Environmental Impact Assessment Report

NISA

*North Irish Sea Array*

Volume 3: Offshore Chapters

# Chapter 11
# Marine Water and Sediment Quality

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# 11. Marine Water and Sediment Quality

## 11.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) presents an assessment of likely significant effects from the North Irish Sea Array (NISA) Offshore Wind Farm (hereafter referred to as the 'proposed development') in relation to Marine Water and Sediment Quality (hereafter referred to as MW&SQ) during the construction, operation and decommissioning phases.

This chapter sets out the methodology followed (Section 11.2), describes the baseline environment (Section 11.3) and summarises the main characteristics of the proposed development which are of relevance to MW&SQ (Section 11.4), including any embedded mitigation. Potential impacts and relevant receptors are identified, and an assessment of likely significant effects on MW&SQ is undertaken, details of which are provided (Section 11.5).

Additional mitigation measures are proposed to mitigate and monitor these effects if required (Section 11.6) and any residual likely significant effects are then described (Section 11.7). Transboundary effects are considered (Section 31.8), and cumulative effects are considered in Section 11.9 and are summarised in Volume 6, Chapter 38 Cumulative and Inter-Related Effects (hereafter referred to as the 'Cumulative and Inter-Related Effects Chapter'). The chapter then provides a reference section (Section 11.10).

The EIAR also includes the following:

- Detail on the competent experts that have prepared this chapter is provided in Volume 9, Appendix 1.1: Competent Experts;
- Detail on the extensive consultation that has been undertaken with a range of stakeholders during the development of the EIAR is set out in Volume 9, Appendix 1.2: Consultation Report; and
- A glossary of terminology, abbreviations and acronyms is provided at the beginning of Volume 2 of the EIAR.

A detailed description of the proposed development including construction, operation and decommissioning is provided in Volume 2, Chapter 6: Description of the Proposed Development – Offshore (hereafter referred to as the 'Offshore Description Chapter'), and Volume 2, Chapter 8: Construction Strategy – Offshore (hereafter referred to as the 'Offshore Construction Chapter').

The assessment should be read in conjunction with following linked EIAR chapters within Volume 3:

- Volume 3, Chapter 10: Marine Geology, Oceanography and Physical Processes (hereafter referred to as the Physical Processes chapter)
- Volume 3, Chapter 12: Benthic and Intertidal Ecology; and
- Volume 3, Chapter 13: Fish and Shellfish Ecology.

This chapter should also be read alongside the following appendices:

- Volume 9, Appendix 11.1: Water Framework Directive Compliance Assessment (hereafter referred to as the WFD Compliance Assessment).

All figures within this chapter are provided in Volume 7A.

## 11.2 Methodology

### 11.2.1 Introduction

The assessments of MW&SQ are consistent with the EIA methodology presented in Volume 2, Chapter 2: EIA and Methodology for the preparation of an EIAR (hereafter referred to as the EIAR Methodology chapter).

### 11.2.2 Study Area

The MW&SQ study area was initially identified at the scoping stage, in line with Department of Communications, Climate Action and Environment (DCCAE) (now the Department of the Environment, Climate and Communications; DECC) Guidance (DCCAE, 2017) (See Appendix 2.1: Scoping Report). 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 zones that might be impacted by an offshore renewable energy project are required so that a source – pathway – receptor risk assessment (as further detailed in Section 11.2.2.1) can be carried out and the subsequent evaluation of effects can be undertaken for key features.

The offshore elements of the proposed development are all within the offshore development area, as shown in Figure 11.1, which is seaward of the High Water Mark (HWM) and consists of the array area and the offshore Export Cable Corridor (ECC). The HWM has been defined as a natural boundary between the offshore and terrestrial environments within this EIAR. Activities associated with the development of the onshore development area (including the landfall works and onshore cabling) which is landward of the HWM that may have the potential to impact on MW&SQ receptors have been considered but have been scoped out of the assessment (further detail is provided Section 11.2.2.1).

For the purposes of the EIAR for the physical marine environment, the study area for MW&SQ is determined by the Zone of Influence (ZoI)[1] of the proposed development and defined using the sediment excursion distance presented within the Physical Processes chapter. The ZoI represents a 12km area around the array area and ECC boundaries (Figure 11.1), thus encapsulating all reasonably foreseeable effects on the physical marine environment.

The assessment of impacts upon MW&SQ within the ZoI has been considered over two spatial scales:

- Far-field. This is defined as the wider area surrounding the offshore development area over which indirect changes may occur (i.e., this encompasses all of the ZoI); and
- Near-field. Defined as the footprint of the offshore development area, including both the array area and ECC, seaward of the HWM.

#### *11.2.2.1 Source-Pathway-Receptor*

The assessment of impacts upon MW&SQ is undertaken using the source-pathway-receptor approach, which is consistent with the EIA methodology presented in the EIAR Methodology chapter, and where:

The source of impacts are project activities within the near-field (Section 11.2.2) which may result in:

- Seabed disturbance – mechanical activities during construction, operational and decommissioning phases which lead to short-term increases in turbidity in the form of sediment plumes; or
- Accidental releases – accidental short-term spill/ releases of materials or chemicals into the marine environment which lead to contamination.

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[1] Also referred to as the 'Sediment Excursion Buffer' (Physical Processes chapter).

Where MW&SQ features (e.g., the designated Bathing Waters) may be affected by these impacts (either at source or across the pathway) they are identified as MW&SQ receptors (as defined in Section 11.3.6). The magnitude (Section 11.2.4.4), extent and duration of these effects is considered against baseline conditions which would be expected to occur if no development took place and the sensitivity (Section 11.2.4.4) of relevant environmental receptors which are expected to be encountered along the impact pathway.

The project activities associated within the onshore development area that may impact on hydrological features have been assessed in Volume 4, Chapter 22: Water. With the inclusion of standard sediment and erosion control measures, pollution control measures and drainage and dewatering measures during construction (as indicated within Volume 8, Appendix 9.1 Onshore Construction Environmental Management Plan; CEMP) there is no pathway for impacts from onshore activities on MW&SQ receptors, and therefore this has not been considered further in this assessment.

### 11.2.3 Relevant Legislation, Policy and Guidance

This section outlines guidance and policy specific to MW&SQ including best practice guidelines. Overarching guidance on EIA is presented in the EIAR Methodology chapter. Furthermore, policy applicable to the proposed development is detailed in Volume 2, Chapter 3: Legal and Policy Framework. Where there is no Irish guidance available, the equivalent from the UK has been used.

The assessment of potential impacts upon MW&SQ has been made with specific reference to the following:

- Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR). Environmental Protection Agency (EPA) 2022
- Guidelines for the Assessment of Dredge Material for Disposal in Irish Waters (2006) and associated Addendum (2019). Marine Institute
- 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 Department of Communications, Climate Action and Environment, 2017) (hereafter referred to as the DCCAE Guidance)
- Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects (DCCAE, 2018)
- Good practice Guidelines for the Irish Wind Energy Industry (IWEA, 2012); and
- Guidance on Environmental Considerations for Offshore Wind Farm Development (Oil Spill Prevention, Administration and Response (OSPAR, 2008).

Consideration of water quality in Natura 2000 sites is required under the European Communities (Birds and Natural Habitats Regulations 2011 (S.I. No. 477 of 2011[2]) which transpose the Habitats Directive and the Birds Directive.

Impacts on the Qualifying Interests of designated sites are assessed against the Conservation Objectives in the Natura Impact Statement (NIS) (North Irish Sea Array Windfarm Ltd, 2024) drafted in relation to the proposed development. The impacts of the proposed development on Natura 2000 sites in the marine environment in relation to compliance with the objectives of the Water Framework Directive has been assessed, refer to Section 11.2.3.1.

The key National Marine Planning Framework (NMPF) policies that are applicable to the assessment of MW&SQ are summarised in Table 11.1. NMPF policies are addressed in their entirety in Appendix 3.1: NMPF Compliance Report.

[2] As amended by: S.I. No. 290 of 2013; S.I. No. 499 of 2013; and S.I. No. 355 of 2015.

**Table 11.1 Key NMPF policies relevant to the assessment**

| Policy Name | Policy Description | Where addressed |
|---|---|---|
| **National Marine Planning Framework (2021)** | **Water Quality Policy 1**<br>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:<br>a) avoid,<br>b) minimise, or<br>c) mitigate significant adverse impacts. | The construction phase has the potential to introduce contaminants and increase suspended sediment in the water column, causing deterioration of the water quality of bathing waters, shellfish water protected areas (WPAs), waterbodies designated under the Water Framework Directive (WFD) and non-designated waterbodies.<br>The effects of the proposed development on the water quality of designated and non-designated waterbodies during the construction, operation and decommissioning phases are assessed in Section 11.5. Embedded mitigation (Section 11.4.5) has been considered when assessing likely significant effects and no significant adverse impacts have been identified in the MW&SQ assessment. |
| | **Sea Floor and Water Column Integrity Policy 1**<br>Proposals that incorporate measures to support the resilience of marine habitats will be supported, subject to the outcome of statutory environmental assessment processes and subsequent decision by the competent authority and where they contribute to the policies and objectives of this NMPF. Proposals which may have significant adverse impacts on marine, particularly deep sea, habitats must demonstrate that they will, in order of preference and in accordance with legal requirements:<br>a) avoid,<br>b) minimise, or<br>c) mitigate significant adverse impacts on marine habitats, or<br>d) if it is not possible to mitigate significant adverse impacts on marine habitats must set out the reasons for proceeding. | The construction phase has the potential to introduce pollutants, chemicals and suspended sediment into the water column, causing deterioration of the water quality.<br>The effects of the proposed development on sea floor and water column integrity during the construction, operation and decommissioning phases are assessed in Section 11.5. All likely significant effects within the potential effects section are of relevance to this policy objective. Embedded mitigation (Section 11.4.5) has been considered when assessing likely significant effects and no significant adverse impacts have been identified in the MW&SQ assessment. |
| | **Sea Floor and Water Column Integrity Policy 2**<br>Proposals, including those that increase access to the maritime area, must demonstrate that they will, in order of preference and in accordance with legal requirements:<br>a) avoid,<br>b) minimise, or<br>c) mitigate adverse impacts on important habitats and species. | The construction phase has the potential to introduce pollutants, chemicals and suspended sediment into the water column, causing deterioration of water quality and consequent adverse impacts on important habitats and species. The placement of temporary and permanent infrastructure on the seabed also has the potential to cause temporary and long-term habitat loss.<br>The effects of the proposed development on sea floor and water column integrity during the construction, operation and decommissioning phases are assessed in Section 11.5. All likely significant effects within the potential effects section are of relevance to this policy objective. Embedded mitigation (Section 11.4.5) has been considered when assessing likely significant effects and no significant adverse impacts have been identified in the MW&SQ assessment. |
| | **Sea Floor and Water Column Integrity Policy 3**<br>Proposals that protect, maintain, restore and enhance coastal habitats for ecosystem functioning and provision of ecosystem services will be supported, subject to the outcome of statutory environmental assessment processes and subsequent decision by the competent authority, and where they | The effects of the proposed development on sea floor and water column integrity during the construction, operation and decommissioning phases assessed in Section 11.5.<br>The effects of the proposed development on sea floor and water column integrity during the construction, |

| Policy Name | Policy Description | Where addressed |
|---|---|---|
| | contribute to the policies and objectives of this NMPF.<br><br>Proposals must take account of the space required for coastal habitats, for ecosystem functioning and provision of ecosystem services, and demonstrate that they will, in order of preference and in accordance with legal requirements:<br><br>a) avoid,<br><br>b) minimise, or<br><br>c) mitigate for net loss of coastal habitat. | operation and decommissioning phases are assessed in Section 11.5.<br><br>All likely significant effects within the potential effects section are of relevance to this policy objective. Embedded mitigation (Section 11.4.5) has been considered when assessing likely significant effects and no significant adverse impacts have been identified in the MW&SQ assessment. |

#### *11.2.3.1 Water Framework Directive*

The European Union (EU) Water Framework Directive (WFD) (2000/60/EC) was established in 2000 in order to provide a single framework for the protection of surface waterbodies (including rivers, lakes, coasts and estuaries) and groundwater. Coastal waters between the coast and one nautical mile (nm) offshore are designated for ecological status under the WFD. Each waterbody has an assigned ecological status. The ecological status is assigned by considering the biological, hydromorphological, chemical and specific chemicals. The WFD is considered in the WFD Compliance Assessment.

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 on a river basin basis of which the second River Basin Management Plan (RMBP) (DHPLG, 2018) was published in 2018, to cover the period of 2018 to 2021. The draft Third Round River Basin Management Plan for Ireland 2022-2027 was issued for public consultation in 2022. The RMBPs outline the approach to protect waters in Ireland, identifies the water bodies which are ‘at risk’ of not achieving their status objective and sets out actions required to achieve ‘good’ ecological status.

The Environmental Quality Standards (EQSs) define the standards for contaminants within surface waters to reduce the polluting substances entering the environment. These standards are established in the Schedule 5 of the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI No. 272 of 2009), as amended.

***Shellfish Directive***

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.

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 Water 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).

#### *11.2.3.2 Bathing Waters*

The EU's revised Bathing Water Directive (rBWD) (2006/7/EC) came into force in March 2006 through transitional measures. The rBWD has four different classifications of performance, these are:

- Excellent - the highest, cleanest classification
- Good - generally good water quality
- Sufficient - the water meets minimum standards; and
- Poor - the water has not met the minimum required standards.

The rBWD was transposed into Irish law by means of the Bathing Water Quality Regulations 2008 (S.I. 79 of 2008) and subsequently the Bathing Water Quality (Amendment) Regulations 2011 (S.I. 351 of 2011) (hereafter referred to as the Bathing Water Regulations). Under the Bathing Water 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.

#### *11.2.3.3 Priority Substances*

The Environmental Quality Standards Directive (EQSD) (2008/105/EC) identifies priority substances and polluting chemical which should be considered in WFD assessments for transitional and coastal water bodies. Both the WFD and 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 and for which a list of Maximum Allowable Concentrations (MAC) is provided.

#### *11.2.3.4 Marine Strategy Framework Directive*

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. The Directive is implemented in six-year cycles and is currently in its second cycle; at the time of writing the Marine Strategy Part 2: Monitoring Programme is being updated (Department of Housing, Local Government and Heritage, 2021).

The MSFD was transposed into Irish law by means of the 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) (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.

#### *11.2.3.5 Urban Wastewater Treatment Directive*

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".* The Urban Waste Water Treatment Regulations, 2001 (S.I. 254 of 2001) (which transpose the Urban Wastewater Treatment Directive (91/271/EEC) into Irish law and updated the Environmental Protection Agency Act, 1992 (Urban Waste Water Treatment) Regulations, 1994 as amended in 1999) list nutrient sensitive waters, which are considered within the baseline environment.

#### *11.2.3.6 Nitrates Directive*

The Nitrates Directive (91/676/EEC) was adopted by the EU member states with the aim of reducing water pollution from agricultural sources, and preventing such pollution in the future. The Directive was transposed into Irish domestic law by the European Union (Good Agricultural Practice for Protection of Waters) Regulations 2017 (and amendments).

### 11.2.4 Data Collection and Collation

#### *11.2.4.1 Site-specific Surveys*

The following surveys were carried out specifically to inform this EIAR:

Benthic survey, including the intertidal, which provides detailed sediment contaminant analysis and real-time turbidity information (Volume 9, Appendix 12.1: Array Area Benthic Survey Report and Volume 9, Appendix 12.2: Cable Route Benthic Survey Report); and

- Geophysical survey, providing information on surficial sediment types, including for inter-tidal and sub-tidal locations. These are reported in:
  - Fugro (2022). Geophysical Survey Results Report. Ireland, Irish Sea. F202831-REP-003 03. 29 November 2022. Final. North Irish Sea Array Windfarm Limited [for array area]; and

- N-Sea. (2023). North Irish Sea Array Windfarm Ltd. Interim Geophysical Survey. Results Report. DOC NO: NSW-PJ00293-RR-DC-SUR-001. Revision 2.0 [for ECC].

- Metocean surveys, providing information on turbidity levels alongside tidal currents and wave characteristic data:
  - Partrac (2022). NISA Offshore Wind Farm. Metocean Campaign. Interim Data Report – Deployment 1. Version 2. May 2022
  - Partrac (2023). NISA Offshore Wind Farm. Metocean Campaign. Interim Data Report – Deployment 2/3. Version 1. February 2023.

**Table 11.2 Site specific surveys which included sediment analysis**

| Title | Summary | Spatial coverage |
|---|---|---|
| Benthic Ecology Baseline ECC Benthic Survey Report (Volume 9, Appendix 12.2: Cable Route Benthic Survey Report). | As part of the intertidal benthic survey, in areas of soft substrate, sediment characteristics were assessed with material collected from eight sites for particle size analysis (PSA) and Total Organic Carbon (TOC) content determination.<br>The subtidal benthic survey campaign was carried out between the 27th of September – 1st October 2022 with 30 sites surveyed. Sediment was collected at ten sites for PSA and TOC determination while surficial sediments were collected for chemical analyses.<br>Turbidity measurements were collected at various depths at three sites; one each located near shore, mid-way along the ECC assessment area and near the array area.<br>Sample sites are indicated on Figure 12.2. | ECC |
| Benthic Ecology Baseline Array Area Benthic Survey Report (Volume 9, Appendix 12.1: Array Area Benthic Survey Report). | A total of 40 sampling stations were selected in the vicinity of the array area and the adjacent subtidal environment, of which 11 sites were within the array area. At each station sediment was collected for physiochemical analyses (PSA, TOC, chemistry) and a single 0.1m$^2$ Day Grab sample was taken for faunal analysis. DDV samples were collected from 12 sampling stations, five of which were within the array area distributed throughout the array. In addition, DDV data were acquired at 20 sites located to the south west of the array area where historical data indicated the prevalence of hard substrate unsuitable for grab sampling.<br>Sample location is indicated on Figure 12.2. | Array area |

Numerical modelling for the proposed development of those construction activities that result in sediment suspension and associated deposition impacts, in addition to the potential impacts associated with the presence of the proposed development infrastructure upon the wave and tidal regimes, has also been completed (Volume 9, Appendix 10.2: Marine Physical Processes Numerical Modelling).

#### *11.2.4.2 Desk-based Review*

The evidence used to characterise the baseline environment was supported by a data and literature search (in addition to the site-specific surveys detailed in Section 11.2.4) and includes:

- Integrated mapping for the sustainable development of Ireland's marine resource (INFOMAR, 2006-2016); and
- Marine Institute:
  - Monthly Model Means for sea surface temperatures and salinity
  - Water quality stations for turbidity
  - Sediment contamination monitoring stations; and
  - Biological Effects and Chemical Measurements in Irish Marine Waters Report (Marine Institute, 2014).

- Environmental Protection Agency (EPA):
  - 'Urban Waste Water Treatment in 2021' (EPA, 2022b)
  - 'The Water Quality 2022 Indicator report' (EPA, 2023); and
  - 'Water Quality in Ireland – 2016 – 2021' (EPA, 2019).
- Dublin Port Authority:
  - Water quality monitoring stations.

#### *11.2.4.3 Data Limitations*

Whilst many of the baseline characteristics are well understood, in some instances, data sources or assumptions are less well studied and/or quantified for the study area. This section identifies areas of uncertainty and potential data gaps as relevant to the MW&SQ assessment.

Grab sampling provides detailed information (sediment; fauna) as data points which must be interpreted alongside other relevant datasets. Existing surveys, including those available from the INFORMAR database, which have included grab sampling, have been conducted in the wider area and show good validation against the regional data. The seabed morphology and sediments in the area are well studied and surveyed (with further detail provided in the Physical Processes chapter). As such, the available evidence base is considered sufficiently robust to underpin the assessment presented here and an overall high confidence is placed in the baseline characterisation.

