Dublin Array
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EIAR Volume 3: Offshore Infrastructure Assessment Chapters Chapter 2: Marine Water and Sediment Quality

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Dublin Array Offshore Wind Farm

Environmental Impact Assessment Report

Volume 3, Chapter 2: Marine Water and Sediment Quality

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Glossary

Term	Definition
Tidal Excursion	Tidal excursion length is the net horizontal distance travelled by a water particle from LWS to HWS or vice versa. It can be used to describe the movement of pollutants in estuaries during a tidal cycle (Zhen-Gang, 2008).
Tidal Ellipse	A tidal ellipse is a plot of tidal current vectors over time, which shows the tidal influence on current velocity. It is a common tool for diagnosing tidal currents.
Mean high water springs (MHWS)	Mean high water springs is the highest level that spring tides reach on the average over a period of time.
Dissolved oxygen	Dissolved oxygen (DO) refers to the volume of oxygen that is contained in water. Oxygen enters the water by photosynthesis of aquatic biota and by the transfer of oxygen across the air-water interface. The amount of oxygen that can be held by the water depends on the water temperature, salinity, and pressure.
Eutrophication	Eutrophication is when a body of water becomes overly enriched with minerals and nutrients which induce excessive growth of plants/ algae.
Primary production	The production of organic compounds through the biological process of photosynthesis by phytoplankton.
Far-field	Defined as the wider area surrounding the array area and the Offshore ECC over which indirect changes may occur (i.e., inherently including the ZoI); and
Near-field	Defined as the footprint of the project, including both the array area and Offshore ECC, below MHWS.
Irish Action Levels	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.
Blackwater	Wasterwater arising from sanitary systems.
Greywater	Greywater is wastewater from household activities like washing dishes, showering, and doing laundry.

Acronyms

Term	Definition
AA	Annual Average
As	Arsenic
BW	Bathing Water
CA	Competent Authority
Cd	Cadmium
CEMP	Construction Environmental Management Plan
Cr	Chromium
Cu	Copper

Term	Definition
DAPPMS	Dublin Array Physical Process Modelling System
DCCAE	Department of Communications, Climate Action and Environment (now DECC)
DECC	Department of Environment, Climate and Communications (formerly DCCAE)
Dublin Array	Dublin Array Offshore Wind Farm
DAS	Dumping at Sea
DBT	Dibenzothiophene
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPA	Environmental Protection Agency
EQS	Environmental Quality Standards
EQSD	Environmental Quality Standards Directive
ERM	Effects Range Median
E.coli	*Escherchia coli*
EU	European Union
GES	Good Environmental Status
HCB	Hexachlorobenzene
HCH	Hexachlorocyclohexane
HDD	Horizontal Directional Drilling
Hg	Mercury
HWS	High Water Springs
IAC	Inter Array Cabling
IE	intestinal enterococci
IRCG	Irish Coast Guard
LWS	Low Water Springs
MARPOL	The International Convention for the Prevention of Pollution from Ships
MDO	Maximum Design Option
MHWS	Mean High Water Springs
MFE	Mass Flow Excavator
MSFD	Marine Strategy Framework Directive
MW	Mean Water
MW&SQ	Marine Water and Sediment Quality

Term	Definition
Ni	Nickel
NIS	Natura Impact Statement
NTU	Nephelometric Turbidity Unit
O&M	Operations and Maintenance
OSMP	Oil Spill Contingency Plan
OSP	Offshore substation platform
OSPAR	Oslo and Paris convention for the Protection of the Marine environment of the North-East Atlantic
PAHs	Polycyclic aromatic hydrocarbons
Pb	Lead
PCBs	Polychlorinated biphenyls
PEMP	Project Environment Management Plan
PEL	Probable Effects Level
PLONOR	Pose Little or No Risk to the Environment
PSA	Particle Size Analysis
PSD	Particle Size Distribution
PSU	Practical Salinity Unit
rBWD	Revised Bathing Water Directive
RBMP	River Basin Management Plan
SFW	Shellfish Water
SPM	suspended particulate matter
SSC	suspended sediment concentrations
SST	sea surface temperature
TBT	Tributyltin
TSHD	Trailer Suction Hopper Dredger
US EPA	United States Environmental Protection Agency
WFD	Water Framework Directive
WTG	Wind Turbine Generator
ZoI	Zone of Influence
Zn	Zinc

2 Marine Water and Sediment Quality

2.1 Introduction

2.1.1 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) on Marine Water and Sediment Quality (hereafter referred to as MW&SQ) receptors.

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

- Volume 3, Chapter 1: Marine Geology, Oceanography and 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, in addition to the metocean conditions. This chapter also provides an assessment of the potential impacts of the project upon marine geology, oceanography and physical processes;

- Volume 4, Appendix 4.3.2-1: Water Framework Directive and Marine Strategy Framework Directive Summary (hereafter referred to as the WFD and MSFD Summary): to be referred to for an assessment of the project's compliance with the requirements of the Water Framework Directive;

- Volume 4, Appendix 4.3.1-1: Technical Baseline Report - Physical Processes (hereafter referred to the Physical Processes technical baseline); to be referenced for a detailed description of the surficial sediment properties, suspended sediments and seabed features, in addition to the metocean (wave; tide) conditions;

- Volume 4, Appendix 4.3.3-3: Subtidal Survey Report Main Array & ECR - Benthic Ecology Monitoring Report (hereafter referred to as the Subtidal Survey Report); to be referred to for supporting information regarding the subtidal survey, including walk-over survey results and imagery, in addition to sediment sampling analysis and interpretation;

- Volume 4, Appendix 4.3.3-2: Marine Intertidal Ecological Survey, Shanganagh & Poolbeg, Co. Dublin (hereafter referred to as the Intertidal Survey Report): to be referred to for supporting information regarding the intertidal survey, including walk-over survey results and imagery, in addition to sediment sampling analysis and interpretation;

- Volume 3, Chapter 3: Benthic Subtidal and Intertidal Ecology (hereafter referred to as the Benthic Ecology chapter): to be referenced for an overview of the features of the benthic subtidal and intertidal ecology. This chapter also provides an assessment of the potential impacts of the project upon the benthic subtidal and intertidal ecology;

- Volume 3, Chapter 4: Fish and Shellfish Ecology (hereafter referred to as the Fish and Shellfish Ecology chapter): to be referred to for an overview of fish and shellfish characteristics. This chapter also provides an assessment of the potential impacts of the project upon the benthic subtidal and intertidal ecology; and
- Volume 4, Appendix 4.3.1-2: Physical Process Modelling for Dublin Array Offshore Wind Farm (hereafter referred to as the Physical Processes Modelling Report); to be referenced for detailed information on the project specific numerical modelling undertaken to support the assessment of the project upon the baseline sedimentological and metocean regimes. This includes a presentation of plume modelling and tidal excursions.

2.2 Regulatory background

2.2.1 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.

2.2.2 The assessment of potential impacts upon marine water and sediment quality has been made with specific reference to the relevant regulations, guidelines and guidance, which include:

- EU Directives:
  - Water Framework Directive (2000/60/EC);
  - Environmental Water Quality Standards Directive 2008/105/EC;
  - Marine Strategy Framework Directive 2008/56/EU;
  - Urban Waste Water Directive (91/271/EEC);
  - Directive 2006/11/EC on pollution caused by certain dangerous substances discharged into the aquatic environment;
  - Bathing Water Directive 2006/7/EC; and
  - Shellfish Waters Directive 2006/113/ EC.
- National Legislation:
  - S.I. No. 722 of 2003 - European Communities (Water Policy) Regulations 2003;
  - S.I. No. 413 of 2005 - European Communities (Water Policy) (Amendment) Regulations 2005;
  - S.I. No. 350 of 2014 - European Union (Water Policy) Regulations 2014;
  - S.I. No. 166 of 2022 - European Union (Water Policy) (Amendment) Regulations 2022

- S.I. No. 272 of 2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009;
- S.I. No. 386 of 2015 - European Communities Environmental Objectives (Surface Waters)(Amendment) Regulations 2015;
- S.I. No. 77 of 2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019;
- S.I. No. 659 of 2021 - European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2021;
- S.I. No. 410 of 2023 - European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2023;
- S.I. No. 249 of 2011 - European Communities (Marine Strategy Framework) Regulations 2011;
- S.I. No. 265 of 2017 - European Communities (Marine Strategy Framework) (Amendment) Regulations 2017;
- S.I. No. 648 of 2018 - European Communities (Marine Strategy Framework) (Amendment) Regulations 2018;
- S.I. No. 254 of 2001 – Urban Waste Water Treatment Regulations 2001;
- S.I. No. 440 of 2004 - Urban Waste Water Treatment (Amendment) Regulations 2004;
- S.I. No. 48 of 2010 - Urban Waste Water Treatment (Amendment) Regulations 2010;
- S.I. No. 684 of 2007 - Waste Water Discharge (Authorisation) Regulations 2007;
- S.I. No. 231 of 2010 - Waste Water Discharge (Authorisation) (Amendment) Regulations 2010;
- S.I. No. 652 of 2016 - Waste Water Discharge (Authorisation) (Environmental Impact Assessment) Regulations 2016;
- S.I. No. 214 of 2020 - European Union (Waste Water Discharge) Regulations 2020;
- S.I. No. 79 of 2008 - Bathing Water Quality Regulations 2008;
- S.I. No. 351 of 2011 - Bathing Water Quality (Amendment) Regulations 2011;
- S.I. No. 163 of 2016 - Bathing Water Quality (Amendment) Regulations 2016;
- S.I. No. 322 of 2024 - Bathing Water Quality (Amendment) Regulations 2024;

- SI No 268 of 2006 - European Communities (Quality of Shellfish Waters) Regulations 2006;
- SI No 55 of 2009 - European Communities (Quality of Shellfish Waters) (Amendment) Regulations 2009; and
- SI No 464 of 2009 - European Communities (Quality of Shellfish Waters (Amendment)(No 2) Regulations 2009

- MARPOL Convention - International Convention for the Prevention of Pollution from Ships 1973; and
- Sea Pollution Act 1991, as amended.

2.2.3 Additional information on these is included below to provide additional context for MW&SQ. The relevance of specific policies or guidance including those captured within the Policy Chapter and their key provisions with regards MW&SQ and how these have been addressed within this assessment are presented in Annex A.

2.2.4 Consideration of MW&SQ in European sites is required by Council Directive 92/43/EEC ("the Habitats Directive ") and Directive 2009/147/EC ("the Birds Directive") as transposed into Irish law by S.I. No. 477 of 2011 - EC (Birds and Natural Habitats Regulations 2011, as amended. An assessment of any likely significant effect in relation to MW&SQ, as a result of the Dublin Array offshore infrastructure, on Natura 2000 sites and their qualifying interests is presented in the Natura Impact Statement (NIS) (Part 4 Habitats Directive Assessments).

Water Framework Directive

2.2.5 The European Union (EU) Water Framework Directive (WFD) (2000/60/EC) was established in 2000 to provide a single framework for the protection of surface waterbodies (including rivers, lakes, transitional and coastal waters and estuaries) and groundwater. The WFD aims to prevent deterioration, and to enhance the status, of aquatic ecosystems, including coastal and transitional waters.

2.2.6 The WFD defines "surface water status" as the general expression of the status of a body of surface water, determined by the poorer of its ecological status and its chemical status. "Good surface water status" means the status achieved by a surface water body when both its ecological status and its chemical status are at least "good".

2.2.7 "Good ecological status" means the status of a surface water body classified in accordance with Annex V of the WFD as it relates to the quality of the structure and functioning of aquatic ecosystems.

2.2.8 "Good surface water chemical status" means the chemical status required to meet the environmental objectives for surface waters, that is the chemical status achieved by a body of surface water in which concentrations of pollutants do not exceed the environmental quality standards established in Annex IX and under Article 16(7) of the WFD, and under other relevant Community legislation setting environmental quality standards at Community level.

2.2.9 Each Member State is required to implement a programme of monitoring the ecological status and chemical status for surface waters, to provide a coherent and comprehensive overview of ecological and chemical status within each river basin.

2.2.10 Coastal waters for the purposes of the WFD are situated between the coast and one nautical mile offshore. Each waterbody has an assigned ecological status. The ecological status is assigned by considering the biological, hydromorphological, chemical and specific chemicals. The different statuses are:

- High;
- Good;
- Moderate;
- Poor; or
- Bad.

2.2.11 The WFD's objective of a "Good surface water chemical status" is defined in terms of compliance with all the quality standards established for chemical substances at a European level. This will ensure at least a minimum chemical quality, particularly in relation to toxic substances and chemicals.

2.2.12 The WFD objective of 'good ecological status' also requires certain chemical conditions as classified in Annex V. The requirements include the achievement of environmental quality objectives for discharged priority substances. It also identifies any other substances liable to cause pollution or being discharged in significant quantities.

2.2.13 The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. 722 of 2003). The Directive requires that management plans are prepared for each river basin. The third River Basin Management Plan - Water Action Plan 2024: A River Basin Management Plan for Ireland – was issued in September 2024. The RMBP "sets out the measures that are necessary to protect and restore water quality in Ireland".

2.2.14 The Environmental Quality Standards (EQSs) for classifying surface water status are established in the Schedule 5 of the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009), as amended.

2.2.15 This chapter should be read in conjunction with the WFD and MSFD Summary which provides a guide to where the various elements have been assessed within the Applicant's EIA.

Bathing Waters

2.2.16 The EU's revised Bathing Water Directive (rBWD) (2006/7/EC) came into force in March 2006 through transitional measures. The rBWD provides more stringent standards than the previous Directive and place an emphasis on providing information to the public. The rBWD has four different classifications of performance, these are:

- Excellent - the highest, cleanest classification;

- Good - good water quality;
- Sufficient - the water meets minimum standards; and
- Poor - the water has not met the minimum required standards.

2.2.17 The rBWD was transposed into Irish law by S.I. No. 79 of 2008 - Bathing Water Quality Regulations 2008 - as amended. Under the Bathing Water Quality Regulations, local authorities measure, and monitor the number of certain types of bacteria which may indicate the presence of pollution, mainly from sewage or animal faeces, these are *Escherchia coli* (*E. coli*) and intestinal enterococci (IE). An increase in the concentrations of these bacteria indicates a decrease in water quality. The Environmental Protection Agency (EPA) is responsible for compiling this Bathing Water (BW) information and its submission to the European Commission.

2.2.18 An overall classification for the BW is then determined by creating a distribution from the monitoring data for the last four years on a rolling basis. A separate distribution is calculated for both *E.coli* and IE. This then enables the determination of the classification for each bacterium for the BW.

2.2.19 If the classification for both types of bacteria is different, then the overall BW compliance is the lowest classification achieved by either type. For example, if E. coli were performing at 'Good' but IE was performing at 'Sufficient', then the Bathing Water would be classified as performing at 'Sufficient'.

2.2.20 This EIAR chapter considered the potential for the reduction in Bathing Water performance as a result of the offshore construction activities associated with the Dublin Array offshore infrastructure.

Shellfish Directive

2.2.21 The WFD incorporates the Shellfish Waters Directive which aims to protect and improve water quality and support the growth of healthy shellfish (bivalve and gastropod molluscs) and support the production of good quality edible shellfish.

2.2.22 The Shellfish Waters Directive 2006/113/EC was designed to protect the aquatic habitat of bivalve and gastropod molluscan species of shellfish. It sets out standards for various parameters that should be monitored in designated shellfish areas.

2.2.23 The Shellfish Waters Directive establishes parameters applicable to designated shellfish waters (SFWs), as well as mandatory values, reference methods of analysis and the minimum frequency for taking samples and measurements. These parameters are set for pH, temperature, salinity and the presence or concentration of certain substances (dissolved oxygen, hydrocarbons, metals, organohalogenated substances, etc.).

2.2.24 The Competent Authorities (CA) for each Member State must take samples from the waters to verify their conformity with the criteria set by the Directive. The following proportions of samples must conform to the established values:

- 100% of the samples for the parameters 'organohalogenated substances'[1] and 'metals';
- 95% of the samples for the parameters 'salinity' and 'dissolved oxygen';
- 75% of the samples for the other parameters; and
- No evidence of harm to the shellfish from organohalogenated compounds.

2.2.25 Additionally, the Shellfish Water Directive stipulates that a discharge should not cause an increase of suspended solids to exceed 30% above background levels, as shellfish can be adversely affected by the smothering effects of sediment settling.

2.2.26 The Shellfish Water Directive was transposed into Irish law by means of the European Communities (Quality of Shellfish Waters) Regulations 2006 (S.I. 268 of 2006) (hereafter referred to as the Shellfish Water Regulations). The Shellfish Regulations applied to 12 designated shellfish waters. The Shellfish Water Regulations were amended in 2009 to include the addition of a further 49 SFWs by the European Communities (Quality of Shellfish Waters) (Amendment) Regulation 2009 (S.I. 55 of 2009). A further SFW (in Cork Harbour at Rostellan) was protected under European Communities (Quality of Shellfish Waters) (Amendment)(No.2) Regulation 2009 (S.I. 464 of 2009).

Priority substances

2.2.27 The Environmental Quality Standards Directive (EQSD) (2008/105/EC) identifies priority substances and polluting chemicals which should be considered in WFD assessments for transitional and coastal water bodies. The WFD Directive and the EQSD seek to reduce these substances entering into the marine environment, primarily from discharges and outfalls. Priority substances include, but are not limited to, benzene, nickel, and lead. Consideration of priority substances is provided in WFD and MSFD Summary and Sections 2.13 to 2.16 of this chapter.

Marine Strategy Framework Directive

2.2.28 The Marine Strategy Framework Directive (MSFD) (2008/56/EC) is similar to the WFD in that it required all EU member states, including Ireland, to reach good environmental status in the marine environment by 2020.

2.2.29 The MSFD was transposed into Irish law by S.I. 249 of 2011 - European Communities (Marine Strategy Framework) Regulations 2011, as amended(hereafter referred to as the MSFD Regulations). The purpose of the MSFD Regulations is to help develop Ireland’s ocean economy whilst protecting and preserving the marine environment.

2.2.30 The following water quality descriptors are considered in determining MSFD Good Environmental Status (GES) :

[1] Organohalogenated substances are organic compounds that contain halogen atoms, such as chlorine, bromine, fluorine, or iodine, in place of hydrogen atoms. They can be either synthetic or naturally occurring.

- (5) Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters.
- (8) Concentrations of contaminants are at levels not giving rise to pollution effects.

2.2.31 As a framework directive, the MSFD draws on the water quality work under WFD and OSPAR. The WFD and MSFD Summary, of the EIAR provides consideration of how Dublin Array adheres to the requirements of the MSFD and WFD and details the implications the proposed activities could have on the attainment of the respective objectives.

Urban Waste Water Treatment Directive

2.2.32 EU member states are required under the Urban Waste Water Treatment Directive (91/271/EEC) to identify nutrient-sensitive areas. These have been defined as "natural freshwater lakes, other freshwater bodies, estuaries and coastal waters which are found to be eutrophic or which in the near future may become eutrophic if protective action is not taken".

2.2.33 S.I. No. 254 of 2001 - Urban Waste Water Treatment Regulations, 2001 updated the list of nutrients to be monitored and assessed .

2.3 Consultation

2.3.1 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 MW&SQ to date for Dublin Array.

2.3.2 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), the Minister of Communications, Climate Action and Environment, Uisce Eireann, the Local Authorities[3] on matters relating to MW&SQ.

2.3.3 No known MW&SQ issues have been raised in the pre-application consultation. Therefore, no informal consultation or specific meetings for MW&SQ have been held.

[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)

[3] Including Dublin City Council, Dun Laoghaire-Rathdown County Council and Wicklow County Council.

Table 1 Summary of consultation relating to M&SQ

Date	Consultation type	Consultation and key issues raised	Section where provision is addressed
October 2020	Scoping Response from Dublin City Council	"As much of the area of Poolbeg is reclaimed land, and some potentially heavily contaminated by past industry, the implications of all proposed sub-surface alternations should be carefully researched to ascertain the specific nature of the material present."	This is acknowledged by the Applicant. Section 2.6 provides a detailed baseline description of the study area including known historical sources of contamination. Furthermore, in order to quantify the risks to disturbing the seabed sediments the Applicant has undertaken site specific surveys to quantify the levels of contamination which could potentially be disturbed by the proposed activities. The results of these surveys are presented in Section 2.6. Note: consideration of the landfall location at Poolbeg considered in the EIA Scoping is no longer being progressed following the confirmation by EirGrid of the connection point at Carrickmines. Full details of the surveys are provided in the Subtidal survey report and Intertidal survey report.

2.4 Methodology

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

Study area

2.4.2 The DCCAE Guidance recommends that the study area is established at the scoping stage. It is acknowledged that the study area may differ depending upon the pressure or ecosystem component under consideration. Data and identification of features of interest within the Zone of Influence (ZoI) that potentially may be impacted by an offshore renewable energy project are required so that a source – pathway – receptor risk assessment (EPA, 2022) can be carried out and the subsequent evaluation of effects can be undertaken for key features.

