LLŶR FLOATING OFFSHORE WIND PROJECT

Llŷr 1 Floating Offshore Wind Farm

Environmental Statement

Volume 3: Chapter 18 – Marine Water and Sediment Quality

August 2024

Prepared by: Llŷr Floating Wind Ltd

FLOVENTIS ENERGY

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Acronyms and abbreviations

Acronym or abbreviation	Definition	Acronym or abbreviation	Definition
As	Arsenic	MNR	Mean Neap Tidal Range
BGS	British Geological Survey	MPA	Marine Protected Area
Cd	Cadmium	MSL	Mean Sea Level
Cefas	Centre for Environment, Fisheries and Aquaculture Science	MSR	Mean Spring Tidal Range
CEMP	Construction Environmental Management Plan	Ni	NickleMean
Cr	Chromium	NRW	Natural Resources Wales
Cu	Copper	OCPs	Organochlorine Pesticides
CEA	Cumulative Effects Assessment	OSPAR	Oslo and Paris Conventions
DEFRA	Department for Environment, Food and Rural Affairs	PAHs	Polycyclic Aromatic Hydrocarbons
DOC	Dissolved Organic Carbon	Pb	Lead
EEZ	Exclusive Economic Zone	PCBs	Polychlorinated Biphenyls
EIA	Environmental Impact Assessment	PINS	The Planning Inspectorate
ES	Environmental Statement	PLONOR	Pose little or no risk to the environment
EQS	Environmental Quality Standards	PNEC	Point of No Effect Concentration
GES	Good Environmental Status	PSA	Particle Size Analysis
HAT	Highest Astronomical Tide	RBMP	River Basin Management Plan
HDD	Horizontal Directional Drilling	ROV	Remotely Operated Vessel
Hg	Mercury	SAC	Special Area of Conservation
IAM	Impact Assessment Matrix	SPA	Special Protection Area
IEMA	Institute of Environmental Management and Assessment	SPM	Suspended Particulate Matter
INNS	Invasive and Non-Native Species	SSC	Suspended Sediment Concentrations
ISQG	Interim Sediment Quality Guidelines	THC	Total Hydrocarbon Content
LAT	Lowest Astronomical Tide	TOC	Total Organic Carbon
MARPOL	The International Convention for the Prevention of Pollution from Ships	TraC	Transitional and coastal WFD water body
MCAA	Marine and Coastal Access Act 2009	TEL	Threshold Effect Level
MCZ	Marine Conservation Zone	WNMP	Welsh National Marine Plan
MHWN	Mean High Water Neap [tide level]	WTG	Wind Turbine Generators
MHWS	Mean High Water Spring [tide level]	UK	United Kingdom
MLWN	Mean Low Water Neap [tide level]	Zn	Zinc
MLWS	Mean Low Water Spring [tide level]		

Glossary of project terms

Term	Definition
The Applicant	The developer of the Project, Llŷr Floating Wind Limited.
Array	All wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure within the Array Area, as defined, when considered collectively, excluding the offshore export cable(s).
Array Area	The area within which the wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure will be located.
Floventis Energy	A joint venture company between Cierco Ltd and SBM Offshore Ltd of which Llŷr Floating Wind Limited is a wholly owned subsidiary.
Landfall	The location where the offshore export cable(s) from the Array Area, as defined, are brought onshore and connected to the onshore export cables (as defined) via the transition joint bays (TJB).
Llŷr 1	The proposed Project, for which the Applicant is applying for Section 36 and Marine Licence consents. Including all offshore and onshore infrastructure and activities, and all project phases.
Marine Licence	A licence required under the Marine and Coastal Access Act 2009 for marine works which is administered by Natural Resources Wales (NRW) Marine Licensing Team (MLT) on behalf of the Welsh Ministers.
Offshore Development Area	The footprint of the offshore infrastructure and associated temporary works, comprised of the Array Area and the Offshore Export Cable Corridor, as defined, that forms the offshore boundary for the S36 Consent and Marine Licence application
Offshore Export Cable	The cable(s) that transmit electricity produced by the WTGs to landfall.
Offshore Export Cable Corridor (OfECC)	The area within which the offshore export cable circuit(s) will be located, from the Array Area to the Landfall.
Onshore Development Area	The footprint of the onshore infrastructure and associated temporary works, comprised of the Onshore Export Cable Corridor and the Onshore Substation, as defined, and including new access routes and visibility splays, that forms the onshore boundary for the planning application.
Onshore Export Cable(s)	The cable(s) that transmit electricity from the landfall to the onshore substation
Onshore Export Cable Corridor (OnECC)	The area within which the onshore export cable circuit(s) will be located.
proposed Project	All aspects of the Llŷr development (i.e. the onshore and offshore components).
Onshore Substation	Located within the Onshore Development Area, converts high voltage generated electricity into low voltage electricity that can be used for the grid and domestic consumption.

Term	Definition
Section 36 consent	Consent to construct and operate an offshore generating station, under Section 36 (S.36) of the Electricity Act 1989. This includes deemed planning permission for onshore works.

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18. MARINE WATER AND SEDIMENT QUALITY

18.1 Introduction

1. Llŷr Floating Wind Limited (hereafter the 'Applicant') is proposing to develop the Llŷr 1 Floating Offshore Wind Farm (hereafter referred to as the proposed 'Project'), located approximately 35 km off the coast of Pembrokeshire in the Celtic Sea.
2. The proposed Project is a test and demonstration wind farm development, comprising up to 10 wind turbine generators (WTGs). The proposed Project will make landfall at Freshwater West before connecting into Pembroke Dock power station and the national grid network.
3. The Applicant is seeking a Section 36 consent and Marine Licence for the proposed Project, and this chapter forms part of the Environmental Statement (ES) which is submitted in support of those consent applications. This chapter describes the potential impacts and effects of the proposed Project on marine water and sediment quality during the construction, operation and maintenance, and decommissioning phases, and includes mitigation and good practice measures to avoid, minimise and reduce the impacts of the proposed Project on marine water and sediment quality.
4. **Section 18.10** of this ES chapter provides a summary of the impact assessment undertaken and any residual significant effects on marine water and sediment quality receptors following consideration of any mitigation measures.
5. The assessment presented in this chapter should be read in conjunction with the following linked and supporting chapters:

