sea Array Windfarm Ltd. North Irish Sea Array Offshore Wind Farm

EIA Scoping Report. Available at: https://northirishseaarray.ie/stat-cont/uploads/2021/05/281240-00-NISA-EIA-Scoping-Report-Final.pdf

NPWS (2008) The Status of EU Protected Habitats and Species in Ireland. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

NPWS (2013) Conservation Objectives: Rockabill to Dalkey Island SAC 003000. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS, (2019). Ireland's Biodiversity Sectoral Climate Change Adaptation Plan. Consultation Draft. Available at: https://www.npws.ie/news/public-consultation-irelands-biodiversity-sectoral-climate-change-adaptation-plan

OREDP, 2010, Strategic Environmental Assessment (SEA) of the Offshore Renewable

Energy Development Plan (OREDP) in the Republic of Ireland.

OSPAR (2008). Guidance on Environmental Considerations for Offshore Wind Farm Development. 19pp.

Pearson, T.H. and Rosenberg, R. (1978). Macrobenthic Succession in Relation to Organic Enrichment and Pollution of the Marine Environment. Oceanography and Marine Biology—An Annual Review, 16, 229-311.

Picton B.E., Emblow, C.S., Morrow, C.C., Sides, E.M., Tierney, P., McGrath, D., McGeough, G., McCrea, M., Dinneen, P., Falvey, J., Dempsey, S., Dowse, J. & Costello, M. J., 1997. Marine sites, habitats and species data collected during the BioMar survey of Ireland.

Rhoads, D. C., 1974. Organism-sediment relations on the muddy sea floor. Annual Reviews. Oceanogr. & Mar. Biol., 12, 263-300.

Roche, C., Lyons, D.O., Fariňas Franco, J. & O'Connor, B., 2007. Benthic surveys of sandbanks in the Irish Sea. National Parks and Wildlife Service. Irish Wildlife Manuals, No. 29. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

Sanders, H.L. (1958). Benthic studies in Buzzards Bay. I. Animal-sediment relationships. Limnology and Oceanography, 3(3), 245-258.

Saorgus Energy Ltd., 2011. Dublin Array – An Offshore Wind Farm on the Kish and Bray Banks: Environmental Impact Statement. Revision 1. Available at: https://www.gov.ie/en/foreshore-notice/60c81-bray-offshore-wind-ltd/.

Scally, L., Pfeiffer, N.J., & Hewitt, E. (2020) The monitoring and assessment of six Annex I marine habitats. Irish Wildlife Manuals, No. 118. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

Scott, K., Harsanyi, P., Easton, B., Piper, A., Rochas, M., Lyndon, A., and Chu K. (2021), Exposure to Electromagnetic Fields (EMF) from Submarine Power Cables Can Trigger Strength-Dependent Behavioural and Physiological Responses in Edible Crab, Cancer Pagurus (L.). Journal of Marine Science and Engineering, 9: 776.

Scottish National Heritage, 2011. Guidance on Survey and Monitoring in Relation to Marine Renewables Deployments in Scotland Volume 5: Benthic Habitats. 115 pp.

Snelgrove, P. V. R., and Butman, C. A., 1994. Animal–sediment relationships revisited: cause versus effect. Oceanography and Marine Biology Annual Review 32: 111–177.

SSE Renewables (2020). Arklow Bank Wind Park Phase 2 Offshore Infrastructure Environmental Impact Assessment Scoping Report. Available at: https://www.sserenewables.com/media/xdtn1vh3/abwp-phase-2-offshore-infrastructure_scopingreport_final.pdf

Stephen Little & Associates (2015). Proposed Cruise Berth Facility, Dun Laoghaire Harbour Environmental Impact Statement. Report to Dun Laoghaire Harbour Company. Available at: https://www.pleanala.ie/publicaccess/EIAR-NIS/PA0042-PA0051/EIS%20Volume%201%20Written%20Statement/EIS_Chapter_1_0_Introduction.pdf

Switzer, T. & Meggitt, D. (2010). Review of Literature and Studies on Electro Magnetic Fields (EMF) Generated by Undersea Power Cables and Associated Influence on Marine Organisms. Presented at OCEAN 2010.

Tillin, H. & Tyler-Walters, H., 2014. Assessing the sensitivity of subtidal sedimentary habitats to pressures associated with marine activities. Phase 2 Report – Literature review and sensitivity assessments for ecological groups for circalittoral and offshore Level 5 biotopes. JNCC Report No. 512B, 260 pp.