2.4.3 For the purposes of the EIA for the physical marine environment, the study area for MW&SQ

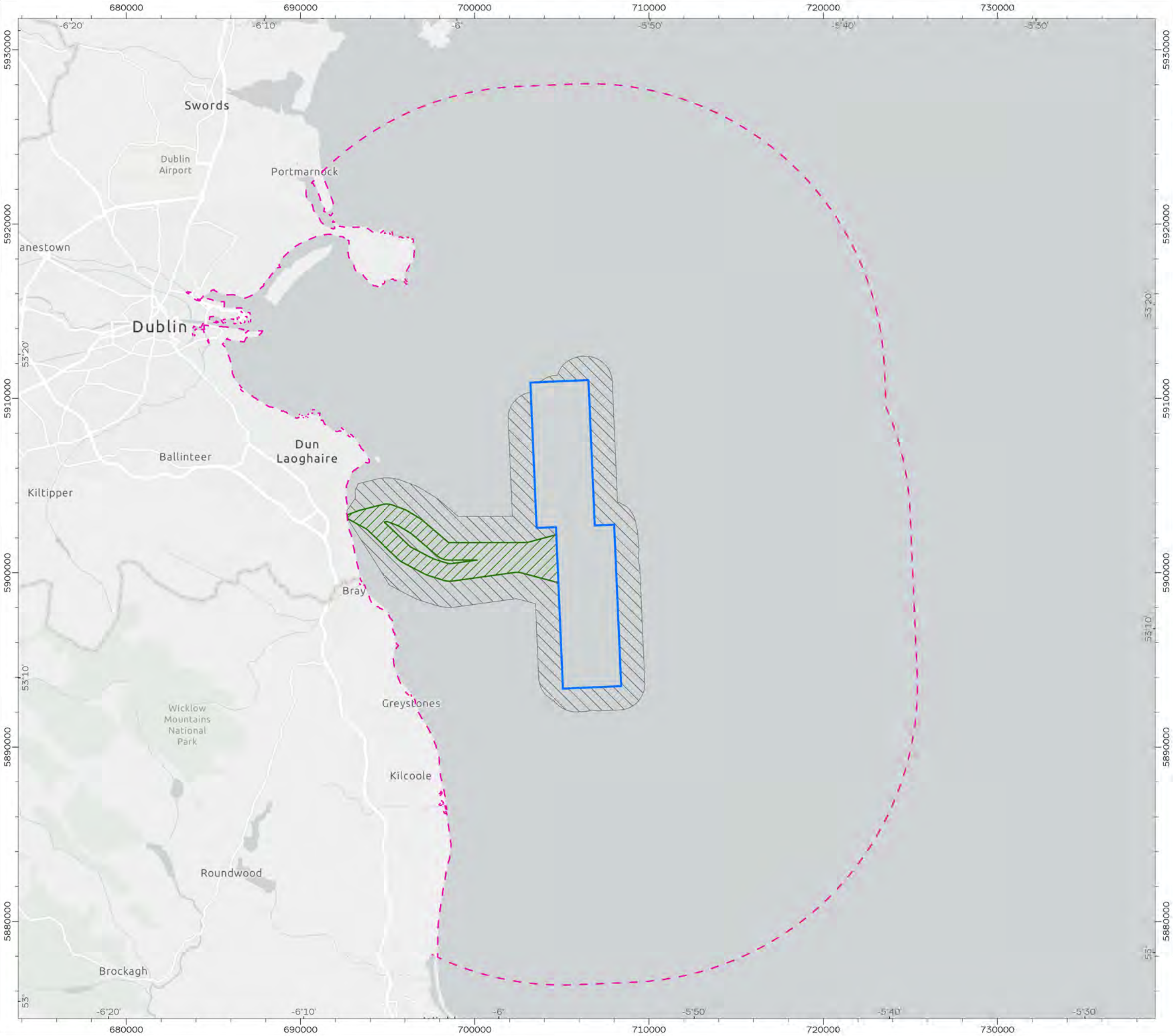
is determined by the ZoI of the offshore infrastructure of Dublin Array. The ZoI for the physical marine environment has been defined by the maximum spring tidal excursion[4] within the proposed development (which is, approximately, 16 km based on the project specific tidal excursion modelling undertaken[5]). Therefore, in this chapter a study area of a 17[6] km buffer around the array and Offshore export cable corridor[7] (ECC) is considered to be appropriately precautionary to encapsulate all reasonably foreseeable effects on MW&SQ receptors. The study area is limited to the marine and coastal environment below Mean High Water Springs (MHWS)[8].

2.4.4 MHWS has been defined as a natural boundary between the offshore and terrestrial environments within this EIAR. The study area for the MW&SQ is presented in Figure 1.

2.4.5 The assessment of impacts on the MW&SQ has been considered over two spatial scales. These are:

- **Far-field**. Defined as the wider area surrounding the array area and the Offshore ECC over which indirect changes may occur (i.e., inherently including the ZoI); and
- **Near-field**. Defined as the footprint of the project, including both the array area and Offshore ECC, below MHWS.

[4] Tidal excursion length is the net horizontal distance travelled by a water particle from LWS to HWS or vice versa. It can be used to describe the movement of pollutants in estuaries during a tidal cycle (Zhen-Gang, 2008).
[5] Based on the distance of sediment plume travelled which was released at low water until the flooding tide during a spring tide within the array area. Further details are provided in the Physical Processes Modelling Report.
[6] All distances are taken from the outer boundary of all offshore works incorporating the offshore infrastructure, the buffer also incorporates the temporary occupation area and as such are inherently precautionary
[7] Activities undertaken within the temporary occupation 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.
[8] Mean high water springs is the highest level that spring tides reach on the average over a period of time.



Marine Water and Sediment Quality Study Area (17km Buffer) (far-field)
Array Area
Temporary Occupation Area
Export Cable Corridor

DRAWING STATUS
FINAL

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Geographical Overview of the Study Area for Marine Water and Sediment Quality

DRAWING NUMBER: 1
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VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-12	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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Baseline data

2.4.6 The evidence used to characterise the baseline for the assessment is supported by a data and literature search both within the study area and the Irish Sea (Figure 1).

2.4.7 Data sources included but were not limited to:

- Integrated mapping for the sustainable development of Ireland's marine resource (INFOMAR, 2006-2016)[9];
- Project specific modelling – further details provided in as the Physical Processes Modelling Report;
- Project specific surveys data – further details provided in the Subtidal and Intertidal survey reports;
- Marine Institute:
  - Marine Institute Monthly Model Means for sea surface temperatures and salinity (2019[10]) ;
  - Marine Institute monitoring stations (M92, M93, M95 and M96) for dissolved oxygen (2015 to 2020);
  - Marine Institute water quality stations (Dublin Station 1 and Dublin Station 2) for turbidity; and
  - Biological Effects and Chemical Measurements in Irish Marine Waters Report (Marine Institute, 2014)[11].
- Environmental Protection Agency (EPA)[12]:
  - 'Urban Waste Water Treatment in 2022' (EPA, 2023);
  - 'The Water Quality Indicators 2023 report' (EPA, 2024); and
  - 'Water Quality in Ireland – 2016 – 2021' (EPA, 2021).

[9] This remains the latest version of these data at the time of writing.
[10] Irish Marine Institute Connemara Model CONN3D; Available via: https://erddap.marine.ie/erddap/griddap/IMI_CONN_3D.html
[11] This remains the latest version of this report at the time of writing.
[12] These are the latest versions of these reports at the time of writing.

- Dublin Port Company water quality monitoring[13]. This includes four turbidity monitoring buoys installed since September 2017 and located within Dublin Bay, of which three are located at the Dublin Port Company DAS site (located approximately 5.5 km from the array area). A further suite of water quality monitoring (turbidity, temperature, dissolved oxygen and salinity) was measured at four locations within the Inner Liffey Channel (RPS, 2021) between September 2019 and 2020. The output from the review is a list of the available literature and data sources and where possible a summary of findings associated with the study area.

2.4.8 As part of the project specific benthic ecology site investigation works, particle size analysis (PSA) was undertaken on grab samples taken from the array area and the Offshore ECC (Fugro, 2021; Aquafact, 2021). These site specific sampling data were used to inform the characterisation of the receiving environment and to provide verification of regional data. Full details of PSA analysis and findings are available in the Subtidal and Intertidal Survey Reports. The verification of the regional data against the site and project specific PSA is presented in the Physical Processes technical baseline.

2.4.9 Additional samples for contaminant analysis were taken at representative locations within each habitat type via the acquisition of an additional grab sample. The selection of these sites had a greater focus on particularly muddy habitats (if any) where there is greater risk of contaminant accumulations. Contaminant samples were taken with the appropriate container and transferred to containers for storage in a cool box/ fridge prior to analysis. The samples were stored in accordance with the Guidelines for sampling / storage of sediments for chemical analyses (from OSPAR Joint Assessment Monitoring Programme guidelines for monitoring contaminants in sediments) (Marine Institute, 2006). These data were used to validate the assumptions of types and levels of contaminants present based on historical data analysis and literature reviews within the proposed development.

Assessment methodology

2.4.10 The assessment of the potential effects on MW&SQ has been considered in terms of a source-pathway-receptor model (EPA, 2022) whereby:

- The source is the initiator event;
- The pathway is the link between the source and the receptor impacted by the effect (e.g. sediment transport processes); and
- The receptors are the receiving entities.

2.4.11 A receptor can only be exposed to change if a pathway exists through which an effect can be transmitted between the source activity and the receptor. In order to assess the potential effects upon the MW&SQ relative to the baseline (receiving) environment, a combination of analytical methods has been used.

[13] These data provide usual context characterising the receiving environment when used in conjunction with the other data sources listed above.

Irish Action Levels

2.4.12 For the purposes of determining the contamination levels within seabed sediments, the thresholds outlined in 'Guidelines for the Assessment of Dredge Material for Disposal in Irish Waters' (Marine Institute, 2006 & 2019) (hereafter referred to as the Irish action levels) have been adopted in this assessment. Table 2 provides those Irish action levels which have been used to contextualise the level of contamination within the study area and the proposed development.

2.4.13 Whilst the construction and operation of the Dublin Array offshore infrastructure is not a dredging scheme, consent will be required from the EPA in the form of a Dumping at Sea permit, to deposit sediment removed during seabed preparation works within the array boundary. Therefore, contaminants identified from the seabed sampling campaign will be compared with the Irish action levels within this EIAR chapter to provide a measure of risk to the environment. These Irish action levels have been used as part of a consideration of the suitability of material for disposal at sea and the degree of contamination within seabed sediments which may be disturbed.

Table 2 Irish Action Levels (Marine Institute 2006 & 2019)

Parameters	Units (dry weight[a])	Lower Level	Upper Level [b]
Arsenic	mg/kg	20[c]	70
Cadmium	mg/kg	0.7	4.2
Chromium	mg/kg	120	370
Copper	mg/kg	40	110[d]
Lead	mg/kg	60	218
Mercury	mg/kg	0.2	0.7
Nickel	mg/kg	40[e]	60
Zinc	mg/kg	160	410
Σ TBT & DBT	mg/kg	0.1	0.5
γ – HCH (Lindane)	µg/kg	0.3	1
HCB	µg/kg	0.3	1
PCB (individual congeners of ICES 7)	µg/kg	1	180
PCB (Σ ICES 7)	µg/kg	7	1260
PAH (Σ 16)	µg/kg	4000	N/A
Total extractable hydrocarbons	g/kg	1	N/A
[a] Total sediment results based on <2mm fraction			
[b] Effects Range Median (ERM) (rounded up)			
[c] This value was amended in the 2019 addendum			
[d] Probable Effects Level (PEL). PEL as ERM considered high			
[e] This value was amended in the 2019 addendum			

Environmental Quality Standards

2.4.14 For the purposes of assessment of contaminants in the water column an assessment against the potential to breach the Maximum Allowable Concentration or Annual Average (AA) thresholds as prescribed by European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. No. 77 of 2019) will be utilised. The AA is an arithmetic mean whereas the Maximum Allowable Concentration is an upper threshold which should not be breached.

2.5 Assessment criteria

2.5.1 This assessment for MW&SQ is consistent with the EIA methodology presented in the EIA Methodology Chapter. The criteria for determining the sensitivity of the receiving environment and the identified impacts for the MW&SQ assessment are defined in Table 3 and Table 4 respectively. A matrix was used for the determination of significance in EIA terms (see Table 5). The combination of the magnitude of the impact with the sensitivity of the receptor(s) determines the outcome of the assessment of significance of the effect.

Sensitivity of receptor criteria

2.5.2 The sensitivity of a receptor is a function of its capacity to accommodate change and it reflects its ability to recover if affected. Sensitivity is quantified via a consideration of the receptor's context (its adaptability, tolerance and recoverability) and value. Table 3 sets out the criteria used in defining the sensitivity of the identified MW&SQ receptors. All definitions of time periods have been defined from the EIAR Guidelines (EPA, 2022). Four defined levels of sensitivity have been determined (High, Medium, Low or Negligible) and where one of the definitions, for a given level, is met then this will determine the sensitivity level assigned. Where a receptor could reasonably be assigned more than one level of sensitivity, professional judgement has been used to determine which level is applicable.

Table 3 Sensitivity/ importance of the environment

Receptor sensitivity	Definition
High	**Adaptability:** The receptor cannot avoid or adapt to an impact. **Tolerance:** The environment has no or a very low capacity to accommodate the proposed form of change. **Recoverability:** The effect on the receptor is anticipated to be permanent (i.e., over 60 years) and recovery is not anticipated. **Value:** The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature.
Medium	**Adaptability:** The receptor has a limited capacity to avoid or adapt to an impact. **Tolerance:** The environment has a moderate to low capacity to accommodate the proposed form of change. **Recoverability:** The receptor is anticipated to recover fully within the medium term (i.e., seven to 15 years) to long term (i.e. 15 to 60 years). **Value:** The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature.
Low	**Adaptability:** The receptor has a reasonable capacity to avoid or adapt to an impact. **Tolerance:** The environment has a high capacity to accommodate the proposed form of change. **Recoverability:** The receptor is anticipated to recover fully within the short-term (i.e., one to seven years). **Value:** The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature.
Negligible	**Adaptability:** The receptor has a high capacity to avoid or adapt to an impact. **Tolerance:** The environment has a high capacity to accommodate the proposed form of change. Specific water quality conditions of the receptor are likely to be able to tolerate change with very little or no impact upon the baseline conditions detectable. **Recoverability:** The receptor is anticipated to recover fully and will be temporary (i.e., lasting less than one year). **Value:** The receptor is not designated but may be of local importance and/ or local socio-economic value.

Magnitude of impact criteria

2.5.3 It is noted here that a distinction is made throughout the assessment between the magnitude, as defined by the extent, duration[14], frequency, probability[15] and consequences of the impact and the resulting significance of the 'effects' upon MW&SQ receptors. The descriptions of magnitude are specific to the assessment of MW&SQ impacts and are considered against the magnitude descriptions presented in Table . Potential impacts have been considered in terms of whether they provide adverse or beneficial effects.

2.5.4 Where an effect could reasonably be assigned to more than one magnitude level, professional judgement has been used to determine which level is the most appropriate for the impact. The magnitude has been assigned based on the most appropriate potential consequences of the impact as defined in Table 4. For example, whilst an impact may occur constantly throughout the O&M period it may not be discernible and immeasurable in practice. Therefore, it would be concluded to be of a Negligible magnitude despite the frequency of the impact.

2.5.5 For the purposes of the definitions below in Table 4 and the assessment, near-field has been defined as within the array area and Offshore ECC. Far-field has been defined as extending beyond these limits (see Section 2.4 and Figure 1).

Table 4 Magnitude of the impact

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

[14] Note: this is the duration of the impact and not the time taken for the receptor to recover.
[15] 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
	Frequency: The impact will occur frequently throughout a relevant project phase. **Consequences: Barely discernible/ 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/ barely discernible change to key characteristics or features of the particular environmental aspect's character or distinctiveness.**

Defining the significance of effect

2.5.6 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 of the significance of potential effects is described in Table 5. Effects defined as Significant, Very Significant and Profound are considered significant in EIA terms (EPA, 2022) and for the purposes of this assessment on MW&SQ receptors

Table 5 Significance of potential effects

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

*Moderate levels of effect have the potential, subject to the assessor's professional judgement, to be significant. 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.

2.6 Receiving environment

2.6.1 The study area encompasses the array area as well as the Offshore ECC, temporary occupation area, up to and including the intertidal zone at the landfall, defined as ending at MHWS (Figure 1). These boundaries and the modelled tidal ellipse effectively characterises the predicted zone of potential primary (direct) and secondary (indirect) impacts of the development on MW&SQ, respectively. The study area has been broken down into three sections (the array area, the Offshore ECC and the far-field study area) for the purposes of characterising the receiving environment. A full characterisation of Irish waters to one nautical mile (nm) from the shore has been undertaken as required by the WFD and the MSFD (further details are provided in Table 7 below).

Far-field study area

Sediment and water contaminants

2.6.2 The concentrations of metals in marine sediments are higher in the coastal zone and around estuaries, decreasing offshore, indicating that river input and run-off from land are significant sources. Particularly high concentrations can be observed in estuaries with historic or current industry, although these may also be the result of the presence of clay rich sediments.

2.6.3 The sewerage system(s) in the vicinity of the study area have undergone several improvements to reduce pollution within Dublin Bay including, but not limited to, the on-going Ringsend Wastewater Treatment Plant Upgrade and the Shanganagh and Bray Main Drainage System Works. Sewage can be a critical source of contaminants in the marine environment from discharges of both treated (from a wastewater treatment works) or untreated (from storm overflows) sewage.

2.6.4 Dublin Bay has historically had issues with contamination though the levels have reduced in the sediments over time due to reductions in shipbuilding (Brooks *et al*, 2016). The Marine Institute (2014) Report "Biological Effects and Chemical Measurements in Irish Marine Waters" revealed that levels of polyaromatic hydrocarbons (PAHs), metals and a range of pesticides are still elevated in parts of the bay. In particular, the Marine Institute noted elevated levels in the Tolka estuary and parts of the Liffey estuary. The Marine Institute (2014) also highlighted the presence of some historical persistent organochlorine contaminants, such as Polychlorinated biphenyls (PCBs) and organochlorines (these chemicals are no longer produced) but noted a decline with time. The Marine Institute recommended that efforts to reduce the introduction of contaminants further upstream in the catchments should be made.

2.6.5 Other pollutants associated with surface run-off, shipping and industry have been a persistent problem in the bay and levels found in both sediment and water remain above the recommended quality standards (Marine Institute, 2014). Tributyltin (TBT) has been used historically on ship hulls and other marine structures to prevent biofouling growth of aquatic organisms (Bryan *et al*, 1986). The use of TBT was prohibited in 1987 but has remained persistent within the marine environment with associated effects on ecology (such as imposed gastropods) (Brooks *et al*, 2016). Dublin Port is an oil-transhipment port which increases the risks associated with contamination from oil. Dublin Port has implemented an Oil Spill Contingency Plan (OSMP) for many years and very few minor oil spills have occurred in Dublin Bay (Brooks *et al*, 2016).

Nutrients

2.6.6 Estuarine and coastal waters are particularly sensitive to high nitrogen concentrations, elevated concentrations may result in the occurrence of harmful algal (phytoplankton) blooms. In lower salinity environments, such as estuaries, phosphate may become the limiting nutrient, and so if elevated may lead to eutrophication[16].

2.6.7 The Water Quality Indicators 2023 report (EPA, 2024) stated that:

"Twenty of the 117 (17%) estuarine and coastal water bodies assessed were in unsatisfactory condition for DIN [dissolved inorganic nitrogen]."

2.6.8 One of the sites, above the DIN threshold was present within Dublin Bay near Dublin Port based on data between 2021-3 (EPA, 2024).

[16] Eutrophication is when a body of water becomes overly enriched with minerals and nutrients which induce excessive growth of plants/ algae.

2.6.9 Whereas for phosphate concentrations the report (EPA, 2022) also concluded that:

"Only two estuarine water bodies were in unsatisfactory condition, both having exceeded the relevant threshold22 over the period."

2.6.10 No sites exceeding the phosphate thresholds were identified by The Water Quality Indicators 2023 report (EPA, 2024) in the study area.

2.6.11 Dublin Bay has had historical (and recent) issues with excess nutrients (Brooks *et al*, 2016). The Lower Liffey and Tolka Estuaries were first designated as 'sensitive' areas under the Urban Waste Water Treatment Directive in 2001. The Liffey Estuary from Islandbridge weir to Poolbeg Lighthouse, including the River Tolka basin and South Bull Lagoon has been designated as nutrient sensitive area (Figure 4). A nutrient removal process was introduced to the Ringsend Wastewater Treatment Works, with works commencing in 2017, prior to discharge into the Lower Liffey Estuary. Following improvements in water quality in the estuary, the WFD chemical status of the estuary is now designated as having the "potential to support **Good** chemical status" (further details are provided in Table).

2.6.12 As detailed in "Water Quality in Ireland – 2016 – 2021" (EPA, 2021) Dublin Bay demonstrated a downwards trend in the winter median nitrogen concentrations (as dissolved inorganic nitrogen). Dublin Bay did not exceed the median winter or summer phosphorous environmental quality standards; however, the Tolka estuary did exceed the standards in the summer (EPA, 2021). Further details of the current status of the relevant WFD waterbodies for this assessment are presented in Table .

Dissolved oxygen

2.6.13 Oxygen sags are important as marine life, in particular fish species, respire using the oxygen in the water and if the levels get too low it can affect these species. For example, salmon and trout begin to be affected by low oxygen levels at about 6 mg/l (around 50% saturation), and at dissolved oxygen levels below 1.7 mg/l death of some adult fish is likely. Over the last five years, no oxygen sags have been recorded at any of the stations despite the capital dredging[17] activities on-going within Dublin Bay (see Table).

2.6.14 Analysis of the Marine Institute data indicates that the percentage of dissolved oxygen saturation at Dublin Station 1 varies between approximately 95% and 125% (see Table 6 and Figure 3). As presented in Table 6 and Figure 2, the dissolved oxygen levels are consistently close (or above) the saturation level at all four of the Marine Institute monitoring stations (M92, M93, M95 and M96)(Figure 3).

[17] Capital dredging, which is carried out in a new location, a large scale and/or in material that has never been dredged before.