    - **Chapter 04: Proposed Project Description** provides further details of the project design parameters.
    - **Chapter 05: EIA Approaches and Methodology** provides further details of the general framework and approach to the EIA.
    - **Chapter 17: Physical Environment** provides further details of the coastal processes in the Offshore Development Area.
    - **Chapter 19: Benthic Ecology** assesses the effects on benthic ecology using the information provided in this chapter.
    - **Chapter 20: Fish and Shellfish Ecology** assesses the effects on fish and shellfish ecology using the information provided in this chapter.
    - **Chapter 21: Marine Mammals** assesses the effects on marine mammals using the information provided in this chapter.
    - **Chapter 22: Ornithology** assesses the effects on ornithology using the information provided in this chapter.
    - **Chapter 26: Commercial Fisheries** assesses the effects on commercial fisheries using the information provided in this chapter.
    - **Appendix 10D: Offshore Water Framework Directive (WFD) Assessment** develops further on the assessment presented in this chapter, focussing specifically on WFD designated water bodies and compliance with WFD targets.
    - **Appendix 19B: Offshore 2023 Benthic Survey Report,** provides the offshore benthic characterisation survey for the proposed Project.

6. Additional information to support the assessment includes:

- **Annex 18A** provides a summary of raw water quality data provided by Natural Resources Wales (NRW) to assist with the assessment presented in this Chapter.
- **Annex 18B** provides a summary of raw sediment quality data provided by NRW to assist with the assessment presented in this Chapter.
- **Appendix 19B: Offshore 2023 Benthic Survey Report,** provide the results of the benthic characterisation survey for the proposed Project. This details the sediment sampling campaign that was undertaken, which informs the marine sediment quality baseline for this Chapter.

7. The assessment has been undertaken by AECOM. Further details of the proposed Project Team's competency are provided in **Appendix 1A: Statement of Competence**.

18.2 Legislation, Policy and Guidance

8. The following sections identify specific legislation, policy and guidance that is applicable to the assessment of marine water and sediment quality. Further detail on the wider legislation, policy and guidance relevant to this ES is provided in **Chapter 02: Regulatory and Planning Policy Context**.

18.2.1. Legislation

9. The following key legislation is applicable to the assessment of marine water and sediment quality and is summarised below.

- **The Environment Act 2023:** Following the exit of the United Kingdom (UK) from the European Union, the Environment Act 2023 outlines the UK's new framework of environmental protection. Under this Act, existing environmental protection measures can be transposed into UK law and enables the UK to set new binding environmental targets. Part 5 of the Act relates specifically to the water environment and water quality, with Section 90 outlining the powers of Welsh Ministers in relation to water quality and the need to consult with NRW ahead of making new regulations under this section of the Act. This new Act also outlines amendments to existing water environment legislation. For example, the Water Industry Act 1991.
- **Marine and Coastal Access Act 2009:** The Marine and Coastal Access Act (MCAA, 2009) introduced a revised system of marine management and licensing which includes marine planning. The MCAA gives devolved administrations responsibility for their inshore and offshore waters as the responsible marine planning authority. Granting of a Marine Licence allows the carrying out of certain activities in the marine environment, including installation activities on the seabed, depositing substances or articles and dredging. The NRW Marine Licensing Team administers marine licensing on behalf of the Welsh Ministers. Under the MCAA (Section 69(1)), NRW are required to consider the following in deciding whether to grant a Marine Licence:
    - The need to protect the environment (which will include considerations of possible effects on marine water and sediment quality); and
    - The need to protect human health (which will include considerations of possible effects on marine water and sediment quality).
- **The Food and Environment Protection Act 1985:** Authorises the making of orders specifying activities which are to be prohibited as a precaution against the consumption of food rendered unsuitable for human consumption in consequence of an escape of substances. The act also replaces the Dumping at Sea Act 1974 with fresh provision for controlling the deposit of substances and articles in the sea, and makes provision for the control of the deposit of substances and articles under the sea-bed. The act regulates

pesticides and substances, preparations and organisms prepared or used for the control of pests or for protection against pests.

- **The Water Environment (Water Framework Directive) (England and Wales) Regulations 2019:** These regulations are transposed into UK law from the European Commission (EC) Directive 2000/60/EC which establishes a framework for Community action in the field of water policy (commonly referred to as the WFD). The 'WFD Regulations' are the main mechanism for assessing and maintaining the water environment in the UK. Under these regulations, WFD water bodies in the UK (including transitional and coastal (TraC) water bodies) are monitored and assigned targets (coastal waters include those within 1 nautical mile (nm) extending to 12 nm for chemical status, i.e., for territorial waters). Works occurring in any areas which are hydrologically connected to these water bodies must undertake a WFD assessment to outline how deterioration of the water body will be prevented and to outline if the proposed Project will contribute towards achieving the target status. The WFD regulations also now take account of the revoked Shellfish Waters Directive which established parameters deemed safe for designated shellfish waters to protect water quality and support the healthy growth of shellfish (including edible shellfish).
- **The Bathing Water Regulations 2013 (as amended 2018):** These regulations are transposed into UK law from EC Directive 2006/7/EC concerning the management of bathing water quality and reappealing Directive 76/160/EEC (commonly referred to as 'the Bathing Water Directive). These regulations outline requirements for monitoring in the bathing water season. The water quality at these designated bathing water sites is monitored for two microbiological parameters that are faecal indicator organisms (FIO) *Escherichia coli* (E.coli) and intestinal enterococci by NRW in the bathing water season (i.e. 15th May to 30th September inclusive). The results of this monitoring programme are used to assess compliance with the regulations.
- **The Marine Strategy Regulations 2010:** The regulations are transposed into UK law from EC 2008/56/EC which establishes a framework for community action in the field of marine environmental policy. These regulations are coordinated across all four UK administrations. The objective of these regulations reflects the UK's vision of having '*clean, healthy, safe, productive and biologically diverse oceans and seas'*. Essentially these regulations ensure that human activities within the marine environment remain compatible with achieving or maintaining Good Ecological Status (GES) or Good Ecological Potential (GEP) for heavily modified water bodies.
- **The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015:** These Directions outline the acceptable standards and status (e.g., chemical and morphological) for water bodies (including transitional and coastal) and outline the requirements for the ongoing monitoring of these water bodies.
- **The International Convention for the Prevention of Marine Pollution by Ships (MARPOL Convention 1978) 73/78:** The UK is a signatory to the MARPOL Convention. All vessels registered to countries that are signatories of the Convention are required to abide to the requirements of the Convention (regardless of which international waters it is sailing within). The Convention seeks to conserve the marine environment through the eventual elimination of shipping related pollutants including oils and other hazardous / harmful substances. This Convention targets accidental shipping spillages of these pollutants.