Information regarding the generation and behaviour of sediment plumes is required in order to allow an assessment of likely significant effects upon baseline water quality/clarity. The increase in suspended sediment concentration (SSC) and remobilisation of contaminants can result in reductions in water quality/clarity. In practice, the generation of sediment plumes due to installation related activities is dependent upon how exactly the seabed geology will respond to drilling and jetting. There are a number of factors which determine the exact volume of material that is entrained into the water column; including the type of drilling/cable installation equipment used, the variability of the forcing conditions at the installation time (i.e. the waves and tidal conditions) and the mechanical properties of the geological units. In the absence of this detailed information, a series of potential release scenarios have been considered within the Physical Processes chapter which capture the highest concentration and persistent suspended sediment plumes and the maximum and greatest spatial extent of changes in bed level elevation. Numerical modelling output (see the Physical Processes chapter; Volume 9, Appendix 10.2: Marine Physical Processes Numerical Modelling) has been supplemented with information based on expert judgement and analogous projects[3] to allow meaningful interpretation.

The availability of robust data relevant for the characterisation and assessment of MW&SQ is such that, despite some data limitations, it is considered that a thorough and meaningful characterisation for the purposes of EIA can be undertaken. As such, the available evidence base is sufficiently robust to underpin the assessment presented here and an overall high confidence is placed on the assessment.

#### *11.2.4.4 Methodology for Assessment of Effects*

EIA significance criteria for MW&SQ follows EPA guidance:

- EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022a).

As presented in Section 11.2.2.1, the assessment of the likely significant effects upon MW&SQ has been considered in terms of a source-pathway-receptor model whereby the:

- Source is the initiator event

[3] With similar environmental settings and project design options

- Pathway is the link between the source and the receptor impacted by the effect (e.g. sediment transport processes); and
- Receptors are the receiving entities.

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. The likely significant effects of the proposed development upon the MW&SQ, relative to the baseline (receiving) environment, have been assessed using a combination of analytical methods. The significance of effect associated with the impact will be dependent upon the sensitivity/ importance of the receptor, with particular consideration given to the receptor's ability to tolerate and recover from the impact, as well as its status.

Various actions may result in effects: for instance, export cable installation which causes a localised and short-term change to SSC (which is defined as a water quality receptor). The significance of effect associated with the impact will be dependent upon the sensitivity/ importance of the receptor, with particular consideration given to the receptor's ability to tolerate and recover from the impact, as well as its status.

Due regard to compliance with the WFD and MSFD has been undertaken during this assessment of likely significant effects upon MW&SQ. Considerations of marine WFD elements are presented in the WFD Compliance Assessment. In doing so, the approach ensures that the proposed development does not prevent the achievement of the WFD objectives for the identified water bodies in subsequent RBMP cycles. This EIAR chapter makes an assessment of whether the proposed development could cause the status to deteriorate or prevent its improvement, where necessary, under the environmental objectives of the WFD and MSFD.

### *Sensitivity criteria*

A receptor's sensitivity is a function of its capacity to accommodate change and indicates its ability to recover if it is affected. The identification of sensitivity is via a consideration of adaptability, tolerance, recoverability and value. The criteria used in defining the sensitivity of the MW&SQ receptor is provided in Table 11.3. Where a receptor could reasonably be assigned more than one level of sensitivity, professional judgement has been used to determine which level is applicable. The inclusion of internationally or nationally important features within the high sensitivity definition provides the opportunity to increase the sensitivity of the receptor if required, even if capacity for dilution exists.

**Table 11.3 Sensitivity of the receiving environment**

| Receptor sensitivity | Definition |
|---|---|
| High | The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature and/ or has a very low capacity to accommodate any change to current water quality status. |
| Medium | The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature and/ or has a moderate to low capacity to accommodate the proposed form of change to current water quality status. |
| Low | The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature and/ or has a high capacity to accommodate the proposed form of change to current water quality status. The proposed change on the receptor would be undetectable within one tidal cycle of the activity. |
| Negligible | 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. |

### *Magnitude of impact criteria*

The magnitude of identified impacts is defined in Table 11.4, where a distinction is made throughout the assessment between the magnitude, extent and duration of 'impacts' and the resulting significance of the 'effects' upon MW&SQ receptors.

Magnitude descriptions are specific to the assessment of MW&SQ impacts and are considered against the magnitude descriptions presented in Table 11.4. Potential impacts have been considered in terms of permanent or temporary, and adverse or beneficial effects. Where an impact could reasonably be assigned more than one level of magnitude, professional judgement has been used to determine which rating is applicable.

**Table 11.4 Magnitude of the impact**

| Magnitude | Definition |
| --- | --- |
| High | Large scale change to key characteristics of the water quality status of the receiving water feature.<br>Water quality status degraded to the extent that a permanent or long-term change (i.e. a WFD reporting cycle) occurs.<br>Inability to meet Environmental Quality Standard(s) (EQS) as a result of the proposed activities. |
| Medium | Medium scale change to key characteristics of the water quality status of the receiving water feature.<br>Water quality status is likely to take considerable time (for example, a change in the annual average turbidity classification (UKTAG, 2014)) to recover to baseline conditions.<br>Ability to meet EQS becomes compromised. |
| Low | Noticeable but not considered to be substantial changes to the water quality status of the receiving water feature.<br>Activity is not likely to alter local status to the extent that water quality characteristics change considerably and/ or EQS become compromised. |
| Negligible | Although there may be some impact upon water quality status, activities are predicted to occur over a short period.<br>Any change to water quality status will be quickly reversed once activity ceases. |

### *Determining the significance of effect*

The significance of effect associated with an impact will be dependent upon the sensitivity of the receptor and the magnitude of the impact. The assessment methodology for determining the significance of likely significant effects is described in Table 11.5. Effects defined as significant, very significant or profound are considered significant in EIA terms. An effect that has a significance of moderate, slight, not significant or imperceptible is not considered significant in EIA terms.

**Table 11.5 Significance of likely significant effects upon MW&SQ**

| | | | Existing Environment - Sensitivity | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | | | **High** | **Medium** | **Low** | **Negligible** |
| Description of Impact Magnitude | **Adverse impact** | **High** | Profound or very significant<br>(significant) | Significant | Moderate | Imperceptible |
| | | **Medium** | Significant | Moderate | Slight | Imperceptible |
| | | **Low** | Moderate | Slight | Slight | Imperceptible |
| | | **Negligible** | Not significant | Not significant | Not significant | Imperceptible |

Where relevant, mitigation measures that are incorporated as part of the proposed development design process and/ or can be considered to be industry standard practice (referred to as 'embedded mitigation') are considered throughout the chapter and are reflected in the outcome of the assessment of effects, described in Section 11.4.5. Additional mitigation measures that are not embedded and are considered as part of the residual effects assessment are described separately (Section 11.6).

***Irish Action Levels***

This assessment has adopted 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) in order to determine the contamination levels within seabed sediments and thus the potential for releasing contaminants into the marine environment through sediment disturbance resulting from activities, such as seabed preparation, drilling, HDD excavation and cable laying.

Further, a consideration of the Irish action levels is required in order to assess the suitability of depositing any sediment removed during seabed preparation works. 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.

The Irish action levels which have been used to contextualise the level of contamination within the study area are presented in Table 11.6 and where (Marine Institute (2006)):

- Lower level guidance values represent those concentrations that are either:
  - At the upper end of the no-effect range; or
  - At background concentrations.
- Upper level guidance values are set at the lower end of the known range of effective concentrations i.e. lowest concentrations shown to have adverse effects on marine organisms.

**Table 11.6 Irish Action Levels. Source: 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 |

| Parameters | Units (dry weight[a]) | Lower Level | Upper Level[b] |
|---|---|---|---|
| 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

***Turbidity Levels***

This assessment has adopted the thresholds for turbidity levels within the water column as outlined in 'Marine Evidence – Based Sensitivity Assessment – A Guide' (UKTAG, 2014) in order to aid in the assessment of increased suspended sediment, as a result of project activities, upon MW&SQ receptors. The UKTAG levels which have been used to contextualise the level of turbidity within the water column are presented in Table 11.7.

**Table 11.7 Water turbidity thresholds. Source: UKTAG, 2014**

| Water turbidity (mg/l) | Definition |
|---|---|
| >300 | Very turbid |
| 100 to 300 | Medium turbidity |
| 10 to 100 | Intermediate |
| <100 | Clear |

## 11.3 Baseline Environment

### 11.3.1 Introduction

The baseline (receiving) environment presented in this chapter focusses on the ZoI (the extent of which is described in Section 11.2.2), with a high-level description of seabed and water column characteristics provided further afield for context. Within the ZoI, the following two areas are characterised in terms of MW&SQ parameters and receptors:

- Array area (including Wind Turbine Generators (WTGs), Offshore Substation Platform (OSP) and inter-array cables); and
- The ECC, including intertidal area.

### 11.3.2 Sediment Characterisation

Surficial sediments outside of the ZoI can be characterised using information available from INFOMAR and the European Marine Observation and Data Network (EMODnet). As shown in Figure 11.2 and described further in the Physical Processes chapter, finer sediments (muds) are located further offshore, with coarser material (sands and gravels) being located in shallower waters towards and at the coast.

#### *11.3.2.1 ECC (including intertidal area)*

A desktop study suggests that the ECC is characterised by a mix of mud to muddy sands, sand, coarse sediment, and rocks and boulders (Figure 11.2). Coarser sediment fractions are mainly present to the south of the middle of the ECC, as well as surrounding small islands close to the coast, whereas sand dominates further offshore.

PSA conducted on sediment samples obtained from the intertidal zone and along the ECC have been used to characterise the baseline environmental conditions. The Particle Size Analysis (PSA) (and Total Organic Carbon; TOC) results from sediment samples collected within the intertidal zone and ECC are presented in Table 11.8 and Table 11.9, respectively, and are presented in Figure 11.4. The site-specific sediment sampling (N-Sea, 2023; Volume 9, Appendix 12.2: Cable Route Benthic Survey Report) determined that the ECC is characterised mainly by sand, with small portions of silt and gravel, classified as Muddy Sand, Sand, and Gravelly Sand. Silt and gravel portions were generally slightly higher at sampling locations further offshore. The intertidal area is characterised by a mix of boulders and rocky outcrops, with shingle and sand at the top of the shore. The intertidal area is bordered to the north and south by sandy areas of coastline.

Further detail regarding the surficial sediment composition within the ECC is provided in the Physical Processes chapter.

**Table 11.8 PSA and TOC analysis results for intertidal area (% of each particle size and TOC)**

| Station | Range of Particle Size | | | | | | | | | PSA Folk Classification | Total Organic Carbon (expressed as LOI) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | >8mm | 4-8mm | 2-4mm | 1-2mm | 0.5-1mm | 0.25-0.5mm | 125-250µm | 62.5-125µm | <62.5µm | | |
| 2 | 0 | 0.8 | 0.2 | 0.1 | 0.5 | 1.9 | 76.2 | 18.4 | 1.9 | (Gravelly) Sand | 1.1 |
| 3 | 0 | 0.6 | 0.7 | 0.8 | 1.2 | 1.6 | 64.8 | 29 | 1.2 | (Gravelly) Sand | 1.37 |
| 4 | 0 | 0 | 0.2 | 0.4 | 1.4 | 2.5 | 88.1 | 7.1 | 0.2 | Sand | 1.48 |
| 6 | 0 | 1.8 | 1 | 0.9 | 1.7 | 1.9 | 66.8 | 23.9 | 1.9 | (Gravelly) Sand | 1.59 |
| 7 | 7.5 | 3.1 | 11.1 | 5.4 | 3.8 | 3.8 | 55.2 | 9.7 | 0.5 | (Gravelly) Sand | 1.29 |
| 8 | 0 | 2 | 2.3 | 4.4 | 5.2 | 7.6 | 74.8 | 3.5 | 0.1 | (Gravelly) Sand | 1.44 |
| 9 | 0 | 1.8 | 3.3 | 2.4 | 2 | 3.8 | 82.9 | 3.7 | 0.1 | (Gravelly) Sand | 1.39 |
| 10 | 0 | 0 | 0.2 | 0.7 | 1.1 | 1.6 | 90.6 | 5.7 | 0.1 | Sand | 0.66 |

Table 11.9 PSA and TOC analysis results for the ECC (% of each particle size and TOC)

| Station | Range of Particle Size | | | | | | | | | PSA Folk Classification | Total Organic Carbon (expressed as LOI) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | >8mm | 4-8mm | 2-4mm | 1-2mm | 0.5-1mm | 0.25-0.5mm | 125-250µm | 62.5-125µm | <62.5µm | | |
| 1 | 0 | 0 | 0.1 | 0.9 | 2.3 | 2.6 | 61.2 | 30.3 | 2.6 | Sand | 3.24 |
| 2 | 0 | 0 | 0.2 | 0.7 | 2.6 | 2.6 | 43.3 | 47.1 | 3.6 | Sand | 4.22 |
| 3 | 0 | 0 | 0.4 | 1.1 | 3 | 3.7 | 38.5 | 48.7 | 4.7 | Sand | 4.1 |
| 4 | 0 | 0.3 | 0.9 | 3.1 | 4.5 | 4.3 | 51.4 | 31.2 | 4.3 | (Gravelly) Sand | 5.42 |
| 5 | 0 | 0.7 | 1.1 | 2.9 | 4 | 4.4 | 54 | 27.7 | 5.1 | (Gravelly) Sand | 4.68 |
| 6 | 0 | 0.3 | 1.5 | 7 | 7.3 | 7.1 | 56 | 14 | 6.8 | (Gravelly) Sand | 8.27 |
| 7 | 0 | 1.5 | 3.4 | 5.5 | 3.9 | 4.6 | 50.9 | 21.8 | 8.5 | (Gravelly) Sand | 5.16 |
| 8 | 0 | 0.1 | 0.8 | 2.2 | 2.1 | 2.3 | 73.9 | 12.8 | 5.8 | Sand | 8.07 |
| 9 | 0 | 0.2 | 1.1 | 4.7 | 5.7 | 7.6 | 67.3 | 9.2 | 4.2 | (Gravelly) Sand | 6.4 |
| 10 | 0 | 0.3 | 1.5 | 4.8 | 5.3 | 5.4 | 70.7 | 9.1 | 2.9 | (Gravelly) Sand | 7.65 |
| 11 | 0 | 0.2 | 1.3 | 5 | 6 | 7.4 | 68.7 | 8.7 | 2.8 | (Gravelly) Sand | 7.28 |
| 12 | 0 | 0.2 | 0.7 | 2.7 | 2.8 | 2.7 | 71.4 | 14.7 | 4.8 | Sand | 7.85 |
| 13 | 0 | 0 | 0.5 | 1.8 | 2.7 | 3.4 | 67.2 | 20.1 | 4.2 | Sand | 6.14 |
| 14 | 0 | 0.2 | 0.8 | 3.7 | 3.8 | 3.9 | 57 | 24.6 | 5.9 | (Gravelly) Sand | 6.33 |
| 15 | 0 | 0.2 | 0.6 | 2.3 | 3.8 | 4.2 | 71.2 | 12.8 | 4.8 | Sand | 7.05 |
| 16 | 0 | 0.5 | 1.3 | 3.9 | 5.1 | 5 | 63.2 | 15.5 | 5.5 | (Gravelly) Sand | 6.3 |
| 17 | 0 | 0.3 | 0.9 | 3.9 | 5.4 | 5.7 | 61.3 | 18 | 4.5 | (Gravelly) Sand | 6.46 |
| 18 | 0 | 0.4 | 0.8 | 1.7 | 4.6 | 4.1 | 42.9 | 36 | 9.6 | (Gravelly) Sand | 3.88 |

| Station | Range of Particle Size | | | | | | | | | PSA Folk Classification | Total Organic Carbon (expressed as LOI) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | >8mm | 4-8mm | 2-4mm | 1-2mm | 0.5-1mm | 0.25-0.5mm | 125-250µm | 62.5-125µm | <62.5µm | | |
| 19 | 0 | 0.9 | 0.6 | 3.1 | 3.4 | 2.8 | 50.7 | 30.7 | 7.9 | (Gravelly) Sand | 6.66 |
| 20 | 0 | 0.4 | 1.2 | 4.3 | 5.8 | 5.3 | 61.2 | 15.8 | 6 | (Gravelly) Sand | 6.45 |
| 21 | 0 | 0.5 | 1.5 | 4.5 | 5.5 | 5 | 56.3 | 20.1 | 6.6 | (Gravelly) Sand | 5.89 |
| 22 | 0 | 0.2 | 1.9 | 5.9 | 6.9 | 5.9 | 39.3 | 31.8 | 8.2 | (Gravelly) Sand | 6.21 |
| 23 | 0 | 1.3 | 2.7 | 7 | 7.3 | 5.5 | 30.9 | 36.1 | 9.1 | (Gravelly) Sand | 5.81 |
| 24 | 0 | 0.3 | 1.7 | 3.3 | 3.5 | 4.1 | 64.7 | 16.6 | 5.7 | (Gravelly) Sand | 6.71 |
| 25 | 0 | 1.3 | 2.3 | 5.6 | 6.1 | 5.6 | 53.6 | 20.4 | 5.2 | (Gravelly) Sand | 5.65 |
| 26 | 0 | 0.9 | 2 | 5.8 | 6.5 | 5.2 | 48.1 | 23 | 8.6 | (Gravelly) Sand | 6.27 |
| 27 | 0 | 1.1 | 0.3 | 2.4 | 5.3 | 3.9 | 29.5 | 46.1 | 11.3 | (Gravelly) Muddy sand | 3.93 |
| 28 | 0 | 2.2 | 4.9 | 7.8 | 7 | 5.3 | 19.4 | 38.4 | 15 | Gravelly muddy sand | 5.17 |
| 29 | 0 | 1 | 2.5 | 7.8 | 8.4 | 5.7 | 23.5 | 39.9 | 11.1 | (Gravelly) Muddy sand | 4.62 |
| 30 | 0 | 0.1 | 0.6 | 3.9 | 5.1 | 4.5 | 47 | 29.5 | 9.4 | Sand | 5.72 |

#### 11.3.2.2 Array area

The array area can be generally characterised using information available from INFOMAR and EMODnet and by the following surficial sediment types:

- Mud to muddy sands
- Sands; and
- Coarse sediments.

As confirmed in the site-specific benthic survey (Table 11.10; Figure 11.4) (Volume 9, Appendix 12.1: Array Area Benthic Survey Report), mud to muddy sands predominates within the array area, as shown in Figure 11.2, with a higher proportion of sand and some evidence of coarse sediments to the southwest of the array area. The geophysical survey (Fugro, 2022;) suggests the uppermost unit across the majority of the array area is composed of laminated/bedded, unconsolidated, fine-grained Holocene clays and silts, ranging from a depth below the seabed of between 0.2m in the south to approximately 24m in the north (Figure 11.3). Further detail regarding the geotechnical survey and surficial sediment composition within the array area is provided in the Physical Processes chapter.