Table 6 Derived statistics of dissolved oxygen percentage between 2015 to 2020 (source: Marine Institute)

	Dublin Stn 1 (M92)	Dublin Stn 2 (M93)	Liffey Lower Estuary (M95)	Broadmeadow Water (M96)
Minimum	94	94	91	94
5%ile	95	96	91	95
95%ile	112	112	126	126
Average	100	100	100	105
Maximum	123	126	126	127

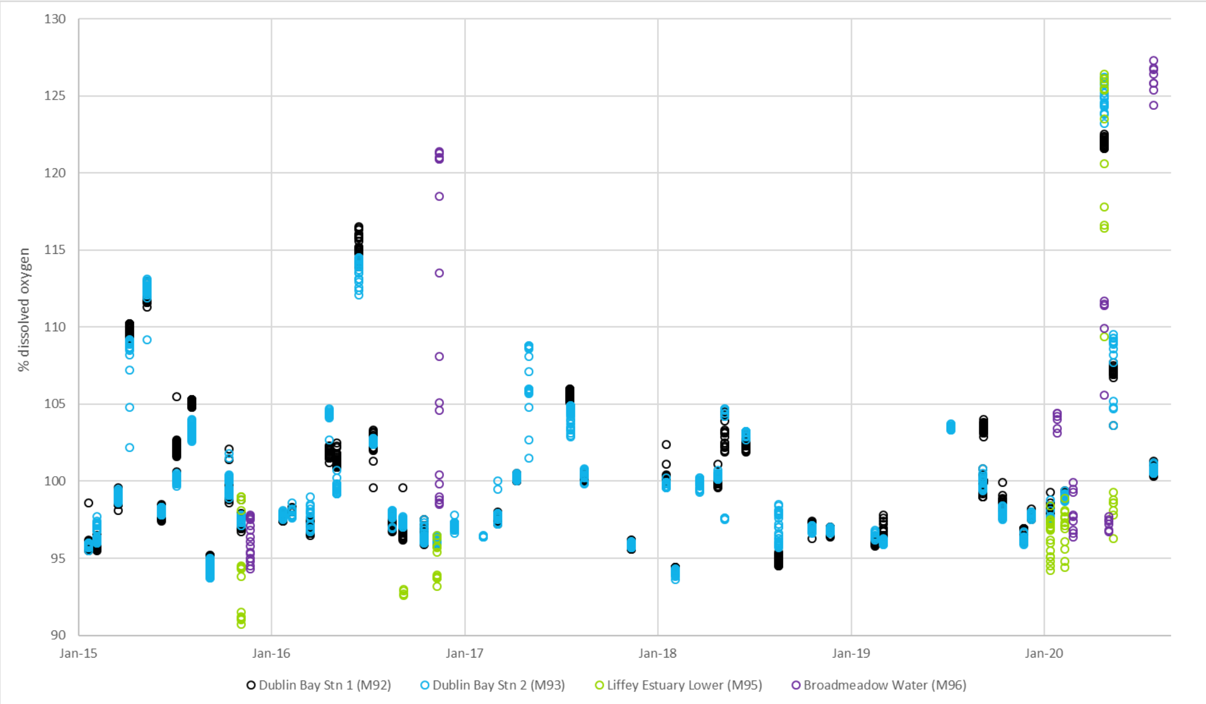
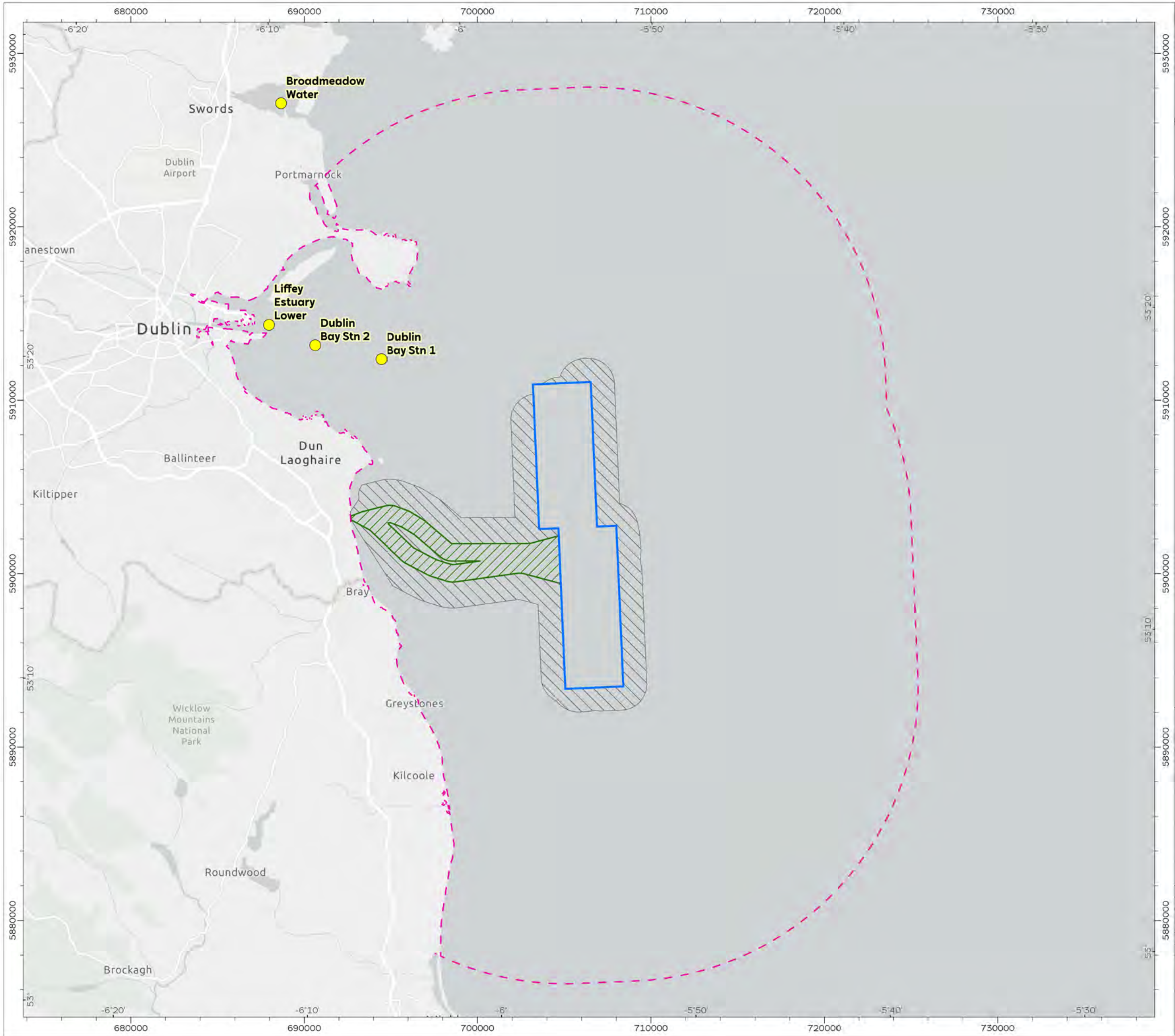


Figure 2 Observed percentage dissolved oxygen at Dublin Station 1 between 2015 to 2020 (source: Marine Institute)



Marine Water and Sediment Quality Study Area (17km Buffer) (far-field)
Array Area
Temporary Occupation Area
Export Cable Corridor
Water Quality Monitoring Points (MI)

DRAWING STATUS
FINAL

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Marine Institute Water Quality Monitoring Stations within the Study Area

DRAWING NUMBER: **3**
PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-12	For Issue	GB	BB	SS

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

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

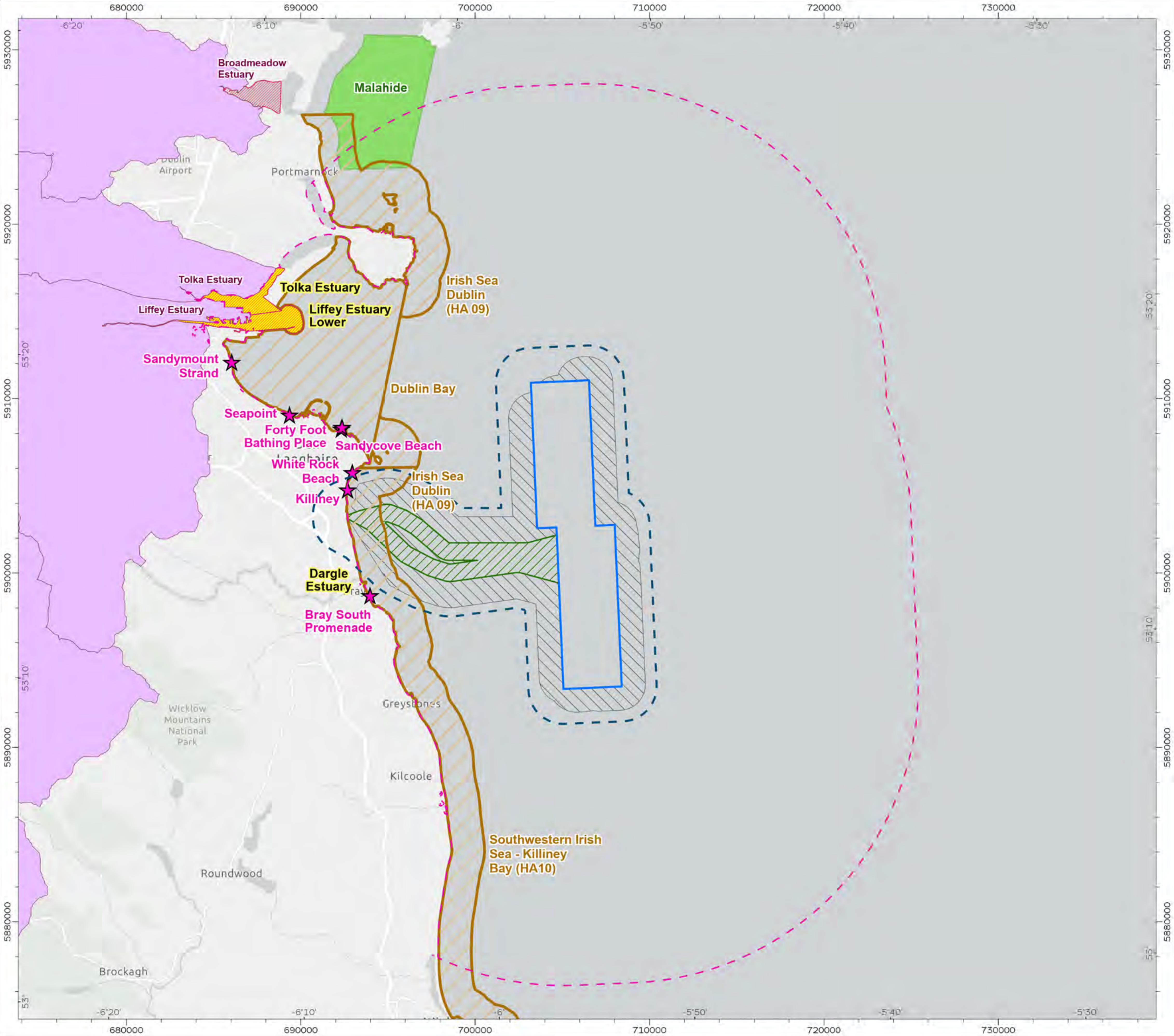
Sediments

2.6.15 There is a trend of decreasing SPM concentrations with distance offshore, with the highest concentrations recorded in the study area observed in Dublin Port. The Marine Institute monitor water quality at two locations in Dublin Bay, one location in the Liffey Estuary and one location in Broadmeadow Water (Figure 8). It should be noted that these data should be taken as indicative rather than an accurate quantitative record. The mean turbidity at the sites is low in Dublin Bay (less than 20 NTU). The sites demonstrated episodic events of elevated turbidity. Some of the highest recorded spikes of turbidity (in the order of 100s to 1000s of mg/l) in the datasets correlated temporally against peak wave heights (in Dublin Bay) (see the Physical Processes technical baseline, for more details).

Water Framework Directive waterbodies

2.6.16 This section details the WFD waterbodies and protected areas and their status within 2 km of the proposed development as defined in the Water Framework Directive assessment: Estuarine and coastal waters guidance[18] (the English Environment Agency, 2017). The identified sites as protected under the WFD and their current status are presented in Table 7 and Figure 4. Further justification and applicability of the 2 km buffer in terms of potential impacts on coastal and transitional water bodies in terms of water quality is provided in the WFD and MSFD Summary.

[18] In the absence of published guidance for Developers in Ireland, the English Environment Agency's guidance has been utilised to assess the potential impacts on WFD status from the proposed activities.



- Marine Water and Sediment Quality Study Area (17km Buffer) (far-field)
- Array Area
- Export Cable Corridor
- Temporary Occupation Area
- 2km Buffer from Array Area and Export Cable Corridor
- Transitional Water Bodies
- Coastal Water Bodies
- Shellfish Waters
- Bathing Waters
- Nutrient Sensitive Areas - Catchments of Interest
- Nutrient Sensitive Areas - Lakes and Estuaries - Latest Cycle
- Nutrient Sensitive Areas - Rivers - Latest Cycle

DRAWING STATUS

FINAL

MAP NOTES / DATA SOURCES:

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Designated Sites Within the Marine Water and Sediment Quality Study Area

DRAWING NUMBER: 4

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-12	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

Table 7 WFD water bodies within 2 km of proposed development (source: EPA, 2023)

Name	ID	Supporting Chemistry Condition	Ecological Status Potential	Overall Status	Hydromorphology	Dissolved Oxygen	Nutrient Condition	Phytoplankton	Specific Pollutants	Identified as being 'at risk' in RBMP?
Coastal water bodies										
Southwestern Irish Sea - Killiney Bay (HA10)	IE_EA_100_0000	High	High	High	Good	N/A	High	N/A	N/A	N/A
Transitional water bodies										
There are no transitional water bodies within 2 km of the Offshore ECC or array area.										

Bathing Waters (BW)

2.6.17 There are two BWs within the study area (Figure 4). There are two BWs within 2 km of the Offshore ECC - Killiney and White Rock Beach (Figure 4). The compliance of these BWs is presented in Table 8.

Table 8 Status achieved by screened in BWs (source: EPA, 2023)

Name	ID	2022 Status
Killiney	IEEABWC100_0000_0400	Excellent
White Rock Beach	IEEABWC100_0000_0450	Excellent

Shellfish Waters

2.6.18 Within the study area there is one SFW designated under the Shellfish Water Regulations (Figure 4). The Malahide SFW has a seasonal classification of A* (the highest classification for quality) for razor clams which reverts to B for the period July through to March (Sea-Fisheries Protection Authority, 2021). The Malahide SFW is beyond 2 km buffer as presented in Figure 4.

Nutrient sensitive areas

2.6.19 The EPA identified 48 areas in Ireland where waste water discharges are the main significant pressure on water bodies at risk of pollution. 'At risk of pollution' is defined as being at risk of not achieving the specific environmental target set for that water body, such as good ecological status under the WFD. Within Dublin Bay, the Liffey Estuary and Tolka Estuary have been designated as a nutrient sensitive area (Figure 4). To the north of the study area, the Broadmeadow Estuary has also been designated as a nutrient sensitive area. There are no nutrient sensitive areas within 2 km of the Offshore ECC or array area.

Dumping at Sea sites

2.6.20 The Foreshore and Dumping at Sea (Amendment) Act 2020 makes it the function of the EPA to issue Dumping at Sea (DAS) Permits. In outer Dublin Bay, to the west of Burford Bank, is an existing licensed offshore DAS site used by Dublin Port to dispose of dredged material as part of the Alexandra Basin re-development scheme. The Burford Bank site has historically been used by Dún Laoghaire Harbour Company, Howth Yacht Club and the Dublin Local Authorities for the disposal of dredged material.

2.6.21 The following permits exist, or have been applied for, in relation to dredging within the study area (EPA, 2023):

- Dublin Port maintenance dredging (Permit: S0004-03) which is permitted until 30th September 2029; and
- Malahide Marine Village (Permit: S0031-01) which is permitted until January 2025.

2.6.22 There are two historic DAS sites which were used for the disposal of sewage sludge by Dublin Corporation (Poolbeg) in the 1990s. These sites are located between Howth and Bennet Bank, and to the east of the Kish Bank. There are also two small historic DAS sites in the mouth of the Liffey estuary, which were permitted for the disposal of dredged material by Dublin Port and Docks Board in the late 1980s and 1990s (Marine Institute, 2016).

The Array Area

Water temperature, salinity and dissolved oxygen

2.6.23 Temperature and dissolved oxygen[19] data show little variation with depth and indicate that the waters in the top 20 m around the Kish Bank were well mixed (EcoServe, 2004). The Marine Institute Monthly Model Means[20] predicts that sea surface salinity on the Kish and Bray Banks is 34 psu with some fluctuation throughout the seasons, whereas sea surface temperature (SST) shows a strong seasonal signal (Marine Institute, 2020) (Figure 5).

---

[19] Dissolved oxygen (DO) refers to the volume of oxygen that is contained in water. Oxygen enters the water by photosynthesis of aquatic biota and by the transfer of oxygen across the air-water interface. The amount of oxygen that can be held by the water depends on the water temperature, salinity, and pressure.

[20] Irish Marine Institute Connemara Model CONN3D; Available via: https://erddap.marine.ie/erddap/griddap/IMI_CONN_3D.html

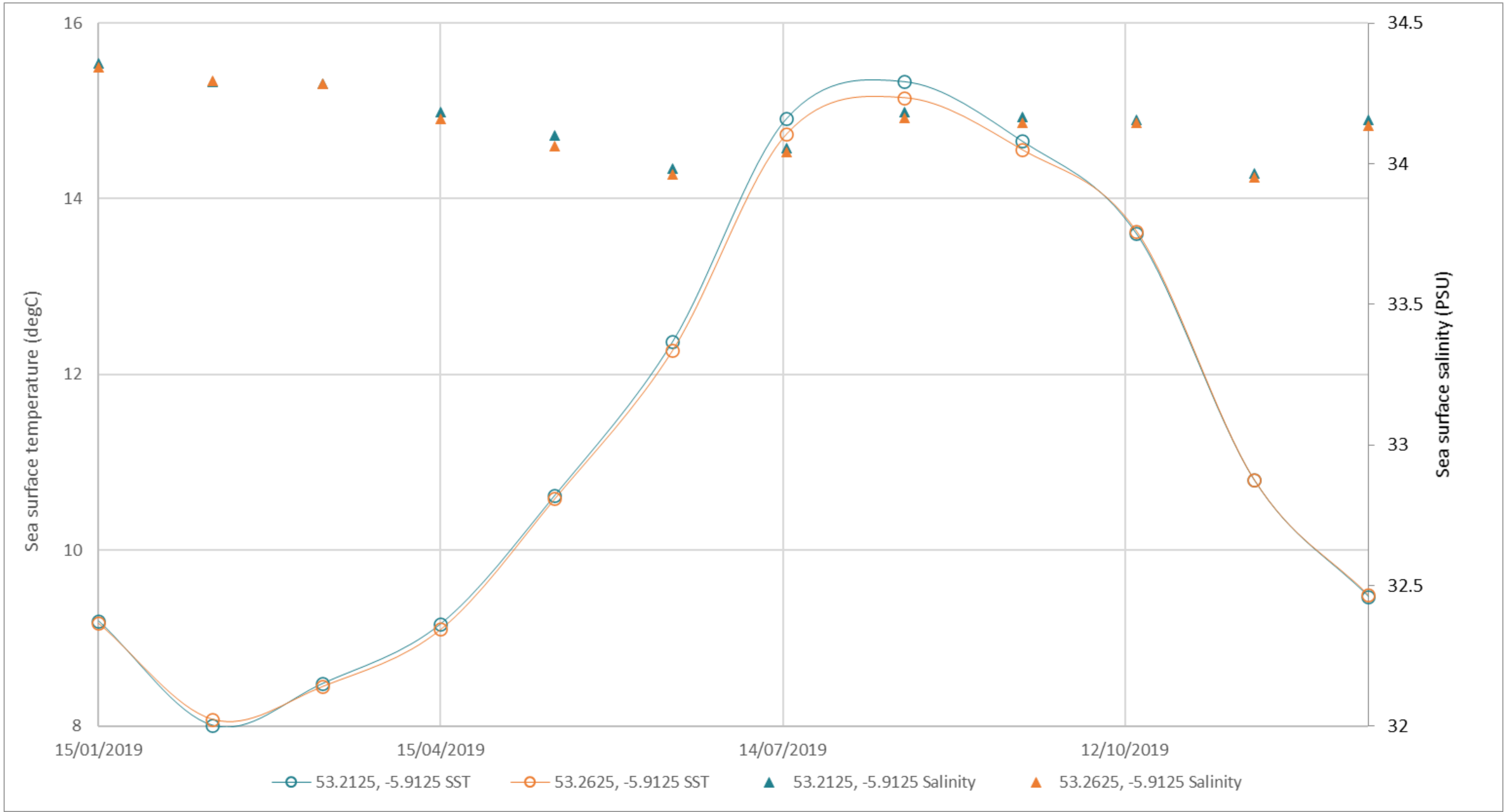


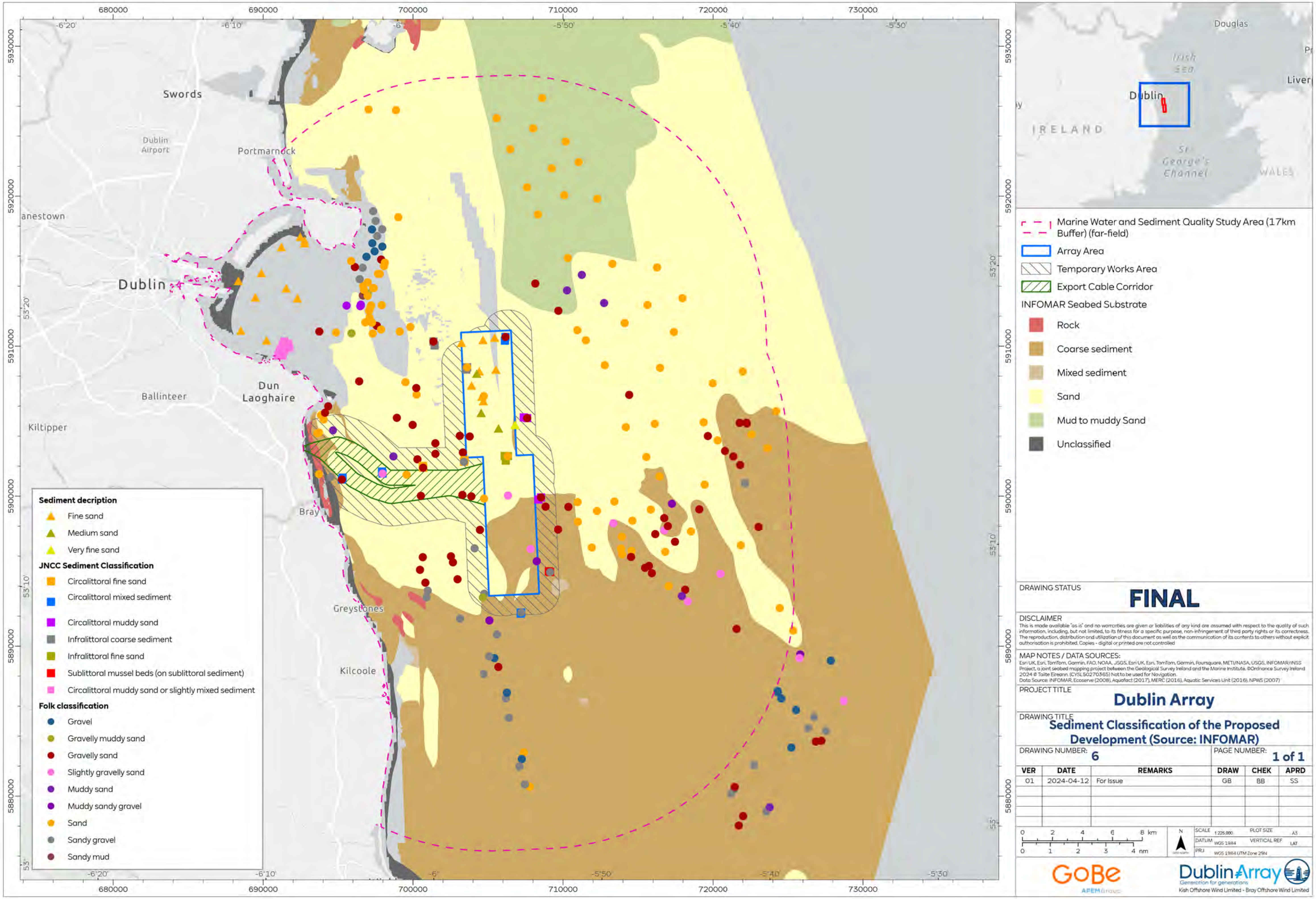
Figure 5 Monthly predictions for sea surface temperature and salinity within the Offshore ECC (source: Marine Institute)

Sediments

2.6.24 The array area is dominated by sand sized sediments (Figure 6). The backscatter data suggests there are finer sand sediments on the crest of the bank and coarser sand on the flanks and to the south of the banks. Sediment mapping, based on both sampling and sonar techniques, indicate that the upper parts of the Kish and Bray Banks are composed of extensive thicknesses of sand-to-gravel sized material, with coarser gravel material located towards the crest of the banks and evidence of sediment fining towards the north of the banks. Roche *et al.* (2007) reported that the sediment had a very low organic carbon fraction on the Kish Bank.