18.2.2. National Planning Policy

10. National planning policy relevant to the assessment of and protection of marine water and sediment quality are summarised in **Table 18-1.**

11. It should be noted that National Policy Statements on Energy have been designated by the UK government to guide decision making on Nationally Significant Infrastructure Projects (NSIPs) consented under the Planning Act 2008. Given that the NPSs only applies to offshore wind projects that exceed 350 MW in capacity, they would not directly guide decision making on the proposed Project. However, because they were written to guide decision making on offshore wind projects, they are considered relevant as material considerations.

Table 18-1. A summary of national planning policy relevant to marine water and sediment quality

Summary of policy	How and where it is considered in the chapter
National Policy Statements (NPS)	
Paragraph 5.16.1 of the NPS for Energy (EN-1) (DESNZ, 2023a) states: *"Infrastructure development can have adverse effects on the water environment, including ground water, inland surface water, transitional waters, coastal, and marine waters*."	Acknowledgement of this statement is made in the fact that marine water and sediment quality has been scoped into this ES as a standalone chapter to fully assess the potential effects of the proposed Project. Potential effects and residual effects are outlined in **Section 18.8**.
Paragraph 5.16.1 of the NPS for Energy (EN-1) (DESNZ, 2023a) states: *"During the construction, operation, and decommissioning phases, development can lead to increased demand for water, involve discharges to water and cause adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats (see Section 4.2) and could result in surface waters, groundwaters or protected areas failing to meet environmental objectives established under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 and the Marine Strategy Regulations 2010."*	**Section 18.8** outlines the assessment of potential effects of the proposed Project on marine water and sediment quality. Specific assessment is made with regards to the increased risk of spills and leaks of pollutants to the water environment in this section (including the construction, operation and maintenance and decommissioning stages). The consideration of potential effects on protected species and habitats is considered separately in **Chapter 19: Benthic Ecology, Chapter 20: Fish and Shellfish Ecology** and **Chapter 21: Marine Mammals**.
Paragraph 3.7.112 of the NPS for Renewable Energy Infrastructure (EN-3) (DESNZ, 2023b) states: *"The Secretary of State should be satisfied that the applicant has demonstrated measures to minimise adverse impacts on water quality and resources as described in Section 5.16 of EN-1."*	The assessment of potential effects of the proposed Project on marine water quality is undertaken in **Section 18.8**. Mitigation measures required to avoid adverse effects are also detailed in this section.
Welsh National Marine Plan (WNMP)	
Section SOC_03 (Marine Pollution Incidents) of the WNMP states that proposals should demonstrate how they minimise their risk of causing or contributing towards marine pollution incidents.	Consideration of potential marine pollution incidents are presented in the assessment of effects in this chapter (**Section 18.8**) and will be considered in the relevant management plans for the proposed Project (**Section 18.7**).

Summary of policy	How and where it is considered in the chapter
Section ENV_01 (Resilient Marine Ecosystems) of the WNMP states that proposals should demonstrate how potential impacts on marine ecosystems have been taken into consideration and should in order of preference: a) Avoid adverse impacts; and/or b) Minimise impacts where they cannot be avoided; and/or c) Mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised, or mitigated, proposals must present a clear and convincing case for proceeding. Proposals that contribute to the protection, restoration and/or enhancement of marine ecosystems are encouraged.	Changes to marine water and sediment quality can have subsequent impacts on other receptors (e.g. marine ecology). The assessment undertaken in this ES chapter will be used to inform the assessment of effects on other receptor chapters. Namely: - **Chapter 19: Benthic Ecology;** - **Chapter 20: Fish and Shellfish Ecology; and** - **Chapter 21: Marine Mammals.**
Section ENV_02 (Marine Protected Areas) of the WNMP states that proposals should demonstrate how they: a) Avoid adverse impacts on individual Marine Protected Areas (MPAs) and the coherence of the network as a whole; b) Have regard to the measures to manage MPAs; and c) Avoid adverse impacts on designated sites that are not part of the MPA network.	This chapter considers designated sites within the Study Area (**Section 18.5.1**). It is recognised that effects on marine water and sediment quality could lead to subsequent effects on designated sites. Effects on marine water and sediment quality are assessed in **Section 18.8.**
Section ENV_06 (Air and Water Quality) of the WNMP states that proposals should demonstrate that they have considered their potential air and water quality impacts and should, in order of preference: a) avoid adverse impacts; and/or b) minimise adverse impacts where they cannot be avoided; and/or c) mitigate adverse impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding.	Changes to marine water and sediment quality can have resulting effects on water quality in the marine environment. This is assessed in **Section 18.8** of this ES chapter**.**
Section GOV_01 (Cumulative Effects) of the WNMP states that proposals should demonstrate that they have assessed potential cumulative effects and should, in order of preference:	Potential cumulative effects on marine water and sediment quality are considered in **Section 18.11.4** of this ES chapter.