Tyler-Walters, H., Tillin, H.M., d'Avack, E.A.S., Perry, F., Stamp, T., 2023. Marine Evidencebased Sensitivity Assessment (MarESA) – Guidance Manual. Marine Life Information Network (MarLIN). Marine Biological Association of the UK, Plymouth, pp. 170. Available at: https://www.marlin.ac.uk/assets/pdf/MarLIN-MarESA-Manual-Jun2023.pdf

Ugolini, A. & Pezzani, A. (1995). Magnetic compass and learning of the Y,axis (sea-land) direction in the marine isopod Idotea baltica basteri. Animal Behaviour 50, 295–300, https://doi.org/10.1006/anbe.1995.0245.

Ugolini, A. (2006). Equatorial sandhoppers use body scans to detect the earth's magnetic field. Journal of Comparative Physiology A 192, 45–49, https://doi.org/10.1007/s00359-005-0046-9.

West, V., Maher, E. & Alexander, D. (2024). Reef Habitat in Irish Intertidal and Near-shore Waters. Irish Wildlife Manuals, No. 150. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

Wheeler, A.J., Walshe, J., Sutton, G.D. (2001). Seabed mapping and seafloor processes in the Kish, Burford, Bray and Fraser Banks area, South-western Irish Sea. Irish geography Volume 34(2). PP 194-211. Available at: http://78.137.164.74/~geograph/irishgeography/v34-2/seabed.pdf

Woodruff, D. L., Schultz, I. R., Marshall, K. E., Ward, J. A. and Cullinan, V. I. (2012) Effects of electromagnetic fields on fish and invertebrates. Report prepared for the U.S. Department of Energy. DE-AC05-76RL01830. 68pp. Available at: http://www.pnnl.gov/main/publications/external/technical_reports/PNNL- 20813Final.pdf

Dublin Array Offshore Wind Farm

Environmental Impact Assessment Report

Annex A: Benthic and Intertidal Ecology Policy

Legislation, Policy and Guidance

<table>
<tr><th>Policy/ Legislation</th><th>Key provisions</th><th>Section where provision is addressed</th></tr>
<tr><td colspan="3">Legislation</td></tr>
<tr><td rowspan="3">European Communities (Marine Strategy Framework) Regulations 2011 (S.I. No. 249 of 2011)</td><td>Biological Features
▪ information on angiosperms, macro-algae and invertebrate bottom fauna, including species composition, biomass and annual/seasonal variability,
▪ a description of the population dynamics, natural and actual range and status of other species occurring in the marine region or subregion which are the subject of Community legislation or international agreements,
▪ an inventory of the temporal occurrence, abundance and spatial distribution of nonindigenous, exotic species or, where relevant, genetically distinct forms of native species, which are present in the marine region or subregion.</td><td>All biological features which will be impacted by the proposed development have been identified considered in Sections 3.6, 3.7 and 3.8.</td></tr>
<tr><td>Habitat Types
▪ identification and mapping of special habitat types, especially those recognised or identified under Community legislation (the Habitats Directive and the Birds Directive) or international conventions as being of special scientific or biodiversity interest,
▪ habitats in areas which by virtue of their characteristics, location or strategic importance merit a particular reference. This may include areas subject to intense or specific pressures or areas which merit a specific protection regime.</td><td>All habitat types, including designated habitats and those of characteristic or strategic importance have been considered in Sections 3.6, 3.7 and 3.8.</td></tr>
<tr><td>Pressures and Impacts:
▪ Biological Disturbance
    ▪ introduction of non-indigenous species and translocations
▪ Physical Loss
    ▪ Smothering (including smothering by man-made structures, disposal of dredge spoil),
▪ Physical Damage</td><td>The pressures and impacts outlined in Schedule 1, Table 2 of the Regulations were considered in the development of the scope of this assessment. The potential for introduction of non-indigenous species and translocations is presented under Impact 6 in Section 3.16, and Impact 11 in Section 3.17.</td></tr>
</table>