2.6.25 Project specific surveys have shown that the seabed sediments are homogeneous (Fugro, 2020), with Particle Size Distribution (PSD) analysis indicating a predominately sandy sediment (Fugro, 2021). Specifically, the sediment samples are classified as gravelly sand, sand and muddy sand, representing 43%, 43% and 14% of the 28 samples collected, respectively (Fugro, 2021). The finer sediments are observed along the, proposed, northern cable route and to the seaward extent of Fraser Bank. As shown in Figure 6 and Figure 4 there is good agreement between the regional sediment data (INFOMAR), the site specific and project specific grab samples collected.

2.6.26 The Physical Processes technical baseline report provides a detailed analysis of turbidity. The key findings have been summarised in this chapter for ease of reference. Turbidity is caused by all kinds of small particles in the water including materials which are organic origin. These particles are summarised under the term suspended particulate matter (SPM). The annual average surface SPM across the array area is approximately 5 mg/l. There is a trend of decreasing SPM concentrations with distance offshore, with the highest concentrations recorded in the study area observed in Dublin Port. Suspended sediment concentrations (SSC) refer to the suspended particles which exclude those organic in origin, SSC can be inferred from turbidity.



Swords
Dublin Airport
Portmarnock
anestown
Dublin
Ballinteer
Dun Laoghaire
Kiltipper
Bray
Greystones
Kilcoole
680000
690000
700000
710000
720000
730000
5930000
5920000
5910000
5900000
5890000
5880000
-6°20'
-6°10'
-6°
-5°50'
-5°40'
-5°30'
53°20'
53°10'
53°
Douglas
Irish Sea
Dublin
IRELAND
St George's Channel
WALES
Marine Water and Sediment Quality Study Area (17km Buffer) (far-field)
Array Area
Temporary Works Area
Export Cable Corridor
INFOMAR Seabed Substrate
Rock
Coarse sediment
Mixed sediment
Sand
Mud to muddy Sand
Unclassified
Sediment decription
Fine sand
Medium sand
Very fine sand
JNCC Sediment Classification
Circalittoral fine sand
Circalittoral mixed sediment
Circalittoral muddy sand
Infralittoral coarse sediment
Infralittoral fine sand
Sublittoral mussel beds (on sublittoral sediment)
Circalittoral muddy sand or slightly mixed sediment
Folk classification
Gravel
Gravelly muddy sand
Gravelly sand
Slightly gravelly sand
Muddy sand
Muddy sandy gravel
Sand
Sandy gravel
Sandy mud
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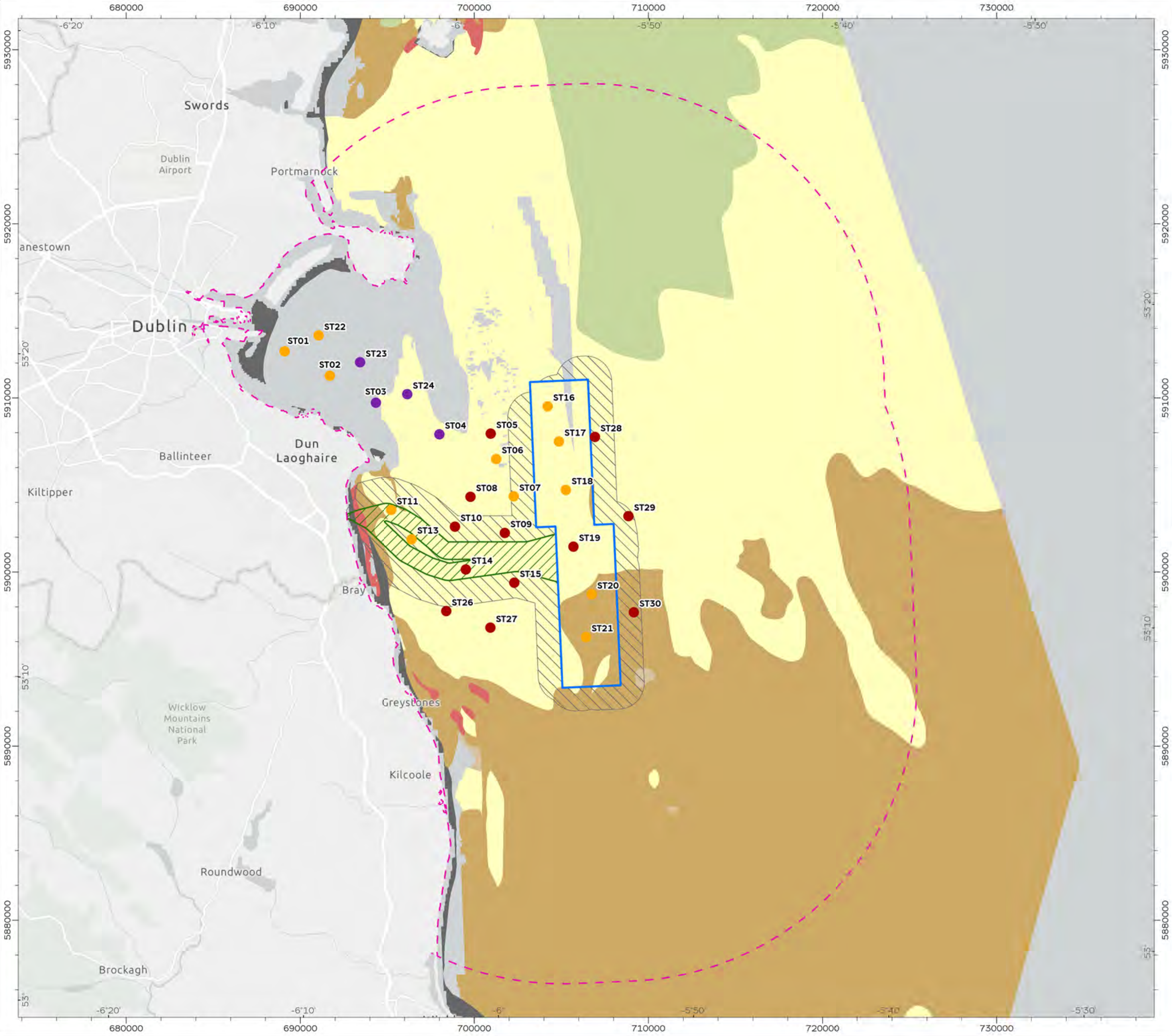
Data Source: INFOMAR, Ecoserve (2008), Aquafact (2017), MERC (2016), Aquatic Services Unit (2016), NPWS (2007)
PROJECT TITLE
Dublin Array
DRAWING TITLE
Sediment Classification of the Proposed Development (Source: INFOMAR)
DRAWING NUMBER: 6
PAGE NUMBER: 1 of 1
VER | DATE | REMARKS | DRAW | CHEK | APRD
01 | 2024-04-12 | 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



Marine Water and Sediment Quality Study Area (17km Buffer) (far-field)

Array Area

Temporary Occupation Area

Export Cable Corridor

Folk classification (Fugro, 2021)

- Sand
- Gravelly sand
- Muddy sand

INFOMAR Seabed Substrate

- Rock
- Coarse sediment
- Mixed sediment
- Sand
- Mud to muddy Sand
- Unclassified

DRAWING STATUS

FINAL

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MAP NOTES / DATA SOURCES:

Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri UK, Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS, INFOMAR/INSS Project, a joint seabed mapping project between the Geological Survey Ireland and the Marine Institute. ©Ordnance Survey Ireland 2024 © Tailte Eireann. (CYSL50270365) Not to be used for Navigation.
Data Source: INFOMAR, Fugro (2021)

PROJECT TITLE

Dublin Array

DRAWING TITLE

Seabed Sediment Classification Based on Project Specific and Regional (INFOMAR) Data

DRAWING NUMBER: 7

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-12	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		

Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

Sediment bound contaminants

2.6.27 In the Irish Sea, sediment contaminant concentrations are higher than those found in the water column (Cefas[21], 2005). For sediment quality, an understanding of the seabed's physical properties is important for providing an indication of the contamination risk. Sediments with a finer particle size, such as clays and muds, can act as adsorption surfaces for contaminants that may be released into the water column if the sediment is disturbed (Cefas, 2001). This is due to their larger surface area to volume ratios and higher organic carbon content. Sediments consisting of coarser sand and gravel are accepted to carry a much lower contamination risk. Information regarding particle sizes is an important step in assessing the contamination risk to the marine environment.

2.6.28 As noted above, the sediment within the array area is dominated by sand. Sand is associated with low contaminant levels; as confirmed by the project specific campaign the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC (see section 2.6.34 - 2.6.37; Fugro,2021). The level of metals present in the sediment samples collected within the array area, the Offshore ECC and wider study area is shown in Table 9. With the exception of sample ST21, which is located at the south of the Bray Bank, there are no occurrences of contaminants exceeding the lower Irish Action Levels. As also shown in Table sample ST21 exceeds the Lower Limit for arsenic (20 mg/kg) by 0.8 mg/kg.

2.6.29 Sediment samples taken to inform this EIA have also been analysed for the Polycyclic Aromatic Hydrocarbons (PAHs)[22], as shown in Table 10. As shown, none of the samples collected exhibit PAH levels in exceedance of the Irish Sediment Quality Guidelines (Table 2). Analysis of the Total Hydrocarbon (THC) and n-Alkanes was also undertaken, with no samples reporting elevated levels (Fugro, 2021;).

2.6.30 All samples collected for the project reported levels of Dibutyl Tin (DBT) and Tributyl Tin (TBT) that were well below the Irish Sediment Quality Lower Level (Table 9); the sample results within the array area were less than 5 µg/kg and 2 µg/kg for DBT and TBT, respectively (Table 10).

[21] The Centre for Environment, Fisheries and Aquaculture Science (Cefas) is an executive agency of the United Kingdom government Department for Environment, Food and Rural Affairs.
[22] The US Environmental Protection Agency's 16 priority PAHs (US EPA, 2008)

Table 9 Summary of sediment metal contamination within the array area, the Offshore ECC and wider study area (Fugro, 2021)

		Aluminum	Arsenic	Cadmium	Chromium	Copper	Mercury	Lithium	Nickel	Lead	Zinc
Irish Action Levels (mg/kg)	Lower Limit	-[23]	20 [c]	0.7	120	40	60	-	40 [e]	60	160
	Upper Limit [b]	-	70	4.2	370	110 [d]	218	-	60	218	410
Sample Level (mg/kg)	ST01	5,990	4.4	<0.10	22.4	2.2	0.02	14.4	6.8	7.7	21.6
	ST03	13,900	7.5	0.11	23.4	7.1	0.02	21.8	12.4	15.3	43.3
	ST05	5,630	16.6	<0.10	11.2	1.9	<0.01	12.8	7.1	8.5	22.3
	ST07	4,630	9.7	<0.10	10.1	1.9	<0.01	11.4	5.5	7	18.6
	ST08	5,400	7	<0.10	11.1	2.2	<0.01	14.1	5.7	7.7	24.6
	ST11	4,110	12.9	<0.10	9.5	1.6	<0.01	<10.00	6.5	7.2	19.9
	ST13	5,170	16	<0.10	9.8	1.9	<0.01	13.3	7.6	7.7	19.9
	ST14	7,030	8.4	<0.10	12.7	2.8	<0.01	16.8	6.8	8.8	35.5
	ST15	5,870	7.1	<0.10	11.8	2.2	0.02	14.3	6.6	5.4	19.1
	ST16	3,190	8.2	<0.10	6.6	0.8	<0.01	<10.00	3.9	3.2	11.9
	ST19	3,070	12.2	<0.10	7.3	1	<0.01	<10.00	4.6	5.4	12.9
	ST21	4,130	20.8	<0.10	8.7	1.3	<0.01	<10.00	6.1	4.4	13.4
	ST23	9,480	5	0.11	19.8	4	0.01	14.9	8.6	10.7	30.7
	ST24	13,200	4.1	0.11	21.8	6.1	0.01	21.2	12.4	12.5	39.4
	ST26	7,720	6.7	<0.10	13.2	3.1	<0.01	6.7	6.7	9.3	33.3
[a] Total sediment results based on <2mm fraction											
[b] Effects Range Median (ERM) (rounded up)											
[c] This value was amended in 2019											
[d] Probable Effects Level (PEL_PEL as ERM considered high											
[e] This value was amended in 2019											
(shaded)	Above Lower Limit of Irish Action Levels										

[23] The metals lithium, aluminium and manganese are included because their concentrations reflect the natural geochemistry of the area and can help to explain variations in the levels of other metals i.e. they can be used as normalisers. Normalisation is a procedure that corrects contamination levels for natural differences in sediment composition, thus improving the basis for comparison between different sediment samples given aluminium and lithium are metals occurring in abundance in the Earth's crust. They are conservative elements and are rarely elevated as a result of pollution (Cronin et al, 2006).

Table 10 Summary of organotins within the array area, the Offshore ECC and wider study area (Fugro, 2021)

	Dibutyl Tin (µg/kg)	Tributyl Tin (µg/kg)
Upper Limit (sum of TBT and DBT)	500	
Lower Limit (sum of TBT and DBT)	100	
ST01	< 5	<2
ST03	< 5	<2
ST05	< 5	<2
ST07	< 5	<2
ST08	< 5	<2
ST11	< 5	<2
ST13	< 5	<2
ST14	< 5	<2
ST15	< 5	<2
ST16	< 5	<2
ST19	< 5	<2
ST21	< 5	<2
ST23	< 5	<2
ST24	< 5	<2
ST26	< 5	<2

Table 11 Summary of sediment polycyclic aromatic hydrocarbon contamination within the array area, the Offshore ECC and wider study area (Fugro, 2021)

PAH	95%ile	Sample Level (ng/g dry sediment)														
		ST01	ST03	ST05	ST07	ST08	ST11	ST13	ST14	ST15	ST16	ST19	ST21	ST23	ST24	ST26
Naphthalene	93	0.5	6.2	0.5	0.4	0.7	0.1	0.1	2.0	1.7	0.1	0.1	<0.1	1.5	5.7	2.3
Acenaphthylene	34	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	0.2	0.7	
Acenaphthene	54	0.1	3.3	0.1	0.1	0.1	<0.1	<0.1	0.2	0.2	<0.1	<0.1	<0.1	0.3	1.8	0.2
Fluorene	129	0.4	5.3	0.3	0.2	0.4	<0.1	<0.1	1.1	0.9	<0.1	0.1	<0.1	0.9	3.6	1.0
Phenanthrene	397	1.4	31.3	1.1	0.9	1.8	0.2	0.4	4.2	3.4	0.1	0.5	0.1	3.4	18.3	4.1
Anthracene	116	0.4	4.8	0.1	0.1	0.2	<0.1	<0.1	0.5	0.4	<0.1	<0.1	<0.1	1.2	4.7	0.6
Fluoranthene	524	2.7	38.1	1.4	1.2	2.1	0.4	0.7	4.3	3.3	0.2	0.3	0.1	4.1	28.1	4.7
Pyrene	459	2.5	32.0	1.1	1.1	1.7	0.5	0.9	3.2	2.2	0.2	0.2	0.1	4.1	27.5	3.3
Benzon(a)anthracene	265	1.3	16.8	0.6	0.4	0.8	0.1	0.2	1.8	1.6	0.1	0.2	<0.1	2.7	15.1	2.1
Chrysene	336	1.5	18.0	0.9	0.6	1.1	0.2	0.4	2.8	2.2	0.1	0.2	0.1	2.7	15.4	2.8
Benzo(b)-Fluoranthene	331	3.9	34.2	2.7	2.3	4.4	0.8	1.2	8.1	5.6	0.6	0.6	0.2	8.0	28.0	7.0
Benzo(k)-Fluoranthene	234	1.2	10.5	0.7	0.6	1.1	0.2	0.3	2.1	1.6	0.1	0.1	<0.1	2.3	8.8	2.0
Benzo(a)pyrene	250	1.2	16.3	0.5	0.3	0.6	0.1	0.1	1.4	1.7	0.1	0.1	<0.1	2.7	14.5	1.8
Indeno(1,2,3-cd)-pyrene	249	1.7	16.5	0.9	0.7	1.0	0.1	0.1	2.6	3.3	0.2	0.1	<0.1	3.1	12.6	3.2
Benzo(ghi)perylene	225	1.4	14.3	0.7	0.5	0.6	0.1	0.1	1.9	2.3	0.1	0.1	<0.1	1.5	10.5	2.0
Dibenzo(a,h)-anthracene	63	0.3	3.4	0.1	0.1	0.1	<0.1	<0.1	0.4	0.5	<0.1	<0.1	<0.1	0.5	2.6	0.5
Total US EPA 16[a]	3759[c]	<20.6	252	<11.8	<9.6	<16.8	<3.3	<5.0	36.7	31.0	<2.4	<3.0	<1.7	39.2	198	37.7

[a] US EPA 16 = United States Environmental Protection Agency's 16 priority PAH. [b] PAH levels derived from 95th percentile of background values, from Marine Institute data, 2001 to 2003; values not normalized for organic carbon; total sediment <2 mm (Cronin et al., 2006). [c] Irish Guidelines lower level 4000

The Offshore Export Cable Corridor

Water temperature and salinity

2.6.31 Similar, to within the array area, a strong seasonal change in SST is predicted across the Offshore ECC (Figure 8) ranging between approximately 7 °C to 16 °C. The Offshore ECC remains stable in terms of SSS (Figure 9) and is considered as saline (approximately 33.5 to 34.5 psu throughout the year).

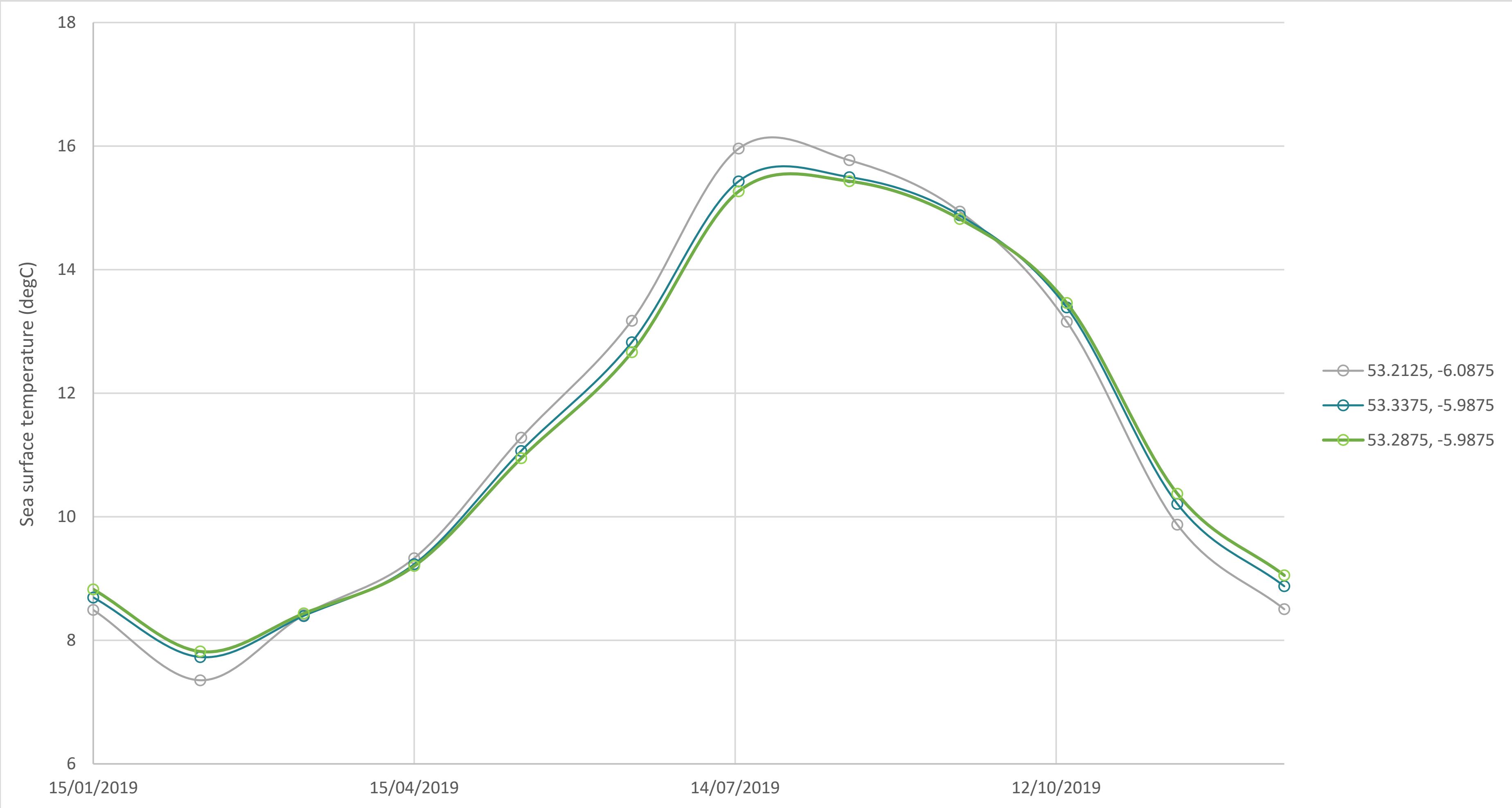

Figure 8 Monthly predictions for sea surface temperature within the Offshore ECC (source: Marine Institute)

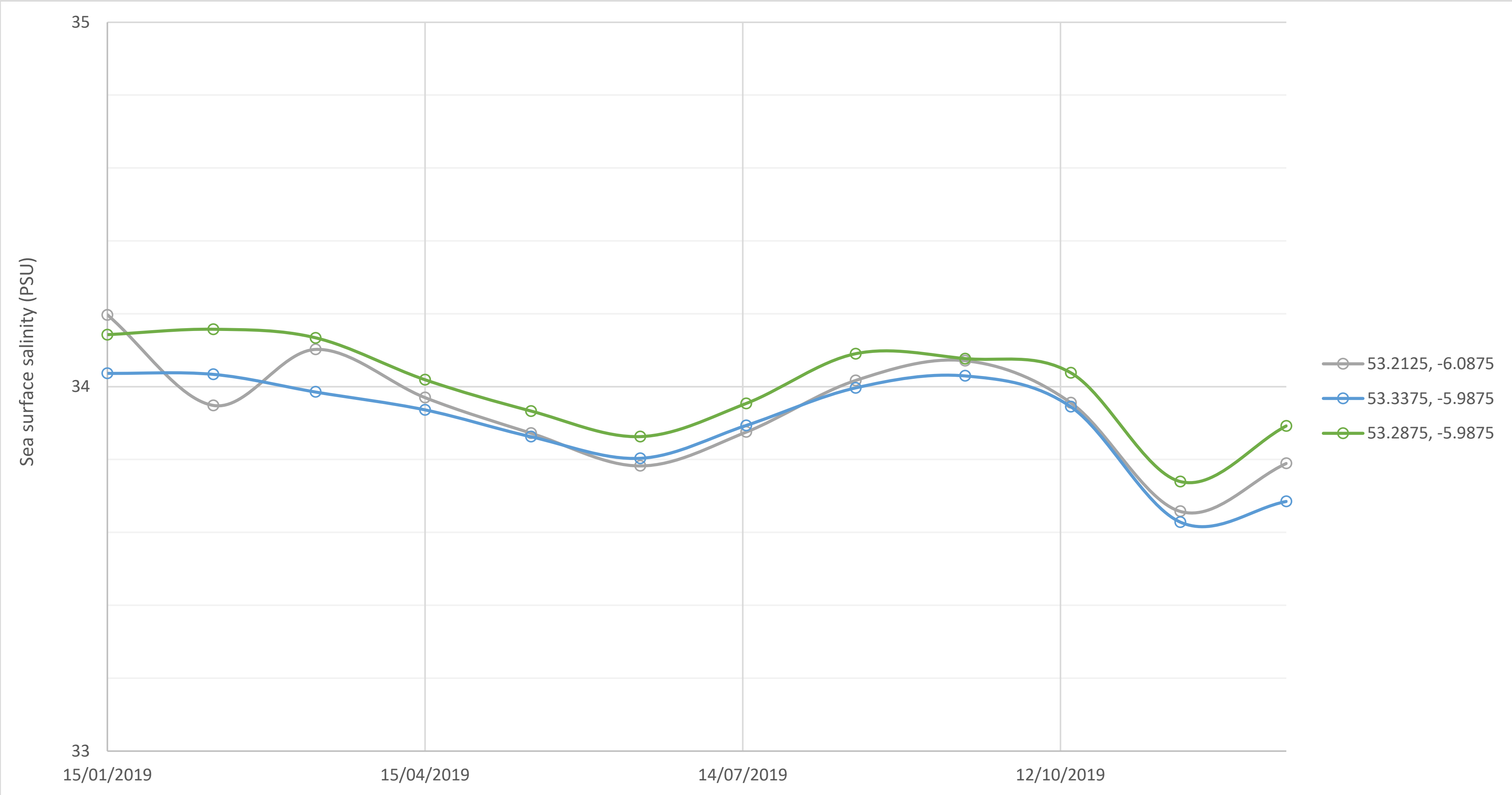

Figure 9 Monthly predictions for sea surface salinity within the Offshore ECC (source: Marine Institute)

Sediments

2.6.32 As demonstrated in Figure 6, the INFOMAR predictive substrate model described sediments as predominantly sandy muds/muddy sands across the inshore portion of the Offshore ECC and as mixed sediment further offshore. The project specific sediment sampling campaign (Fugro, 2021), as illustrated in Figure 7, supported the INFOMAR predicted modelling. The southern Offshore ECC seabed sediments are a mixture of sand, sand gravel, gravelly sands and mixed sediments across the inshore with predominantly gravelly sands and sands further offshore. Of note is that both data sources identify the presence of rock further inshore (Figure 7).