**Table 11.10 PSA analysis results for the array area (% of each particle fraction)**

| Station | Major Sediment Fractions | | | PSA Folk Classification |
|---|---|---|---|---|
| | % Gravel | % Sand | % Mud | |
| 1 | 0.00% | 17.65% | 82.35% | (Sandy) Mud |
| 2 | 0.00% | 13.92% | 86.08% | (Sandy) Mud |
| 3 | 0.00% | 24.03% | 75.97% | (Sandy) Mud |
| 4 | 0.00% | 21.60% | 78.40% | (Sandy) Mud |
| 5 | 0.00% | 24.41% | 75.59% | (Sandy) Mud |
| 6 | 0.00% | 44.20% | 55.80% | (Sandy) Mud |
| 7 | 0.00% | 33.01% | 66.99% | (Sandy) Mud |
| 8 | 0.00% | 24.82% | 75.18% | (Sandy) Mud |
| 9 | 0.00% | 28.88% | 71.12% | (Sandy) Mud |
| 10 | 0.00% | 48.27% | 51.73% | (Sandy) Mud |
| 11 | 0.00% | 37.49% | 62.51% | (Sandy) Mud |
| 12 | 0.00% | 51.25% | 48.75% | (Muddy) Sand |
| 13 | 0.00% | 37.03% | 62.97% | (Sandy) Mud |
| 14 | 0.00% | 33.42% | 66.58% | (Sandy) Mud |
| 15 | 0.00% | 41.95% | 58.05% | (Sandy) Mud |
| 16 | 0.00% | 43.85% | 56.15% | (Sandy) Mud |
| 17 | 0.00% | 53.20% | 46.80% | (Muddy) Sand |
| 18 | 0.00% | 52.40% | 47.60% | (Muddy) Sand |
| 19 | 0.17% | 69.01% | 30.82% | (Muddy) Sand |
| 20 | 0.00% | 43.27% | 56.73% | (Sandy) Mud |

| Station | Major Sediment Fractions | | | PSA Folk Classification |
|---|---|---|---|---|
| | % Gravel | % Sand | % Mud | |
| 21 | 0.00% | 42.38% | 57.62% | (Sandy) Mud |
| 22 | 0.00% | 69.05% | 30.95% | (Muddy) Sand |
| 23 | 0.00% | 66.01% | 33.99% | (Muddy) Sand |
| 24 | 0.00% | 73.31% | 26.69% | (Muddy) Sand |
| 25 | 0.00% | 74.82% | 25.18% | (Muddy) Sand |
| 26 | 0.00% | 72.72% | 27.28% | (Muddy) Sand |
| 27 | 0.00% | 72.10% | 27.90% | (Muddy) Sand |
| 28 | 0.16% | 79.20% | 20.65% | (Muddy) Sand |
| 29 | 0.13% | 81.08% | 18.79% | (Muddy) Sand |
| 30 | 0.00% | 71.26% | 28.74% | (Muddy) Sand |
| 31 | 0.09% | 82.30% | 17.61% | (Muddy) Sand |
| 32 | 0.00% | 71.92% | 28.08% | (Muddy) Sand |
| 33 | 0.31% | 75.60% | 24.09% | (Muddy) Sand |
| 34 | 0.25% | 76.47% | 23.28% | (Muddy) Sand |
| 35 | 0.00% | 82.06% | 17.94% | (Muddy) Sand |
| 36 | 0.90% | 82.83% | 16.28% | (Muddy) Sand |
| 37 | 0.36% | 76.06% | 23.58% | (Muddy) Sand |
| 38 | 0.49% | 75.27% | 24.23% | (Muddy) Sand |
| 39 | 0.09% | 73.71% | 26.20% | (Muddy) Sand |
| 40 | 0.65% | 72.36% | 26.99% | (Muddy) Sand |

### 11.3.3 Seabed Chemistry and Contaminants

Within the Irish Sea, the concentration of contaminants within sediments are typically greater than those found in seawater (Cefas, 2005). Concentrations of Polycyclic Aromatic Hydrocarbons (PAH) and Polycholorinated Biphenyls (PCBs) have been shown to be significantly higher in inshore areas where there was either riverine input and/or direct industry discharges, for example Dublin Bay and Drogheda Port (Section 11.3.2). An offshore negative correlation has been found in the Western Irish Sea between PAH concentration and the sediment grain size, whilst a positive correlation was found between metal distribution and the percentage of silt and clay sized sediments (Cefas, 2005).

A suite of 17 sediment samples have previously been taken within Drogheda Harbour and its approaches; of these, one was located at the entrance of the River Boyne and two further offshore. All three samples had concentrations less than the Irish Lower Action Level for all contaminants analysed (Drogheda Port Company, 2019).

Thirty sediment samples have previously been collected within Dublin Harbour and its approaches; of these only one returned concentrations above the Upper Action Level– with a concentration of 61.8mg/kg of nickel (Dublin Port Company, 2019). Seven samples returned concentrations above the Lower Action Level for total extractable hydrocarbons (TEH), three for cadmium, one sample for lead and one for PCB 028.

These sediments, outside the sample returning high levels of nickel, were approved for disposal offshore by the Marine Institute, and were classified as uncontaminated with no biological effects likely (Dublin Port Company, 2019).

#### *11.3.3.1 ECC (including intertidal area)*

Project-specific sediment sampling was undertaken along the ECC (Figure 11.4) for which a full breakdown of the sampling locations, methodologies, and results are presented in Volume 9, Appendix 12.2: Cable Route Benthic Survey Report.

The locations of the sediment sampling locations were based upon the absence/presence of publicly available data, such as that held in the INFORMAR database, at the time of survey design. The sediment samples collected were analysed for the Marine Institute full suite of analyses, with results compared against the Irish Action Levels. Contaminants analysed for include heavy metals, PCBs, PAHs, and tributyltin (TBT) and dibutyltin (DBT). Contaminant concentrations falling below the lower level are considered unlikely to produce adverse environmental impacts, whereas concentrations above the upper levels are considered likely to lead to adverse environmental impacts. The analyses show:

- The heavy metal and organotin analysis (presented in Table 11.11) showed generally low contaminant concentrations within the sediments sampled. The Lower Action Level was exceeded for cadmium (two samples) and zinc (one sample) (Figure 11.5). The organotin (DBT/ TBT) contaminant concentrations reported were below all guidelines for every sampling location
- The concentration of PAHs and total hydrocarbon content (THC) were recorded below the lower Irish Action Levels for all sampling locations; and
- The PCB and organochlorine pesticide (OCP) sediment concentrations recorded were below all guidelines for every sampling location.

**Table 11.11 Heavy metal and organotin analysis results for the ECC**

| Metals (mg/kg) | Sampling Stations | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | 7 | 8 | 9 | 11 | 12 | 13 | 23 | 27 | 28 |
| Arsenic | 8.3 | 8.2 | 6.7 | 7.2 | 6.3 | 6.4 | 6.1 | 6.7 | 6.8 | 7.7 |
| Cadmium | 2.8 | 0.7 | 0.2 | 0.2 | 0.15 | 0.16 | 0.14 | 0.15 | 0.17 | 0.16 |
| Chromium | 46.8 | 45.9 | 39.1 | 36.8 | 36.1 | 35.8 | 39.7 | 39.2 | 42.3 | 49.9 |
| Copper | 13 | 10 | 7.2 | 7.7 | 6.5 | 6.6 | 6.7 | 7.8 | 8.3 | 9.7 |
| Lead | 36.9 | 24.2 | 18.5 | 20.6 | 17.3 | 17.8 | 17.8 | 18.6 | 19.7 | 21.9 |
| Mercury | 0.05 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.04 |
| Nickel | 14.8 | 15.8 | 12.4 | 13.3 | 11.8 | 11.9 | 12.1 | 15 | 15.5 | 18.5 |
| Zinc | 187 | 81.8 | 54.5 | 57.5 | 48.7 | 44.3 | 44.5 | 48.5 | 52.3 | 59.9 |
| Aluminium* | 22200 | 25100 | 21500 | 20500 | 19500 | 21200 | 20800 | 24900 | 26200 | 30900 |
| Lithium* | 23 | 26.4 | 21.7 | 20.9 | 19.8 | 20.9 | 21 | 25.1 | 26.2 | 32.1 |
| **Organotins (μg/kg)** | | | | | | | | | | |
| Dibutyltin (DBT) | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Tributyltin (TBT) | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |

Cells highlighted in red denote metal concentrations which exceeded the Irish Lower Action Level

*Both Lithium and Aluminium are not included in the Irish Action Levels. For these, the Guidelines for Canadian sediment quality guidelines are used to assess contaminant levels. The Canadian Sediment quality guidelines (CCME, 2001) were developed by the Canadian Council of Ministers of the Environment as broadly protective tools to support the functioning of healthy aquatic ecosystems.

#### *11.3.3.2 Array area*

As stated in Section 11.3.3 and shown in Figure 11.2, there is a predominance of mud to muddy sand sediments within the array area, inferring the possibility for elevated metal concentrations within the seabed sediments. Project specific sediment sampling (Natural Power, 2022) was undertaken within the array area to determine sediment contamination levels (Figure 11.4), summarised below with further detail presented in Volume 9, Appendix 12.1: Array Area Benthic Survey Report.

At all forty stations (Figure 11.4), sediment samples were analysed and subsequently assessed for a range of contaminants (Section 11.2.4.4):

- No contaminants exceeded the Irish Lower Action Level (Table 11.6); and
- PAH and PCB levels were all below the Irish Lower Action Level (Table 11.6).

The contamination levels in all of the forty samples analysed were within the no-effect range/ at background levels. For a full suite of the contaminants and their concentrations please refer to Volume 9, Appendix 12.1: Array Area Benthic Survey Report.

### 11.3.4 Suspended Sediments

The Irish Sea is characterised by a high degree of spatial and temporal (both annual and inter-annual) variability in SSC. In general, there exists an inshore to offshore gradient in SSC, with the highest concentrations observed close to and especially within bay inlets, such as Dublin Bay (Figu; Cefas, 2016).

Whilst the Marine Geology, Oceanography and Physical Processes technical baseline report (Appendix 10.2) provides a detailed analysis of turbidity, the key findings have been summarised in this chapter for ease of reference. Turbidity is caused by a range of small particles in the water column, including materials which are of organic origin. These particles are typically summarised under the term Suspended Particulate Matter (SPM).

Research has shown that it is the tidal forcing that results in predictable patterns and temporal variability in the Irish Sea turbidity levels (Bowers et al., 1998; Bowers et al., 2002). Overall, concentrations are considered to be low.

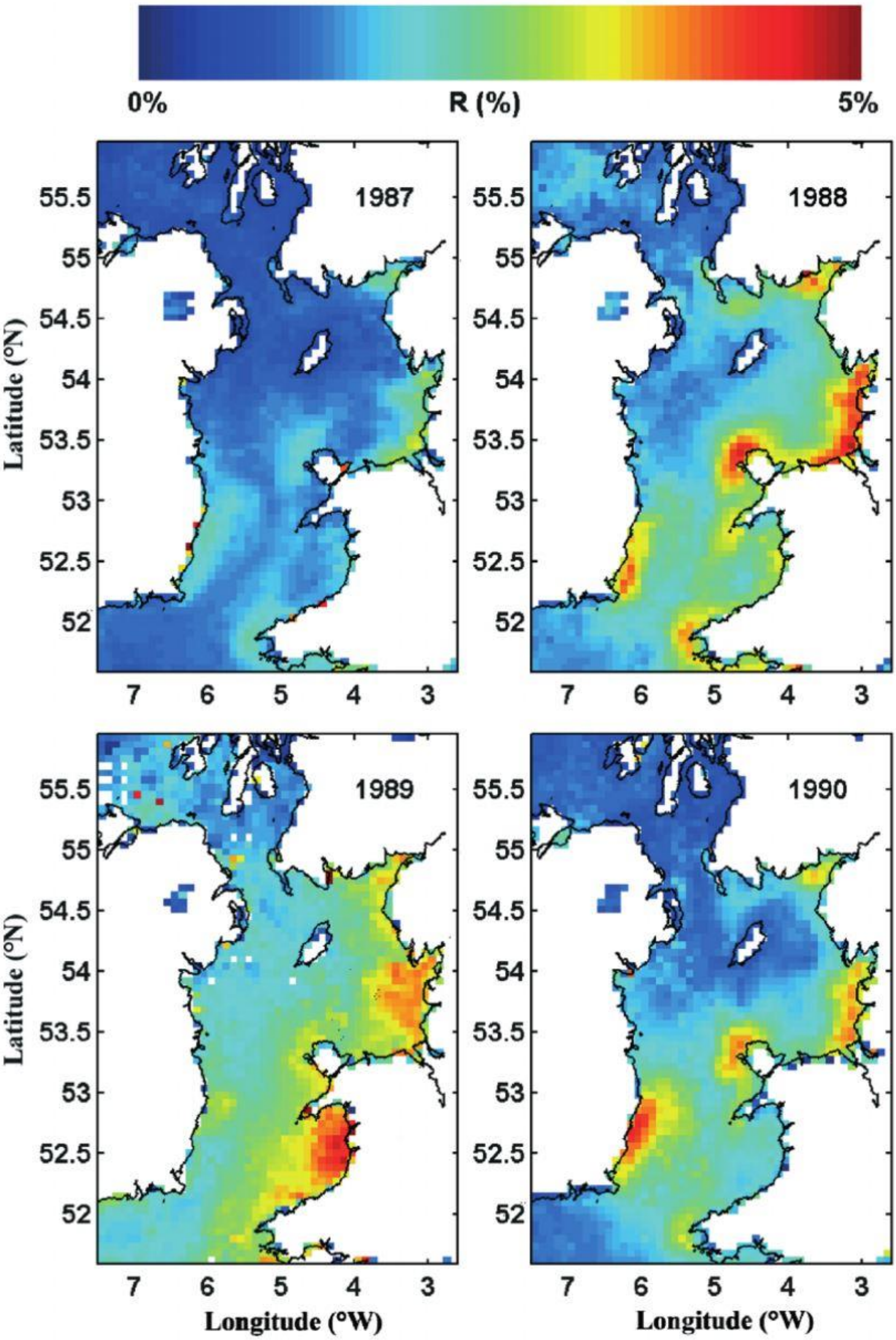
Recent analyses of remote sensing data within UK territorial waters have shown an increase in turbidity since the beginning of the 20$^{th}$ Century. Within the Irish Sea, this increase is observed for the period 1998 to 2015 during the spring and of the order of 2.7mg/l (MOAT, 2019). The elevated substance irradiance reflectance (R) value within the entirety of the Irish Sea occurs during a period of high North Atlantic Oscillation (NAO) index (White et al., 2015). It can be seen that, throughout the period, levels are relatively low within the western Irish Sea, including the study area. Within the Irish Sea, maximum SPM values are coincidental with a high NAO index. In such circumstances, high wind stresses result in a greater wave generation and thus higher turbidity levels (Figure 11.6; White et al., 2015). Of note, and with reference to Graph 11.1 is that metocean influences are particularly apparent in the shallower coastal waters.

#### *11.3.4.1 ECC (including intertidal area)*

Project specific water quality monitoring illustrates the presence of a turbidity gradient where turbidity levels are greatest nearshore, reducing towards the array area (Volume 9, Appendix 12.2: Cable Route Benthic Survey Report). Monthly averaged satellite imagery of (surface) SPM, from the period 1998 to 2015 (Graph 11.1; Cefas, 2016), shows:

- For the ECC mid-section, the monthly mean sea surface SPM varies from 1.3mg/l in July to 6.3mg/l in January (± 1.3mg/l standard deviation); and
- For the nearshore part of the ECC towards landfall, the monthly mean sea surface SPM varies from 2.9mg/l in July to 8.3mg/l in December (± 1.3mg/l standard deviation).

Localised areas of higher concentrations, of the order of 14mg/l, correlate with headlands, estuaries and bays during the winter months and are outside the proposed landfall area (Graph 11.1).




**Graph 11.1 Turbidity Levels**

### *11.3.4.2 Array area*

Monthly averaged satellite imagery of (surface) SPM, from the period 1998 to 2015, shows limited variation within the array area (Cefas, 2016). For the array area, the monthly mean sea surface SPM varies from 0.6mg/l in June/July to 4.8mg/l in December/January (± 0.5mg/l standard deviation); Graph 11.1.

Project specific turbidity monitoring was undertaken, through the collection of water samples, as part of the metocean campaign (Partrac 2022, 2023) within the array area. The results[4] show that at measurement sites A2 (north-east of the array) and Site B (south of the array) in January 2023, levels of between 13 to 38mg/l for a range of water depths. Of note is that the samples were taken following a period of strong winds and were below the sea surface. Overall, it is considered that all concentrations are considered to be relatively low.

## 11.3.5 Water Column Characteristics

### *11.3.5.1 ECC (including intertidal area)*

Modelled temperature values across the ECC are similar to those found in the array area, with slightly (0.1 to 0.2 practical salinity units; psu) higher salinity values consistent with increased proximity to terrestrial freshwater sources, although still characteristic of an offshore marine environment throughout the year (Table 11.12; Figure 11.7).

**Table 11.12 Modelled monthly mean sea surface temperature and salinity values across the ECC for 2021 from the Marine Institute SWAN and ROMS models (source: Marine Institute). Mean, minimum, and maximum values are shown**

| Month | Sea Surface Temperature (oC) | Sea Surface Salinity (psu) | Sea Bottom Temperature (oC) | Sea Bottom Salinity (psu) |
|---|---|---|---|---|
| January | 8.1<br>(6.3–9.3) | 34.1<br>(32.8–34.5) | 8.1<br>(6.3–9.3) | 34.1<br>(33.5–34.5) |
| February | 7.4<br>(6.3–8.2) | 34.1<br>(32.4–34.6) | 7.4<br>(6.2–8.3) | 34.2<br>(33.6–34.6) |
| March | 7.9<br>(7.8–8.0) | 34.3<br>(33.3–34.6) | 7.8<br>(7.8–7.9) | 34.4<br>(33.8–34.6) |
| April | 8.6<br>(8.4–9.2) | 34.4<br>(34.1–34.6) | 8.5<br>(8.3–9.1) | 34.4<br>(34.1–34.6) |
| May | 10.2<br>(9.8–11.3) | 34.3<br>(34.0–34.6) | 10.0<br>(9.6–11.2) | 34.4<br>(34.0–34.6) |
| June | 12.9<br>(12.5–14.3) | 34.3<br>(33.9–34.4) | 12.0<br>(10.5–14.2) | 34.4<br>(34.1–34.6) |
| July | 16.6<br>(16.1–17.6) | 34.3<br>(34.2–34.4) | 14.0<br>(12.2–17.3) | 34.4<br>(34.2–34.5) |
| August | 16.5<br>(16.1–17.6) | 34.4<br>(34.3–34.5) | 15.1<br>(13.1–17.5) | 34.4<br>(34.3–34.5) |
| September | 16.2<br>(15.7–17.1) | 34.4<br>(34.3–34.5) | 15.5<br>(14.1–17.1) | 34.5<br>(34.3–34.5) |
| October | 14.2<br>(14.0–14.4) | 34.6<br>(34.3–34.7) | 14.2<br>(13.9–14.4) | 34.6<br>(34.4–34.7) |
| November | 12.3<br>(11.2–12.9) | 34.5<br>(34.1–34.6) | 12.3<br>(11.1–12.9) | 34.5<br>(34.2–34.6) |
| December | 10.2<br>(8.6–11.0) | 34.4<br>(33.7–34.6) | 10.2<br>(8.5–11.1) | 34.4<br>(34.1–34.6) |

[4] analysis of samples indicating total suspended solid concentrations

### *11.3.5.2 Array area*

Surface temperature values across the array area vary from lows of 6.5°C in February to highs of 17.3°C in June, with a seasonal cycle of around 9°C. Temperature values show little variation with depth throughout the winter months, indicating well mixed conditions, with mean sea bottom temperatures between 1.5° to 5.3°C colder during the summer indicating the presence of temperature stratification. The region is generally saline, with salinity values ranging from approximately 33.2 to 34.6 psu throughout the year, with minimal variation with depth (Table 11.13).

**Table 11.13 Modelled monthly mean sea surface temperature and salinity values across array area over 2021 from the Marine Institute SWAN and ROMS models (source: Marine Institute). Mean, minimum and maximum values are shown for each parameter**

| Month | Sea Surface Temperature (ºC) | Sea Surface Salinity (psu) | Sea Bottom Temperature (ºC) | Sea Bottom Salinity (psu) |
|---|---|---|---|---|
| January | 8.5<br>(6.7–9.7) | 34.3<br>(33.5–34.7) | 8.6<br>(6.7–9.7) | 34.3 (33.6–34.7) |
| February | 7.7<br>(6.5–8.5) | 34.3<br>(33.2–34.8) | 7.7<br>(6.5–8.5) | 34.4 (33.8–34.8) |
| March | 7.9<br>(7.8-8.2) | 34.5<br>(33.7–34.8) | 7.9<br>(7.7–8.2) | 34.5 (34.0–34.8) |
| April | 8.5<br>(8.3–9.0) | 34.5<br>(34.1–34.7) | 8.4<br>(8.2–9.0) | 34.5 (34.2–34.7) |
| May | 10.0<br>(9.8–10.9) | 34.4<br>(34.1–34.7) | 9.8<br>(9.4–10.9) | 34.4 (34.1–34.7) |
| June | 12.8<br>(12.4–13.7) | 34.4<br>(34.1–34.5) | 11.3<br>(9.9–13.6) | 34.5 (34.2–34.7) |
| July | 16.6<br>(15.7–17.0) | 34.3<br>(34.2–34.4) | 11.3<br>(11.3–16.6) | 34.4 (34.2–34.6) |
| August | 16.4<br>(16.0–17.3) | 34.4<br>(34.3–34.5) | 14.2<br>(12.1–17.2) | 34.5 (34.3–34.6) |
| September | 16.1<br>(15.7–17.0) | 34.5<br>(34.3–34.6) | 14.9<br>(12.9–17.0) | 34.5 (34.3–34.6) |
| October | 14.2<br>(13.9–14.5) | 34.6<br>(34.4–34.7) | 14.0<br>(13.2-14.5) | 34.6 (34.4–34.7) |
| November | 12.6<br>(11.5–13.0) | 34.6<br>(34.2–34.7) | 12.6<br>(11.5-13.0) | 34.6 (34.2–34.7) |
| December | 10.6<br>(8.9–11.3) | 34.5<br>(34.0–34.7) | 10.6<br>(8.9–11.3) | 34.5 (34.2–34.7) |

These modelled temperature and salinity values are generally comparable to those found from conductivity, temperature, and depth (CTD) data taken from four recent research cruises located approximately in or around the array area, with temperature values within 1.5°C and salinities within 0.4psu of the modelled range (Table 11.14; Figure 11.7). Measurements of dissolved oxygen range from 5.4ml/l in the summer to up to 6.4ml/l in the winter months, with corresponding saturation values ranging from 90.2% (August) to 98.2% (January). Spatially, it can be seen (Figure 11.7) that, in general terms, temperatures are higher whilst dissolved oxygen and oxygen saturations are lower in the south of the array area (noting that the samples in the north of the array were collected in January whilst those in the south were sampled in October/August).