Summary of policy	How and where it is considered in the chapter
a) Avoid adverse effects; and/or b) Minimise effects where they cannot be avoided; and/or c) Mitigate effects where they cannot be minimised. If significant adverse effects cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	

18.2.3. Regional and Local Planning Policy

12. No regional planning policy applicable to marine water and sediment quality has been identified.

13. Local planning policy relevant to the assessment of and protection of marine water and sediment quality are summarised in **Table 18-2.**

Table 18-2 A summary of local planning policy relevant to marine water and sediment quality

Summary of policy	How and where it is considered in the chapter
Pembrokeshire Coast National Park Local Development Plan 2 (2020), end date 2031.	
Policy 8 (Special Qualities) identifies that the special qualities of the Pembrokeshire Coast National Park will be conserved and enhanced [this includes safeguarding the water quality of the national park].	Marine water and sediment quality is considered to be a receptor within the Pembrokeshire Coast National Park, and therefore potential effects on this receptor could lead to subsequent effects on the National Park. Effects on this receptor are considered in the wider assessment in **Section 18.8** (the presence of national parks and designated sites determines the sensitivity of the receptors).
Policy 11 (Nationally Protected Sites and Species) identifies that development likely to have an adverse effect either directly or indirectly on the conservation value of nationally protected sites will only be permitted where it is demonstrated that a number of criteria in this policy are met [see policy wording for further detail].	The baseline condition of designated sites is presented in **Section 18.5.1**. It is recognised that effects on marine water and sediment quality could lead to subsequent effects on designated sites. Effects on marine water and sediment quality are assessed in **Section 18.8.**
Policy 17 (Shore Based Facilities) identifies that the development of shore-based facilities, including those linked to proposals below mean low water (MLW), will be permitted within the developed areas of the coast where compatible with adjacent uses.	The proposed Project incorporates development below MLW. The potential effects of this development on marine water and sediment quality are assessed in **Section 18.8**.
Policy 33 (Renewable and Low Carbon Energy) identifies that proposals for renewable and low carbon energy development including those	The proposed Project incorporates development relating to renewable energy development. The potential effects of this

Summary of policy	How and where it is considered in the chapter
relating to wind, solar and hydro power, anaerobic digestion and biomass will be permitted subject to criteria outlined in this policy [see policy wording for further detail].	development on marine water and sediment quality are assessed in **Section 18.8**.

18.2.4. Guidance

14. Guidance that is relevant to the assessment of and protection of marine water and sediment quality in the Study Area are summarised in **Table 18-3.**

Table 18-3. A summary of guidance relevant to marine water and sediment quality

Summary of Guidance	How and where it is considered in the chapter
NRW databases, including access to Water Quality Sampling Data pool where appropriate.	This guidance on assessment and provision of data was used to inform the baseline conditions for the Study Area **Section 18.5.1.5**.
Relevant data relating to relevant designated Bathing waters and shellfish waters statutory Environmental Quality Standards (EQS) limits / Point of No Effect Concentration (PNEC) Values.	The provision of this data was used to inform the baseline conditions for the Study Area **Section 18.5.1.**
UK Government Guidance (used by NRW) on undertaking WFD assessment in estuarine and coastal waters based on 'Clearing the Waters for All' (Environment Agency, 2017).	This guidance has been used to inform the impact assessment for this chapter **Section 18.8**.
Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (Canadian Council of Ministers of the Environment, 2002).	This guidance has been used to inform the impact assessment for this chapter **Section 18.8**.
Centre for Environment, Fisheries and Aquaculture Science (Cefas) Action Levels for the disposal of dredged material (Cefas, 1995).	This guidance has been used to inform the impact assessment for this chapter **Section 18.8**.
OSPAR Standards (OSPAR) [commission] is the mechanism by which 15 Governments and the European Union cooperate to protect the marine environment of the North-East Atlantic.	This guidance has been used to inform the impact assessment for this chapter **Section 18.8**.
Department for Environment, Food and Rural Affairs (DEFRA) action levels guidance (DEFRA, 2003).	This guidance has been used to inform the impact assessment for this chapter **Section 18.8**.
Guidance for Pollution Prevention: GPP 5: Works and maintenance in or near water GPP 6 working on construction and demolition sites. GPP 8: Safe storage and disposal of used oils. GPP 13: Vehicle Cleaning and Washing GPP 21: Pollution Incident response planning. GPP 22: Dealing with Spills (Northern Ireland Environment Agency, et al, 2017)	This guidance has been used to inform the impact assessment for this chapter **Section 18.8**.
2011 Guidelines for the control and management of ship's biofouling to minimise the transfer of invasive aquatic species.	This guidance has been used to inform the impact assessment for this chapter **Section 18.8**.

Summary of Guidance	How and where it is considered in the chapter
International Maritime Organisation (IMO) Marpol Regulations.	This guidance has been used to inform the impact assessment for this chapter **Section 18.8**.
Work Boat Code (Maritime & Coastguard Agency, 2014).	This guidance has been used to inform the impact assessment for this chapter **Section 18.8**.
Coastal and Marine environmental site guide (Second Edition) (C744) (CIRIA, 2015).	This guidance has been used to inform the impact assessment for this chapter **Section 18.8**.

18.3 Stakeholder Engagement and Consultation

15. Consultation with statutory and non-statutory organisations is a key element of the EIA process. Consultation with regards to marine water and sediment quality has been undertaken to inform the approach to, and scope of, the assessment. Stakeholders for the proposed Project include statutory consultees, landowners, local communities and other sea users. In addition to the statutory consultation process, there has been ongoing engagement with statutory and non-statutory consultees to steer the development of the proposed Project and this is detailed in **Table-18-4.**

Table-18-4. Summary of the key issues raised by consultees and how each issue was addressed

Consultee	Consultation type and date	Comment raised	How issue has been addressed and location of response in chapter
Scoping			
NRW	Scoping Opinion (July 2022)	NRW requested information relating to marine water and sediment quality to be presented in a standalone ES chapter and not as part of the 'Physical Environment' chapter (as presented at the Scoping stage).	Marine water and sediment quality is now set out in a standalone chapter as requested. This chapter relates solely to marine water and sediment quality.
NRW	Scoping opinion (July 2022)	NRW requested that Cycle 3 WFD classifications should be used in the assessment.	Data obtained from Water Watch Wales (Cycle 3 WFD Classifications) has been incorporated into the baseline section of this chapter (see **Section 18.5.1**, with particular note to **Table 18-10**).
NRW	Scoping opinion (July 2022)	NRW requested for smaller streams that run into coastal water bodies to be scoped into the assessment, due to their potential to create a mixing zone of a pollutant that could impact on biota.	This has been scoped in and the extent of the Study Area incorporates the tidal excursion extent (including the coastline and any smaller streams that run into the coastal water bodies) (**Section 18.4.3**). Onshore water quality assessments are presented in