Policy/ Legislation	Key provisions	Section where provision is addressed
	▪ Changes in siltation (e.g. by outfalls, increased run-off, dredging/disposal of dredge spoil), ▪ abrasion (e.g. impact on the seabed of commercial fishing, boating, anchoring), ▪ Contamination by hazardous substances ▪ Introduction of synthetic compounds (e.g. priority substances under Directive 2000/60/EC which are relevant for the marine environment such as pesticides, antifoulants, pharmaceuticals, resulting, for example, from losses from diffuse sources, pollution by ships, atmospheric deposition and biologically active substances), ▪ introduction of non-synthetic substances and compounds (e.g. heavy metals, hydrocarbons, resulting, for example, from pollution by ships and oil, gas and mineral exploration and exploitation, atmospheric deposition, riverine inputs), ▪ introduction of radio-nuclides. ▪ Systematic or intentional release of substances or both ▪ Introduction of other substances, whether solid, liquid or gas, in marine waters, resulting from their systematic or intentional release or both release into the marine environment, as permitted in accordance with other Community legislation and/or international conventions.	The potential for physical loss by smothering, and damage from changes in siltation on benthos are presented under Impacts 1 and 2 in Section 3.16, and Impact 14 in Section 3.18. The potential for physical damage from abrasion is addressed under Impacts 4 and 5 in Section 3.16, Impact 8 in Section 3.17, and Impact 14 in Section 3.18. The potential for impacts from contamination from hazardous substances or systematic or intentional releases of substances have been address under Impacts 5, 12 and 17 in Sections 3.16, 3.17 and 3.18.

Policy/ Legislation	Key provisions	Section where provision is addressed
Planning and Development Regulations, 2001, as amended (S.I. No. 600/2001) Schedule 6, Part 2 (b)	A description of the aspects of the environment likely to be significantly affected by the proposed development, including in particular: ▪ human beings, fauna and flora,	This assessment provides a description of the likely significant effects on the marine benthic ecology in conjunction with Volume 3, Chapter 1.
National Marine Planning Framework (2021) Department of Local Government and Heritage (DHLGH)	**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.	Likely significant effects of relevance to Biodiversity Policy 2 are addressed in: • Section 1.17 Impact 1: Increased SSC and sediment deposition; • Section 1.17 Impact 3: Temporary habitat loss/disturbance; and • Section 1.18 Impact 7: Long-term habitat loss/change from the presence of foundations, scour protection and cable protection. • Section 1.19 Impact 15: Increased SSC and sediment deposition;
	Water Quality Policy 1 Proposals that may have significant adverse impacts upon water quality, including upon habitats and species beneficial to water quality, must demonstrate that they will, in order of preference and in accordance with legal requirements: a) avoid, b) minimise, or c) mitigate significant adverse impacts.	Likely significant effects of relevance to Water Quality Policy 1 are addressed in: • Section 1.17 Impact 1: Increased SSC and sediment deposition; • Section 1.17 Impact 3: Temporary habitat loss/disturbance; • Section 1.17 Impact 5: Seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology in the array area, and Offshore ECC; • Section 1.19 Impact 15: Increased SSC and sediment deposition;

Policy/ Legislation	Key provisions	Section where provision is addressed
		• Section 1.19 Impact 17: Seabed disturbances leading to the release of sediment contaminants and /or accidental contamination resulting in potential effects on benthic ecology in the array area, and Offshore ECC; and • Marine pollution contingency measures would be implemented as part of the offshore Environmental Management Plan (EMP) to manage the risk of accidental spillages from construction equipment or collision incidents. This would include a chemical risk review with information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance. This measure would reduce the likelihood of potentially harmful pollutants to be released into the marine environment which may then impact on benthic receptors.
	Sea floor and Water Column Integrity Policy 1 Proposals that incorporate measures to support the resilience of marine habitats 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 which may have significant adverse impacts on marine, particularly deep sea, habitats must demonstrate that they will, in order of preference and in accordance with legal requirements:	Likely significant effects of relevance to Sea Floor and Water Column Integrity Policy 1 are addressed in: • Section 1.17 Impact 3: Temporary habitat loss/disturbance; • Section 1.18 Impact 7: Long-term habitat loss/change from the presence of foundations, scour protection and cable protection.

Policy/ Legislation	Key provisions	Section where provision is addressed
	a) avoid, b) minimise, or c) mitigate significant adverse impacts on marine habitats, or d) if it is not possible to mitigate significant adverse impacts on marine habitats must set out the reasons for proceeding.	
	Sea floor and Water Column Integrity Policy 2 Proposals, including those that increase access to the maritime area, must demonstrate that they will, in order of preference and in accordance with legal requirements: a) avoid, b) minimise, or c) mitigate adverse impacts on important habitats and species.	Likely significant effects of relevance to Sea Floor and Water Column Integrity Policy 2 are addressed in: • Section 1.17 Impact 3: Temporary habitat loss/disturbance; • Section 1.18 Impact 7: Long term habitat loss from the presence of foundations, scour and cable protection; and • Section 12.5.4.2 Impact 13: Loss of habitat (damage and/or loss to habitats and non-mobile species).
	Sea floor and Water Column Integrity Policy 3 Proposals that protect, maintain, restore and enhance coastal habitats for ecosystem functioning and provision of ecosystem services will be supported, subject to the outcome of statutory environmental assessment processes and subsequent decision by the competent authority, and where they contribute to the policies and objectives of this NMPF. Proposals must take account of the space required for coastal habitats, for ecosystem functioning and provision of ecosystem services, and demonstrate that they will, in order of preference and in accordance with legal requirements: a) avoid, b) minimise, or c) mitigate for net loss of coastal habitat	Likely significant effects of relevance to Sea Floor and Water Column Integrity Policy 3 are addressed in: • Section 1.17 Impact 3: Temporary habitat loss/disturbance; • habitat loss from the presence of foundations, scour and cable protection.