**Table 11.14 Temperature, salinity, and dissolved oxygen characteristics for CTD samples taken from across the array area over four research cruises (source: Marine Institute). Mean, minimum and maximum values by depth are shown for each parameter**

| Date | CTD (ID & Coordinates) | Temperature (ºC) | Salinity (psu) | DO (ml/l) | Oxygen Saturation (%) |
|---|---|---|---|---|---|
| 2019-01 | 135415 (53.730000, -6.096833) | 8.9 (8.9-8.9) | 33.7 (33.7-33.7) | 6.3 (6.3-6.3) | 96.9 (96.2-97.4) |
| 2019-01 | 135432 (53.728500, -6.000333) | 9.4 (9.2-9.7) | 33.9 (33.8-34.0) | 6.3 (6.2-6.3) | 97.4 (95.9-98.4) |
| 2019-01 | 135431 (53.730000, -5.899333) | 10.1 (10.0-10.3) | 34.1 (34.0-34.1) | 6.2 (6.2-6.3) | 98.2 (97.0-98.9) |
| 2019-01 | 135369 (53.730167, -5.899333) | 10.2 (10.0-10.6) | 34.1 (34.0-34.3) | 6.2 (6.1-6.3) | 98.1 (96.4-98.9) |
| 2019-10 | 206504 (53.543333, -5.930833) | 13.4 (13.3-13.4) | 33.9 (33.9-33.9) | 5.4 (5.4-5.4) | 91.0 (90.6-91.5) |
| 2019-10 | 206514 (53.573167, -5.939667) | 13.2 (13.2-13.2) | 33.9 (33.9-33.9) | 5.4 (5.4-5.4) | 90.8 (90.5-91.1) |
| 2019-10 | 206516 (53.583833, -5.948000) | 13.0 (13.0-13.0) | 33.8 (33.8-33.8) | 5.4 (5.4-5.4) | 90.6 (90.2-90.9) |
| 2019-10 | 206518 (53.732500, -6.090000) | 12.5 (12.5-12.5) | 33.7 (33.7-33.7) | 5.6 (5.6-5.6) | 92.9 (92.8-93.2) |
| 2020-08 | 206554 (53.502611, -5.880837) | 14.7 (14.6-14.7) | 33.9 (33.9-33.9) | 5.4 (5.4-5.4) | 94.1 (94.0-94.4) |
| 2021-01 | 206573 (53.730217, -6.213150) | 6.6 (6.6-6.6) | 32.9 (32.8-32.9) | 6.4 (6.4-6.4) | 92.1 (92.0-92.3) |
| 2021-01 | 206575 (53.729600, -6.101650) | 7.3 (6.9-7.6) | 33.3 (32.8-33.4) | 6.3 (6.3-6.4) | 93.4 (93.1-93.6) |
| 2021-01 | 206578 (53.729950, -5.998783) | 8.4 (8.4-8.5) | 33.8 (33.8-33.8) | 6.2 (6.1-6.2) | 93.4 (93.1-93.6) |
| 2021-01 | 206579 (53.730100, -5.898683) | 9.2 (9.2-9.2) | 34.0 (34.0-34.0) | 6.0 (6.0-6.0) | 93.0 (92.2-93.3) |
| 2021-01 | 206580 (53.729517, -5.747300) | 9.6 (9.6-9.6) | 34.0 (34.0-34.0) | 5.9 (5.9-6.0) | 92.6 (92.4-93.3) |

#### *11.3.5.3 Water Column Chemistry and Contaminants*

Due to the hydrophobic nature of many organic compounds and the partitioning of metals to suspended particles, the concentrations of dissolved contaminants in seawater samples are often low or below detection limits (Cefas, 2005). Within the Irish Sea, over 80% of the measured concentrations of metals originate from riverine inputs, the exception being mercury for which riverine sources contribute circa 50% (OSPAR, 2004). Typically, metal concentrations reduce significantly in water samples taken further offshore; with the highest concentrations typically found in estuarine and coastal waters subject to industrial and wastewater inputs, such as Dublin Bay and Drogheda Harbour (Cefas, 2005). Typical contaminants within seawater include:

- Radioactive isotopes
- Hydrocarbons; and
- Trace metals.

#### *11.3.5.4 ECC (including intertidal area)*

Estuarine and coastal waters are sensitive to inputs of nutrients from agricultural runoff, particularly nitrogen and phosphate. Elevated concentrations of these nutrients may lead to harmful algal blooms and eutrophication, with nitrogen considered the primary limiting nutrient in coastal ecosystems. Twenty one of the 103 (21%) estuarine and coastal water bodies assessed by the EPA were in unsatisfactory condition for dissolved inorganic nitrogen (DIN). Conversely, nearly all (97%) estuaries and coastal waters assessed were in satisfactory condition for phosphate (EPA Water Quality In 2022 – An Indicators Report, 2023).

With respect to the study area, the most recent (2018 to 2020) information provided by the EPA shows that the water quality is considered unpolluted (Figure 11.8).

#### *11.3.5.5 Array area*

Aside from the physical parameters data previously presented within Section 11.4.1, which include project-specific sediment contaminant analysis, there is limited publicly available information pertaining to chemical and contaminant concentrations within the ZoI.

### 11.3.6 Designated Sites

As specified by the WFD and MSFD, there is a requirement to fully characterise the marine environment to 1nm offshore. This MW&SQ Chapter further characterises a study area based on the ZoI, which has been defined based on the expected maximum distance that water from within the array area and ECC might be transported on a single mean spring tide, in either the flood and/ or ebb direction (see the Physical Processes chapter). All sites within the ZoI that are designated under these directives are assessed as receptors within this EIAR Chapter and include (Figure 11.9):

- Six coastal and two transitional water bodies (Table 11.15)
- Eight bathing waters (Table 11.16)
- Two shellfish waters (Table 11.17); and
- Four nutrient sensitive areas designated under urban waste-water treatment directive (Table 11.18).

**Table 11.15 WFD water bodies considered within the MW&SQ assessment (Source: EPA, 2021a; 2021b) and Department of Housing, Local Government and Heritage, 2018)**

| Name (from north to south) | ID | Distance to the array area (km) | Distance to ECC (km) | Distance to offshore development area (km) | Water Body Risk (*) | WFD status (**) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Overall | Ecological | Chemical |
| Coastal water bodies | | | | | | | | |
| Louth Coast | IE_EA_025_0000 | 14.5 | 10.4 | 14.5 | Not at risk | High | High | Unassigned |
| Boyne Estuary Plume Zone | IE_EA_010_0000 | 14.5 | 8.3 | 14.5 | At risk | Moderate | Moderate | Good |
| Northwestern Irish Sea (HA 08) | IE_EA_020_0000 | 0.2 | 0.0 | 7.7 | At risk | Good | Good | High |
| Rockabill | IE_EA_040_0000 | 1.8 | 1.7 | 3.3 | Review | Unassigned | Unassigned | Unassigned |
| Malahide Bay | IE_EA_060_0000 | 11.6 | 16.2 | 21.7 | At risk | Moderate | Moderate | Good |
| Irish Sea Dublin (HA 09) | IE_EA_070_0000 | 10.2 | 19.1 | 22.2 | Not at risk | Good | Good | Unassigned |
| Transitional water bodies | | | | | | | | |
| Boyne Estuary | IE_EA_010_0100 | 16.4 | 9.7 | 16.4 | At risk | Moderate | Moderate | Good |
| Rogerstown Estuary | IE_EA_050_0100 | 9.6 | 12.3 | 17.3 | At risk | Poor | Poor | Good |

(*) Risk for each water body of failing to meet their WFD objectives by 2027. The risk of not meeting WFD objectives was determined by assessment of monitoring data, data on the pressures and data on the measures that have been implemented. Waterbodies that are At Risk are prioritised for implementation of measures. This assessment is based upon the WFD period 2016 to 2021.

(**) Based on WFD period 2016 to 2021
Shaded cells represent those within 2km (1nm) of the ECC

**Table 11.16 Bathing Waters included within the MW&SQ assessment (Source: EPA, 2022b)**

| Name (from north to south) | ID | Distance (km) to | | | 2022 Annual Water Quality Rating(a) | Bathing Season Status(b) | | |
|---|---|---|---|---|---|---|---|---|
| | | Array Area | ECC | Offshore development area | | 2023 | 2022 | 2021 |
| Mornington(c) | n/a | 9.9 | 16.9 | - | n/a | Poor | Excellent | Excellent |
| Laytown/ Bettystown | IEEABWC020_0000_0700 | 16.8 | 7.7 | 16.8 | Excellent | Restricted(d) | Good | Excellent |
| Balbriggan, Front Strand Beach (e) | IEEABWC020_0000_0600 | 15.4 | 0.9 | 15.8 | Poor | Restricted€ | Poor | Excellent |
| Skerries, South Beach | IEEABWC020_0000_0500 | 9.3 | 4.9 | 11.7 | Sufficient | Excellent | Good | Excellent |
| Loughshinny Beach | IEEABWC020_0000_0400 | 7.7 | 9.1 | 12.9 | Sufficient | Excellent | Excellent | Excellent |
| Rush, North Beach | IEEABWC020_0000_0350 | 7.8 | 11.3 | 14.7 | Excellent | Excellent | Excellent | Excellent |
| Rush, South Beach | IEEABWC020_0000_0300 | 8.6 | 12.4 | 16.1 | Excellent | Excellent | Excellent | Excellent |
| Portrane, the Brook Beach | IEEABWC020_0000_0200 | 9.4 | 14.5 | 18.4 | Excellent | Excellent | Excellent | Excellent |

Shaded cells represent those within 1nm/ 2km of the ECC.

(a) Annual water quality rating is based on water quality monitoring results covering the previous four years. The 2022 results are based on bacteriological results from the period 2019 to 2022.

(b) Samples taken during the bathing season 22nd May to 15th September annually. Bathing season status is based on the last sample taken at the end of each bathing season.

(c) Mornington: site is not a designated Bathing Water and is listed by the EPA as an Other Monitored Water. Included on request of Meath County Council's Scoping Response.

(d) Laytown/Bettystown currently has a temporary swim restriction due to pollution resulting from animals/birds and contamination of urban surface waters discharging into the bathing water.

(e) Balbriggan, Front Strand Beach has a full 2023 season swim restriction due to the 'poor' classification from the 2022 season.

**Table 11.17 Designated Shellfish Waters included within the MW&SQ assessment (Source: Sea-Fisheries Protection Agency, 2021)**

| Name (north to south) | Distance (km) to | | | Species | Class |
|---|---|---|---|---|---|
| | Array area | ECC | Offshore development area | | |
| Balbriggan/ Skerries | 4.1 | 0.0 | 8.2 | Razor Clams (*Ensi siliqua*) | A |
| Malahide | 4.1 | 15.2 | 16.6 | Razor Clams | A* |

*Seasonal classification 1 July to 1 April, reverts to Class B at other times

**Table 11.18 Designated Nutrient Sensitive Sites included within the MW&SQ assessment. Source: Environmental Protection Agency**

| Name (north to south) | ID | Distance to (km) | |
|---|---|---|---|
| | | Array Area | ECC |
| Boyne Estuary | IE_EA_010_0100 | 16.4 | 9.6 |
| Boyne Estuary Plume Zone | IE_EA_010_0000 | 14.9 | 8.3 |
| Broadmeadow Water | IE_EA_060_0100 | 10.0 | 13.0 |
| Malahide Estuary | IE_EA_060_0000 | 13.0 | 10.0 |

#### *11.3.6.1 Dumping at Sea Sites*

There are a number of historic and one active Dumping at Sea sites which are of relevance to the study area, and in particular the ECC. These are detailed in Table 11.19 (refer to Figure 20.3).

Increased SPM concentrations are also correlated with Dumping at Sea activities; although it is noted in the case of those sites used by Drogheda Port (refer to the EPA website[5] and Figure 20.3), the sediment plume was considered to not extend further than 600m from the discharge point (RPS, 2019).

[5] https://www.epa.ie/our-services/licensing/freshwater--marine/dumping-at-sea-das/

**Table 11.19 Designated Dumping at Sea sites included within the MW&SQ assessment. Source: Environmental Protection Agency.**

| Permit No (north to south) | Permit Holder | Permit Issue – Permit End Date | Volume Disposed (tonnes) | Method of Disposal | Distance to (km) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Array area | ECC | Offshore development area |
| S0015-02 | Drogheda Port Company | 2013 – 8 years from date of commencement of activities | 2,816,000 | Through vessel hull | 11.7 | 9.5 | 11.7 |
| S0015-03 | Drogheda Port Company | 2021 – 12/02/ 2029 | 2,816,000 | Through vessel hull as vessel moving | 11.7 | 9.5 | 11.7 |
| 164(*) | Drogheda Harbour Commissioners | 1993 – 31/12/1993 | Unknown | Through vessel hull | 12.7 | 10.1 | 12.7 |
| 70(*) | Drogheda Harbour Commissioners | 1986 – 30/09/1987 | Unknown | Through vessel hull | 12.7 | 10.1 | 12.7 |
| 210 | Drogheda Harbour Commissioners | 1995 – 31/12/1995 | Unknown | Through vessel hull | 11.6 | 9.4 | 11.6 |
| 225 | Drogheda Harbour Commissioners | 1996 – 31/12/1996 | Unknown | Through vessel hull | 11.6 | 9.4 | 11.6 |
| 261 | Drogheda Harbour Commissioners | 1997 – 31/12/1997 | Unknown | Through vessel hull | 11.6 | 9.4 | 11.6 |
| 278 | Drogheda Harbour Commissioners | 1998 – 31/12/1998 | Unknown | Through vessel hull | 11.6 | 9.4 | 11.6 |
| 286 | Drogheda Port Company | 1998 – 31/12/1998 | Unknown | unknown | 11.6 | 9.4 | 11.6 |
| 293 | Drogheda Port Company | 1999 – 31/12/1999 | Unknown | Through vessel hull | 11.6 | 9.4 | 11.6 |
| 301 | Drogheda Port Company | 1999 – 30/06/1999 | Unknown | Through vessel hull | 11.6 | 9.4 | 11.6 |
| 325 | Drogheda Port Company | 2001 – 19/02/2001 | Unknown | Through vessel hull | 11.6 | 9.4 | 11.6 |
| 329 | Drogheda Port Company | 2001 – 30/09/2001 | Unknown | Through vessel hull | 11.6 | 9.4 | 11.6 |
| 345 (*) | Drogheda Port Company | 2002 – 31/12/2007 | Unknown | Through vessel hull as vessel moving/ release through barge hull splitting in motion | 11.6 | 3.7 | 11.6 |
| 27 | Drogheda Harbour Commissioners | 1983 – 30/09/1984 | Unknown | Through vessel hull | 13.3 | 9.9 | 13.3 |
| 279 | Drogheda Port Company | 1998 – 31/12/1998 | Unknown | Through vessel hull | 15.2 | 10.3 | 15.2 |
| 294 | Drogheda Port Company | 1999 – 31/12/1999 | Unknown | Through vessel hull | 15.2 | 10.3 | 15.2 |
| 340(*) | Bórd Gáis Éireann (Gormanstown, Cork) | 2002 – 31/08/2002 | Unknown | Through barge hull splitting in motion | 13.1 | 1.8 | 13.1 |
| 245 and 252 | Malahide Marina Village Ltd | 1996 – 31/08/1997 | Unknown | unknown | 9.5 | 16.5 | 20.0 |

(*) two locations are given for the same permit number (https://gis.epa.ie/EPAMaps/)

## 11.4 Characteristics of the Proposed Development

This section outlines the characteristics of the proposed development that are relevant to the identification and assessment of effects on MW&SQ during each phase of the proposed development. In this chapter this is limited to activities and infrastructure occurring in the offshore environment and it considers both Project Option 1 and Project Option 2 (the key characteristics of which are provided in Table 11.20 and are detailed in full in the Offshore Project Description).

**Table 11.20 Key characteristics of Project Option 1 and Project Option 2**

| Key Offshore Characteristics | Project Option 1 | Project Option 2 |
|---|---|---|
| Array area | 88.5km2 | 88.5km2 |
| ECC | 36.45km2 | 36.45km2 |
| Landfall | One landfall site, immediately south of Bremore Point, which includes two subtidal exit pits within the ECC | One landfall site, immediately south of Bremore Point, which includes two subtidal exit pits within the ECC |
| Wind Turbine Generator (WTG) | 49 WTGs with 250m rotor diameter | 35 WTGs with 276m rotor diameter |
| WTG Foundations | 49 monopiles of 12.5m diameter requiring seabed preparation | 35 monopiles of 12.5m diameter or jacket foundations (three or four leg configurations, with 6m diameter pin piles) requiring seabed preparation |
| Offshore Substation Platform (OSP) Foundations (array area) | One OSP, with either a four-legged jacket foundation with pin piles, or one monopile; or two monopiles | One OSP, with either a four-legged jacket foundation with pin piles, or one monopile; or two monopiles |
| Cables | Installation of 111km of array cables within the array area and installation of two 18km export cables within the ECC | Installation of 91km of array cables within the array area and installation of two 18km export cables within the ECC |

A presentation of the potential impacts in relation to Project Option 1 and Project Option 2 is provided, and the magnitude of those impacts in relation to the size and scale of the proposed development parameters. This enables the identification of the project option that will result in the greatest magnitude of impact on receptors and will therefore present the greatest potential for a likely significant effect (Table 11.22).

To determine the magnitude of the impact level, modelling, calculations and mapping have been undertaken for the project option with the greatest magnitude of impact, for all impacts for the relevant receptor/s.

The significance of effect assessment is then undertaken for both project options, which considers both receptor sensitivity and the magnitude of the impact and is detailed in Section 11.5. Given the similarity of the project options, in most instances the conclusions are the same. In some instances, the difference in magnitude of impact between project options results in a different categorisation of significance.

### 11.4.1 Parameters for assessment

The below activities, infrastructure and key design parameters have been considered within this chapter when determining the potential impacts. Further detail on the offshore elements of the proposed development is provided in the Offshore Description Chapter and Offshore Construction Chapter. These parameters apply to both project options and any differences in values that may require consideration have been identified in Table 11.22.

### 11.4.2 Construction

During construction the following activities and infrastructure have the potential to impact on MW&SQ:

- Pre-construction surveys including geophysical surveys and potentially the use of remotely operated vehicles (ROVs)
- Seabed preparation and installation of WTG foundations which can lead to an increase in suspended sediment

- Seabed preparation and installation of OSP foundations which can lead to an increase in suspended sediment
- Seabed preparation and installation of inter-array cables which can lead to an increase in suspended sediment
- Seabed preparation and installation of ECC cables which can lead to increase an in suspended sediment
- Installation of the WTG, OSP and cables for which the presence of construction vessels has the potential to cause accidental release of spills or materials or chemicals; and
- Release of drilling mud during HDD export cable installation at the subtidal HDD exit pit.