Consultee	Consultation type and date	Comment raised	How issue has been addressed and location of response in chapter
			Chapter 10: Water Environment.
NRW	Scoping opinion (July 2022)	NRW requested for any assessment to include the potential for chemical contaminant release with a comparison made against Cefas Action Levels. Dependent on the sediment type present at the landfall location, NRW would require an assessment of the potential to release bacteria from the sediment (noting this is typically associated with fine sediment).	The assessment of effects presented within this chapter considers the comparison of baseline contaminant levels against Cefas Action Levels (**Section 18.8**). The consideration of the potential to release bacteria from the sediment during the works is also assessed (**Section 18.8**).
NRW	Scoping opinion (July 2022)	NRW requested that should drilling fluids (such as bentonite) be used for installation, this would need to be assessed in the context of suspended sediment releases. NRW welcome early confirmation of the composition of drilling fluids.	This is considered in the assessment of effects presented within this chapter (**Section 18.8**).
NRW	Scoping opinion (July 2022)	NRW requested that the following aspects were included for assessment in this ES chapter: i) Installation / Decommissioning: Contaminants must be considered all the way up to landfall and must be compared against CEFAS action levels; ii) Installation / Decommissioning: The potential for bacteria mobilisation must be considered; iii) Operation: The potential to increase temperature as a result of cabling must be considered – this could also impact both benthic ecology and bacterial growth; iv) Installation: While Horizontal Directional Drilling (HDD) has	i) Assessment of contaminant mobilisation is considered across the entire Study Area, and comparison made to CEFAS action levels (**Section 18.8**). ii) An assessment of the potential for changes in bacteria activity levels is included in this chapter (**Section 18.8**). iii) The potential to increase temperature because of cabling is considered from a bacteriology perspective in this chapter. Considerations of temperature increases on marine ecology are considered in **Chapter 19: Benthic Ecology**. iv) Impacts of trenching for installation of the Offshore Export Cables between the HDD

Consultee	Consultation type and date	Comment raised	How issue has been addressed and location of response in chapter
		been included (and scoped out) in terms of water contamination, trenching has not. Trenching should be included, and the impacts scoped in due to the potential to release chemicals and / or bacteria; v) It would be helpful to lay out the potential impact pathways for marine water quality more explicitly and within its own section of the ES, so that it can be determined if all correct impact pathways have been identified. For example, it appears that no (or very limited) consideration has been made of the potential for bacterial and turbidity releases to impact on Bathing water quality.	and the Array Area are assessed in this chapter (**Section 18.8**). v) Marine water and sediment quality is now set out in a standalone chapter as requested.
Pre-application			
NRW	Email (25/05/2023)	A request for data was made to NRW on 25/05/2023 to request data on certain water quality parameters within the Study Area and for three WFD water bodies (Milford Haven Inner WFD water body (ID: GB531006114100), Milford Haven Outer WFD water body (ID: GB641008220000), and Pembrokeshire South WFD water body (ID: GB611008590003)). Data was received from NRW on 30 May 2023	This information has been provided and used to inform the baseline conditions within the Study Area (**Section 18.5**).
NRW	Meeting (30-03-23) with regards to marine water quality, sediment quality and WFD	A meeting was held with NRW to outline the project elements as they were at that point in time (March 2023) and to discuss the outcomes of the Scoping Opinion. Topics covered included the ES structure with NRW preferring a	A separate marine water quality and sediment quality chapter has been provided herein as required by NRW. This chapter includes bacterial assessment and provides full detail and assessment of the cable

Consultee	Consultation type and date	Comment raised	How issue has been addressed and location of response in chapter
		separate offshore marine and sediment quality ES chapter. Nature of the landfall at Freshwater West (HDD) and requirement for bacterial assessment was also discussed.	installation where it occurs within the marine environment.

18.4 Approach to Assessment

18.4.1. Assessment Methodology

16. **Chapter 05: EIA Approach and Methodology** provides a summary of the general impact assessment methodology applied in this ES. The following sections provide further detail on the specific methodology used to assess the potential impacts on marine water and sediment quality.

17. The approach to the assessment of cumulative impacts, transboundary impacts and interrelated effects is provided in **Sections 18.11** to **18.13**.

18. The significance of potential effects has been evaluated using a systematic approach together with the professional judgement of the specialist consultant. The systematic approach is based upon the determination of the importance/value of receptors and their sensitivity to the proposed Project, independently from the predicted magnitude of the potential impact, which are then combined using a significance of effects matrix.

19. The terms used to define receptor sensitivity and magnitude of impact are based on guidance outlined in **Section 18.4**.

18.4.2. Significance Criteria

Magnitude of Impact

20. The scale or magnitude of potential impacts (both beneficial and adverse) is determined by a combination of three criteria: scale of change, spatial extent of change, and duration of change, as outlined in **Chapter 05: EIA Approach and Methodology, Section 5.4.9.**

21. The specific criteria for defining magnitude of impact for the purpose of the assessment on marine water and sediment quality are provided in **Table 18-5.**

Table 18-5. A summary of the magnitude criteria that are associated to specific impacts

Magnitude Criteria	Definition
High	Extensive alterations to key characteristics of the physical environment (e.g. marine sediment or water quality status); water or sediment quality status degraded to a level that causes permanent or long term (>5 years) or regional change.
Medium	Medium scale (1-5 years, local level) alterations to key characteristics of the marine physical environment (e.g. sediment or water quality status). Associated expectation that marine sediment or water quality status likely to require extensive time for recovery to baseline conditions.