Policy/ Legislation	Key provisions	Section where provision is addressed
Guidelines and technical standards		
Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of Housing, Planning and Local Government, 2018) (hereafter referred to as the EIA Guidelines) Para 4.31.	The starting point for EIA is an assessment of the current state of the environment and how this is likely to evolve without the proposed project but having regard to existing and approved projects and likely significant cumulative effects – in other words the 'do nothing' scenario.	A full characterisation of the receiving environment is presented in Volume 5, Appendix 5. 3.4-1. The findings of this characterisation have been summarised in this chapter for the ease of the reader.
Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of Housing, Planning and Local Government, 2018) (hereafter referred to as the EIA Guidelines) Para 6.12.	The Directive requires that the EIAR describes the cumulation of effects. Cumulative effects may arise from: ▪ The interaction between the various impacts within a single project; ▪ The interaction between all of the different existing and/or approved projects in the same area as the proposed project.	The interactions between various environmental aspects within the proposed developments are presented in Section 3.19 of this chapter. The interactions between Dublin Array and other plans and projects, for physical processes, ae presented in Section 3.19 of this EIAR chapter.
Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2018)	The construction of a wind farm may have a variety of local effects, but defining the zones of influence of the project also needs to take account of the potential for more widespread impacts, such as: ▪ changes to sediment movement and potentially to coastal morphology depending upon proximity to the shore and the method of protecting transmission cables; ▪ direct construction impacts; ▪ provision of substrate for colonisation by native or non-native species.	The ZoI as informed by the Physical Processes Chapter, incorporates the extent of any potential primary and secondary impacts on benthic receptors as a result of the development. The ZoI is defined in full in Section 3.1.

Policy/ Legislation	Key provisions	Section where provision is addressed
Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Cefas, 2012)	The guidance provides an overview of the approach to data utilisation and collection in benthic studies to provide site characterisation and assess impacts as part of the EIA process. Use of oceanographic data - hydrodynamic regime (tidal currents and waves), in combination with sediment source data should be utilised to determine the characteristics of seabed sediments and inform the benthic assessment. Long term data sets provide a more realistic view of the situation.	Oceanographic data from the Physical Processes Chapter and sediment source has been used to inform the benthic ecology baseline and assessment. A comprehensive list of the data sources is provided in Section 3.1 of this chapter.
Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Cefas, 2012)	The guidance provides an overview of the approach to data utilisation and collection in benthic studies to provide site characterisation and assess impacts as part of the EIA process. ▪ Acoustic surveys – can be used to delineate strata and such data are then used for informing design of ground-truthing surveys and to identify the presence and extent of areas of interest; Grab and trawl ground-truthing surveys – Homogenous seabed: where acoustic data indicates a largely homogenous substrate the ground-truthing surveys should adopt a grid approach across the whole zone of potential impact – the number and spatial frequency of sampling will depend on how much existing knowledge and data there is about the seabed.	Groundtruthing data has been collected across the subtidal study area to inform the assessment. Further detail on the data used to inform the benthic ecology baseline and assessment is provided in Section 3.1 of this chapter.
Guidance on Survey and Monitoring in Relation to Marine Renewables Deployments in Scotland Volume 5: Benthic Habitats (SNH, 2011)	The guidance details a focus on considering monitoring protocols to detect potential impacts of wave and tidal devices.	A detailed description of the baseline survey data (inclusive of site-specific surveys) utilised to inform an assessment of potential effects on benthic receptors is provided in Section 4.4 of this chapter.
Guidance on Marine Baseline Ecological Assessments & Monitoring Activities for Offshore Renewable Energy Projects Parts 1 and 2 (DCCAE, 2018);	Preconstruction baseline surveys should calculate the total habitat area and the approximate area of each biotope within the habitat. Site characterisation by drop down video should be used in the first instance, followed by grab sampling surveys to assess the macrofaunal communities, sediment particle size and organic carbon content.	A detailed description of the baseline survey data (inclusive of site-specific surveys) is provided in Section 3.1 of this chapter.