### 11.4.3 Operational Phase

During operation and maintenance, the following activities and infrastructure have the potential to impact on MW&SQ:

- Maintenance and repair of ECC and inter-array cabling, which can lead to an increase in suspended sediment; and
- Maintenance activities including the presence of vessels, which has the potential to cause accidental release of spills or materials or chemicals.

### 11.4.4 Decommissioning

During decommissioning, the following activities and infrastructure have the potential to impact on MW&SQ:

- Removal of proposed development infrastructure which can lead to an increase in suspended sediment; and
- Decommissioning activities including the presence of vessels could result in accidental spills of materials or chemicals.

### 11.4.5 Embedded Mitigation Measures

The following embedded mitigation measures in Table 11.21 have been identified through the design and consultation process and are incorporated as part of the proposed development. The embedded mitigation measures will not be considered again at the residual effect stage.

**Table 11.21 Embedded mitigation measures of relevance to MW&SQ**

| Measure | Mitigation detail |
|---|---|
| **Construction** | |
| Cable design | HDD of cables will be undertaken in the intertidal zone, thus avoiding direct sediment disturbance in the intertidal zone and minimising increases in suspended sediment.<br>Export and inter-array cables will be buried where practically possible to avoid the requirement for protection measures.<br>The design development process for the proposed offshore development has included a reduction in the overall array area, which has a potential beneficial reduction to impacts on marine physical processes receptors (see the Physical Processes chapter) |
| Cable specification and installation measures | Development of a detailed CBRA to enable informed judgements regarding burial depth to maximise the chance of cables remaining buried whilst limiting the amount of sediment disturbance to that which is necessary. |
| Pollution prevention design measures | Marine pollution contingency measures will be implemented as part of Volume 8, Appendix 6.1: Offshore Environmental Management Plan (EMP; hereafter the Offshore EMP) to manage the risk of accidental spillages from construction equipment or collision incidents.<br>This will include a chemical risk review with information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance.<br>Typical measures will include: |

| Measure | Mitigation detail |
| --- | --- |
| | storage of all chemicals in secure designated areas with impermeable bunding (generally to 110% of the volume); and<br>double skinning of pipes and tanks containing hazardous materials.<br>This measure would reduce the likelihood of potentially harmful pollutants to be released into the marine environment and ensure that potential for contaminant release is strictly controlled. |
| Pollution prevention management and best practice measures | The Offshore EMP includes Marine Pollution Contingency elements and incorporates procedures to cover accidental spills, potential contaminant release and include key emergency contact details (e.g. Marine Survey Office (MSO), Commissioners for Irish Lights (CIL) and Irish Coast Guard (IRCG) and the proposed development site co-ordinator). Guidance for Pollution Prevention 5 (GPP5): Works and maintenance in or near water has been used to inform the development of the Offshore EMP.<br>Measures to ensure safe passage of vessels and avoid collision are also captured within Appendix 17.2: Vessel Management Plan (VMP). |
| Disposal of waste management | The developer commits to the disposal of sewage and other waste in a manner which complies with all regulatory requirements, including but not limited to the International Maritime Organization (IMO) International Convention for the Prevention of Pollution from Ships (MARPOL) requirements. |
| **Operation** | |
| Scour protection and cable protection measures | Development of a Scour Protection and Cable Protection strategy which sets out the details of the protection where there is the potential for scour to develop around wind farm infrastructure, including turbine and substation/ platform foundations and cables. This will be included within the Offshore EMP once the site condition information is available following the detailed site investigation surveys. |
| Scour protection of other infrastructure | In areas where there is potential for scour pits to develop around the foundations of structure, there is potential for release of sediment and concurrent sediment-bound contaminants into the water column. Therefore, in areas where there is potential for scour pits to occur  scour protection will be implemented removing the potential for scour development. |
| **Decommissioning** | |
| Removal of infrastructure | Infrastructure above seabed level will be removed and foundations cut to approximately 1 to 2m below seabed level and it is anticipated that cables, cable protection and scour protection will remain in-situ' and there will be secure burial of export cables in the intertidal area. These measures will reduce the potential for seabed disturbance and thus increased suspended sediment concentrations and the release of sediment-bound contaminants. This will be managed as part of the decommissioning strategy within the Offshore EMP. |
| Assessment of impacts and best practice environmental management | Prior to decommissioning a study of the potential environmental impacts to benthic ecology receptors from the proposed decommissioning activities will be undertaken, considering the baseline environment at the pre-decommissioning stage. All mitigation measures to be captured will be captured within the Rehabilitation Schedule and decommissioning strategy within the Offshore EMP. Any licences or authorisations that might be required will be identified and obtained prior to decommissioning, including any validation, updating or new submission of an EIAR, as required. |

### 11.4.6 Potential Impacts

The identification of potential impacts has been undertaken by considering the relevant characteristics from both project options (refer to Section 11.4.1) and the potential for a pathway for direct and indirect effects on known receptors (as identified in Section 11.4.1). Each identified impact relevant to MW&SQ is presented in Table 11.22.

For each impact, the relevant characteristics of Project Option 1 and Project Option 2 are presented to determine the magnitude (size or extent) of the potential impact, defined by the proposed development parameters in the Offshore Description Chapter and in consideration of the WTG Limits of Deviation (LoD[6]), in line with the approach detailed in the EIAR Methodology chapter. A comparison of the project options has then been undertaken to determine which project option has the greatest magnitude of impact.

The marine processes model identified potential impact pathway scenarios. The scenarios identified are C-01, C-03, C-04. C-05 and C-06. These scenarios form the basis of the particle tracking modelling relating to seabed preparation works, cable installation (both array area and ECC), and the HDD works and bentonite release at landfall.

[6] Both Project Option 1 and Project Option 2 layouts have a 500m Limit of Deviation (LoD)

Further detail can be found in Volume 9, Appendix 10.1: Marine Processes Review of Project Options. The results of the marine processes model have been used to inform the assessment of some of the impacts in this chapter.

**Table 11.22 Potential impacts per project option. The project option that has the greatest magnitude of impact is identified in blue.**

| Potential impact | Project Option 1 (49 WTG) | Project Option 2 (35 WTG) | Rationale for the project option with the greatest magnitude of impact |
|---|---|---|---|
| **Construction** | | | |
| 1. Deterioration in water quality due to sediment suspension.<br><br>Temporary increases may occur as a result of construction (i.e. seabed levelling). This in turn may result in a reduction of water clarity and potentially the resuspension of nutrients and contaminants (see Impact 4). | **Total volume of suspended sediment and sediment deposition 805,292m$^3$.**<br><br>**WTG foundation drill cuttings:**<br><br>49 turbines foundations with 75% requiring drilling = 338,243m$^3$<br><br>**OSP foundations (array):**<br><br>One OSP foundation requiring seabed preparation and drilling = 22,089m$^3$<br><br>**Cable trenching:**<br><br>Installation of 111km of array cables = 333,000m$^3$<br><br>Installation of two (18 km) export cables resulting in the suspension of 108,000m$^3$ of sediment (excluding the part of the export cable within the array area).<br><br>**Subtidal HDD:**<br><br>Exit pits total volume = 3,960m$^3$.<br><br>Release of drilling muds (i.e. bentonite) during exit pit punch-out = 30 tonnes | **Total volume of suspended sediment and sediment deposition 897,061m$^3$.**<br><br>**WTG Foundations:**<br><br>35 turbine foundations with 100% requiring drilling, resulting in the suspension of 356,257m$^3$ of sediment.<br><br>**OSP Foundations (array):**<br><br>One OSP foundation requiring seabed preparation, resulting in the suspension of 22,089m$^3$ of sediment.<br><br>**Cable Trenching:**<br><br>Installation of 91km of array cables resulting in the suspension of 237,000m$^3$ of sediment.<br><br>Installation of two (18km) export cables resulting in the suspension of 108,000m$^3$ of sediment (excluding the part of the export cable within the array).<br><br>**Subtidal HDD:**<br><br>Exit pits total volume = 3,960m$^3$.<br><br>Release of drilling muds (i.e. bentonite) during exit pit punch-out = 30 tonnes | **Project Option 1 represents the greatest magnitude of impact in relation to this impact.**<br><br>Project Option 1 results in the greatest sediment volumes being disturbed for all construction activities.<br><br>The method selected also allows for the most energetic sediment release into the water column:<br><br>Trailing Suction Hopper Dredger (TSHD) for seabed preparation works and sediment disposal at the sea surface (scenario C-01); and<br><br>Jetting for:<br><br>inter-array cable trenching (scenario C-03); and<br><br>jetting for ECC trenching (scenario C-04). |
| 2. Accidental releases or spills of materials or chemicals.<br><br>The proposed development has the potential to result in accidental spills during all phases, including construction. If an accidental spill were to occur, this may lower the water quality in the study area. | **Construction component substances:**<br><br>Each WTG will contain components that require lubricating oils, hydraulic oils and coolants for operations such as grease, synthetic oil, nitrogen, transformer oil, sulphur hexafluoride (SF6) and glycerol. The volume of oils and fluids will vary depending on the WTG design.<br><br>The OSP will contain diesel for the emergency diesel generators contained in tanks, oil for transformers, deionised water for cooling systems, glycol, lead acid for UPS and batteries, engine oil and SF6. | **Construction component substances:**<br><br>Each WTG will contain components that require lubricating oils, hydraulic oils and coolants for operations such as grease, synthetic oil, nitrogen, transformer oil, sulphur hexafluoride (SF6) and glycerol. The volume of oils and fluids will vary depending on the WTG design.<br><br>The OSP will contain diesel for the emergency diesel generators contained in tanks, oil for transformers, deionised water for cooling systems, glycol, lead acid for UPS and batteries, engine oil and SF6. | **Project Option 1 represents the greatest magnitude of impact in relation to this impact.**<br><br>Project Option 1 presents the design with the greatest potential for accidental spills or releases (due to WTG/OSP presence, and number of vessel movement) during the construction period.<br><br>These parameters present the greatest volumes of compounds which could be associated with the proposed development infrastructure. |

| Potential impact | Project Option 1 (49 WTG) | Project Option 2 (35 WTG) | Rationale for the project option with the greatest magnitude of impact |
|---|---|---|---|
| | **WTGs:**<br>49 turbines, each with the potential for accidental spills/releases.<br>**OSP:**<br>One OSP, with potential for accidental spills/releases.<br>**Construction vessels:**<br>• 10 helicopter trips will occur during WTG installation;<br>• 672 vessel return trips for WTG installation<br>• 570 vessel return trips for WTG commissioning<br>• 350 vessel return trips will occur during foundation installation activities;<br>• 560 vessel return trips for OSP installation<br>• 140 vessel return trips during inter-array cable installation;<br>• 92 vessel return trips during export cable installation;<br>• 672 guard vessel return trips<br>• Maximum vessel return trips for construction stage: 3,008 | **WTGs:**<br>35 turbines, each with the potential for accidental spills/releases.<br>**OSP:**<br>One OSP, with potential for accidental spills/releases.<br>**Construction vessels:**<br>A maximum of:<br>• 10 helicopter trips will occur during WTG installation;<br>• 500 vessel return trips for WTG installation<br>• 440 vessel return trips for WTG commissioning<br>• 150 vessel trips will occur during foundation installation activities;<br>• 560 vessel return trips for OSP installation<br>• 120 vessel trips during inter-array cable installation;<br>• 92 vessel return trips during export cable installation;<br>• 572 guard vessel return trips<br>• Maximum vessel return trips for construction stage: 2,530 | |
| 3. Deterioration in water clarity due to the release of drilling mud. | Two offshore HDD subtidal exit pits require excavation of 3,960m$^3$ which will be side-cast onto the adjacent seabed. Backfilling of exit pits will recover a similar amount from the surrounding seabed, as required.<br>Drilling mud loss of 30 tonnes as associated release rates of bentonite are 4,000g/s (for 100 seconds) followed by a release rate of 19g/s (for 24 hours) per trench. There are two trenches, therefore this results in 48 hours in total. | Two offshore HDD subtidal exit pits require excavation of 3,960m$^3$ which will be side-cast onto the adjacent seabed. Backfilling of exit pits will recover a similar amount from the surrounding seabed, as required.<br>Drilling mud loss of 30 tonnes as associated release rates of bentonite are 4,000g/s (for 100 seconds) followed by a release rate of 19g/s (for 24 hours). There are two trenches, therefore this results in 48 hours in total.<br>Cable pull in is 24 hours per cable, with 48 hours in total. | **Both project options represent the same magnitude of impact in relation to this impact.**<br>Project Option 1 and Project Option 2 both present the same excavation and drilling mud volumes, due to the identical HDD methodologies between the two options.<br>The bentonite volume of which could be released as part of the HDD cable pull in at the subtidal exit pit is considered. Further detail is provided in scenarios C-05 and C-06 within the marine processes model. The method is assumed to not allow for the capture of bentonite and as such it is released directly into the marine environment |
| 4. Release of sediment-bound contaminants from disturbed sediments. | Impact 1 represents sediment disturbance volume associated with construction activities. The greatest release of sediment bound contaminants will be associated with this greatest release of suspended sediment (due to the partitioning of contaminants into the water column from the disturbed sediment). | Impact 1 represents sediment disturbance volume associated with construction activities. The greatest release of sediment bound contaminants will be associated with this greatest release of suspended sediment (due to the partitioning of contaminants into the water column from the disturbed sediment). | **Project Option 2 represents the greatest magnitude of impact in relation to this impact.**<br>Project Option 2 results in the greatest sediment volumes being disturbed for all construction activities. |

| Potential impact | Project Option 1 (49 WTG) | Project Option 2 (35 WTG) | Rationale for the project option with the greatest magnitude of impact |
|---|---|---|---|
| | As Project Option 1 represents the greatest sediment disturbance scenario, it will also represent the greatest potential release of sediment bound contaminants. | As Project Option 1 represents the greatest sediment disturbance scenario, it will also represent the greatest potential release of sediment bound contaminants. | The method selected also allows for the most energetic sediment release into the water column:<br>Trailing Suction Hopper Dredger (TSHD) for seabed preparation works and sediment disposal at the sea surface (scenario C-01); and<br>Jetting for:<br>inter-array cable trenching (scenario C-03); and<br>jetting for ECC trenching (scenario C-04). |
| **Operation** | | | |
| 5. Deterioration in water quality due to sediment suspension.<br>Temporary increases may occur as a result of operational activities (i.e. cable protection remediation). This in turn may result in a reduction of water clarity and potentially the resuspension of nutrients and contaminants. | Increases in SSC due to activities causing seabed disturbance.<br>**Total temporary habitat disturbance: 675,134m$^2$.**<br>Array area:<br>JUV operations - Major WTG component repair/replacement = 646,540m$^2$.<br>JUV - Major OSP component replacement = 13,195m$^2$.<br>Inter array cable repair and/or replacement of cabling = 7,000m$^2$.<br>Inter array cable reburial of any section of the offshore export cable which has become exposed = 700m$^2$.<br>**ECC**<br>Export Cable - Repair and/or replacement of cabling = 7,000m$^2$.<br>Export Cable - Reburial of any section of the offshore export cable which has become exposed = 700m$^2$. | Increases in SSC due to activities causing seabed disturbance.<br>**Total temporary habitat disturbance: 675,134m$^2$.**<br>**Array area:**<br>JUV operations - Major WTG component repair/replacement = 461,814m$^2$.<br>JUV - Major OSP component replacement = 13,195m$^2$.<br>Inter array cable repair and/or replacement of cabling = 7,000m$^2$.<br>Inter array cable reburial of any section of the offshore export cable which has become exposed = 700m$^2$.<br>**ECC**<br>Export Cable - Repair and/or replacement of cabling = 7,000m$^2$.<br>Export Cable - Reburial of any section of the offshore export cable which has become exposed = 700m$^2$. | **Project Option 1 represents the greatest magnitude of impact in relation to this impact.**<br>Project Option 1 presents the design with the longest length of cabling which could require protection. |
| 6. Accidental releases or spills of materials or chemicals.<br>The proposed development has the potential to result in accidental spills during all phases, including the operational phase. | **Operational component substances:**<br>Each WTG will contain components that require lubricating oils, hydraulic oils and coolants for operations such as grease, synthetic oil, nitrogen, transformer oil, sulphur hexafluoride (SF6) and glycerol.<br>The volume of oils and fluids will vary depending on the WTG design.<br>The OSP will contain diesel for the emergency diesel generators contained in tanks, oil for transformers, deionised water for cooling systems, glycol, lead acid | **Operational component substances:**<br>Each WTG will contain components that require lubricating oils, hydraulic oils and coolants for operations such as grease, synthetic oil, nitrogen, transformer oil, sulphur hexafluoride (SF6) and glycerol.<br>The volume of oils and fluids will vary depending on the WTG design.<br>The OSP will contain diesel for the emergency diesel generators contained in tanks, oil for transformers, deionised water for cooling systems, glycol, lead acid | **Project Option 1 represents the greatest magnitude of impact in relation to this impact.**<br>Project Option 1 presents the design with the higher number of proposed vessel movement during the operational period.<br>These parameters present the largest volumes of compounds which could be associated with the proposed development infrastructure. |

| Potential impact | Project Option 1 (49 WTG) | Project Option 2 (35 WTG) | Rationale for the project option with the greatest magnitude of impact |
|---|---|---|---|
| If an accidental spill were to occur, this may lower the water quality in the study area. | for UPS and batteries, engine oil and SF6.<br>**WTGs:**<br>49 turbines, each with potential for accidental spills/releases.<br>**OSP:**<br>One OSP, with potential for accidental spills/releases.<br>**Vessels:**<br>A daily peak of 12 vessel trips will occur during operation activities. | for UPS and batteries, engine oil and SF6.<br>**WTGs:**<br>35 turbines, each with potential for accidental spills/releases.<br>**OSP:**<br>One OSP, with potential for accidental spills/releases.<br>**Vessels:**<br>A daily peak of 12 vessel trips will occur during operation activities. | |
| **Decommissioning** | | | |
| 7. Deterioration in water quality due to sediment suspension.<br>Temporary increases may occur as a result of decommissioning (i.e. removal of proposed development infrastructure). This in turn may result in a reduction of water clarity and potentially the resuspension of nutrients and contaminants. | As a worst-case scenario, it is assumed that the decommissioning phase of works is a reverse of the construction process, should there be a requirement to remove the seabed infrastructure:<br>• Array area comprising the largest number of foundations (cut to approximately 1m to 2m below seabed to be removed);<br>• Discrete lengths of cable requiring removal (envisaged buried assets will be left in-situ, unless need identified for cables to be wholly or partially removed).<br>The following are expected to remain in situ:<br>• Foundation pile lengths greater than 2m below seabed;<br>• Cables (except where removal is required);<br>• Scour protection; and<br>• Rock protection over cables.<br>The infrastructure will be decommissioned in accordance with the decommissioning plan in addition to the industry practice/option at the time. | As a worst-case scenario, it is assumed that the decommissioning phase of works is a reverse of the construction process, should there be a requirement to remove the seabed infrastructure:<br>• Array area comprising the largest number of foundations (cut to approximately 1m to 2m below seabed to be removed);<br>• Discrete lengths of cable requiring removal (envisaged buried assets will be left in-situ, unless need identified for cables to be wholly or partially removed).<br>The following are expected to remain in situ:<br>• Foundation pile lengths greater than 2m below seabed;<br>• Cables (except where removal is required);<br>• Scour protection; and<br>• Rock protection over cables.<br>The infrastructure will be decommissioned in accordance with the decommissioning plan in addition to the best environmental practice/option at the time. | **Project Option 1 represents the greatest magnitude of impact in relation to this impact.**<br>Project Option 1 represents the design with the most impactful decommissioning parameters, due to the greater amount of infrastructure that may require removal. |
| 8. Accidental releases or spills of materials or chemicals.<br>The proposed development has the potential to result in accidental spills during all phases, including decommissioning | **Decommissioning component substances:**<br>Each WTG will contain components that require lubricating oils, hydraulic oils and coolants for operations such as grease, synthetic oil, nitrogen, transformer oil, sulphur hexafluoride (SF6) and glycerol. The volume of oils and fluids will vary depending on the WTG design. | **Decommissioning component substances:**<br>Each WTG will contain components that require lubricating oils, hydraulic oils and coolants for operations such as grease, synthetic oil, nitrogen, transformer oil, sulphur hexafluoride (SF6) and glycerol. The volume of oils and fluids will vary depending on the WTG design. | **Project Option 1 represents the greatest magnitude of impact in relation to this impact.**<br>Project Option 1 presents the design with the greatest potential for vessel movement during the construction period.<br>These parameters present the greatest volumes of compounds which could be associated with the proposed development infrastructure. |

| Potential impact | Project Option 1 (49 WTG) | Project Option 2 (35 WTG) | Rationale for the project option with the greatest magnitude of impact |
|---|---|---|---|
| If an accidental spill were to occur, this may lower the water quality in the study area. | The OSP will contain diesel for the emergency diesel generators contained in tanks, oil for transformers, deionised water for cooling systems, glycol, lead acid for UPS and batteries, engine oil and SF6.<br><br>The number of decommissioning vessels will be the same as construction stage or lower (Impact 2) | The OSP will contain diesel for the emergency diesel generators contained in tanks, oil for transformers, deionised water for cooling systems, glycol, lead acid for UPS and batteries, engine oil and SF6.<br><br>The number of decommissioning vessels will be the same as construction stage or lower (Impact 2) | |

## 11.5 Potential Effects

The likely significant effects, both beneficial and adverse, on MW&SQ for each stage of the project development are considered, specifically, the likely effects of the proposed development during its construction, operational, and decommissioning phases associated with the offshore development area. The environment in the vicinity of the proposed development is naturally dynamic, and as such will exhibit some level of natural variation and change over time whether the proposed development proceeds or not. Consequently, the identification and assessment of likely significant effects must be done in the context of natural change, both spatial and temporal.