2.6.33 As detailed in the Physical Processes technical baseline, there is a trend of decreasing SPM concentrations with distance offshore, with the highest concentrations recorded in the study area observed in Dublin Port.

Sediment bound contaminants

2.6.34 As noted above, the sediment within the Offshore ECC is dominated by sand. Sand is associated with low contaminant levels; as confirmed by the project specific campaign the levels of sediment bound contaminants are low in the Offshore ECC. The level of metals present in the sediment samples collected within the array area, the Offshore ECC and wider study area are presented in Table 9 There were no occurrences of contaminants exceeding the lower Irish Action Levels in the project specific campaign in the Offshore ECC. All samples collected for the project reported levels of Dibutyl Tin (DBT) and Tributyl Tin (TBT) that were well below the Irish Sediment Quality Lower Level; the sample results within the Offshore ECC were less than 5 µg/kg and 2 µg/kg for DBT and TBT, respectively (Table 10).

2.6.35 None of the samples collected in the Offshore ECC exhibit PAH levels in exceedance of the Irish Sediment Quality Guidelines (Table 10). Analysis of the Total Hydrocarbon (THC) and n-Alkanes was also undertaken, with no samples reporting elevated levels (Fugro, 2021) in the Offshore ECC (see the Subtidal Survey Report).

2.6.36 Inter-tidal sampling at the landfall locations demonstrates low contaminant levels in the beach sediments, with arsenic the only parameter which exceeded the Lower Action Level. As shown in Table 12, this exceedance occurs at all samples, with levels remaining well below the upper Action Level. Whilst aluminium levels appear high at all of the intertidal sediment samples and at two from the Offshore ECC (ST03 and ST24), the samples align with expected contaminant levels (pers.comm, Cronin, 2021). All samples collected for the project at Shanganagh reported levels of Dibutyl Tin (DBT) and Tributyl Tin (TBT) that were well below the Irish Sediment Quality Lower Level (Table 2); samples taken at the landfall all reported levels less than 1 µg/kg for both contaminants.

2.6.37 Sediment samples taken at landfall have also been analysed for the US Environment Environmental Protection Agency's 16 priority Polycyclic Aromatic Hydrocarbons (PAH), as shown in Table 13. None of the samples collected exhibit PAH levels in exceedance of the Irish Sediment Quality Guidelines (Table 2). Analysis of the Total Hydrocarbon (THC) and n-Alkanes was also undertaken, with no samples reporting elevated levels (Aquafact, 2021).

Table 12 Summary of sediment metal contamination within the landfall area (Aquafact, 2021)

Metal	Irish Action Levels (mg/kg)		Sample Level (mg/kg)					
	Lower Limit	Upper Limit b	Sh1 Upp	Sh1 Mid	SH1 Lwr	SH2 Uppp	Sh2 Mid	Sh2 Lwr
Al	-	-	15,900	19,100	16,800	18,100	17,100	20,200
As	20 [c]	70	34.4	41.6	44.8	47	54.7	59.6
Cd	0.7	4.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cr	120	370	18.6	26.3	23.1	24.5	30.2	21.9
Cu	40	110 [d]	11.9	14.9	11.6	13.8	13.6	13
Hg	60	218	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Li	-	-	23.2	20.9	21.4	20.7	20.2	23.7
Ni	40 [e]	60	11.4	18.4	13.7	15.8	19.1	12.3
Pb	60	218	14.9	12.2	15.5	18.6	18.1	16.5
Zn	160	410	42.1	43.5	46.5	46.3	51.9	45.2
[a] Total sediment results based on <2mm fraction								
[b] Effects Range Median (ERM) (rounded up)								
[c] This value was amended in 2019								
[d] Probable Effects Level (PEL_PEL as ERM considered high								
[e] This value was amended in 2019								
Al: Aluminium; As: Arsenic; Cd; Cadium; Cr: Chromium; Cu: Copper; Hg: Mercury; Ni: Nickel: Pb: Lead; Zn: Zinc								
	Above Lower Limit of Irish Action Levels							

Table 13 Summary of sediment hydrocarbon contamination within the landfall area (Aquafact, 2021)

PAH	95%ile[b]	Sample Level (ng/g dry sediment)					
		Sh1 Upp	Sh1 Mid	SH1 Lwr	SH2 Uppp	Sh2 Mid	Sh2 Lwr
Naphthalene	93	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Acenaphthylene	34	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Acenaphthene	54	<1.00	<1.00	<1.00	<1.00	<1.00	1.65
Fluorene	129	<1.00	<1.00	<1.00	<1.00	<1.00	1.48
Phenanthrene	397	2.53	2.29	5.16	8.29	2.02	19
Anthracene	116	<1.00	<1.00	1.23	2.15	<1.00	5.09
Fluoranthene	524	1.43	1.32	8.17	15.5	<1.00	28.2
Pyrene	459	1.55	1.43	7.67	12.9	<1.00	22.6
Benzon(a)anthracene	265	<1.00	2.03	4.28	8.66	<1.00	13.5
Chrysene	336	2.05	1.87	5.34	9.45	1.58	15.5
Benzo(b)-Fluoranthene	331	1.09	<1.00	3.69	6.52	<1.00	9.18

PAH	95%ile[b]	Sample Level (ng/g dry sediment)					
		Sh1 Upp	Sh1 Mid	SH1 Lwr	SH2 Uppp	Sh2 Mid	Sh2 Lwr
Benzo(k)-Fluoranthene	234	<1.00	<1.00	2.9	4.47	<1.00	6.76
Benzo(a)pyrene	250	<1.00	<1.00	3.85	8.94	<1.00	11.2
Indeno(1,2,3-cd)-pyrene	249	<1.00	<1.00	3.28	7.36	<1.00	9.69
Benzo(ghi)perylene	225	1.04	<1.00	3.73	7.76	<1.00	10
Dibenzo(a,h)-anthracene	63	<1.00	<1.00	<1.00	1.8	<1.00	1.79
Total US EPA 16[a]	3759[c]	9.69	8.94	49.3	93.8	3.6	155.64

[a] US EPA 16 = United States Environmental Protection Agency's 16 priority PAH. [b] PAH levels derived from 95th percentile of background values, from Marine Institute data, 2001 to 2003; values not normalized for organic carbon; total sediment <2 mm (Cronin et al., 2006). [c] Irish Guidelines lower level 4000

2.7 Future receiving environment

2.7.1 Global changes to seawater chemistry, including reductions in pH and salinity, have been observed and attributed to anthropogenically induced climate change. These changes may result indirectly from changes in coastal dynamics, water column stability and water quality. In addition, marine biological systems have been shown to be very sensitive to changes in water chemistry (EPA, 2017). In Ireland, significant research has been conducted into the impacts of changes in chemistry on natural systems and growth. There is evidence of freshening in coastal waters on the Irish continental shelf as a result of increased winter precipitation, however it should be noted that there is inter-annual variability and lower confidence in salinity projections (Nolan *et al.*, 2010).

2.8 Do-nothing environment

2.8.1 In the absence of Dublin Array being constructed, the characterisation of the receiving and future environment, as presented above, is anticipated to remain valid, i.e. no alterations to the evolving baseline environment outwith any natural responses to climate change, in respect of MW&SQ, are anticipated to occur. A deterioration in water quality and in particular biological characteristics and nutrient loads is predicted to result from climate change, and in particular in response to an increased frequency of extreme weather events, increased water flows and temperature fluctuations (EPA, 2021; Walker Institute for Climate Change, 2014)).

2.9 Uncertainties and technical difficulties encountered

2.9.1 To address and minimise the level of uncertainty for assessments, the best practice and knowledge gained from the State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World (Copping *et al.*, 2020) and from operational sites where the understanding of water quality issues have been progressed from monitoring of the construction and operation of offshore wind farms across Europe and North America, has been considered throughout.

2.9.2 Some aspects of the baseline are well understood, such as the temperature and salinity in the water column. However, 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. Where possible, this assessment has been based on conservative assumptions, such as maximum design parameters and modelling options, in order to add additional precaution into its findings.

2.9.3 Grab sampling, while providing detailed site-specific information on the sediment types (and fauna) present, cannot cover wide swaths of the seabed and consequently 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 INFOMAR predictive substrate model, including the project specific sediment sampling campaign (Figure 7; Fugro, 2021). Therefore, the INFOMAR data are considered sufficient to characterise the study (and wider) area. The seabed in the area is well studied and surveyed. As such, the available evidence base is sufficiently robust to underpin the assessment presented here and an overall high confidence is placed the characterisation of the baseline.

2.9.4 Uncertainty exists with regards to characterisation of the future baseline including the potential changes in seawater chemistry which may occur. In addition to the uncertainty described above with the future baseline, 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 drilling and jetting. The exact volume of material entrained into the water column will be dependent upon a number of factors including the type of drilling/ cable installation equipment used and the mechanical properties of the geological units. In line with the opinion on unconfirmed details provided by An Bord Pleanála under section 287A of the Planning and Development Act 2000, as amended ('2000 Act'), certain details will remain unconfirmed during the development consent procedure. The type of technology to be deployed and the final layout will influence the type of drilling / cable installation equipment used, and other features of the construction methodology. Until a main contractor is appointed to the project, after development consent is obtained, there will be a lack of confirmed detail on the installation and construction methodologies from the appointed contractor. In response to this inherent uncertainty, a series of potential release options have been considered in the EIA. Together, these options capture the worst-case impacts in terms of the highest concentration suspended sediment plumes, the most persistent suspended sediment plumes, the maximum changes in seabed level elevation and the greatest spatial extent of change in seabed level. Therefore, no effects will arise which are worse than those presented in this EIAR.

2.9.5 Where this activity occurs within one model cell, this process can be considered to occur at a sub-grid scale, with no meaningful interpretation for the size of the dispersal plume. Further information is provided in the Physical Processes Modelling Report. Therefore, this has been supplemented with information based on expert judgement and analogous projects to allow meaningful interpretation.

2.9.6 However, despite the above uncertainties, it should be noted that there is robust data available on the sediment types and contaminants present within the study area. The seabed in the area is well studied and surveyed, and as such the available evidence base is considered to be sufficiently robust to underpin the assessment presented here and an overall high confidence is placed on the assessment.

2.10 Scope of the assessment

Scoped in

2.10.1 The impacts assessed for MW&SQ receptors are detailed in Table 14.

Table 14 Scope of the MW&SQ assessment

Potential impact/ change	Impact
Construction	
Deterioration in water quality due to re-suspension of sediments	Impact 1
Deterioration in water quality due to re-suspension of sediment bound contaminants	Impact 2
Accidental releases of chemicals	Impact 3
Deterioration in water clarity from the release of drilling mud during landfall operations	Impact 4
Operation and Maintenance	
Deterioration in water quality due to re-suspension of sediments and sediment bound contaminants	Impact 5
Accidental releases of chemicals	Impact 6
Decommissioning	
Deterioration in water quality due to re-suspension of sediments and sediment bound contaminants	Impact 7
Accidental releases of chemicals	Impact 8

Scoped out from further evaluation in this EIAR

Shellfish waters

2.10.2 Impacts upon Malahide shellfish waters (as presented in Figure 4) have been scoped out from this assessment based on the site specific modelling undertaken which demonstrates that these designated shellfish waters are too remote (approximately 14 km) from the proposed development for significant effects on water quality at the site to occur. The Physical Processes Modelling Report provides further details of the project specific modelling undertaken.

Transitional waters and nutrient sensitive areas

2.10.3 Impacts on transitional waters and nutrient sensitive areas have been scoped out from this assessment as potential receptors on which significant effects may occur. These designations are beyond the 2 km buffer applied, as detailed in the WFD guidance, and therefore have not been considered further. However, further detail is provided in the WFD and MSFD Summary.

Artificial radionuclides

2.10.4 The most significant source of artificial radionuclides in the Irish marine environment is the discharge of low level liquid radioactive waste from the Sellafield Nuclear Fuel Reprocessing Plant on the Cumbrian Coast of England, located approximately 170 km (112 miles) from the north east coast of Ireland. The EPA (EPA, 2017b) concluded that:

"the results of the 2014 and 2015 environmental radioactivity monitoring programme show that, while levels of artificial radioactivity in the Irish environment remain detectable, they are low and broadly consistent with levels reported previously, posing no risk to the health of the Irish population".

2.10.5 Therefore, further consideration of artificial radionuclides in the marine environment has been scoped out from this assessment as no likely significant effects are anticipated.

Resuspension of sediment from scour development

2.10.6 The term scour refers here to the development of pits, troughs or other depressions in the seabed sediments around the base of project infrastructure, such as the foundations of the wind turbine generators or cable protection. The magnitude of any changes to the seabed through development of scour features (and so resuspension of sediment) will vary depending upon the infrastructure type (including different foundation types) installed and the local scale baseline oceanographic and sedimentary environments. This is because scour is the result of net sediment removal over time due to the complex three-dimensional interaction between the foundation and ambient flows (currents and/ or waves).

2.10.7 Sediment resuspension (and sediment bound contaminants) from scour around subsea structures has been scoped out from further evaluation for this chapter. Any effect will be highly localised and associated volumes of mobilised sediment (including associated contaminants) are within the range of natural variability. Whilst there is the potential that sediment could be re-suspended because of scour around project infrastructure (including WTGs and cable protection), the suspended sediment volume released during operation via scour would be much lower than the sediment resuspended during construction. No likely significant effects are anticipated from scour and any further assessment has been scoped out of this EIAR for MW&SQ receptors.

Temporary Vessel Activities

2.10.8 The use of jack-up vessels and anchors during the construction, O&M and decommissioning phases within the temporary occupation area is considered to be inconsequential to the receiving environment unlike those activities outlined in Table . This is primarily as their use will result in the suspension of very small sediment volumes close to the seabed, which will rapidly settle from suspension within the immediate area. Therefore, the use of the jack-up vessels and anchors will not result in notable changes of SSC and associated sediment deposition on MW&SQ receptors. The use of the anchors would be analogous with other marine traffic in the study area. No likely significant effects are anticipated from the use of jack-up vessels and any further assessment has been scoped out of this EIAR for MW&SQ receptors.

Surveys

2.10.9 No pathways on MW&SQ receptors which could result in significant effects in EIA terms have been identified for the pre-construction surveys including geotechnical drilling. Therefore, these surveys have been scoped out for further consideration in this EIAR for MW&SQ receptors.

Shallow Gas

2.10.10 No shallow gas found at the surface to date has been found within the array area, although acoustic blanking[24] has been observed. It is known that there are shallow gas reserves to the east of the Dublin Array as identified throughout scientific literature and investigations (Coughlan *et al*., 2017). There will be no direct interaction with any shallow gas reserves during the construction and operation of Dublin Array, and no pathway for the gas to be released into the marine environment has been identified. Therefore, this has been scoped out from further consideration in this assessment and other EIAR chapters for interactions of environmental factors.

[24] Acoustic blanking is characterised by strong and consistent reflections in seismic data.

Microplastics

2.10.11 Insofar as microplastics and weather erosion is concerned, the blades used in the Dublin Array windfarm are specifically designed to have high resistance to weathering, with the protective coatings being non-toxic. The high resistance of blades to weather erosion is further borne out by the study conducted at the Hywind Scotland Offshore Wind farm. The study was undertaken to quantify and characterise microplastic particles in the sediment around the windfarm and in its vicinity (Piarulli et al., 2023). The study classified the microplastic particles from those associated with the blades of the wind turbines, and from other sources. The analysis concluded that there were no microplastics from the wind farm in the sediments. Nor were any traces of other materials used on the turbines on Hywind Scotland found. However, microplastics originating from other sources were found. The polymers found are some of the most common in marine environments, originating from human activity, such as packaging material. Accordingly, based on the best available scientific evidence, and the planned high weather-resistance specification for Dublin Array blades, the erosion of structures is not considered to result in a likely significant effect in relation to microplastics and therefore has been scoped out from further consideration in this chapter.

Sensitive receptors

2.10.12 The identified sensitive receptors to these potential impacts, beyond the wider marine environment, are the water bodies and features designated under the WFD, within a 2 km buffer namely:

- Coastal waterbodies:
  - Southwestern Irish Sea - Killiney Bay.
- Bathing Waters:
  - Killiney; and
  - White Rock Beach.

2.11 Key parameters for assessment

2.11.1 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 Volume 2, Chapter 6: Project Description [hereafter referred to as 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).

2.11.2 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 those associated with 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.

2.11.3 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.

2.11.4 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 EIA (see the Project Description Chapter). Whilst flexibility is not being sought for these elements, the relevant parameters are also incorporated into the MDO and alternative option(s) table to ensure that all elements of the project details are fully considered and assessed.

2.11.5 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, 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 Planning Application they will be agreed prior to the commencement of development by way of compliance with a planning condition. With respect to design details where flexibility is not being sought, such as cable installation methodology at landfall, the MDO and alternative design option(s) are the same (as there is no alternative). 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 flexibility is being sought, and wider design details and normal construction practises where flexibility is not being sought.

2.11.6 No discharges[25] (continuous or intermittent) of chemicals or construction materials, which may be toxic or persistent within the marine environment, are proposed during the construction phase of Dublin Array. The Applicant will seek a Dumping at Sea (DAS) permit for the disposal of dredged material within the array area.

2.11.7 Full details of how these design options have been modelled are available in the Physical Processes Modelling Report.

[25] Drilling mud is assessed in Impact 4 below. Assessment of drill cuttings and the disposal of dredged sediment associated with seabed preparation are assessed in Impacts 1 and 2 as detailed in Table .

Table 15 Maximum and Alternative Design Options assessed

Maximum design option	Alternative design options	Justification
Construction		
Impact 1: Deterioration in water quality due to re-suspension of sediments		
Dredging prior to foundation installation: Trailer suction hopper dredger (TSHD). - Option B: 45 WTGs - One Offshore Substation Platform (OSP) requiring seabed preparation 100% of WTGs requiring seabed preparation **Foundation installation** Option C: 39 WTGs with four-legged jacket foundations; Jacket pin-piles foundations for one OSP Drilling required at 100% of foundations **Disposal:** For all options where seabed preparation prior to foundation installation will take place, the material is dredged by a TSHD. **IAC - Cable Installation:** - The maximum total length of IAC has been identified as 120 km. 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 - 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).	**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 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. **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. Alternative options include the potential for varying percentages, less than 50%, of foundation locations requiring drilling. **Disposal:** For all options where seabed preparation prior to foundation installation will take place, the material is dredged by a TSHD. **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). 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).	The MDO for seabed preparation prior to foundation installation results in the largest footprint on the seabed and the greatest volumes of disturbed sediment from the WTG and foundation options. 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 time period l which has the potential to give highest SSC 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 to be the realistic worst-case option for cable installation. Alternative foundation types and WTG options will give rise to varying volumes of drill arisings, all less than the maximum design option.