Policy/ Legislation	Key provisions	Section where provision is addressed
Guidance on Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) Preparation for Offshore Renewable Energy Projects (Environmental Working Group of the Offshore Renewable Energy Steering Group and the DCCAE, 2017) (hereafter referred to as the DCCAE Guidance)	Cumulative impact assessments only need to take account of existing and/or approved projects and not other projects within the planning process.	A precautionary approach was undertaken to consider and plans or projects which could result in a cumulative effect. The cumulative assessment is presented in Section 3.19. To account for the uncertainty associated with projects and plans which have not yet been consented a tiering system was adopted. Further details of the approach are available in the Cumulative Impact Assessment Methodology Chapter.
	"Environmental protection by assessment of likely significant effects of projects to promote sustainable development"	The scope of this assessment is presented in Section 3.13. All effects which have been assessed were identified, in the Dublin Array Scoping Report, with the potential to arise in significant effects in EIA terms.
	Developers and competent authorities should have regard to when planning/assessing a project – ▪ Protected sites and species	Due regard has been given to protected sites and species in Sections 3.7 and 3.8.
	Developers and competent authorities should have regard to when planning/assessing a project – ▪ Benthic ecology	This chapter provides an assessment on the potential effects on benthic ecology.
	Developers and competent authorities should have regard to when planning/assessing a project – ▪ Sediments	The potential for physical loss by smothering, and damage from changes in siltation on benthos are presented under Impacts 1 and 2 in Section 3.16, and Impact 14 in Section 3.18. Changes in sediment transportation are assessed under Impact 12 in Section 3.17.
	All phases of the development should be considered in the assessment process. Each of these phases will have its own specific effects on the environment and will differ in duration. Considering all	All phases of the development have been considered within this physical process EIA assessment.

Policy/ Legislation	Key provisions	Section where provision is addressed
	phases of the development will address full lifecycle effects of a proposed development.	The assessment of effects in the construction phase are presented in Section 3.16. The assessment of effects in the operational phase (including maintenance) are presented in Section 3.17. The assessment of effects in the decommissioning phase are presented in Section 3.18.
	"The zones of influence may differ depending upon the topic under consideration (e.g. the visual zone will differ from the biodiversity zone). In establishing the zones of influence, the following should be identified: ▪ the physical footprint of the project; ▪ the measures required to determine the overall ZoIs of a project (i.e. the area impacted by the development with reference to the of likely significant effects); and ▪ the study area (i.e. that selected for the review). Specific modelling techniques, typically simulating water mixing processes to predict temporal and spatial variations, can be used to assist in the exercise. The zones of influence relate primarily to ecological and visual impacts of the development."	The ZoI for Dublin Array benthic ecology was developed through use of project specific modelling. Further details of the zone of influence and the development of the study area are presented in Volume 3, Chapter 1.
	A source – pathway – target risk assessment methodology may be of benefit in establishing the potential zones of influence.	A source-pathway-receptor assessment methodology was used to scope the receptors within the ZoI for this assessment - see Section 3.13 for those receptors scoped in for assessment.
	A description of the existing environment is required to allow for a prediction of significant likely effects of a development.	A full characterisation of the receiving environment is presented in Volume 5, Annex 3.4-1. The findings of this characterisation have

Policy/ Legislation	Key provisions	Section where provision is addressed
		been summarised in this chapter for the ease of the reader.
	The condition of the receiving environment should be used to inform whether or not an effect is significant and to understand its vulnerability and sensitivity.	The assessment criteria for assessing the sensitivity of receptor to a potential effect is outlines in Section 3.5. The criterion including a consideration of its context (its adaptability, tolerance and recoverability) and value.
	Indicative list of impacts – ▪ Benthic ecology (subtidal and intertidal) Damage/loss to habitats and non-mobile species Smothering Scouring of seabed Suspended sediments and increased turbidity Changes in wave and tidal regime Disturbance of contaminated sediments Contamination (hydraulic fluids/vessel fuel) Improved vertical mixing	Benthic ecology (subtidal and intertidal) receptors have all been characterised and potential impacts on the receptors assessed accordingly within this chapter.
	Mitigation measures are usually required where likely significant effects on the environment are identified. Mitigation measures may be proposed in order to *avoid, prevent, reduce, rectify,* or sometimes *compensate* any major adverse effects. The impact of residual effects should then be assessed.	The Project Design Features and Avoidance and Preventative Measures relevant to this benthic ecology processes assessment is presented in Table 11. Where significant adverse effects arose (with the Project Design Feature / Avoidance and Preventative Measure in place) then additional mitigation measures have been proposed and the effects have been reassessed with the mitigation measures in place to determine the residual effect.

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