### 11.5.1 Do-Nothing Scenario

Should the proposed development not be constructed, the baseline environment is unlikely to show future natural variations out with those presented in the future receiving environment (Section 11.3).An assessment of past trends of ocean indicators provides some insight into potential future trends in the absence of any climatic interventions (Marine Institute, 2023), for example sea temperatures increased strongly from the 1980s to the mid-2000s, with the highest annual sea surface temperatures recorded in 2007 at over 0.8°C above the 1960 to 1990 average. More recently temperatures have declined by over -0.3°C/decade, hypothesised to be linked to the decline in the Atlantic Meridional Overturning Current (AMEC).

Of relevance to MW&SQ, climate change is predicted to result in a deterioration in water quality, in particular through changes in biological characteristics and nutrient loads.

A predicted increase in the frequency of extreme weather events, increased water flows and temperature fluctuations will also result in a reduction in water quality (EPA, 2021a; Walker Institute for Climate Change, 2014). Further information relating to climate change implications upon the marine physical processes, including metocean conditions, is provided in the Physical Processes chapter.

The receiving environment is not static and will exhibit some degree of natural change over time, due to naturally occurring cycles and processes. Therefore, when undertaking impact assessments, it is necessary to place any potential impacts in the context of the envelope of change that might occur naturally over the timescale of the proposed development.

Further to potential change associated with existing cycles and processes, it is necessary to take account of the potential likely significant effects of climate change on the marine environment. The quality of the marine environment remains at risk from the impact of global climate change, especially increasing sea temperatures (SEIA, 2010). The marine environment is impacted by warming temperatures, changing wind patterns, shifting oceanic circulation patterns, increasing acidification, and altering precipitation rates and associated salinity (Marine Institute, 2023).

Sea surface temperatures in Irish waters have shown a progressive warming from the mid-1980s (Marine Institute, 2023). The warming observed in the last three decades has been particularly strong in parts of the north-east Atlantic, with the sea surface around Ireland warming at rates up to six times greater than the global average (Dye et al., 2013).

In addition to marine temperature changes influencing marine habitats, it can also result in deoxygenation within the water column. Over decadal timescales, there has been a measurable decline in dissolved oxygen content in the global ocean in response to ocean warming (Mahaffey et al., 2020), with a further 7% decrease predicted for the year 2100 (IPCC, 2013).

As such, the baseline presented in the preceding sections of this chapter presents a ‘snapshot’ of the present MW&SQ conditions within a gradually, yet continuously, changing environment. Any changes that may occur during the proposed development’s 35-year design life span should be considered in the context of both greater variability and sustained trends occurring on national and international scales within the marine environment.

#### *11.5.1.1 Development Scenario*

The following sections present an assessment of the proposed development’s effects upon MW&SQ receptors based upon the Project Option 1 and Project Option 2 presented in Table 11.20.

***Increases in suspended sediment***

An assessment of the potential SSC increases is presented in the Physical Processes chapter for all lifecycle phases. The conclusions of this MW&SQ assessment are primarily based upon this sediment plume assessment, the full details of which, including the methodological approach used to assess the characteristics of sediment plumes and associated bed level changes are given in Volume 9, Appendix 10.1: Marine Processes Review of Project Options.

For ease of reference, this section provides a summary of the key results regarding the likely significant effects upon SSC that have been used to inform this MW&SQ assessment.

The predicted SSC increases are temporary relative to the baseline conditions (Section 11.3.1.3). The increases are presented on a scale relative to the baseline conditions and are shown in Table 11.23 (further detail is provided in the Physical Processes chapter.

**Table 11.23 Assessment of elevated suspended sediment concentrations**

| Suspended Sediment Concentration (mg/l) | Relative to baseline conditions |
|---|---|
| <1 | Trace level, largely undetectable |
| 1-2 | Normal variation in ambient concentration (magnitude of standard deviation) |
| 2-5 | Typical ambient concentration (summer) |
| 5-10 | Typical ambient concentration (winter) |
| 10–20 | 2*ambient |
| 20–50 | 4*ambient |
| 50–100 | 10*ambient |
| 100–200 | 20*ambient |
| 200–500 | 40*ambient |
| 500–1,000 | 100*ambient |
| 1,000 | 200*ambient |

### 11.5.2 Construction Phase

This section presents the assessment of impacts arising from the construction phase of the proposed development. The effects of construction of the proposed development have been assessed upon MW&SQ receptors. The potential impacts arising from construction of the proposed development are listed in Table 11.22 along with the project option with the greatest magnitude of impact against which each construction phase impact has been assessed. A description of the likely significant effects upon MW&SQ receptors caused by each identified impact is given below.

The different construction activities have been numerically assessed and reported in detail within the Physical Processes chapter. The results have been used to inform the MW&SQ assessments, for which a summary of these assessments is provided below:

- Seabed preparation activities using TSHD dredge and disposal (Figure 10.11):
  - The greatest SSC (approximately 1,000mg/l) remain within the ZoI
  - Subsequent excursions (with concentrations <100mg/l) tend to develop a net excursion to the north due to the flood dominant flow; and
  - After, approximately, 20 hours following initial release, the sediment plume covers an area of between 0.2 to 0.4km$^2$ on neap releases (peak concentration around 240 to 270mg/l) and 0.8 to 0.9km$^2$ on spring releases (peak concentration of 100 to 110mg/l).
- Foundation installation using drill techniques (Figure 10.13):
  - Highest concentrations in the range 500 to 1,000mg/l are confined close to the point of discharge
  - All occasions with an increased concentration of suspended sediment above background > 10mg/l remain within the tidal excursion buffer
  - Outside the tidal excursion buffer suspended sediment concentrations are <10mg/l and equivalent to background levels
  - After, approximately, 20 hours following initial release, the sediment plume covers an area of up to 8km2 on neap releases (peak concentration around 26mg/l) and 10km2 on spring releases (peak concentration of around 31mg/l).
- Cable installation using jetting (inter-array cable and export cable):
  - Inter-array cables (Figure 10.15): elevated SSC resulting from inter-array cable construction activities result in sediment plumes aligned to the tidal flow, predominately in a northerly direction with no advection towards the coast. Once trenching activities are completed, the plume advects with the tide, increasing in size, which in turn lowers concentrations. Specifically:
    - The highest SSC (300 to 500mg/l) occurs along the trenching line and only during jetting activities
    - All concentrations less than 50mg/l remain within the ZoI; and
    - After, approximately, 20 hours following initial release, the narrow plume covers an area between 1.7 to 2.1km$^2$ on neap releases (peak concentration around 20 to 10mg/l, respectively) and 4.7 to 5.5km$^2$ on spring releases (peak concentration of 11 to 8mg/l, respectively).
  - Export cables (Figure 10.17; Figure 11.11): once the activity is completed, the sediment plume advects away from the source with the tide. In doing so, it increases in size due to spreading and dispersing which in turn lowers the SSC:
    - The highest SSC (600 to 800mg/l) occurs along the trenching line and only during jetting activities
    - The actual size of the sediment plume varies over time and distance from source, initially being small in width but elongated over the length of the 1.9km section of cable over the six-hour release period; and
    - After, approximately, 10 hours following initial release, the narrow plume covers an area of between 1.2 to 1.7km$^2$ on neap releases (peak concentration around 5 to 2mg/l, respectively) and 3.6 to 3.9km$^2$ on spring releases (peak concentration of up to 2mg/l).
- Subtidal HDD exit pit excavation and cable installation:
  - Subtidal HDD exit pits (Figure 10.19; Figure 11.12):

  - Spring tide releases indicate a maximum excursion distance of the sediment plume along the coast of around 2.2km to the north-west (flood) and to the south-east (ebb) for concentrations greater than 1mg/l
  - Neap releases travel a shorter distance along the coast of around 1.3km on flood and ebb
  - All releases cross in front of Balbriggan Bay (around 1.5km south of the exit pits) but with concentrations that remain low at all times (less than 10mg/l) and for a short duration (less than four hours). The highest elevated concentrations remain close to the exit pits with levels up to 1,120mg/l.
- Subtidal bentonite release (Figure 10.21; Figure 11.13):
  - Spring tide releases indicate a maximum excursion distance of around 1.1km to the north-west (flood) and 0.8km to the south-east (ebb) for concentrations greater than 1mg/l
  - Neap releases travel a shorter distance along the coast
  - Concentrations greater than 1mg/l do not reach Balbriggan Bay (around 1.5km south of the exit pits). The highest elevated concentrations remain close the exit pits with levels up to 29mg/l.

#### *11.5.2.1 Impact 1: Deterioration in water quality due to sediment suspension*

Elevated SSC resulting from the generation of sediment plumes are a consequence of the following offshore construction activities (Table 11.23):

- Seabed preparation and installation of:
  - WTG foundations
  - OSP foundations
  - Inter-array cables; and
  - ECC cables.

An increase in SSC, and thus turbidity, may result in a decrease in the depth to which natural light can penetrate into the water column. In turn, this may result in a reduction in primary productivity and/or an increase in bacterial growth. Seabed disturbance may also release additional, previously sediment-bound, nutrients into the water column, consequentially increasing associated concentrations.

Fish and many other organisms require dissolved oxygen in the water to survive. Dissolved oxygen levels can decrease due to various factors, including rapid temperature and salinity changes, 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. Bacteria and other decomposer organisms then use oxygen to break down the available organic matter, thus reducing dissolved oxygen levels in the water column.

***Sensitivity of the receptor***

In accordance with the criteria detailed in Table 11.3, the sensitivity of the identified MW&SQ receptors are:

- Bathing Waters: medium sensitivity for potential increased bacterial counts (due to national designation and moderate capacity to accommodate the changes within natural variation)
- Shellfish Water Protected Areas: low sensitivity to reductions in water clarity (due to the regional importance of razor clams together with their medium tolerance to, and medium to high recoverability from increases in SSCs (further detail is provided in Volume 3, Chapter 13: Fish and Shellfish Ecology)
- WFD water bodies (six coastal and two transitional): medium sensitivity with respect to water quality reductions (due to international designation and moderate capacity to accommodate the changes within natural variation)

- Non-designated waters: negligible sensitivity (due to resistance to temporary reductions in water clarity).

***Magnitude of impact***

The magnitude of impact for each of the offshore construction activities identified in Table 11.22 has been presented in Section 11.4.6 of this report and is fully detailed in the Physical Processes chapter.

The proposed activities are not anticipated to affect phytoplankton or dissolved oxygen as no nutrients are anticipated to be continually released in concentrations from the seabed. Further, there will be no outfalls or discharges associated with the proposed development. As such, the proposed activities are not expected to cause a reduction in the dissolved oxygen in the water column. Consequently, no source-receptor-pathways are identified for a deterioration of dissolved oxygen, phytoplankton blooms or eutrophication, as a result of the proposed construction activities.

The maximum concentration at the centre of the plume anticipated after one day of cessation of jetting or the disposal of spoil will be less than 270mg/l (40* ambient levels; Table 11.23). This would be classified as 'medium turbidity[7]' in the UKTAG (2014) water turbidity ranking. Less than a week following the completion of activities, the sediment plumes would be immeasurable in practice beyond ambient levels (Table 11.23) and classified as 'clear'[8] (UKTAG, 2014).

Bacterial mortality, including *E.coli* and IE, within the water column is strongly influenced by the amount of ultraviolet (UV) light penetrating the water column. Under higher UV scenarios, the mortality of bacteria is higher. Therefore, 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 and UV light within the water column, and the potential release of sediment bound bacteria (including *E.coli* and IE). These elevated bacterial counts could theoretically cause a water quality deterioration and should this occur at the identified Bathing Waters (Section 11.3.6) during the designated bathing season, it may theoretically cause a deterioration in their performance classifications (Table 11.16).

Given the temporary nature of the activities in addition to tidal dispersion, it is expected that any bacterial increases in the water column would be in the order of days, i.e. as long as the plumes persisted. Following the sediment plumes dispersion, and subsequent increases in UV light, the bacterial counts in the water column will return to "do-nothing" baseline conditions.

Activities disturbing sediment undertaken in the array area are not anticipated to impact on the designated WFD waterbodies. The project-specific modelling indicates that no works undertaken in the array area (Figures 10.15, 10.17, and 10.19 in the Physical Processes chapter) have measurable changes in SSC within the WFD water bodies.

The SSC elevation and associated decrease in bacterial mortality, would be localised, within the range of natural variability and temporary. The magnitude of these elevated SSC and potential bacterial counts on water quality receptors are considered to be negligible**.**

***Significance of the effect***

In accordance with the matrix presented in Table 11.5, significance of the effect of Project Option 1 and Project Option 2 upon the identified MW&SQ receptors are:

- Bathing Waters: Overall, it is predicted that the sensitivity of Bathing Waters for Project Option 1 and Project Option 2 is medium and the magnitude of the impact is negligible. The medium sensitivity and negligible magnitude of the impact on Bathing Waters receptors could result in a not significant effect, which is not significant in EIA terms

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[7] 100 to 300mg/l

[8] less than 10mg/l

- Shellfish Water Protected Areas: Overall, it is predicted that the sensitivity of Shellfish Water Protected Areas receptors for Project Option 1 and Project Option 2 is low and the magnitude of the impact is negligible. The low sensitivity and negligible magnitude of the impact on Shellfish Water Protected Areas receptors could result in a not significant effect, which is not significant in EIA terms

- WFD water bodies (six coastal and two transitional): Overall, it is predicted that the sensitivity of the WFD water body receptors for Project Option 1 and Project Option 2 is medium and the magnitude of the effect is negligible. The medium sensitivity and negligible magnitude of the impact on WFD water body receptors could result in a not significant effect, which is not significant in EIA terms

- Non-designated waters: Overall, it is predicted that the sensitivity of the non-designated water receptors for Project Option 1 and Project Option 2 is negligible and the magnitude of the impact is negligible. The negligible sensitivity and negligible magnitude of the impact on non-designated water receptors could result in an imperceptible effect, which is not significant in EIA terms.

#### *11.5.2.2 Impact 2: Accidental releases or spills of materials or chemicals*

There is a possibility that substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment. The Developer is committed to the use of good practice, due diligence and pollution prevention guidelines at all times. Any planned releases will adhere to the pollution prevention and control requirements of the Industrial Emissions Directive 2010/75/EU (European Parliament and Council, 2010) as well as to MARPOL in order to ensure any potential risk is minimised. Any planned discharges be permitted small volumes, intermittent and would dilute and disperse quickly. Should an accidental spill occur, all relevant parties will be informed to manage any such event.

***Sensitivity of the receptor***

In accordance with the criteria detailed in Table 11.3, the sensitivity of the identified MW&SQ receptors are:

- Bathing Waters: the status of these receptors is dependent on bacterial counts, which is independent from accidental spills and consequently is considered to be of negligible sensitivity

- Shellfish Water Protected Areas: as presented in Volume 3, Chapter 13: Fish and Shellfish Ecology, there is a lack of research on the sensitivity of the shellfish to the predicted changes resulting from increased chemical/ material spills. Therefore, a precautionary approach has been adopted, assuming the greatest magnitude of sensitivity. As such the sensitivity of shellfish receptors to the accidental releases/ spills is considered to be high

- WFD water bodies (six coastal and two transitional): whilst these receptors are internationally designated sites under the WFD, it is considered that they have a high ability to accommodate a small accidental spill (if it were to occur). The sensitivity of the water bodies to the change is considered low

- Non-designated waters: negligible sensitivity as these sites have no international/ national designation and are able to tolerate changes resulting from accidental spill events.

***Magnitude of impact***

There are no discharges (continuous or intermittent) proposed during the construction phase, with the exception of drilling mud (see Impact 3). The most impactful options for the volumes of chemicals and materials used in the construction/ infrastructure associated with the proposed development are presented in Table 11.22.

Any quantities of accidentally released materials are likely to be small with associated lateral and vertical dispersion rates expected to be high. The potential impacts will be temporary in nature and project controls will be in place. The magnitude of this potential impact is considered to be negligible; it is not anticipated to affect the designated water bodies performance against their EQSs.

***Significance of the effect***

In accordance with the matrix presented in Table 11.5 significance of the effect of Project Option 1 and Project Option 2 upon the identified MW&SQ receptors are:

- Bathing Waters: Overall, it is predicted that the sensitivity of Bathing Water receptors for Project Option 1 and Project Option 2 is negligible and the magnitude of the impact on Bathing Water receptors is negligible. The negligible sensitivity and negligible magnitude of the impact on Bathing Water receptors could result in an imperceptible effect, which is not significant in EIA terms
- Shellfish Water Protected Areas: Overall, it is predicted that the sensitivity of Shellfish Water Protected Area receptors for Project Option 1 and Project Option 2 is high and the magnitude of the impact is negligible. The high sensitivity and negligible magnitude of the impact on Shellfish Water Protected Area receptors could result in a not significant effect, which is not significant in EIA terms
- WFD water bodies (six coastal and two transitional): Overall, it is predicted that the sensitivity of the WFD water body receptors is low and the magnitude of the impact is negligible. The low sensitivity and negligible magnitude of the impact on WFD water body receptors could result in a not significant effect, which is not significant in EIA terms
- Non-designated waters: Overall, it is predicted that the sensitivity of the non-designated water receptors is negligible and the magnitude of the impact is negligible. The negligible sensitivity and negligible magnitude of the impact on non-designated water receptors could result in an imperceptible effect, which is not significant in EIA terms.

#### *11.5.2.3 Impact 3: Deterioration in water quality due to the release of drilling mud*

In order to undertake HDD and make landfall, there is a requirement to use drilling mud, such as bentonite (or another inert mud). The option with the greatest magnitude of impact (in this case both project options) assumes that drilling mud will be released within the subtidal area at the punch out point.

Bentonite is a non-toxic, inert, natural clay mineral (<63µm particle diameter) included in the List of Notified Chemicals approved for use and discharge into the marine environment. Classified as a Group E substance under the Offshore Chemical Notification Scheme[9] for which it is least likely to cause environmental harm being "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).

This assessment has been based on the maximum bentonite volume which could be released into the environment (Table 11.18). The principal issue, for MW&SQ receptors, relating to bentonite release to the water column comprises the potential for an increase in SSC (and so turbidity) within the water column and thus a potential reduction in bacterial mortality, as detailed in *Impact 1: deterioration in water quality due to suspension of sediment*.

With the exception of the potential for increased turbidity from a bentonite release, no other potential deterioration in water quality, such as the introduction of contaminants or nutrients, is anticipated following the release of drilling mud.