Maximum design option	Alternative design options	Justification
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; Export Cables Dredging using TSHD to undertake sandwave clearance and disposal - Two cables; - Maximum length of one export cable = 18.35 km; - up to 70% requiring seabed preparation.	**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 length of one export cable = 18.35 km; - Up to 25% requiring seabed preparation.	(See previous page)
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 m^3 x 2 (number of cables) = **750 m^3;** - Maximum length of drill = 856 m; and - Maximum installation period: 40 weeks subject to suitable weather conditions, inclusive of site mobilisation and demobilisation.	No alternative options have been considered for this operation, as the methodology described as the maximum design option is considered the most appropriate option.	
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: Deterioration in water quality due to re-suspension of sediment bound contaminants		
As above. See Impact 1: Deterioration in water quality due to re-suspension of sediments		
Impact 3: Accidental releases of chemicals		
Accidental pollution may result from construction vessels with up to 813 round trips to port from construction vessels and 1,825 round trips from crew transfer vessels during construction period.	Accidental pollution may result from any of the up to 774 round trips to port from construction vessels and 538 round trips from crew transfer vessels during construction period.	These parameters are considered to represent the maximum and minimum adverse option with regards to vessel movement during the construction

Maximum design option	Alternative design options	Justification
The number of vessel round trips is based on fewer larger generating capacity WTGs.	The number of vessel round trips is based on the smaller generating capacity WTGs.	period. These encapsulate the upper and lower range of round trips required for construction.
No chemicals (with the exception of drilling mud – see Impact 4) are proposed to be discharged into the environment as part of construction activities.	No chemicals (with the exception of drilling mud – see Impact 4) are proposed to be discharged into the environment as part of construction activities.	
Impact 4: Deterioration in water clarity from the release of drilling mud at landfall		
Use of drilling fluid (landfall) using trenchless techniques: - The drilling fluid is anticipated to be a low concentration bentonite/water mixture. - Drill head will stop short of punch out, flush bentonite, and complete the final 10 m in order to mitigate bentonite release on punch out. - Total mud losses on the seabed = <20 m^3.	**Use of drilling fluid using trenchless techniques:** - The drilling fluid is anticipated to be a low concentration bentonite/water mixture. - Drill head will stop short of punch out, flush bentonite, and complete the final 10 m in order to mitigate bentonite release on punch out. - Total mud losses on the seabed = <10 m^3.	The maximum design option presented results in the largest volumes of drilling fluid potentially discharged into the marine environment from using trenchless techniques. This maximum design option leads to the greatest potential for impact and informs the subsequent detailed assessment. The alternative design options 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. Table 39 of the Physical Processes Design Options Annex provides a detailed breakdown of the parameters that inform the maximum and alternative design options.
Operation and Maintenance		
Impact 5: Deterioration in water quality due to re-suspension of sediments and sediment bound contaminants		
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) Alternative options for the use of maintenance activities involve the requirement for fewer maintenance events to be required over the lifetime of the project.	This scenario represents the maximum total seabed disturbance indicates the maximum potential amount of contaminated sediment released into the water column during O&M activities.
Impact 6: Accidental releases of chemicals		
Option C: 39 WTGs may be installed. A WTG in Option C: 39 WTGs may contain up to: 1,086 litres of grease; 4,205 litres of drive train oil; 2,142 litres of hydraulic oil; 137,340 litres of Nitrogen; 24,780 litres of coolant; 14,730 litres of transformer oil; and 250 kg of SF6 gas.	Option B: 45 WTGs or Option A: 50 WTGs may be installed A WTG in Option A: 50 WTGs may contain up to: 780 litres of grease; 3,000 litres of drive train oil; 1,500 litres of hydraulic oil; 98,000 litres of Nitrogen; 17,700 litres of coolant; 10,500 litres of transformer oil; and 250 kg of SF6 gas.	The maximum and alternative design options is based on the maximum and minimum volumes respectively which may be contained with the infrastructure during the O&M phase. The maximum design option includes the maximum adverse option with regards to vessel movements during the O&M period. Whereas the alternative design options represent the design option with the fewest round trip vessel movements.

Maximum design option	Alternative design options	Justification
The OSS may contain up to: 3,000 litres of fuel storage; 20,000 litres of potable water; 20,000 litres of grey water; 8,000 litres of black water; 300 tonnes of mineral oil (which may be replaced by ester based or silicon based oils which provide improved fire resistance); 2,000 kg of switchgear sulphur hexafluoride insulating gas; 228 kg of fire suppression systems (halocarbon extinguishant gas); 5,000 kg of electrolytes being used for UPS and DC system batteries; and 250 kg of HVAC coolant.	The volumes of chemicals will range from not being required (i.e., 0 litre) up to the maximum design option. The OSS may be designed to reduce the need for grey and black water systems with the provision of portaloos or vessel facilities as an alternative.	
Accidental pollution may also result from the three daily CTV trips with the addition of up to 100 vessels trips to support scheduled routine and non-routine maintenance per year.	Accidental pollution may also result from the two daily CTV trips with the addition of up to 75 vessels trips to support scheduled routine and non-routine maintenance.	
No chemicals are proposed to be discharged into the marine environment as part of O&M activities.	No chemicals are proposed to be discharged into the marine environment as part of O&M activities.	
Decommissioning		
Impact 7: Deterioration in water quality due to re-suspension of sediments and sediment bound contaminants		
Removal of structures is expected to be undertaken as an approximate reverse of the installation process;	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.
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.		
Removal of foundations: Option A: 50 WTGs; and -One OSP	**Removal of foundations:** - Option C: 39 WTGs and Option B: 45 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.	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.	
Impact 8: Accidental releases of chemicals		
As above. See Impact 7: Deterioration in water quality due to re-suspension of sediments and sediment bound contaminants		

2.12 Project Design Features and Avoidance and Preventative Measures

2.12.1 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 Marine Water and Sediment Quality. These are presented within Table 16.
- 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 16.
- 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 2.13, 2.14 and 2.15 of this EIAR chapter.

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

Table 16 Project design features and other avoidance and preventative measures relating to

Project design feature / other avoidance and preventative measure	Where secured
To avoid the release of bentonite on punch out of the cable landfall the drill head will stop short of punch out, flush bentonite, and then complete the final 10 m	Outlined in the Project Description
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 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	The PEMP includes measures outlined within the Marine Pollution Contingency Plan compliant with relevant legal obligations and frameworks

Project design feature / other avoidance and preventative measure	Where secured
designated areas with impermeable bunding (up to 110% of the volume); and double skinning of pipes and tanks containing hazardous materials to avoid contamination	
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.
During the lifetime of the project the Applicant and its contractors will comply with all measures outlined in the Marine Biosecurity Plan to include: -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. 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)	The PEMP includes details of the Marine Biosecurity plan that details requirements and relevant legislation
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. "
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,

Project design feature / other avoidance and preventative measure	Where secured
	type, quantity and installation methods for scour protection which will be undertaken in accordance with the design options, quantities & methods outlined the Project Description

2.13 Environmental Assessment: Construction phase

Impact 1: Deterioration in water quality due to re-suspension of sediments

2.13.1 As described in Table , the construction of the Dublin Array offshore infrastructure has the potential to increase SSC in the marine environment through the generation of sediment plumes. Increases in SSC and turbidity may result in a decrease in the depth to which natural light can penetrate into the water column, and may therefore result in a reduction in primary productivity[26] and/ or an increase in bacterial growth. The disturbance of the seabed sediments may also result in the release of additional nutrients which were sediment bound and therefore increase their concentrations in the water column and availability for aquatic plants.

2.13.2 Fish and many other organisms need dissolved oxygen in the water to survive. Dissolved oxygen levels can decrease due to various factors, including rapid changes in temperature and salinity, as well as from the respiration of organic matter. Dissolved oxygen levels can also decrease as a reaction to nutrient inputs. When nutrient loading is too high, phytoplankton and/or seaweed can bloom and then die, this process is known as eutrophication. Bacteria and other decomposer organisms then use oxygen to break down the organic matter.

2.13.3 An assessment of the potential changes to the physical environment is provided in the Physical Processes Chapter; including a summary of the Physical Processes Technical Baseline. The baseline provides a full characterisation of the receiving environment in the study area and wider Irish Sea and the project specific modelling. Full details of the options modelled, including the fate of sediment plumes and subsequent deposition under different tidal states, and results are presented in Physical Process Modelling for Dublin Array Offshore Wind Farm. The magnitude of increase in SSC and subsequent deposition predicted as a result of each of the construction activities are assessed as pathways in Physical Processes chapter. The following pathways are of relevance to this assessment:

- Pathway 1 - Increases in Suspended Solids Concentrations (SSC) and deposition of disturbed sediments to the seabed due to dredging for seabed preparation prior to foundation installation;

[26] The production of organic compounds through the biological process of photosynthesis by phytoplankton.

- Pathway 2 - Increases in SSC and deposition of disturbed sediments to the seabed due to the release of drill arisings during foundation installation;
- Pathway 3 - Increases in SSC and deposition of disturbed sediment to the seabed due to inter-array cable installation;
- Pathway 4 - Increases in SSC and deposition of disturbed sediment to the seabed due to export cable installation;
- Pathway 5 - Increases in SSC and deposition of disturbed sediment to the seabed due to release of drilling mud;
- Pathway 6 - Increases in SSSC and deposition of disturbed sediment to the seabed due to sandwave clearance; and
- Pathway 7 - Sandwave crest level preparation resulting in a change to local hydrodynamic, wave and sediment transport processes.

2.13.4 To summarise, sediment plumes caused by seabed preparation and installation activities will be restricted to well-within a single tidal excursion distance, with plumes occurring over a maximum distance of 10 km from the source. Sediment plumes, particularly those containing coarser sediment fractions, will quickly (in the order of minutes) dissipate after cessation 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). As predicted by the project specific modelling, the proposed activities within the array will not measurably affect the coastal or identified bathing waters. Therefore, activities within the array are only applicable to the wider marine environment as the array is greater than 10 km from the nearest protected areas under the WFD.

2.13.5 The magnitude of the impact (temporary increase in SSC and sediment deposition) is assessed in Table based on the methodology outlined in Section 2.4. For the design alternative options detailed in Table 14 which will not result in any sediment disturbance then there will be no deviation from the future receiving environment for those activities.

2.13.6 For the identified water quality receptors, the sensitivity of the receptors is assessed in Table 18.

Table 17 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 will be restricted to the near field and the adjacent areas of the far-field (within one tidal cycle/ mean spring tidal excursion).	The temporary impact of increased SSC and deposition from construction activities will be restricted to the near field and the adjacent areas of the far-field (within one tidal cycle/ mean spring tidal excursion).
Duration	The impact will be restricted to the construction phase of the project (for which the offshore phase is scheduled for a 30 month duration) and will therefore be short-term (1 - 7 years), although works in any given discrete location and activity within the project boundary will often be temporary (considerably less than 1 year).	The impact will be restricted to the construction phase of the project (for which the offshore phase is scheduled for a 18 month duration) and will therefore be short-term (1 - 7 years), although works in any given discrete location and activity within the project boundary will often be temporary (considerably less than 1 year).
Frequency	The impact will occur frequently in discrete areas throughout the construction phase of the development.	The impact will occur frequently in discrete areas throughout the construction phase of the development.
Probability	The impact upon the water quality receptors can reasonably be expected to occur.	The impact upon the water quality receptors can reasonably be expected to occur.
Consequence	Sediment plumes will quickly dissipate after cessation of the activities, due to settling and wider dispersion with the concentrations reducing quickly over time to background levels. Therefore, the consequence will be noticeable but brief changes in SCC concentrations occurring during the construction phase within the near-field and the adjacent areas of the far-field.	Sediment plumes will quickly dissipate after cessation of the activities, due to settling and wider dispersion with the concentrations reducing quickly over time to background levels. Therefore, the consequence will be noticeable but brief changes in SCC concentrations occurring during the construction phase within the near-field and the adjacent areas of the far-field.
Overall magnitude	*The potential magnitude of the predicted changes is rated as **Low adverse.***	*The potential magnitude of the predicted changes is rated as **Low adverse.***

Table 18 Determination of sensitivity for receptors to potential changes in water quality

	Justification
Context	**Adaptability:** No notable releases of nutrients or organic matter from the seabed sediment are anticipated to occur as a result of the proposed construction activities. The project will not release nutrients or organic matter from outfalls or discharges into the marine environment. Therefore, the proposed activities will not cause a measurable reduction in the dissolved oxygen in the water column. Therefore, no source-receptor-pathways are identified for a deterioration of dissolved oxygen or eutrophication. On this basis, no likely significant effects are predicted on WFD water bodies, the wide marine environment or indirectly on marine life (see Section 2.2 and 2.6) in terms of dissolved oxygen. A reduction in water clarity associated with the proposed activities in coastal waters, namely the export cable installation and associated preparation, will occur in temporary and discrete events. Owing to the temporal nature of the impact, these events will not alter the water clarity status of the WFD water bodies or wider marine environment within the study area. The mortality of bacteria, including *E.coli* and IE, within the water column is strongly influenced by the amount of ultraviolet light penetrating the water column. Under higher ultraviolet conditions the mortality of bacterium is higher and faster. The reduced water clarity due to works in the coastal waters could result in temporary increases in bacterial counts within the water column due to decreased bacterial mortality. There is also the potential release of sediment bound bacteria (including *E.coli* and IE) from disturbing the seabed sediments. These elevated bacterial counts could theoretically cause a deterioration in the water quality at the local bathing waters. However, given the predicted levels of dilution and dispersion of the suspended sediments from the modelling and so bacteria, coupled with the temporary nature of the activities; it is expected that any increases in bacterial counts in the water column would be in the order of days. The resultant increase in bacterial counts from the proposed activities would be analogous to storm events and therefore not anticipated to result in a reduction of water quality at the identified bathing waters beyond the background conditions and natural variation. **Tolerance:** The environment has a moderate capacity to accommodate the proposed form of change. **Recoverability:** The environment has a high capacity to recover from SSC as demonstrated from the recovery of storm events which increase turbidity.

	Justification
Value	The receptors designated under the WFD are of international importance. The water quality for the wider marine environment is of local importance.
Overall sensitivity	*The potential sensitivity of receptors designated under the WFD (including BWs) are rated as Medium.* *The potential sensitivity of the wider marine environment is rated as Low.*

2.13.7 A consideration of the impact upon two receptors, water quality and microbiology, and as discussed in Table 18, is as follows:

- The magnitude of the impact has been assessed as **Low adverse**, with the maximum sensitivity of the designated receptors being **Medium**. Therefore, the significance of potential changes to water quality (and marine microbiology) due to the re-suspension of sediments occurring as a result of the proposed construction activities is **Slight adverse**, which is not significant in EIA terms.

- The magnitude of the impact has been assessed as **Low adverse**, with the maximum sensitivity of the wider marine environment receptors being **Low**. Therefore, the significance of potential changes to water quality (and marine microbiology) occurring as a result of the proposed construction activities is **Slight adverse**, which is not significant in EIA terms.

2.13.8 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 from changes in water quality (and marine microbiology) occurring as a result of the proposed construction activities is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table is considered necessary. ***No significant adverse residual effects*** *have been predicted in respect of changes in water quality (or marine microbiology).*

Impact 2: Deterioration in water quality due to re-suspension of sediment bound contaminants

2.13.9 As described in Table 14, the construction of the offshore infrastructure has the potential to increase SSC in the marine environment through the generation of sediment plumes. While in suspension, 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 water quality receptors.

2.13.10 A full assessment of increased SSC is presented in the Physical Processes Chapter for all phases of the development. The findings of the assessment were that the magnitude of the maximum potential increase in SSC resulting from construction activities is within the natural range of

SSC within the region and the impact will be short-term, intermittent, of localised extent and reversible. The maximum magnitude of the impact is considered to be **Low adverse** for both the MDO and alternative design options (see Table 15). For the design alternative options detailed in Table 15 which will not result in any sediment disturbance then there will be no deviation from the further receiving environment for those activities. For the identified water quality receptors, the sensitivity of the receptors is assessed in Table 19.

Table 19 Determination of sensitivity for receptors to potential changes in water quality from the release of sediment bound contaminants

	Justification
Context	**Adaptability:** The total area that is likely to be disturbed by construction activities, and so the potential volume of material disturbed, resulting in the potential release of sediment bound contaminants is small and localised in extent. In addition, the nature of the subtidal sediments is predominantly coarse with low levels of fines adhering to them. The site specific surveys have indicated low levels of contaminants in the Offshore ECC and array (see Section 2.6). The release of contaminants from the fine sediments is likely to be rapidly dispersed with the tide and/ or currents. So, the increased bio-availability of contaminants resulting in adverse eco-toxicological effects is not expected. The levels found are all comparable to the wider regional background and not considered to be of a low quality and will not result in a significant effect-receptor pathway if made bioavailable. In addition, under normal circumstances, very small concentrations of contaminants enter to the dissolved phase (and as such bioavailable), with the vast majority adhering to the sediment particles when temporarily entering suspension in the water column. Partition coefficients may be applied to estimate the concentration of the contaminants entering the dissolved phase which will result in a reduction of several orders of magnitude than the concentrations associated with suspended sediments. As such, it is considered highly unlikely that the Maximum Allowable Concentration will be exceeded for any of the substances as a result of disturbing sediment in the water body from the proposed activities, given the fates of the plumes. Moreover, given the short-term nature of the works and the short-term nature of the sediment plumes, any small uplift in the water concentrations of ESQ substances would be anticipated to return to background levels very quickly (in the order of minutes) and so not impact their AAs. **Tolerance:** The environment has a moderate capacity to accommodate the proposed form of change. **Recoverability:** Following the dispersion of the plumes, and subsequent settlement of sediment, the concentrations in the water column will recover to ambient conditions.

	Justification
Value	The receptors designated under the WFD are of international importance. The water quality for the wider marine environment is of local importance.
Overall sensitivity	*The potential sensitivity of receptors designated under the WFD (including BWs) are rated as Medium.* *The potential sensitivity of the wider marine environment is rated as Low.*

2.13.11 A consideration of the impact upon water column contaminants receptors, within designated receptors and the wider marine environment and as discussed in Table , is as follows:

- The magnitude of the impact has been assessed as **Low adverse**, with the maximum sensitivity of the designated receptors being **Medium**. Therefore, the significance of potential changes to contaminants in the water column occurring as a result of the proposed construction activities is **Slight adverse**, which is not significant in EIA terms.
- The magnitude of the impact has been assessed as **Low adverse**, with the maximum sensitivity of the wider marine environment receptors being **Low**. Therefore, the significance of potential changes to contaminants in the water column occurring as a result of the proposed construction activities is **Slight adverse**, which is not significant in EIA terms.

2.13.12 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 effect

*The significance of effect from changes in contaminants in the water column occurring as a result of the proposed construction activities is not significant in EIA terms. No additional mitigation to that already identified in Table 16 is considered necessary. Therefore, **no significant adverse residual effects** have been predicted in respect of changes in water quality.*

Impact 3: Accidental releases of chemicals

2.13.13 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).

2.13.14 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 the Project Description Chapter).

The magnitude of the impact is assessed in Table 20 based on the methodology outlined Section 2.4. For the identified water quality receptors, the sensitivity of the receptor is assessed in Table 21.

Table 20 Determination of magnitude for accidental releases or spills of construction materials or chemicals

	Maximum design option	Alternative design options
Extent	Any quantities of accidentally released materials are likely to be restricted to the near field.	Any quantities of accidentally released materials are likely to be restricted to the near field.
Duration	Duration of measurable concentrations would be temporary if accidental spills were to occur. Rapid lateral and vertical dispersion are anticipated resulting in rapid dilution of any spilt materials.	Duration of measurable concentrations would be temporary if accidental spills were to occur. Rapid lateral and vertical dispersion are anticipated resulting in rapid dilution of any spilt materials.
Frequency	Infrequent (if it were to occur) as any leakage/ spillage would be accidental.	Infrequent (if it were to occur) as any leakage/ spillage would be accidental.
Probability	The impact is not anticipated to occur during the proposed construction activities as controls will be in place (Table 16).	The impact is not anticipated to occur during the proposed construction activities as controls will be in place (Table 16).
Consequence	If accidental spills occurred, a reduction in water quality is not anticipated to be sufficient to alter water quality in the wider marine environment or effect the waterbodies performance.	If accidental spills occurred, a reduction in water quality is not anticipated to be sufficient to alter water quality in the wider marine environment or effect the waterbodies performance.
Overall magnitude	*The potential magnitude on marine water quality is rated as Negligible.*	*The potential magnitude on marine water quality is rated as Negligible.*

Table 21 Determination of sensitivity for the marine environment to accidental releases or spills of construction materials or chemicals

	Justification
Context	**Adaptability:** The dispersion of any spilt materials is anticipated to occur via natural processes, i.e., via tidal currents, which are present within the study area. **Tolerance:** The environment has a moderate capacity to accommodate the proposed form of change. **Recoverability:** No discernible changes from the baseline are predicted on marine water quality and so recoverability is not relevant.
Value	The designated sites under the WFD are of international importance. The wider marine environment is of local importance.
Overall sensitivity	*The potential sensitivity on designated sites is rated as Medium. The potential sensitivity of the wider marine environment is rated as Low.*

2.13.15 The magnitude of the impact has been assessed as **Negligible**, with the maximum sensitivity of the receptors being **Medium**. Therefore, the significance of effect from accidental releases or spills of construction materials or chemicals is a **neutral effect**, which is not significant in EIA terms.

2.13.16 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 effect

The significance of effect from accidental releases or spills of construction materials or chemicals is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table is considered necessary. Therefore, ***no significant adverse residual effects*** *have been predicted in respect of marine water quality.*

Impact 4: Increases in turbidity due to release of drilling fluid from trenchless techniques

2.13.17 The requirement for drilling mud, such as bentonite (or another inert mud) and associated chemicals, in order to drill and make landfall, could result in its release within the subtidal area at the drilling punch out point[27] in the Offshore ECC.

2.13.18 Bentonite is a non-toxic, inert, natural clay mineral (<63 µm particle diameter). It is included in the List of Notified Chemicals approved for use and discharge into the marine environment and is classified as a Group E substance under the Offshore Chemical Notification Scheme[28]. Substances in Group E are defined as the group least likely to cause environmental harm and are "readily biodegradable and non-bioaccumulative". This is further supported by bentonite being included on the OSPAR List of Substances Used and Discharged Offshore which are considered to Pose Little or No Risk to the Environment (PLONOR)[29].

2.13.19 The bentonite would be dispersed and transported by tidal currents. The Applicant will implement control measures to appropriately manage and minimise releases of bentonite into the environment as detailed in the Project Description Chapter and Table 16. This assessment has been undertaken on the basis of these avoidance and preventative measures being implemented.

[27] Where the drilling bit associated with the cable exits out of the pilot hole on the seabed.
[28] Offshore Chemical Notification Scheme operated by Cefas - https://www.cefas.co.uk/cefas-data-hub/offshore-chemical-notification-scheme/hazard-assessment/
[29] OSPAR (2019) 'OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment' Available from: https://www.ospar.org/work-areas/oic/chemicals

2.13.20 The principal issues relating to bentonite release to the water column is the potential for an increase in turbidity within the water column and/or deposition causing a risk of smothering of benthic organisms should the material settle on the seabed, for example during low tidal flow states (see the Benthic Ecology Chapter). Further information on the fate of bentonite in the marine environment is provided in Physical Processes Modelling Report. With the exception of the potential for increased turbidity from the release of bentonite, no other potential deterioration in water or sediment quality, such as the introduction of contaminants or nutrients, is anticipated.