Magnitude Criteria	Definition
Low	Site-specific and short term (<1 year) alterations to marine physical environment (e.g. sediment or water quality status) expected to be measurable above background concentrations, but not considered to be substantial changes. Activity not likely to lead to compromise of water or sediment Environmental Quality Standard (EQS). The underlying character / composition of the baseline condition will be similar to the pre-development situation.
Negligible	Any changes to marine physical environment (e.g. sediment or water quality) will extend for short periods of time and are expected to be quickly reversed once activity ceases, approximating to a 'no change' situation.

Sensitivity and Importance of Receptor

22. Receptor sensitivity is defined as the degree to which a receptor would be affected by an impact and is defined by its vulnerability to change and its recoverability from that change, as outlined in **Chapter 05: EIA Approach and Methodology, Section 5.4.10**. The importance of a receptor is defined as the value placed on a feature by virtue of aspects of quality, rarity or as a resource. For the water environment, it is more common to refer to 'importance' rather than sensitivity as larger water features can be less sensitive but still very important, although in practice either term can be referred to.

23. The criteria for defining receptor sensitivity/importance for the purpose of the assessment on marine water and sediment quality are provided in **Table 18-6.**

Table 18-6. A summary of the criteria determining a receptor's sensitivity/importance

Receptor Sensitivity / Importance Criteria	Definitions
High	The marine environment receptor (e.g. sediment or water quality receptor) provides key supportive contribution to the designation. Receptor has little or no ability to absorb change without fundamentally altering its character. Receptor has low / no capacity to return to baseline condition within Project life, e.g. low tolerance to change and low ability to recover, such as a physical feature formed over a geological time scale.
Medium	Receptor has moderate capacity to absorb change (e.g. water quality impact) without significantly altering its character. The marine sediment or water quality receptor supports high biodiversity. Medium capacity to return to baseline condition, e.g. >5 of up to 10 years.

Receptor Sensitivity / Importance Criteria	Definitions
Low	The receptor is tolerant to change without significant detriment to its character. The marine sediment or water quality receptor has reasonable capacity for change to status, due, for example, to fast current speeds or relatively large size of the receiving waterbody leading to increased capacity for dilution and flushing.
Negligible	The receptor is tolerant to change with no effect on its character.

Significance of Effect

24. As set out in **Chapter 05: EIA Approach and Methodology**, an Impact Assessment Matrix (IAM) is used to determine the significance of effect which is a function of the sensitivity of the receptor and the magnitude of the impact, as shown in **Table 18-7.**

25. The matrix provides a framework for the consistent and transparent assessment of predicted effects across all receptor topics, however, it is important to note that the IAM acts as a guide and that assessments also allow for the application of professional judgement.

Table 18-7. Significance matrix

		Magnitude of change			
		Negligible	Low	Medium	High
Sensitivity of Receptor	High	Negligible/Minor	Moderate	Major	Major
	Medium	Negligible	Minor	Moderate	Major
	Low	Negligible	Negligible	Minor	Moderate
	Negligible	Negligible	Negligible	Negligible	Negligible/Minor

26. The IAM provides levels of effect significance ranging from major to negligible. Assignment of significance is carried out with consideration of embedded mitigation measures relevant to marine water and sediment quality. Embedded mitigation measures (including proposed Project design measures and good practice) are presented within **Section 18.7**. Details on additional mitigation measures and associated definitions can be found in **Section 18.9**. For this assessment, Moderate and Major levels of significance are defined as significant (i.e. shaded cells in **Table 18-7.** Significance matrix), and where relevant additional mitigation measures may be required, whilst Negligible or Minor impacts are defined as not significant.

27. Definitions of the significance of each of the effects (negligible, minor, moderate, and major) are provided in **Table 18-8.**

Table 18-8 A summary of the definitions of each significant of effect criteria

Significance Category	Definitions	Significant / Not Significant Effect
Major	A large and detrimental change to a valuable / sensitive receptor; likely or apparent exceeding of accepted (often legal) threshold. Or A large and beneficial change, resulting in improvements to the baseline result in previously poor conditions being replaced by new legal compliance or a major contribution being made to national targets. These effects may represent key factors in the decision-making process. Potentially associated with sites and features of national importance or likely to be important considerations at a regional or district scale. Major effects may relate to resources or features which are unique and which, if lost, cannot be replaced or relocated.	Significant
Moderate	A medium scale change which, although not beyond an acceptable threshold, is still considered to be generally unacceptable, unless balanced out by other significant positive benefits of a project. Likely to be in breach of planning policy rather than a legal statute. Or A positive moderate effect is a medium scale change that is significant in that the baseline conditions are improved to the extent that guideline targets (e.g. UK BAP targets) are contributed to. These effects, if adverse, are likely to be important at a local scale and on their own could have a material influence on decision making.	Significant
Minor	A small change that, whilst adverse, does not exceed legal or guideline standards. Unlikely to breach planning policy. Or A small positive change, but not one that is likely to be a key factor in the overall balance of issues. These effects may be raised as local issues and may be of relevance in the detailed design of a project but are unlikely to be critical in the decision-making process.	Not Significant
Negligible	A very small change that is so small and unimportant that it is considered acceptable to disregard. Effects which are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error. These effects are unlikely to influence decision making irrespective of other effects.	Not Significant

18.4.3. Study Area

28. The Study Area for the assessment of effects on marine water and sediment quality has been defined based on the extent of one spring tidal excursion limit, which is considered the zone of influence (ZOI) for this receptor. This is considered to represent the maximum distance that any measurable plume effects could extend to, or the maximum area for deleterious substances to disperse within, in the marine environment. A spring tidal excursion is chosen as this presents a worst-case scenario as any plume or substance will travel further in the marine environment under spring tide conditions (see **Section 17.4.3** of **Chapter 17: Physical Environment** for more detail on the spring tidal excursion.

29. The distance of this tidal excursion from the Offshore Development Area is typically in the order of 8 to 14 km (depending on the local peak current speed, which is typically smaller

offshore and greater nearshore)[1]. This is measured from the edge of the Offshore Development Area in the direction of the tidal axis. As a result of these tidal variations, the tidal excursion distance differs around various sections of the Offshore Development Area (for example, where the Offshore Development Area is more aligned to the tidal axis).