***Sensitivity of the receptor***

In accordance with the criteria detailed in Table 11.3, the sensitivity of the identified MW&SQ receptors are:

- Bathing Water: medium sensitivity for potential increased bacterial counts (due to national designation and moderate capacity to accommodate the changes within natural variation)

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[9] https://www.cefas.co.uk/cefas-data-hub/offshore-chemical-notification-scheme/hazard-assessment/

- Shellfish Water Protected Area: low sensitivity to reductions in water clarity (due to the regional importance of razor clams together with their medium tolerance to, and medium to high recoverability from increases in SSCs (further detail is provided in Volume 3, Chapter 13: Fish and Shellfish Ecology)
- WFD water body (one coastal): medium sensitivity with respect to water quality reductions (due to international designation and moderate capacity to accommodate the changes within natural variation)
- Non-designated waters: negligible sensitivity (due to resistance to temporary reductions in water clarity).

***Magnitude of impact***

Bentonite is a clay-based substance and as such may persist in suspension for hours to days following its release, becoming diluted to very low concentrations (indistinguishable from natural background levels and variability). The majority of the plume will be advected in the direction of the ambient tidal currents, which are broadly aligned to the coast. The transport direction will depend upon the tidal state (flood/ebb) during release and it is expected that the plume would be dispersed to relatively low concentrations within hours of release and to background concentrations within a few tidal cycles.

As previously described, a relationship exists between increased turbidity/SSC and decreased bacterial mortality within the water column. Given the predicted dilution levels, the temporary nature of the activities and SSC dispersion by tidal currents, it is expected that any bacterial increases within the water column would be in the order of days. Following the dispersion of the bentonite plumes, and subsequent increases in UV light, the bacterial counts in the water column will return to "do-nothing" baseline conditions. The resultant reduction in water clarity is considered to be analogous to storm events and as such these potential changes remain within the marine environment's natural variation.

The SSC elevation and potential decrease in bacterial mortality as a consequence of the release of inert drilling mud, such as bentonite, is considered to be temporary, localised and within the range of natural variability.

As shown in Figure 11.9 and Figure 10.21, the only designated MW&SQ receptors likely to be impacted by the release of construction associated material at landfall are:

- Bathing Water: Balbriggan, Front Strand Beach
- Shellfish Water Protected Areas: Balbriggan/ Skerries; and
- WFD water bodies: Northwestern Irish Sea.

The magnitude of the elevated suspended sediment concentrations (Figure 10.21) is temporary and comparable to ambient conditions away from the disturbance location and therefore is considered to be low.

***Significance of the effect***

In accordance with the matrix presented in Table 11.5, significance of the effect of Project Option 1 and Project Option 2 upon the identified MW&SQ receptors are:

- Bathing Water: Overall, it is predicted that the sensitivity of the Bathing Water receptors for Project Option 1 and Project Option 2 is medium and the magnitude of the impact is low. The medium sensitivity and low magnitude of the impact on Bathing Water receptors could result in a slight effect, which is not significant in EIA terms
- Shellfish Water Protected Area: Overall, it is predicted that the sensitivity of the Shellfish Water Protected Area receptors is low and the magnitude of the impact is low. The low sensitivity and low magnitude of the impact on Shellfish Water Protected Area receptors could result in a slight effect, which is not significant in EIA terms
- WFD water body (one coastal): Overall, it is predicted that the sensitivity of the WFD water body receptors for Project Option 1 and Project Option 2 is medium and the magnitude of the impact is low. The medium sensitivity and low magnitude of the impact on WFD water body receptors could result in a slight effect, which is not significant in EIA terms

- Non-designated waters: Overall, it is predicted that the sensitivity of the non-designated water receptors for Project Option 1 and Project Option 2 is negligible and the magnitude of the impact is low. The negligible sensitivity and low magnitude of the impact on non-designated water receptors could result in an imperceptible effect, which is not significant in EIA terms.

#### *11.5.2.4 Impact 4: Release of sediment-bound contaminants from disturbed sediments*

The construction activities associated with the proposed development have the potential to increase SSC in the marine environment through the generation of sediment plumes. Whilst 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 adverse effect on water quality receptors.

As stated in Sections 11.3.4 and 11.3.5, sediment contamination levels:

- Within the array area are below Irish Action Levels; and
- Along the ECC, there were generally low contaminant concentrations within the sediments sampled with exceedance above Irish Action Lower Level for arsenic, cadmium, chromium, lead, and zinc at four sample locations (Figure 11.7).

***Sensitivity of the receptor***

In accordance with the criteria detailed in Table 11.3, the sensitivity of the identified MW&SQ receptors are:

- Bathing Waters: the status of these receptors is dependent on bacterial counts rather than any temporary increase in contaminated sediments and consequently is considered to be of low sensitivity
- Shellfish Water Protected Areas: as presented in Volume 3, Chapter 13: Fish and Shellfish Ecology, there is a lack of research on the sensitivity of the shellfish to the predicted changes in contaminant levels. Therefore, a precautionary approach has been adopted, assuming the greatest magnitude of sensitivity. As such the sensitivity of shellfish receptors to the disturbance and release of contaminated sediments is considered to be high
- WFD water bodies (six coastal and two transitional): whilst these receptors are internationally designated sites under the WFD, it is considered that they have a medium ability to accommodate a temporary increase in contaminated sediments. The sensitivity of the water bodies to the change is considered medium
- Non-designated waters: negligible sensitivity as such as those within the array area, are judged to be insensitive to short-term and discrete disturbances of the sediments present which may release sediment-bound contaminants. There is no applicable quality status which may be affected by these works. The sensitivity of non-designated waters is judged to be negligible.

***Magnitude of impact***

An assessment of sediment plumes (see the Physical Processes chapter) as previously summarised, indicates the rapid dispersion of suspended sediments following the cessation of seabed disturbance activities. As such, any contaminant release, such as metals and PAHs, is also likely to be rapidly dispersed with the tidal currents; therefore increased bioavailability resulting in adverse eco-toxicological effects is not expected.

Under normal circumstances, whilst very small concentrations of contaminants enter the dissolved phase, the vast majority will adhere to 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 typically 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 MAC EQS threshold will be exceeded for any of the substances as a result of disturbing sediment from the proposed activities, given the fates of the plumes.

Moreover, given the short-term nature of the works and presence of the sediment plumes, any small uplift in the water concentrations of ESQ substances that might occur would be anticipated to rapidly return to ambient levels.

Of note, is that any installation activities within the array area which disturb the seabed sediment are not anticipated to impact on the designated WFD waterbodies. The project-specific modelling indicates that no works undertaken in the array area have measurable changes in SSC within the WFD water bodies (see the Physical Processes chapter).

The magnitude of this potential impact is considered to be low as a result of the short-term nature of the impact. Furthermore, it is not anticipated that disturbance of sediment-bound contaminants would affect a water body's performance against its EQSs as the potential impacts will be temporary in nature.

***Significance of the effect***

In accordance with the matrix presented in Table 11.5, significance of the effect of Project Option 1 and Project Option 2 upon the identified MW&SQ receptors are:

- Bathing Waters: Overall, it is predicted that the sensitivity of the Bathing Water receptors for Project Option 1 and Project Option 2 is low and the magnitude of the impact is low. The low sensitivity and low magnitude of the impact on Bathing Water receptors could result in a slight effect, which is not significant in EIA terms
- Shellfish Water Protected Areas: Overall, it is predicted that the sensitivity of the Shellfish Water Protected Area receptors for Project Option 1 and Project Option 2 is high and the magnitude of the impact is low. The high sensitivity and low magnitude of the impact on Shellfish Water Protected Area receptors could result in a moderate effect, which is not significant in EIA terms
- WFD water bodies (six coastal and two transitional): Overall, it is predicted that the sensitivity of the WFD water body receptors for Project Option 1 and Project Option 2 is medium and the magnitude of the impact is low. The medium sensitivity and low magnitude of the impact on WFD water body receptors could result in a slight effect, which is not significant in EIA terms
- Non-designated waters: Overall, it is predicted that the sensitivity of the non-designated water receptors for Project Option 1 and Project Option 2 is negligible and the magnitude of the impact is low. The negligible sensitivity and low magnitude of the impact on non-designated water receptors could result in an imperceptible effect, which is not significant in EIA terms.

### 11.5.3 Operational Phase

The impacts of the activities during the operational phase of the proposed development have been assessed on MW&SQ receptors. A description of the significance of effect upon MW&SQ receptors caused by each identified impact is provided below.

#### *11.5.3.1 Impact 5: Deterioration in water quality due to sediment suspension*

As presented in Table 11.22, 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 and bed level changes associated with cable installation activities (see the Physical Processes chapter). The lengths of exposed/damaged cable would be shorter and the potential impacts would consequently be more localised and occur over a shorter duration than those considered during the construction phase.

Any operational activities which are undertaken in the array area are considered highly unlikely to impact on designated WFD waterbodies, as presented in the assessment undertaken in the Physical Processes chapter.

***Sensitivity of the receptor***

In accordance with the criteria detailed in Table 11.3, the sensitivity of the identified MW&SQ receptors are:

- Bathing Waters: medium sensitivity for potential increased bacterial counts (with a moderate capacity to accommodate the changes within natural variation)
- Shellfish Water Protected Areas: low sensitivity to reductions in water clarity (due to the regional importance of razor clams together with their medium tolerance to, and medium to high recoverability from increases in SSCs (further detail is provided in Volume 3, Chapter 13: Fish and Shellfish Ecology)

- WFD water bodies (six coastal and two transitional): medium sensitivity with respect to water quality reductions
- Non-designated waters: negligible sensitivity to temporary reductions in water clarity.

***Magnitude of impact***

The magnitude of the impact on water quality resulting from operational activities would be no greater than those assessed in Impact 1. Therefore, the magnitude of the impact is considered to be negligible for the potential deterioration in water quality.

***Significance of the effect***

In accordance with the matrix presented in Table 11.5, significance of the effect of Project Option 1 and Project Option 2 upon the identified MW&SQ receptors are:

- Bathing Waters: Overall, the sensitivity of the Bathing Waters receptors from Project Option 1 and Project Option 2 is medium and the magnitude of impact is negligible. The medium sensitivity and negligible magnitude of the impact on Bathing Water receptors could result in a not significant effect, which is not significant in EIA terms
- Shellfish Water Protected Areas: Overall, it is predicted that the sensitivity of the Shellfish Water Protected Area receptors for Project Option 1 and Project Option 2 is low and the magnitude of the impact is negligible. The low sensitivity and negligible magnitude of the impact on Shellfish Water Protected Area receptors could result in a not significant effect, which is not significant in EIA terms
- WFD water bodies (six coastal and two transitional): Overall, it is predicted that the sensitivity of the WFD water body receptors for Project Option 1 and Project Option 2 is medium and the magnitude of the impact is negligible. The medium sensitivity and negligible magnitude of the impact on WFD water body receptors could result in a not significant effect, which is not significant in EIA terms
- Non-designated waters: Overall, it is predicted that the sensitivity of the non-designated waters receptors for Project Option 1 and Project Option 2 is negligible and the magnitude of the impact is negligible. The negligible sensitivity and negligible magnitude of the impact on non-designated waters receptors could result in an imperceptible effect, which is not significant in EIA terms.

#### *11.5.3.2 Impact 6: Accidental releases or spills of materials or chemicals*

During operational activities, there is a potential risk of the accidental spillage or release of materials, such as grease and oils. As noted above, good practice and pollution prevention guidelines will be applied at all times in line with the Offshore EMP. Any discharges would be small volumes, intermittent and dilute and disperse quickly.

***Sensitivity of the receptor***

In accordance with the criteria detailed in Table 11.3, the sensitivity of the identified MW&SQ receptors are:

- Bathing Waters: the status of these receptors is dependent on bacterial counts, which is independent from accidental spills and consequently is considered to be of negligible sensitivity
- Shellfish Water Protected Areas: as presented in Volume 3, Chapter 13: Fish and Shellfish Ecology, there is a lack of research on the sensitivity of the shellfish to the predicted changes resulting from increased chemical/ material spills. Therefore, a precautionary approach has been adopted, assuming the greatest magnitude of sensitivity. As such the sensitivity of shellfish receptors to the accidental releases/ spills is considered to be high
- WFD water bodies (six coastal and two transitional): whilst these receptors are internationally designated sites under the WFD, it is considered that they have a high ability to accommodate a small accidental spill (if it were to occur). The sensitivity of the water bodies to the change is considered low
- Non-designated waters: negligible sensitivity as these sites have no international/ national designation and are able to tolerate changes resulting from accidental spill events.

*Magnitude of impact*

There are no continuous/intermittent discharges proposed for the operational phase in volumes that are likely to impact MW&SQ receptors. The option with the greatest magnitude of impact for the volumes of chemicals and materials used in the construction/ infrastructure associated with the proposed development are presented in Table 11.20.

Any quantities of accidentally released materials are likely to be small. Associated lateral and vertical dispersion rates are expected to be high. The potential impacts will be temporary in nature and project controls will be in place. The magnitude of this potential impact is considered to be negligible, as it is not anticipated to affect the waterbodies performance against their EQSs.

***Significance of the effect***

In accordance with the matrix presented in Table 11.5, significance of the effect of Project Option 1 and Project Option 2 upon the identified MW&SQ receptors are:

- Bathing Waters: Overall, it is predicted that the sensitivity of the Bathing Waters receptors for Project Option 1 and Project Option 2 is negligible and the magnitude of the impact is negligible. The negligible sensitivity and negligible magnitude of the impact on Bathing Waters receptors could result in an imperceptible effect, which is not significant in EIA terms
- Shellfish Water Protected Areas: Overall, it is predicted that the sensitivity of the Shellfish Water Protected Area receptors for Project Option 1 and Project Option 2 is high and the magnitude of the impact is negligible. The high sensitivity and negligible magnitude of the impact on Shellfish Water Protected Area receptors could result in a not significant effect, which is not significant in EIA terms
- WFD water bodies (six coastal and two transitional): Overall, it is predicted that the sensitivity of WFD water body receptors for Project Option 1 and Project Option 2 is low and the magnitude of the impact is negligible. The low sensitivity and negligible magnitude of the impact on WFD water body receptors could result in a not significant effect, which is not significant in EIA terms
- Non-designated waters: Overall, it is predicted that the sensitivity of the non-designated waters receptors for Project Option 1 and Project Option 2 is negligible and the magnitude of the impact is negligible. The negligible sensitivity and negligible magnitude of the impact on non-designated waters receptors could result in an imperceptible effect, which is not significant in EIA terms.

### 11.5.4 Decommissioning Phase

The effects of the decommissioning phase have been assessed on MW&SQ receptors within the MW&SQ study area (Figure 11.1). The environmental impacts arising from the decommissioning of the project options are listed in Table 11.22, along with the most impactful parameters against which each decommissioning phase impact has been assessed.

As presented in Table 11.22, the nature and extent of the environmental impacts arising during decommissioning is assumed (for the purposes of this assessment) to be similar to that described for the equivalent activities during the construction phase. Therefore, these have been assessed based on the magnitude of impacts from the construction phase and are presented in the following sections.

#### *11.5.4.1 Impact 7: Deterioration in water quality due to sediment suspension*

As outlined in Table 11.22, the infrastructure associated with the proposed development will be decommissioned in accordance with the Offshore EMP, and the best environmental practice/option at the time of decommissioning. This may indicate infrastructure such as cables should be retained *in situ*. For the purposes of undertaking an assessment of the most impactful scenario, it is assumed that the decommissioning would be a reversal of the construction process if infrastructure were removed.

***Sensitivity of the receptor***

In accordance with the criteria detailed in Table 11.3, the sensitivity of the identified MW&SQ receptors are:

- Bathing Waters: medium sensitivity for potential increased bacterial counts (with a moderate capacity to accommodate the changes within natural variation)

- Shellfish Water Protected Areas: low sensitivity to reductions in water clarity (due to the regional importance of razor clams together with their medium tolerance to, and medium to high recoverability from increases in SSCs (further detail is provided in Volume 3, Chapter 13: Fish and Shellfish Ecology)
- WFD water bodies (six coastal and two transitional): medium sensitivity with respect to water quality reductions.
- Non-designated waters: negligible sensitivity to temporary reductions in water clarity.

***Magnitude of impact***

The impacts during decommissioning are considered to be similar, or less, than during construction. Therefore, the magnitude of the impact is considered to be negligible, for the potential changes in water quality.

***Significance of the effect***

In accordance with the matrix presented in Table 11.5, significance of the effect of Project Option 1 and Project Option 2 upon the identified MW&SQ receptors are:

- Bathing Waters: Overall, it is predicted that the sensitivity of the Bathing Waters receptors for Project Option 1 and Project Option 2 is medium and the magnitude of the impact is negligible. The medium sensitivity and negligible magnitude of the impact on Bathing Waters receptors could result in a not significant effect, which is not significant in EIA terms.
- Shellfish Water Protected Areas: Overall, it is predicted that the sensitivity of the Shellfish Water Protected Area receptors for Project Option 1 and Project Option 2 is low and the magnitude of the impact is negligible. The low sensitivity and negligible magnitude of the impact on Shellfish Water Protected Area receptors could result in a not significant effect, which is not significant in EIA terms.
- WFD water bodies (six coastal and two transitional): Overall, it is predicted that the sensitivity of the WFD water body receptors for Project Option 1 and Project Option 2 is medium and the magnitude of the impact is negligible. The medium sensitivity and negligible magnitude of the impact on WFD water body receptors could result in a not significant effect, which is not significant in EIA terms.
- Non-designated waters: Overall, it is predicted that the sensitivity of the non-designated waters receptors for Project Option 1 and Project Option 2 is negligible and the magnitude of the impact is negligible. The negligible sensitivity and negligible magnitude of the impact on non-designated waters receptors could result in an imperceptible effect, which is not significant in EIA terms.

#### *11.5.4.2 Impact 8: Accidental releases or spills of materials or chemicals*

The potential impacts during decommissioning are considered to be similar or less than during construction for accidental spills and releases. As previously stated, good practice and pollution prevention guidelines are embedded within all design phases and are applicable at all times.

***Sensitivity of the receptor***

In accordance with the criteria detailed in Table 11.3, the sensitivity of the identified MW&SQ receptors are:

- Bathing Waters: the status of these receptors is dependent on bacterial counts, which is independent from accidental spills and consequently is considered to be of negligible sensitivity.
- Shellfish Water Protected Areas: as presented in Volume 3, Chapter 13: Fish and Shellfish Ecology, there is a lack of research on the sensitivity of the shellfish to the predicted changes resulting from increased chemical/ material spills. Therefore, a precautionary approach has been adopted, assuming the greatest magnitude of sensitivity. As such the sensitivity of shellfish receptors to the accidental releases/ spills is considered to be high.
- WFD water bodies (six coastal and two transitional): whilst these receptors are internationally designated sites under the WFD, it is considered that they have a high ability to accommodate a small accidental spill (if it were to occur). The sensitivity of the water bodies to the change is considered low.

- Non-designated waters: negligible sensitivity as these sites have no international/ national designation and are able to tolerate changes resulting from accidental spill events.

***Magnitude of impact***

The magnitude of this potential impact is considered to be negligible as a result of the controls and good practice measures that will be captured within the CEMP. Furthermore, it is not anticipated that any accidental release or spill would affect the waterbody's performance against its EQSs as the potential impacts will be temporary in nature.

***Significance of the effect***

In accordance with the matrix presented in Table 11.5, significance of the effect of Project Option 1 and Project Option 2 upon the identified MW&SQ receptors are:

- Bathing Waters: Overall, it is predicted that the sensitivity of the Bathing Waters receptors for Project Option 1 and Project Option 2 is negligible and the magnitude of the impact is negligible. The negligible sensitivity and negligible magnitude of the impact on Bathing Waters receptors could result in an imperceptible effect, which is not significant in EIA terms.
- Shellfish Water Protected Areas: Overall, it is predicted that the sensitivity of the Shellfish Water Protected Area receptors for Project Option 1 and Project Option 2 is high and the magnitude of the impact is negligible. The high sensitivity and negligible magnitude of the impact on Shellfish Water Protected Area receptors could result in a not significant effect, which is not significant in EIA terms.
- WFD water bodies (six coastal and two transitional): Overall, it is predicted that the sensitivity of the WFD water body receptors for Project Option 1 and Project Option 2 is low and the magnitude of the impact is negligible. The low sensitivity and negligible magnitude of the impact on WFD water body receptors could result in a not significant effect, which is not significant in EIA terms.
- Non-designated waters: Overall, it is predicted that the sensitivity of the non-designated waters receptors for Project Option 1 and Project Option 2 is negligible and the magnitude of the impact is negligible. The negligible sensitivity and negligible magnitude of the impact on non-designated waters receptors could result in an imperceptible effect, which is not significant in EIA terms.