2.13.21 The magnitude of the impact is assessed in Table 22 based on the methodology outlined in Section 2.4. For the identified water quality receptors, the sensitivity of the receptor is assessed in Table .

Table 22 Determination of magnitude of the release of bentonite

	Maximum design option	Alternative design option
Extent	The plume is expected to be measurable within tens of metres from the area of release. No measurable thickness of bentonite deposition is expected.	The plume is expected to be measurable within tens of metres from the area of release. No measurable thickness of bentonite deposition is expected.
Duration	The measurable effect is anticipated to be brief (i.e., lasting less than a day) per drill.	The measurable effect is anticipated to be brief (i.e., lasting less than a day) per drill.
Frequency	The impact described will occur up to two times during the construction phase, i.e., once per borehole.	The impact described will occur up to two times during the construction phase, i.e., once per borehole.
Probability	The predicted impacts can reasonably be expected to occur.	The predicted impacts can reasonably be expected to occur.
Consequence	Noticeable but extremely brief changes in turbidity occurring during the construction phase within the near-field and the adjacent areas of the far-field. Bentonite is a non-toxic, inert, natural clay mineral (<63 µm particle diameter). It is included in the List of Notified Chemicals approved for use and discharge into the marine environment and is classified as a group E substance under the Offshore Chemical Notification Scheme[30]. Substances in group E are defined as the group least likely to cause environmental harm and are "readily	Noticeable but extremely brief changes in turbidity occurring during the construction phase within the near-field and the adjacent areas of the far-field. Bentonite is a non-toxic, inert, natural clay mineral (<63 µm particle diameter). It is included in the List of Notified Chemicals approved for use and discharge into the marine environment and is classified as a group E substance under the Offshore Chemical Notification Scheme[32]. Substances in group E are defined as the group least likely to cause environmental harm and are "readily

[30] Offshore Chemical Notification Scheme operated by Cefas - https://www.cefas.co.uk/cefas-data-hub/offshore-chemical-notification-scheme/hazard-assessment/

[32] Offshore Chemical Notification Scheme operated by Cefas - https://www.cefas.co.uk/cefas-data-hub/offshore-chemical-notification-scheme/hazard-assessment/

	Maximum design option	Alternative design option
	biodegradable and is non-bioaccumulative". This is further supported by bentonite being included on the OSPAR List of Substances Used and Discharged Offshore which are considered to Pose Little or No Risk to the Environment (PLONOR)[31]. Further, all associated HDD chemicals have undergone a risk assessment to ensure certification as biodegradable/ environmentally friendly and present on the PLONOR list.	biodegradable and is non-bioaccumulative". This is further supported by bentonite being included on the OSPAR List of Substances Used and Discharged Offshore which are considered to Pose Little or No Risk to the Environment (PLONOR)[33]. Further, all associated HDD chemicals have undergone a risk assessment to ensure certification as biodegradable/ environmentally friendly and present on the PLONOR list.
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 23 Determination of sensitivity for receptors to the release of bentonite

Sand banks and sandwaves	Justification
Context	**Adaptability:** As outlined in Impact 1, whilst a potential pathway has been identified for the reduction in water clarity at the WFD waterbodies (directly) and bathing waters (indirectly through the potential increase in bacterial counts and reduction in bacterial mortality), given the rapid and high levels of dilution of the bentonite (Physical Processes Modelling Report), the temporary nature of the activities it is expected that any reduction in water clarity and bacterial mortality would be analogous to storm events and therefore no significant effects are anticipated beyond the background conditions. **Tolerance:** The environment has a moderate capacity to accommodate the proposed form of change. **Recoverability:** Following the dispersion of the bentonite plumes, and subsequent increases in ultra-violet light, the bacterial counts in the water column will recover to normal conditions.
Value	The receptors designated under the WFD are of international importance. The water quality for the wider marine environment may be of local importance.
Overall sensitivity	*The potential sensitivity of receptors designated under the WFD (including BWs) are rated as Medium.* *The potential sensitivity of the wider marine environment is rated as Low adverse.*

[31] OSPAR (2019) 'OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment' Available from: https://www.ospar.org/work-areas/oic/chemicals
[33] OSPAR (2019) 'OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment' Available from: https://www.ospar.org/work-areas/oic/chemicals

2.13.22 The magnitude of the impact has been assessed as **Negligible**, with the maximum sensitivity of the designated receptors being **Medium**. Therefore, the significance of potential changes to water quality occurring as a result of the trenchless technology is **Not Significant**, which is not significant in EIA terms.

2.13.23 The magnitude of the impact has been assessed as **Negligible**, with the maximum sensitivity of the wider marine environment receptors being **Low**. Therefore, the significance of potential changes in water quality occurring as a result of the HDD activities is **Not Significant**, which is not significant in EIA terms.

2.13.24 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 from the release of bentonite into the marine environment is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table is considered necessary. Therefore, **no significant adverse residual effects** have been predicted in respect of marine water quality.*

2.14 Environmental assessment: operational phase

Impact 5: Deterioration in water quality due to re-suspension of sediments and sediment bound contaminants

2.14.1 If a section of the cable became exposed or damaged it would require reburial and/ or replacement. Reburial (and/ or replacement) would be undertaken using similar techniques to that set out in the assessment of SSC associated with cable installation activities (Impacts 1 and 2). The magnitude of increase in SSC and subsequent deposition predicted as a result of O&M activities are assessed as pathways in Physical Processes Chapter. The following pathways which are of relevance to this assessment:

- Pathway 10 - Changes to sediment transport and sediment transport pathways; and
- Pathway 11 - Increases in SSC and deposition of disturbed sediment to the seabed during O&M.

2.14.2 The lengths of cable to be replaced or reburied would be shorter, and so the scale of the operations would be less, and the potential impacts will be more localised and occur over a shorter duration than those considered during the construction phase. The magnitude (and so significance) of the effect on water and sediment quality in the marine environment resulting from O&M activities would be no greater than those assessed in Impacts 1 and 2 (see Section 2.13). Therefore, **no significant adverse residual effects** have been predicted in respect of marine water or sediment quality.

Impact 6: Accidental releases of chemicals

2.14.3 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).

2.14.4 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.

2.14.5 All project and contractor vessels involved in the O&M phase shall comply with MARPOL and the Sea Pollution Act and associated regulations.

2.14.6 Accordingly, the magnitude (and so significance) of the effect on water and sediment quality in the marine environment resulting from O&M activities would be no greater than those assessed in Impacts 3 (see Section 2.13). Therefore, **no significant adverse residual effects** have been predicted in respect of marine water or sediment quality.

2.15 Environmental assessment: decommissioning phase

2.15.1 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).

2.15.2 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.

2.15.3 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 (e.g. inter array cables, scour protection), however the general principle for decommissioning is for all structures to be removed and it is assumed that the wind turbine generators (WTGs) will be dismantled and completely removed to shore.

2.15.4 For the purposes of the assessment of decommissioning, all activities outlined within the Decommissioning and Restoration Plan relevant to marine water and sediment quality have been considered.

Impact 7: Deterioration in water quality due to re-suspension of sediments and sediment bound contaminants

2.15.5 As outlined in Table 15, structures above the seabed are to be decommissioned in reverse of the construction process (see Section 2.13) with cables and cable protection proposed to be left in situ. The impacts during decommissioning for removal of the structures are considered to be similar or less than those previously considered for construction (see Section 2.13). The working areas identified for removal of the structures will be restricted to the area used for installation; accordingly, any impacts would be no greater in magnitude than for the construction phase. If the cables are left in situ at the end of the project lifespan, impacts will be the same as those described previously for the operational phase.

2.15.6 In the event that cables require removal, the impacts during decommissioning are considered to be similar or less than those previously considered for construction (see Section 2.13). The working areas identified for removal will be restricted to the area used for installation; accordingly, any impacts would be no greater in magnitude than for the construction phase with no requirement for seabed preparation works.

2.15.7 As outlined in Impact 1, the installation of cables was associated with the most notable SSC plumes. The magnitude (and so significance) of the effect on water and sediment quality in the marine environment resulting from decommissioning activities will be no greater than those assessed in Impacts 1 and 2. Therefore, **no significant adverse residual effects** have been predicted in respect of marine water or sediment quality.

Impact 8: Accidental releases of chemicals

2.15.8 As the decommissioning activities are anticipated to be a reversal of those in construction, the potential impacts during decommissioning are considered to be similar or less than during construction. Accordingly, the magnitude (and so significance) of the effect on water and sediment quality in the marine environment resulting from O&M activities would be no greater than those assessed in Impacts 3. Therefore, **no significant adverse residual effects** have been predicted in respect of marine water or sediment quality.

2.16 Environmental assessment: Cumulative Effects

2.16.1 This section outlines the cumulative effect assessment on MW&SQ and takes into account the impacts of the proposed development alone, together with other plans and projects. As outlined in Volume 2, Chapter 4: Cumulative Effect Assessment Methodology (hereafter referred to as the Cumulative Effect Assessment Methodology Chapter), the screening process involved determination of appropriate search areas for projects, plans and activities and Zones of Influence (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.

2.16.2 The cumulative effects assessment long list of projects, plans and activities with which Dublin Array's offshore infrastructure has the potential to interact with to produce a cumulative impact is presented in the Cumulative Effect 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 within a search area defined as the ICES Ecoregion subsection 7a. Division 7a of the Celtic Sea ICES Ecoregion is considered appropriate for this exercise in relation to MW&SQ 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 the Dublin Array offshore infrastructure.

2.16.3 The ZoI for the purposes of this assessment has been defined by the maximum areas that a sediment plume will travel from the offshore infrastructure, being 17 km (equal to a single tidal ellipse in addition to a 1 km buffer). On the basis that these tidal ellipses will be regionally similar, and therefore sediment plumes from nearby projects and plans may 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, presented in the Physical Processes Modelling Report, the plumes associated with the proposed activities for the offshore infrastructure 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 temporary occupation 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 MW&SQ ZoI.

Projects scoped out

2.16.4 The following types of developments have been scoped out from this cumulative assessment on MW&SQ receptors based on a lack of a spatial overlap (i.e. stage 1):

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

2.16.5 Marine surveys were screened out from a cumulative effects assessment for MW&SQ receptors on the basis of a lack of pathway which could result in significant effects in EIA terms.

Projects for cumulative assessment

2.16.6 The specific projects scoped into this Cumulative Effect Assessment on MW&SQ receptors, and the tiers into which they have been allocated are presented in Table 24 below. 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).

2.16.7 The MDO for each of the scoped in projects, as identified in Table 24, is presented in Table 25 for the assessment of additive SSC plumes on MW&SQ receptors.

Table 24 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 Licence FS006893	Consented	High – Consented	2021 - 2036
Dredging	Dublin Port Company Licence FS007132	Consented	High – Consented	2022 - 2029
Dumping at sea	Dublin Port Company Permit: S0004-03	Consented	High – Consented	2022 - 2029
Dumping at sea	Dublin Port Company Permit: S0024-02	Consented	High – Consented	2022 - 2035
Subsea cable	HIBERNIA ATLANTIC	Operation	Low	Unknown O&M works as required
Subsea cable	ESAT 2	Operation	Low	Unknown O&M works as required
Subsea cable	CeltixConnect - Sea Fibre Networks	Operational	Low	Unknown O&M works as required
Subsea cable	HIBERNIA 'C'	Operational	Low	Unknown O&M works as required
Subsea cable	ZAYO Emerald Bridge One	Operational	Low	Unknown O&M works as required
Tier 2				
No screened projects classed at Tier 2				

Development type	Project Name	Current Status of Development	Data confidence assessment/ phase	Planned programme
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[34]	Low	Unknown O&M works as required
Offshore Wind Farm	Codling Wind Park and Codling Wind Park Extension	Pre-consent	Low – Scoping Report submitted at the time of writing. However, a foreshore licence application for site investigations has been submitted.	Commencement in 2027 with construction lasting 2-3 years.

2.16.8 The impacts that have been considered in the cumulative effects assessment is cumulative temporary increases in SSC and associated deterioration of marine water quality during construction and O&M (Impacts 9 and 10 respectively).

2.16.9 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.

2.16.10 Certain impacts assessed for the Dublin Array offshore infrastructure alone are not considered in the Cumulative Effect Assessment where the magnitude of the effects from Dublin Array offshore infrastructure alone has been assessed as Negligible (as defined in Table). The impacts, with a negligible magnitude, and so are excluded from the cumulative effects assessment for MW&SQ receptors for these reasons are:

- Accidental releases of spills of materials or chemicals during all phases of the project; and
- Deterioration in water clarity from the release of drilling mud at landfall.

[34] Construction is programmed to be complete in 2027.

Table 25 Cumulative Maximum Design Option

Impact	Projects to be assessed	Maximum design option assessed	Justification for scoping in
Impact 9: Cumulative increases in SSC and associated sediment deposition resulting in a reduction of marine water quality during construction	Tier 1: ▪ Dublin Port Company MP2 Project ▪ Dublin Port Company (Licence FS007132) ▪ Dublin Port Company (DAS permit: S0004-03) ▪ Dublin Port Company (DAS permit: S0024-02)	**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 ▪ Dredging will consist of: ▪ Berth 53 ▪ 10m CD ▪ 159,595 m^3 ▪ Channel Widening ▪ 10.0m CD ▪ 111,995 m^3 ▪ Oil Berth 3 ▪ 13m CD ▪ 83,414 m^3 ▪ Berth 50A ▪ 11m CD ▪ 69,640 m^3 **Dublin Port Company (Licence FS007132):** ▪ 300,000 m^3 of material to be dredged per annum; ▪ Disposal of material into a licenced DAS site (west of Burford Bank);	If the intermittent activities overlap temporally with offshore construction activities for the offshore infrastructure , there is potential for cumulative deterioration of MW&SQ receptors.

Impact	Projects to be assessed	Maximum design option assessed	Justification for scoping in
		▪ Mostly of silt and sand with elements of clay, gravel and cobbles; and ▪ Dredging will be carried out by a trailer suction hopper dredger and support vessels. **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; and ▪ Disposal of material into a licenced DAS site (west of Burford Bank). **Dublin Port Company (DAS permit: S0024-02):** ▪ Material arising from the MP2 project; ▪ The activities involve the loading and dumping of a maximum of 1,102,723 tonnes (wet weight) of dredged material; and ▪ Disposal of material into a licenced DAS site (west of Burford Bank).	

Impact	Projects to be assessed	Maximum design option assessed	Justification for scoping in
	Tier 1: ▪ HIBERNIA ATLANTIC ▪ ESAT 2 ▪ HIBERNIA 'C' ▪ ZAYO Emerald Bridge One ▪ CeltixConnect - Sea Fibre Networks	▪ 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 regarding the methodology and scale of the works.	SSC plumes maybe generated through cable installation, reburial and repair operations which has the potential to result in a cumulative deterioration in water quality.
	Tier 3: ▪ Dublin Port Company 3FM Project ▪ Mares Connect Tier 3: ▪ Codling Wind Park Offshore Wind Farm	**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 ▪ 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	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 which has the potential to result in a cumulative deterioration in water quality.

Impact	Projects to be assessed	Maximum design option assessed	Justification for scoping in
		- 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)	
		Construction[35] and/or maintenance of the proposed Mares Connect power cable: - Two HVDC subsea cables; - Construction between 2026 to 2029; - Landfall in the Greater Dublin area; - Installation methodologies and exact route is unknown at the time of writing; and - Routine planned and unplanned cable maintenance over the lifetime of the cables.	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.
		Codling Wind Park: Installation of the Codling Wind Park's three export cables into Dublin Bay making landfall at Poolbeg. The export cables maybe installed using a variety	If these intermittent activities overlap temporally with construction activities for the offshore infrastructure , there is potential for cumulative deterioration of MW&SQ receptors.

[35] Note: construction is included here for completeness as it is proposed to be considered as it will occur following the characterization of the receiving environment.

Impact	Projects to be assessed	Maximum design option assessed	Justification for scoping in
		of techniques, however, in the absence of assessment for the installation of the project alone the modelling from Dublin Array has been applied.	
Impact 10: Cumulative increases in SSC and associated sediment deposition resulting in a reduction of marine water quality during the O&M phase	Tier 1: ▪ Dublin Port Company MP2 Project ▪ Dublin Port Company (DAS permit: S0024-02)	**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 (DAS permit: S0024-02):** ▪ Material arising from the MP2 project; ▪ The activities involve the loading and dumping of a maximum of 1,102,723 tonnes (wet weight) of dredged material; and ▪ Disposal of material into a licenced DAS site (west of Burford Bank).	If these intermittent activities overlap temporally with O&M activities for the offshore infrastructure, there is potential for cumulative deterioration of MW&SQ receptors.
	Tier 1: ▪ HIBERNIA ATLANTIC ▪ ESAT 2 ▪ HIBERNIA 'C' ▪ ZAYO Emerald Bridge One	Routine planned and unplanned cable maintenance over the lifetime of the cables. Exact details and programme are unknown and so there is a high uncertainty.	If these intermittent activities overlap temporally with offshore O&M activities for the offshore infrastructure, there is potential for cumulative deterioration of MW&SQ receptors.

Impact	Projects to be assessed	Maximum design option assessed	Justification for scoping in
	▪ CeltixConnect - Sea Fibre Networks		
	Tier 3: Mares Connect	Routine planned and unplanned cable maintenance over the lifetime of the cables. Exact details and programme are unknown and so there is a high uncertainty.	If these intermittent activities overlap temporally with offshore O&M activities for the offshore infrastructure, there is potential for cumulative deterioration of MW&SQ receptors.
	Tier 3: Codling Wind Park Offshore Wind Farm	Routine planned and unplanned cable maintenance over the lifetime of the development. Exact details and programme are unknown and so there is a high uncertainty.	If these intermittent activities overlap temporally with offshore O&M activities for the offshore infrastructure, there is potential for cumulative deterioration of MW&SQ receptors.

Effect 9: Cumulative temporary increases in SSC and associated deterioration of marine water quality during construction

2.16.11 The potential for significant cumulative effects on MW&SQ receptors, as a result of simultaneous sediment disturbance, is presented in Table 26 to Table 30.

2.16.12 It should be noted that dredging in Dublin Bay and use of the DAS west of Burford has been considered in the characterisation of the receiving environment (Section 2.6). However, these activities have been considered further in this cumulative assessment given the potential for on-going effects to occur.

Table 26 Considerations of potential for cumulative deterioration in MW&SQ receptors –capital dredge

	Justification
Step 1: Drivers	Capital dredging and disposal in Dublin Bay.
Step 2: Pressures	Temporary increases in SSC and associated sediment deposition which could potentially result in a reduction in water clarity, re-suspension of contamination, a reduction in primary production, an increase in bacterial growth, increased nutrients within the water column and/ or a reduction in dissolved oxygen concentrations.
Step 3: States	The identified receptors include sites designated under the WFD and the wider marine environment.
Step 4: Impacts	As detailed in the Physical Processes Chapter, cumulative effects may arise between the installation of the offshore components of Dublin Array and the MP2 project and maintenance dredging in Dublin Bay, and so could result in the potential for interaction of sediment plumes. If this interaction were to occur, based on the modelling undertaken in the MP2 EIAR, the plumes concentration may increase by an additional 10 mg/l but will dissipate quickly (in the order of minutes) following cessation of cable laying activity (after approximately an hour) (Dublin Port Company, 2020). The potential increases in SSC, when considered cumulatively, are still anticipated to be within natural variation within Dublin Bay. 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), elevated suspended sediment concentrations resulting from seabed activities will remain local to the works. Furthermore, 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 offshore infrastructure cumulatively with MP2. The magnitude (and so significance) of the effect on marine water and sediment quality in the marine

	Justification
	environment resulting from these activities would be no greater than those assessed in Impacts 1 and 2 (see Section 2.13).
Step 5: Responses	No additional mitigation to that already identified in Table are considered necessary to prevent significant effects.
Conclusion	*Therefore, no significant adverse residual effects have been predicted in respect of marine water or sediment quality when considered cumulatively with Tier 1 plans and projects.*

Table 27 Considerations of potential for cumulative deterioration in MW&SQ receptors – subsea cables

	Justification
Step 1: Drivers	Maintenance work of subsea cables.
Step 2: Pressures	Temporary increases in SSC and associated sediment deposition which could potentially result in a reduction in water clarity, re-suspension of contamination, a reduction in primary production, an increase in bacterial growth, increased nutrients within the water column and/ or a reduction in dissolved oxygen concentrations.
Step 3: States	The identified receptors include sites designated under the WFD and the wider marine environment.
Step 4: Impacts	As detailed in the Physical Processes Chapter, 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 impacts on MW&SQ receptors. 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 offshore 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 marine water and sediment quality in the marine environment resulting from these activities would be no greater than those assessed in Impacts 1 and 2 (see Section 2.13).
Step 5: Responses	No additional mitigation to that already identified in Table are considered necessary to prevent significant effects.
Conclusion	*Therefore, no significant adverse residual effects have been predicted in respect of marine water or sediment quality when considered cumulatively with subsea cables plans and projects.*

Table 28 Consideration of potential for cumulative increases in SSC and deposition – 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 which could potentially result in a reduction in water clarity, re-suspension of contamination, a reduction in primary production, an increase in bacterial growth, increased nutrients within the water column and/ or a reduction in dissolved oxygen concentrations.
Step 3: States	The identified receptors include sites designated under the WFD and the wider marine environment.
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 and 2 (see Section 2.13).
Step 5: Responses	No additional mitigation to that already identified in Table 16 are considered necessary to prevent significant effects.
Conclusion	*Therefore, no significant adverse residual effects have been predicted in respect of marine water or sediment quality cumulatively with the Dublin Port Company 3FM Project.*

Table 29 Considerations of potential for cumulative deterioration in MW&SQ receptors – Tier 3 projects – MaresConnect

	Justification
Step 1: Drivers	Installation of the MaresConnect cable and landfall activities.
Step 2: Pressures	Temporary increases in SSC and associated sediment deposition which could potentially result in a reduction in water clarity, re-suspension of contamination, a reduction in primary production, an increase in bacterial growth, increased nutrients within the water column and/ or a reduction in dissolved oxygen concentrations.
Step 3: States	The identified receptors include sites designated under the WFD and the wider marine environment.
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

	Justification
	highly unlikely that the proposed construction programmes would be proposed to overlap. 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 marine water and sediment quality in the marine environment resulting from these activities would be no greater than those assessed in Impacts 1 and 2 (see Section 2.13).
Step 5: Responses	No additional mitigation to that already identified in Table are considered necessary to prevent significant effects.
Conclusion	*Therefore, no significant adverse residual effects have been predicted in respect of marine water or sediment quality when considered cumulatively with Tier 3 plans and projects.*

Table 30 Considerations of potential for cumulative deterioration in MW&SQ receptors – Tier 3 – Codling

	Justification
Step 1: Drivers	Simultaneous export cable laying in the greater Dublin area.
Step 2: Pressures	Temporary increases in SSC and associated sediment deposition which could potentially result in a reduction in water clarity, re-suspension of contamination, a reduction in primary production, an increase in bacterial growth, increased nutrients within the water column and/ or a reduction in dissolved oxygen concentrations.
Step 3: States	The identified receptors include sites designated under the WFD and the wider marine environment.
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 and specialist installation contractors. However, the projects could undertake these activities sequentially to one another where appropriate. As predicted in the Dublin Array modelling, the SSC plumes are anticipated to quickly (in the order of minutes) 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 marine water and sediment quality in the marine environment resulting from these activities would be no greater than those assessed in Impacts 1 and 2 (see Section 2.13).
Step 5: Responses	No additional mitigation to that already identified in Table are considered necessary to prevent significant effects.
Conclusion	*Therefore, no significant adverse residual effects have been predicted in respect of marine water or sediment quality when considered cumulatively with other Tier 3.*

2.16.13 The significance of effect has been carefully assessed in accordance with the matrix provided in Table 5. Where the cumulative magnitude of the offshore construction activities of the Dublin Array project acting cumulatively with Tier 1, and Tier 3 is deemed Low adverse (i.e. no greater than those assessed in Impacts 1 and 2 (see Section 2.13)). The sensitivity of the MW&SQ receptors is Low to Medium (i.e.no greater than those assessed in Impacts 1 and 2 (see Section 2.13)).