30. The Study Area (the limit of extent of one spring tidal excursion) is depicted in (**Figure 18-1**). The assessment within this chapter relates only to the area contained within the Study Area. Outside of this area, it is considered that any effects on marine water quality and sediment quality would be negligible due to sufficient dispersal throughout the water column from tidal action (as outlined in **Chapter 17: Physical Environment**).

[1] Calculations based on the data presented in ABPmer (2008). Tidal excursion ellipses for a mean tide in the proposed Array Area are approximately 6 – 8 km in length. The tidal ellipses 20 km offshore representing the location of the Offshore Export Cable Scoping Boundary are approximately 8 – 10 km long. The length of the nearshore (6.5 km offshore of Freshwater West Beach) tidal ellipses are approximately 14 km.

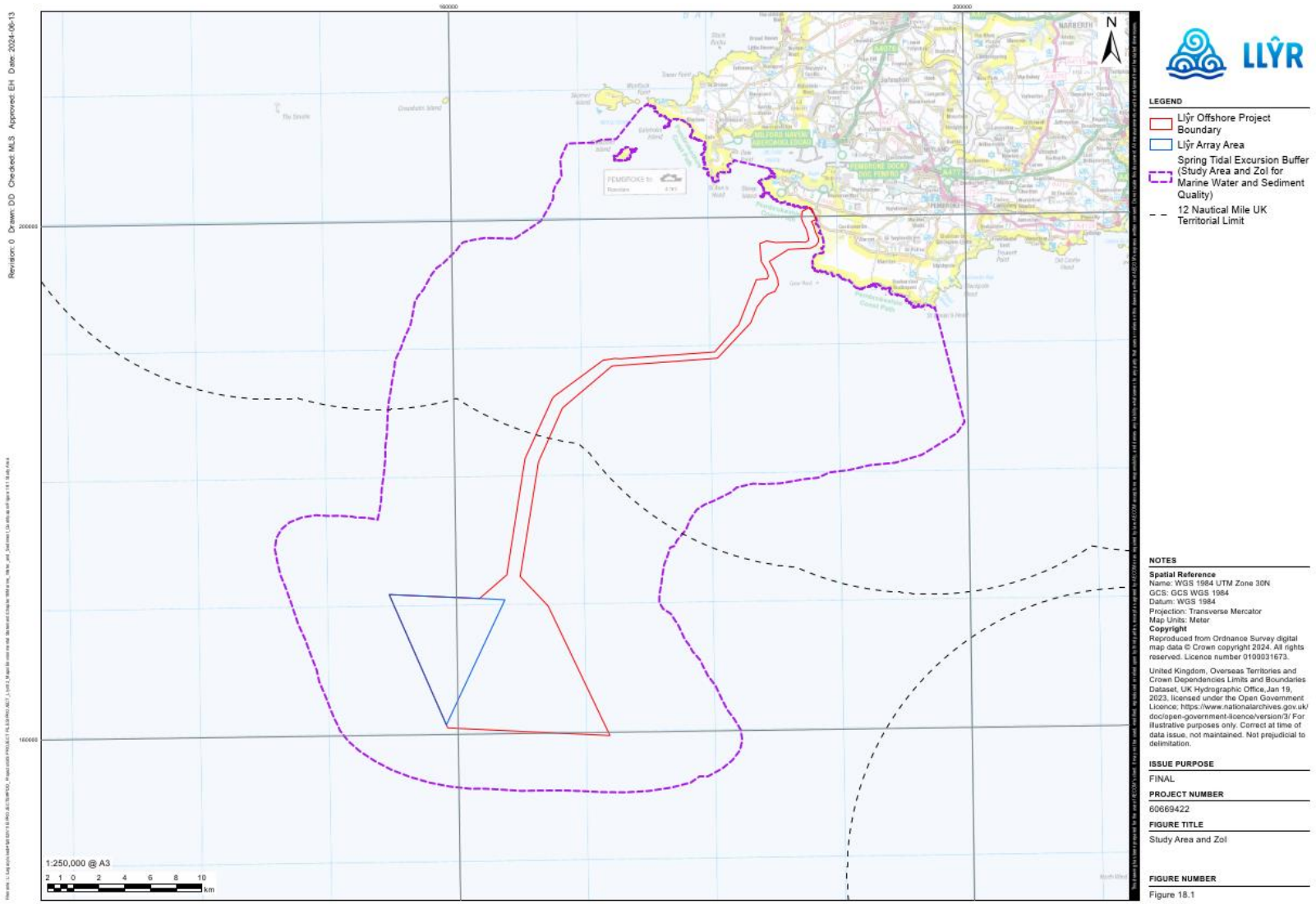

Figure 18-1 Llŷr array, landfall location and study area

18.4.4. Data Sources

Site Specific Surveys

31. To provide site specific information on which to base the impact assessment for marine water and sediment quality (i.e. characterise the benthic environment), a site specific survey was carried out to collect sediment samples from within the Offshore Development Area during December 2022. A total of 30 grab samples were taken from the Offshore Development Area (see **Figure 6** of **Appendix 19B: Offshore 2023 Benthic Survey Report**). These samples were analysed for Total Organic Carbon (TOC) content, Particle Size Distribution (PSD), and underwent sediment chemistry analysis. More details on the results from these grab samples are provided in **Section 18.5.1**.

32. It should be noted that since this survey report was commissioned, the Array Area has been refined. As a result, while a number of samples are still within the Array Area and Offshore Development Area, a number of sediment samples (14 out of 30 samples) are now outside of the Array Area and Offshore Development Area (see **Figure 18-4** for clarity on the locations of the sediment sampling points and the location of the Offshore Development Area). Nonetheless, this provides a wider understanding of baseline marine sediment conditions across the Study Area and therefore is considered to provide a suitable baseline for the assessment.