## 11.6 Mitigation and Monitoring Measures

Mitigation measures that were identified and adopted as part of the evolution of the proposed development design (embedded into the proposed development design) and that are relevant to MW&SQ are listed in Table 11.21 and not considered again here. No additional mitigation or monitoring measures are considered necessary for the construction, operation and decommissioning phases specific to the potential impacts on marine water and sediment quality.

## 11.7 Residual Effects

This section presents the residual effects of the proposed development once the mitigation outlined in Section 11.6 has been applied.

As no additional mitigation was identified in Section 11.6, there has been no change in the effect level for MW&SQ impacts identified.

The residual effects of the project options are summarised in Table 11.25. No residual effects, which are considered to be significant in EIA terms, have been identified.

**Table 11.24 Residual effects relating to MW&SQ**

| Potential impact | Likely significant effect (pre-mitigation) – Project Option 1 | Likely significant effect (pre-mitigation) – Project Option 2 | Residual effect – Project Option 1 | Residual Effect – Project Option 2 |
|---|---|---|---|---|
| **Construction** | | | | |
| Impact 1: Deterioration in water quality due to sediment suspension. | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible |
| Impact 2: Accidental releases or spills of materials or chemicals. | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible |
| Impact 3: Deterioration in water clarity due to the release of drilling mud. | Bathing Waters: slight<br>Shellfish Water Protected Areas: slight<br>WFD waterbodies: slight<br>Non-designated waters: imperceptible | Bathing Waters: slight<br>Shellfish Water Protected Areas: slight<br>WFD waterbodies: slight<br>Non-designated waters: imperceptible | Bathing Waters: slight<br>Shellfish Water Protected Areas: slight<br>WFD waterbodies: slight<br>Non-designated waters: imperceptible | Bathing Waters: slight<br>Shellfish Water Protected Areas: slight<br>WFD waterbodies: slight<br>Non-designated waters: imperceptible |
| Impact 4: Release of sediment-bound contaminants from disturbed sediments. | Bathing Waters: slight<br>Shellfish Water Protected Areas: moderate<br>WFD waterbodies: slight<br>Non-designated waters: imperceptible | Bathing Waters: slight<br>Shellfish Water Protected Areas: moderate<br>WFD waterbodies: slight<br>Non-designated waters: imperceptible | Bathing Waters: slight<br>Shellfish Water Protected Areas: moderate<br>WFD waterbodies: slight<br>Non-designated waters: imperceptible | Bathing Waters: slight<br>Shellfish Water Protected Areas: moderate<br>WFD waterbodies: slight<br>Non-designated waters: imperceptible |
| **Operation** | | | | |
| Impact 5: Deterioration in water quality due to sediment suspension. | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible |

| Potential impact | Likely significant effect (pre-mitigation) – Project Option 1 | Likely significant effect (pre-mitigation) – Project Option 2 | Residual effect – Project Option 1 | Residual Effect – Project Option 2 |
|---|---|---|---|---|
| Impact 6: Accidental releases or spills of materials or chemicals. | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible |
| **Decommissioning** | | | | |
| Impact 7: Deterioration in water quality due to sediment suspension. | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: not significant<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible |
| Impact 8: Accidental releases or spills of materials or chemicals. | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible | Bathing Waters: imperceptible<br>Shellfish Water Protected Areas: not significant<br>WFD waterbodies: not significant<br>Non-designated waters: imperceptible |

## 11.8 Transboundary Effects

Transboundary effects are defined as those effects upon the receiving environment of other states, whether occurring from the proposed development alone, or cumulatively with other projects in the wider area.

No transboundary effects have been identified in terms of MW&SQ receptors. This is because the predicted changes to the key physical process pathways (i.e. tides, waves, and sediment transport) are not anticipated to be sufficient to influence identified MW&SQ receptors at this distance from the proposed development, with the Ireland-UK border being located 13.6km north and 36.5km east of the offshore development area.

## 11.9 Cumulative Effects

Likely significant cumulative effects of the proposed development in-combination with existing and / or approved projects for MW&SQ have been identified, considered and assessed. The methodology for this cumulative assessment is a three-stage approach which is presented in the Cumulative and Inter-Related Effects Chapter.

The Cumulative and Inter-Related Effects Chapter contains the outcome of Stage 1 Establishing the list of 'Other Existing and/or Approved Projects'; and Stage 2 'Screening of 'Other Existing and/or Approved Projects'. This section presents Stage 3, an assessment of whether the proposed development in combination with other projects, grouped in tiers, would be likely to have significant cumulative effects.

The assessment specifically considers whether any of the approved developments in the local or wider area have the potential to alter the significance of effects associated with the proposed development. Developments which are already built and operating, and which are not identified in this chapter, are included in the baseline environment or have been screened out as there is no potential to alter the significance of effects.

The assessment of cumulative effects has considered likely significant effects that may arise during construction, operation and decommissioning of the proposed development. Cumulative effects were assessed to a level of detail commensurate with the information that has either been directly shared with the proposed development, or was publicly available at the time of assessment.

Given the location and nature of the proposed development, a tiered approach to establishing the list of other existing and/or approved projects has been undertaken in Stage 1 of the cumulative effects assessment. The tiering of projects is based on project relevance to the proposed development and it is not a hierarchical approach nor based on weighting. Further information on the tiers is provided in Section 11.10 and in the Cumulative and Inter-Related Effects Chapter.

The tiering structure is intended to provide an understanding of the potential for likely significant effects of the proposed development with the construction of its Operation and Maintenance Facility (OMF) (tier one); followed by a cumulative assessment of the likely significant effect of that scenario combined with the east coast Phase One OWFs (tier two); and lastly the combination of tier one and tier two with all other existing and/or approved projects that have been screened in (tier three).

### 11.9.1 MW&SQ cumulative screening exercise

The existing and/or approved projects selected as relevant to the cumulative effects assessment of impacts to MW&SQ are based on an initial screening exercise undertaken on a long list (see Cumulative and Inter-Related Effects Chapter) based on spatial distance to the proposed development. Consideration of effect-receptor pathways, data confidence and temporal and spatial scales has then allowed the selection of the relevant projects for the MW&SQ cumulative short-list.

When assessing likely significant effects for MW&SQ, projects were screened into the assessment based on a 24km screening range surrounding the array area, and a 24km range around the offshore ECC representing twice the tidal ellipse distance for a single tidal cycle and therefore encompasses the combined extent of impacts to MW&SQ receptors from the proposed development and also any regional projects likely to contribute to cumulative effects under a precautionary assumption that other projects may have a similar ZoI to the proposed development.

For the full list of projects considered, including those screened out, please see the Cumulative and Inter-Related Effects Chapter and Appendix 38.1.

### 11.9.2 Projects considered within the cumulative effect assessment

The planned, existing and/or approved projects selected through the screening exercise as potentially relevant to the assessment of impacts to MW&SQ are presented in Table 11.26. The tiers for the assessment are:

- Tier 1 is limited to the OMF for the proposed development. The OMF option being considered involves the adaption and leasing part of an existing port facility at Greenore. Further detail is provided in the Offshore Description Chapter.
- Tier 2 is the east coast Phase One Offshore Wind Farms.
- Tier 3 is all other projects that have been screened in for this topic.

The tiering structure is intended to provide an understanding of the potential for likely significant effects of the proposed development with the construction of its OMF (tier one); followed by a cumulative assessment of the likely significant effect of that scenario combined with the east coast Phase One Offshore Wind Farms (tier two); and lastly the combination of tier one and tier two with all other existing and/or approved projects that have been screened in (tier three).

**Table 11.25 Projects and plans considered within the cumulative impact assessment**

| Development type | Project | Status | Data confidence | Distance to the proposed development | | Justification for screening into the cumulative effects assessment |
|---|---|---|---|---|---|---|
| | | | | Array area | ECC | |
| **Tier 1** | The OMF is not screened into the MW&SQ cumulative effects assessment due to the onshore nature (above HWM) of the infrastructure and associated works associated offshore works being outside of the tidal excursion considered for the cumulative effects assessment. | | | | | |
| **Tier 2** | | | | | | |
| Phase One Offshore wind farm | Oriel Wind Park | Pre-consent | Medium – scoping report available at time of writing. A foreshore licence has been granted for site investigations (2022-2027). Reference FS007383 | 16.9km | 21.6km | Overlap in construction period, Oriel Wind Park due to construct during 2026-2028. |
| **Tier 3** | | | | | | |
| Subsea Cables | HIBERNIA ‘C’ | Active | High | 7.7km | 17.0km | Subsea cable may require maintenance activities which may result in short-term, temporary seabed disturbance. |
| | Rockabill Telecoms Cable | Active | High | 4.9km | 13.0km | |
| | East West Interconnector | Active | High | 5.0km | 11.4km | |
| | Havhingsten Telecoms Cable | Active | High | 0.7km | 9.7km | |
| | SIRIUS SOUTH | Active | High | 9.4km | 18.7km | |
| | CeltixConnect - Sea Fibre Networks | Active | High | 11.3km | 20.1km | |

| Development type | Project | Status | Data confidence | Distance to the proposed development | | Justification for screening into the cumulative effects assessment |
|---|---|---|---|---|---|---|
| | | | | Array area | ECC | |
| | ZAYO Emerald Bridge One | Active | High | 12.1km | 20.2km | |
| Oil and Gas Pipelines | PL938: Interconnector Scotland to Ireland IC1 | Active | High | 4.2km | 10.6km | Pipelines may require maintenance activities which may result in short-term, temporary seabed disturbance. |
| | PL1890: Interconnector Scotland to Ireland IC2 | Active | High | 0.5km | 2.7km | |
| Dumping at Sea | Drogheda Port Company – Dumping Site A1 | Active | High | 15.3km | 14.3km | Ongoing dumping at sea activities within the ZoI and within the proposed development construction phase may result in a cumulative increase in SSC |
| | Drogheda Port Company – Dumping Site A2 | Active | High | 15.3km | 14.3km | Ongoing dumping at sea activities within the ZoI and within the proposed development construction phase may result in a cumulative increase in SSC |
| Coastal Assets and Infrastructure | Greater Dublin Drainage Outfall Pipe | Licence valid 2020 to 2045 | High | 11.3km | 24.8km | Installation activities are likely to result in temporary, short-term seabed disturbances. |
| | Irish Water - Lusk | Approved June 2016 | High | 8.0km | 15.6km | Emergency discharges from municipal pumping stations are likely to result in temporary, short-term organic, including nitrate, releases |
| | Irish Water - Loughshinny | Completed | High | 7.7km | 12.8km | |

### 11.9.3 Project impacts and options included in the assessment

The identification of potential impacts for the cumulative assessment has been undertaken by considering the relevant characteristics from both project options (refer to Section 11.4) and the potential for a pathway for them to have direct and indirect effects on known receptors (as identified in Section 11.5) when combined with other projects.

For each impact, the project option with the greatest potential for a likely significant effect has been determined based on the comparison and justification provided in Table 12.6. The impacts considered in the cumulative assessment are presented in Table 11.26. As the residual effects for Project Option 1 and Project Option 2 are the same (as identified in Section 11.7), the cumulative effects assessment presented in this section applies to both options.

Due the distance of projects screened into the assessment, impacts from activities or events that are considered to have a highly localised range and therefore do not have the potential for a pathway to effect MW&SQ receptors in the study area have been scoped out of the assessment. This includes accidental releases or spills of materials or chemicals during construction and the deterioration in water quality due to the release of drilling mud construction during construction.

**Table 11.26 Potential cumulative impacts and tiers for assessment**

| Potential cumulative impact | Phase | Tiers and projects | Justification for inclusion in cumulative effects assessment |
|---|---|---|---|
| Impact 1: Deterioration in water quality due to sediment suspension arising from cumulative activities. | Construction/<br>Operation and Maintenance/<br>Decommissioning | **Tier 2:**<br>Oriel Wind Park<br>**Tier 3:**<br>Subsea Cables:<br>• HIBERNIA 'C'<br>• Rockabill Telecoms Cable<br>• East West Interconnector<br>• Havhingsten Telecoms Cable<br>• SIRIUS SOUTH<br>• CeltixConnect - Sea Fibre Networks<br>• ZAYO Emerald Bridge One<br>Oil and Gas Pipelines:<br>• PL938: Interconnector Scotland to Ireland IC1<br>• PL1890: Interconnector Scotland to Ireland IC2<br>Dumping at Sea<br>• Drogheda Port Company – Dumping Site A1<br>• Drogheda Port Company – Dumping Site A2<br>Coastal Assets and Infrastructure:<br>• Greater Dublin Drainage Outfall Pipe<br>• Irish Water – Lusk<br>• Irish Water - Loughshinny | The projects are assumed to require methods/activities that may have allows for the most energetic sediment release into the water column.<br>Construction:<br>• TSHD for seabed preparation works and sediment disposal at the sea surface (scenario C-01);<br>• Drilling for foundation installation (scenario C-02); and<br>• Jetting for inter-array cable trenching (scenario C-03); and ECC trenching (scenario C-04).<br>Operation:<br>• Cable repair/ reburial.<br>Decommissioning:<br>• Infrastructure removal.<br>If these intermittent activities overlap temporally with either the construction/decommissioning or operation and maintenance activities, there is potential for cumulative SSC and sediment deposition to occur. |
| Impact 2: Release of sediment-bound contaminants from disturbed sediments. | Construction/<br>Operation and Maintenance/<br>Decommissioning | **Tier 2:**<br>Oriel Wind Park<br>**Tier 3:**<br>Subsea Cables:<br>• HIBERNIA 'C' | The project methods selected also allows for the most energetic sediment release into the water column: |

| Potential cumulative impact | Phase | Tiers and projects | Justification for inclusion in cumulative effects assessment |
|---|---|---|---|
| | | • Rockabill Telecoms Cable<br>• East West Interconnector<br>• Havhingsten Telecoms Cable<br>• SIRIUS SOUTH<br>• CeltixConnect - Sea Fibre Networks<br>• ZAYO Emerald Bridge One<br>Oil and Gas Pipelines:<br>• PL938: Interconnector Scotland to Ireland IC1<br>• PL1890: Interconnector Scotland to Ireland IC2<br>Dumping at Sea<br>• Drogheda Port Company – Dumping Site A1<br>• Drogheda Port Company – Dumping Site A2<br>Coastal Assets and Infrastructure:<br>• Greater Dublin Drainage Outfall Pipe<br>• Irish Water – Lusk<br>• Irish Water - Loughshinny | Construction:<br>• TSHD for seabed preparation works and sediment disposal at the sea surface (scenario C-01);<br>• Drilling for foundation installation (scenario C-02); and<br>• Jetting for inter-array cable trenching (scenario C-03); and ECC trenching (scenario C-04).<br>Operation:<br>• Cable repair/ reburial.<br>Decommissioning:<br>• Infrastructure removal.<br>If these intermittent activities overlap temporally with either the construction/decommissioning or operation and maintenance activities, there is potential for any sediment-bound contaminants to act cumulatively. |

### 11.9.4 Cumulative Impact 1 – Deterioration in water quality due to sediment suspension arising from cumulative activities.

#### *11.9.4.1 Tier 1*

The screening range for all potential impacts does not extend far enough north to interact with the assumed ZoI of the proposed OMF, which is limited to onshore expansion of facilities and increased vessel use. Therefore, this project is not screened into the assessment.

#### *11.9.4.2 Tier 1 and 2*

Plans for Oriel OWF indicate that the proposed development will comprise 25 WTGs. Owing to the early stage of the Oriel OWF project within the planning process, site-specific information relating to construction, operation and decommissioning activities that may impact on water quality from sediment suspension is very limited.

The nature of the impacts associated with construction and decommissioning of Oriel OWF are assumed to be of similar to that for the proposed development as it is a OWF of a similar size and scale to the proposed development. The interaction of sediment plumes from the proposed development with activities from Oriel Wind Farm is considered unlikely due to the distance from the proposed development and being outside of the tidal excursion local to the proposed development, even if construction activities occurred at the same time. The sensitivity of receptors to a deterioration in water quality is assumed to be the same as the project alone assessment for Impact 1, 5 and 7, and the magnitude of impact is assessed to be negligible for Project Option 1 and Project Option 2. Consequently, cumulative effect from a temporary deterioration in water quality due to sediment suspension are expected to be not significant across all receptors, which is not significant in EIA terms.

#### *11.9.4.3 Tier 1, 2 and 3 (all tiers)*

Tiers 1 is not considered in this cumulative impact assessment.

The discussion presented within this assessment is qualitative given the uncertainty associated with the exact (day/ month) timings of other plans and projects; there is insufficient data on either project scale or timings on which to undertake a quantitative or semi-quantitative assessment. Each of the identified projects are unlikely to be undertaking require routine activities and/or maintenance work, in particular asset reburial or repairs, as these are infrequent occurrences during the lifetime of such developments.

When assessing the cumulative impact arising from seabed sediment disturbance, it is noted that good practice during construction activities includes an allowance for buffers to ensure that activities are not immediately adjacent to each other.

Sediment plumes generated by the other projects considered here, are anticipated to behave in a similar pattern as the sediments being disturbed by the proposed development due to expected similarities in engineering, design combined with a similar environmental setting and sediment characteristics. Differences will occur as a result of the sediment volumes likely to be disturbed, with disturbance relating to any subsea cable and gas pipeline maintenance activities likely to be much smaller than associated with any ECC or inter-array cable installation. The potential increases in SSC, when considered cumulatively with Tier 2, are still anticipated to be within the natural variation within the MW&SQ study area. Therefore, the potential cumulative effects on water quality and direct and indirect effects on MW&SQ receptors are deemed to be comparable to the proposed development alone and as such are considered not significant, which is not significant in EIA terms.

### 11.9.5 Cumulative Impact 2 – Release of sediment-bound contaminants from disturbed sediments.

#### *11.9.5.1 Tier 1*

The screening range for all potential impacts does not extend far enough north to interact with the assumed ZoI of the proposed OMF, which is limited to onshore expansion of facilities and increased vessel use. Therefore, this project is not screened into the assessment.

### 11.9.5.2 Tier 1 and 2

Plans for Oriel OWF indicate that the proposed development will comprise 25 WTGs. Owing to the early stage of the Oriel OWF project within the planning process, site-specific information relating to construction, operation and decommissioning activities that may impact on water quality from sediment suspension is very limited.

The nature of the impacts associated with construction and decommissioning of Oriel OWF are assumed to be of similar to that for the proposed development as it is a OWF of a similar size and scale to the proposed development. The interaction of sediment-bound contaminants from disturbed seabeds from the proposed development with activities from Oriel Wind Farm is considered unlikely due to the distance from the proposed development and being outside of the tidal excursion local to the proposed development, even if construction activities occurred at the same time.

The sensitivity of receptors to a deterioration in water quality is assumed to be the same as the project alone assessment for Impact 4 and the magnitude of impact is assessed to be negligible for Project Option 1 and Project Option 2. Consequently, cumulative effect from a temporary deterioration in water quality due to sediment suspension are expected to be not significant across all receptors, which is not significant in EIA terms.

### 11.9.5.3 Tier 1, 2 and 3 (all tiers)

Tiers 1 is not considered in this cumulative impact assessment.

The discussion presented within this assessment is qualitative given the uncertainty associated with the exact (day/ month) timings of other plans and projects; there is insufficient data on either project scale or timings on which to undertake a quantitative or semi-quantitative assessment. Each of the identified projects are unlikely to be undertaking require routine activities and/or maintenance work, in particular asset reburial or repairs, as these are infrequent occurrences during the lifetime of such developments.

For the same rationale as provided in Section 11.5.2, it is considered that any contaminants will rapidly disperse from the point of disturbance with high dilution levels achieved. Therefore, the potential cumulative effects on MW&SQ receptors from contaminants released into the water column from Tier 2 and Tier 3 projects are deemed to be equivalent to the proposed development alone and as such are considered not significant, which is not significant in EIA terms.

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