2.16.14 Therefore, the significance of effect of Impact 1 from the construction cumulatively with the Tier 1 and Tier 3 projects is expected to be **Slight adverse.**

The significance of cumulative effect from changes in water quality occurring as a result of the proposed construction activities is not significant in EIA terms when all tiers are combined. Therefore, no additional mitigation to that already identified in Table is considered necessary. ***No significant adverse residual cumulative effects*** *have been predicted in respect of changes in water quality.*

Effect 10: Cumulative temporary increases in SSC and associated deterioration of marine water quality during O&M

2.16.15 If a section of the Dublin Array offshore export or inter-array cables became exposed or damaged it would require reburial and/ or replacement. Reburial (and/ or replacement) would be undertaken using similar techniques to that set out in the assessment of SSC associated with cable installation activities (Impacts 1 and 2).

2.16.16 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 during the construction phase for the project alone.

2.16.17 In addition, it is anticipated that, if consented, the MaresConnect cable will be operational during the O&M phase of the Dublin Array offshore infrastructure. As a result, any potential activities undertaken on the cable are anticipated to be maintenance works similar to those required for the Dublin Array offshore infrastructure.

2.16.18 Therefore, owing to the reduction in the spatial scale and duration of works for the Dublin Array offshore infrastructure, the magnitude of the cumulative impacts with Tier 1 and 3 projects will be no greater than assessed in Impact 9. Furthermore, if consented, it is assumed that the MaresConnect cable (Tier 3) will be operational during the Dublin Array O&M phase. Therefore, it is assumed that any works will also be reduced in spatial scale and duration throughout its operational lifetime compared to its installation. Therefore, the magnitude of the cumulative impacts of Dublin Array and Tier 3 projects will be no greater than assessed for the Tier 1 projects in Impact 9.

The significance of cumulative effect from changes in water quality occurring as a result of the proposed O&M activities is not significant in EIA terms when all tiers are combined. Therefore, no additional mitigation to that already identified in Table is considered necessary. ***No significant adverse residual cumulative effects*** *have been predicted in respect of changes in water quality.*

2.17 Interactions of environmental factors

2.17.1 A matrix illustrating the likely interactions of the foregoing arising from Dublin Array on MW&SQ receptors is provided in Volume 8, Chapter 1: Interactions of the Environmental Factors.

2.17.2 Interactions of the foregoing 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 (pre-construction, 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 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.

2.17.3 As indicated in the interactions matrix (Volume 8, Chapter 1: Interactions of the Environmental Factors) 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).

2.17.4 The different MW&SQ effects studied are already inter-related; in particular, suspended sediment and deterioration of water quality therefore these linked processes have been considered within the assessment. The potential effects on MW&SQ during construction, operational and maintenance and decommissioning phases of the Project have been assessed in Sections 2.13– 2.15. In turn, this assessment of changes to MW&SQ has been used to inform other EIA aspects.

2.17.5 Effects on MW&SQ (e.g. from increases in SSC or accidental release or spill of materials or chemicals) 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 3: Benthic, Subtidal and Intertidal Ecology;
- Chapter 4: Fish and Shellfish;
- Chapter 5: Marine Mammals and Reptiles;
- Chapter 8: Nature Conservation; and
- Chapter 11: Infrastructure and Other Users.1

2.17.6 MW&SQ is not just a receptor in its own right, but also provides impact pathways for other receptors. For example, physiochemical properties of the marine environment, such as temperature, salinity, and contaminant bioavailability, are a pathway for impacts on other receptors. As such, changes to MW&SQ have the potential to indirectly effect other environmental receptors. The following potential effects have been considered within the interactions assessment:

- Deterioration in water quality due to re-suspension of sediments and sediment bound contaminants; and
- Accidental release or spills of materials or chemicals.

Project lifetime effects

2.17.7 Project lifetime effects consider impacts from the construction, operation or decommissioning of the Dublin Array offshore infrastructure on the same receptor (or group). The potential inter-related effects that could arise in relation to MW&SQ receptors are presented in Table 31 .

Table 31 Project lifetime effects assessment for potential inter-related effects on MW&SQ.

Impact Type	Effects (Assessment Alone)			Interaction Assessment
	C	O&M	D	Project lifetime effects
Deterioration in water quality due to re-suspension of sediments and sediment bound contaminants	Slight adverse	Slight adverse	Slight adverse	The majority of the seabed disturbance resulting in the highest resuspension of sediment and sediment bound contaminants will occur during the construction phase, with any effects being of short-term duration and high reversibility. Due to this and the low to medium sensitivity of MW&SQ receptors to increased SSC, the interaction of these impacts across the stages of the project lifecycle is not expected to result in an effect of any greater significance than those assessed in the individual project phases and presented here. During the construction and decommissioning phases, the magnitude of the impact of increased SSC is projected to be of local spatial extent, short-term duration, intermittent and of high reversibility, with an even lower (negligible) magnitude of impact on MW&SQ receptors predicted during the O&M phase. As such, it is not anticipated that any potential effects will remain into the O&M activities. It is therefore considered that impacts in the operation phase will not materially contribute to inter-related effects. The

Impact Type	Effects (Assessment Alone)			Interaction Assessment
	C	O&M	D	Project lifetime effects
				construction and decommissioning phases are significantly temporally separate such that there will be no interaction between the two. There will therefore be no inter-related effects of greater significance compared to the impacts considered alone.
Accidental releases or spills of materials or chemicals	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 MW&SQ 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.

Receptor led effects

2.17.8 Potential exists for spatial and temporal interactions between increased SSC, release of sediment bound contaminants and accidental release or spills of materials or chemicals effects during the lifetime of the proposed development. Based on current understanding, the greatest scope for potential interactions between impacts is predicted to arise through the interaction of increased SSC and associated release of sediment bound contaminants during the construction phase. These individual impacts were assigned a significance of slight adverse as standalone impacts and although potential combined impacts may arise, it is important to take into consideration the source-pathway-receptor of each effect. The majority of effects associated with increased SSC (Impact 1) and the release of sediment bound contaminants (Impact 2) will arise from seabed preparation works or inter-array cable installation. In the evaluation of increased SSC, construction phase activities were examined separately and there is a potential that more than one activity may occur at a given time. However, it should be noted that resulting sediment plumes would not travel towards each other as they are carried by the tide. It is also unlikely that two activities would occur in close proximity simultaneously as the processes are consecutive, for example the site must be prepared prior to foundation installation.

2.17.9 Since the proposed development is located in an area of strong tidal currents and with an active sediment transport regime, the interaction of these impacts across the stages of the Proposed Development lifecycle is not predicted to result in an effect of any greater significance than those assessed in the individual project phases. This is because both Impact 1 and Impact 2 rely on the source-receptor-pathways in question lasting in a given area for an extended period of time. Moreover, sediment plumes are not expected singularly or additively to alter the quality status of any WFD waterbodies or protected areas.

2.17.10 Any effects relating to re-suspension of sediment or sediment bound contaminants are likely to be limited, both in extent (i.e. largely within the array area and Offshore ECC and temporary occupation area) and also in magnitude, with receptors having no notable sensitivity to the scale of the changes predicted. As such, these interactions are predicted to be no greater than the individual effects assessed in isolation.

2.18 Transboundary statement

2.18.1 No transboundary effects have been identified in terms of MW&SQ. This is because the predicted changes to MW&SQ and associated pathways (i.e. tides, waves, and sediment transport) are not anticipated to be sufficient to influence transboundary receptors due to the distance of neighbouring States from the proposed works, i.e. MW&SQ pathways do not exceed the ZoI which is within Irish Waters.

2.19 Summary of effects

2.19.1 A summary of the effects presented within this EIAR chapter are presented in Table . From the consideration of the different impacts arising from the proposed project activities, as presented in previous sections, it can be concluded that the proposed works will not affect the status of coastal or marine waters, and are compliant with the requirements of the Water Framework Directive and the Marine Strategy Framework Directive.

Table 32 Summary of effects assessed for MW&SQ

Description of impact	Impact	Additional mitigation measures	Residual impact
Construction			
Impact 1	Deterioration in water quality due to re-suspension of sediments	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 2	Deterioration in water quality due to re-suspension of sediment bound contaminants	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 3	Accidental releases of chemicals	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 4	Increases in turbidity from the release of drilling fluid from horizontal directional drilling	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Operation and maintenance			
Impact 5	Deterioration in water quality due to re-suspension of sediments and sediment bound contaminants	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 6	Accidental releases of chemicals	Not Applicable – no additional mitigation identified	No significant adverse residual effects

Description of impact	Impact	Additional mitigation measures	Residual impact
Decommissioning			
Impact 7	Deterioration in water quality due to re-suspension of sediments and sediment bound contaminants	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 8	Accidental releases of chemicals	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Cumulative effects			
Impact 9	Cumulative temporary increases in SSC and associated deterioration of marine water quality during construction	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 10	Cumulative temporary increases in SSC and associated deterioration of marine water quality during O&M	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Transboundary			
No transboundary effects have been identified.			

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Annex A: Marine Water and Sediment Quality Policy

Legislation, Policy and Guidance

Policy/ Legislation	Key provisions	Section where provision is addressed
Legislation		
The International Convention for the Prevention of Pollution from Ships (MARPOL Convention)	The International Convention for the Prevention of Pollution from Ships (MARPOL) has several requirements for ships, including: ▪ Annex I - Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983): ▪ Regulates oil pollution, including requirements for double hulls on oil tankers and segregated ballast tanks on new oil tankers. It also sets limits on allowable discharges of oily water from cargo tanks and bilge water. ▪ Annex II - Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983, provisions took effect from 6 April 1987): ▪ Details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk; some 250 substances were evaluated and included in the list appended to the Convention. No discharge of residues containing noxious substances is permitted within 12 miles of the nearest land. ▪ Annex III - Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992): ▪ Contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications. ▪ Annex IV - Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003) ▪ Contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited. Sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land. ▪ Annex V - Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988) ▪ Deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of; the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics.	As described in Table 16, these measures are legally binding and the developer will dispose of sewage and other waste in a manner which complies with all regulatory requirements detailed in the IMO MARPOL Convention.

Policy/ Legislation	Key provisions	Section where provision is addressed
	▪ Annex VI - Prevention of Air Pollution from Ships (entered into force 19 May 2005) ▪ Regulates air pollution from ships, including limits on nitrogen oxides (NOx) and sulfur oxides (SOx) emissions, and the use of lower sulfur fuel. It also prohibits the deliberate release of ozone-depleting substances. ▪ Certificates: Ships on international voyages must carry valid international certificates that can be used as evidence of compliance with MARPOL. ▪ Oil record books: Ships must keep an oil record book that includes details of oil filtering equipment failures, accidental oil spills, and other discharges. The book must be kept on the ship and be available for inspection by authorities for at least three years after the last entry.	
Sea Pollution Act (S.I. 27 of 1991)	The Sea Pollution Act of 1991 was enacted to prevent oil and other substances from polluting the sea and to implement the IMO Marpol Convention.	As described in Table 16, these measures are legally binding and the developer will dispose of sewage and other waste in a manner which complies with all regulatory requirements detailed in the Sea Pollution Act.
European Communities (Marine Strategy Framework) Regulations 2011 (S.I. No. 249 of 2011) Schedule 1, Table 1	"Physical and chemical features: ▪ topography and bathymetry of the seabed, features ▪ annual and seasonal temperature regime and ice cover, current velocity, upwelling, wave exposure, mixing characteristics, turbidity, residence time, ▪ spatial and temporal distribution of salinity"	Consideration of all chemical features which may be potentially impacted by the proposed development have been considered in Sections 2.13 to 2.15. Consideration of all relevant physical characteristics are provided in Volume 3, Chapter 1: Marine Geology, Oceanography and Physical Processes (hereafter called the Physical Processes chapter).
European Communities (Marine Strategy Framework) Regulations 2011 (S.I. No. 249 of 2011)	Pressures and Impacts:Contamination by hazardous substances: ▪ introduction of synthetic compounds (e.g. priority substances hazardous 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),	The pressures and impacts outlined in Schedule 1; Table 2 of the Regulations were considered in the development of the scope of this assessment. No source-receptor-pathways were identified for the potential change for the introduction of

Policy/ Legislation	Key provisions	Section where provision is addressed
Schedule 1, Table 2	▪ 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 radionuclides. Nutrient and organic matter enrichment: ▪ Inputs of fertilisers and other nitrogen — and phosphorus-rich matter enrichment substances (including such inputs from point and diffuse sources, including agriculture, aquaculture, atmospheric deposition).	radionuclides as a result of the proposed development.
Water Framework Directive (WFD) (2000/60/EC)	The Water Framework Directive (WFD) (2000/60/EC) requires good ecological and good chemical status in inland and coastal waters by 2015. The WFD relates to water bodies up to 1nm from the baseline; with the exception of chemical status which also includes territorial waters i.e. to 12nm.	A full assessment of the proposed development on the chemical and ecological status of relevant WFD water bodies is provided in Volume 4, Chapter 4.3.2-1: Water Framework Directive and Marine Strategy Framework Directive Summary. The information from this chapter has been used to inform the conclusions of the WFD assessment for which the objectives of the Third River Basin Management Plan - Water Action Plan 2024: A River Basin Management Plan have been considered.
National Marine Planning Framework (2021) Department of Housing, Local Government and Heritage (DHLGH)	**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.	A full assessment of potential impacts to water quality resulting from the proposed development is outlined within section 2.13 to 2.15, with project design and avoidance measures outlined in section 2.12. As demonstrated in section 2.13 to 2.15, no adverse significant effects upon water quality receptors have been identified.

Policy/ Legislation	Key provisions	Section where provision is addressed
	Water Quality Policy 2 Proposals delivering improvements to water quality, or enhancing habitats and species, which can be of benefit to water quality, should be supported.	A full assessment of potential impacts to water quality resulting from the proposed development is outlined within section 2.13 to 2.15, with project design and avoidance measures outlined in section 2.12. As demonstrated in section 2.13 to 2.15, no adverse significant effects upon water quality receptors have been identified. Dublin Array will actively contribute to a reduction in greenhouse gas emissions and minimise changes to seawater chemistry, including reductions in pH and salinity, have been observed and attributed to anthropogenic climate change (see paragraph 2.7.1).
European Communities (Marine Strategy Framework) Regulations 2011 (S.I. 249 of 2011) and subsequently amended by the European Communities (Marine Strategy Framework) Regulations 2017 (S.I. 265 of 2017)	▪ (5) Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters. The binding environmental targets for this descriptor are: ▪ (D5T1) Nutrient concentrations are not at levels that indicate adverse eutrophication effects; ▪ (D2T2) Chlorophyll concentrations are not at levels that indicate adverse effects of nutrient enrichment; and ▪ (D2T5) The concentration of dissolved oxygen is not reduced, due to nutrient enrichment.	The potential for the offshore activities to result in eutrophication effects and reduction of dissolved oxygen is assessed in Sections 2.13 to 2.15 (Impacts 1, 5, and 7).
European Communities (Marine Strategy Framework)	▪ (8) Concentrations of contaminants are at levels not giving rise to pollution effects. The binding environmental targets for this descriptor are:	Evaluation of the potential for the release of contaminants into the marine environment as

Policy/ Legislation	Key provisions	Section where provision is addressed
Regulations 2011 (S.I. 249 of 2011) and subsequently amended by the European Communities (Marine Strategy Framework) Regulations 2017 (S.I. 265 of 2017)	▪ (D8T1a) Within coastal and territorial waters, the concentrations of contaminants do not exceed the thresholds specified in Directive 2000/60/EC[36]; ▪ (D8T1b) Concentration of contaminants in marine matrices assessed in accordance with OSPAR Co-ordinated Environmental Monitoring Programme (CEMP) do not exceed OSPAR Environmental Assessment Criteria (EAC) and concentrations are not increasing; ▪ (D8T2) The degree of biological or ecological effects that can be specifically attributed to contaminants is below the agreed OSPAR criteria. At present, this is limited to evaluation of reproductive impairment in marine gastropods associated with tributylin (TBT); and ▪ Spatial extent and duration of significant acute pollution events are minimised.	a result of the offshore works is considered in Sections 2.13 to 2.15 (Impacts 2, 5 and 7). The likelihood, extent and duration of any accidental spills of construction materials and chemicals will be reduced by the PEMP (see Table). Assessment of accidental spills is presented in Sections 2.13 to 2.15 (Impacts 3, 6 and 8).
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) 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' option.	A full characterisation of the receiving environment is presented in Section 2.6. 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	The Directive requires that the EIAR describes the cumulation of effects[37]. Cumulative effects may arise from: ▪ The interaction between the various impacts within a single project;	The interactions between various environmental aspects within the proposed developments are presented in Volume 8,

[36] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Paragraph 2.2.5 of this document)

[37] Annex IV, point 5(e) of the Directive. See also Schedule 6(2)(e)(i)(V) to the Regulations.

Policy/ Legislation	Key provisions	Section where provision is addressed
Environmental Impact Assessment (Department of Housing, Planning and Local Government, 2018) (hereafter referred to as the EIA Guidelines) Para 6.12.	▪ The interaction between all of the different existing and/or approved projects in the same area as the proposed project.	Chapter 1 of this EIAR. A summary is provided in Section 2.16 of this chapter. The interactions between Dublin Array and other plans and projects, for MW&SQ, are presented in Section 2.16 of this EIAR chapter.
DCCAE Guidance,2017	"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 2.16. 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 Volume 2, Chapter 4: Cumulative Impact Assessment Methodology.
DCCAE Guidance, 2017 Table 3	"Environmental protection by assessment of likely significant effects of projects to promote sustainable development"	The scope of this assessment is presented in Section 2.10. 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.
DCCAE Guidance, 2017 Table 4	"developers and competent authorities should have regard to when planning/assessing a project – ▪ Protected sites and species "	An assessment of the potential changes in the MW&SQ on protected sites and species is presented in the Natura Impact Statement (Part 4 Habitats Directive Assessments).

Policy/ Legislation	Key provisions	Section where provision is addressed
DCCAE Guidance, 2017 Table 4	"developers and competent authorities should have regard to when planning/assessing a project – Water Quality"	An assessment of the potential changes to water quality and the associated implications are presented Sections 2.13 to 2.15.
DCCAE Guidance, 2017 Table 4	"developers and competent authorities should have regard to when planning/assessing a project – Sediments "	An assessment of the potential changes to marine sediment composition and suspended concentrations are presented Sections 2.13 to 2.15.
DCCAE Guidance, 2017 Section 3.2	"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 phases of the development will address full *lifecycle* effects of a proposed development."	All phases of the development have been considered within this MW&SQ EIA assessment. The assessment of effects in the construction phase are presented in Section 2.13. The assessment of effects in the operational phase (including maintenance) are presented in Section 2.14. The assessment of effects in the decommissioning phase are presented in Section 2.15.
DCCAE Guidance, 2017 Section 4.5.3	"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 zones of influence 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, simulating water mixing processes to predict temporal and spatial variations, can be used to assist in the exercise. The zones	The Zone of Influence (ZoI) for Dublin Array offshore infrastructure on the physical marine environment 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 Section 2.4.

Policy/ Legislation	Key provisions	Section where provision is addressed
	of influence relate primarily to ecological and visual impacts of the development."	
DCCAE Guidance, 2017 Section 4.5.3	"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 2.10 for those receptors scoped in for assessment.
DCCAE Guidance, 2017 Section 4.6.3	"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 Section 2.6.
DCCAE Guidance, 2017 Section 4.6.3	"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 Section2.5. The criterion including a consideration of its context (its adaptability, tolerance and recoverability) and value.
DCCAE Guidance, 2017 Table 9	Indicative list of impacts – ▪ Water quality	Water quality is considered in throughout this chapter.
DCCAE Guidance, 2017 Section 4.6.5	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 and avoidance measures relevant to this MW&SQ assessment are presented in Section 2.12. Where significant adverse effects arose (with the project design and avoidance measures 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 – see Sections 2.13 and 2.15.
Guidelines on the Information to be	"The Guidelines have been drafted with the primary objective of improving the quality of EIARs with a view to facilitating compliance (with the [EIA] Directive).	The methodology presented within the EIAR Guidelines was utilised in the development of

Policy/ Legislation	Key provisions	Section where provision is addressed
contained in Environmental Impact Assessment reports (Environmental Protection Agency, 2022) (hereafter referred to as the Guidelines)	By doing so they contribute to a high level of protection for the environment through better informed decision-making processes. They are written with a focus on the obligations of developers who are preparing EIARs." "The Guidelines emphasise the importance of the methods used in the preparation of an EIAR to ensure that that the information presented is adequate and relevant."	the EIA methodology applied within this EIAR. Further details are provided in Volume 2, Chapter 3: EIA Methodology.
Coastal Process Modelling for Offshore Wind Farm Environmental Impact Assessment: Best Practice Guidance (ABPmer and HR Wallingford, 2009)	The report provided an update to existing guidance on the application and use of numerical models to predict the potential impact from offshore wind farms on coastal processes.	This report and principles outlined within were adopted in the construction of the DAPPMSs during its application. This guidance was adopted to support this application as it is considered by the technical authors as the most comprehensive and detailed available guidance of numerical modelling to inform coastal modelling. In addition, it has been widely adopted for similar EIA assessments of OWFs in jurisdictions/countries with established offshore renewable energy sectors where comprehensive guidance has been developed.
Potential Effects of Offshore Wind Developments on Coastal Processes (ABPmer and Metoc Plc, 2002)	This study sought to identify, review and assess the potential effects on coastal processes relation to the development of offshore wind farms around the UK.	This study was considered during the development of potential impacts, as outlined in Section 2.10.

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