Desk Study

33. A comprehensive desk-based review was undertaken to inform the baseline for the marine water and sediment quality. Key data sources used to inform the assessment are set out in **Table 18-9.**

34. Existing datasets provided by NRW and for the Erebus project are considered as adequate suitable additional data to inform the baseline conditions for marine water quality (to complement site specific data obtained through surveys) and no additional site specific monitoring has been undertaken.

Table 18-9 Summary of key sources for the desk-based study

Title	Source	Year	Brief description	Author
Water quality data provided by NRW (**Annex 18A: NRW Water Quality Summary Data)**	NRW	2023	This water quality data from NRW provides measured parameters of water samples taken from the coastal areas presented in **Figure 18-2**. As no water quality samples were taken for the proposed Development itself, these results have been relied upon to provide a wider understanding of the likely baseline water quality conditions in the Offshore Development Area. Due to the difference in location between the Offshore Development Area and the location of these water	NRW

Title	Source	Year	Brief description	Author
			quality samples, this is noted as a limitation for the proposed Project in **Section 18.6.1.**	
2024 Bathing Water Profile for Freshwater West	NRW	(2024)	Further water quality data is available for the Study Area in the form of bathing water quality data for Freshwater West. Water quality at this bathing water site is assessed by NRW. Annual ratings will help to establish any recurring activities in the area which could alter the water quality baseline (such as pollution risks). This is considered further in **Section 18.5.1.**	
Sediment quality data provided by NRW (**Annex 18B: NRW Sediment Quality Summary Data**)	NRW	2023	This sediment quality data from NRW provides measured parameters of sediment samples taken from the coastal areas presented in **Figure 18-4**. Sediment samples have been obtained for the proposed Project itself, but these NRW results have been used to compliment the proposed Project's survey data to enhance understanding of the wider sediment conditions throughout the ZoI. As the NRW data does not overlap directly with the location of the OfECC, or the Array Area these results cannot be relied upon as being fully representative of the conditions in the Offshore Development Area. As a result this is noted as a limitation for the proposed Project in **Section 18.6.1.**	NRW
British Geological Survey data	British Geological Survey (BGS)	(2024)	The BGS provides records of sediment conditions across the UK. These have been used to further understand	BGS

Title	Source	Year	Brief description	Author
			the sediment and seabed conditions throughout the Study Area to further clarify the baseline.	
The Ocean Ecology Offshore Benthic Characterisation Survey technical report (**Appendix 19B**)	Ocean Ecology	2023	This outlines the sediment sampling campaign that was undertaken through the Offshore Development Area (a total of 30 grab samples were taken and analysed). As the OfECC has altered since the survey was undertaken (see **Chapter 03: Alternatives**) these survey results are no longer fully representative of conditions in the OfECC and this has been added as a limitation for this Chapter in **Section 18.6.1.** The results themselves are discussed in more detail in **Section 18.5.1**.	Ocean Ecology
Erebus project water quality and sediment quality surveys	Marine Space	2019	As the Erebus project is located within the ZoI for the proposed Project, the summary of water quality and sediment samples presented in the Erebus Environmental Statement has been reviewed to provide a greater understanding of the likely water and sediment quality conditions in the ZoI. As the Erebus project only overlaps with part of the proposed Project's OfECC, these results cannot be considered to be fully representative for conditions present in the Offshore Development Area of the proposed Project. As a result, this has been added as a limitation for this Chapter in **Section 18.6.1**.	Marine Space
Cefas action levels	Cefas	1995	These action levels provide guidance on the suitability of the disposal of certain	Cefas

Title	Source	Year	Brief description	Author
			sediments at sea in the UK. This is provided by classifying sediments as either Cefas Action Level 1, or Action Level 2 depending on the chemical contents (contaminant concentration) of the sediment itself. Cefas action levels are considered further to greater understand the baseline conditions of existing sediments within the Offshore Development Area (determined from the analysis of grab samples obtained). More details on this are provided in **Section 18.5.1**.	
Canadian Environmental Quality Guidelines (CEQGs) (for sediments)	Canadian Council of Ministers of the Environment	2002	As described by the Canadian Council of Ministers of the Environment (2024), "*these guidelines are numerical concentrations or narrative statements intended to protect all forms of freshwater and marine (including estuarine) aquatic life during all aspects of their aquatic life cycles for an indefinite period of exposure to substances associated with bed sediments*". These guidelines are considered in the Existing Baseline section of this Chapter (**Section 18.5.1**) to help classify and understand existing sediment conditions across the Offshore Development Area.	Canadian Council of Ministers of the Environment
WFD Cycle 3 Rivers and Waterbodies	Water Watch Wales	2021	The results from WFD Cycle 3 provided by Water Watch Wales have been used to understand the overall, ecological and chemical status of designated	Water Watch Wales

Title	Source	Year	Brief description	Author
			waterbodies in the ZoI. This helps to understand likely stressors to these waterbodies and reasons that they are either failing, complying, or exceeding targets.	

18.5 Baseline

35. The following sections describe the baseline environment relating to marine water and sediment quality.

18.5.1. Existing Baseline

General Baseline

36. A general baseline outlining the physical environment within the Study Area, including tidal, wave, wind, and seabed sediment conditions is provided in **Chapter 17: Physical Processes** (**Section 17.5**). The information provided in that chapter has been used throughout the assessment in this chapter to assist with the identification and assessment of potential effects. Where utilised, this baseline information has been referenced.

Marine Water Quality baseline

WFD Water Bodies

37. Two WFD water bodies are located within the Study Area and will be considered within this assessment. These are outlined in **Table 18-10** below and are displayed visually within **Figure 18-2.** The summary classification data presented is for Cycle 3 of the River Basin Management Cycle from 2021[2]. **Appendix 10D: Offshore WFD Assessment** includes further information regarding WFD status as well as information on pressures.

Table 18-10. WFD water bodies within the study area

WFD Water body	Water body ID	Current Status	Target Status
Pembrokeshire South	(ID: GB611008590003)	Overall: **Good** Ecological: **Good** Chemical: **High**	Good (2015)
Milford Haven Outer	(ID: GB641008220000)	Overall: **Moderate** Ecological: **Moderate** Chemical: **Failing Status**	Good (2021)

38. With reference to **Figure 18-2**, the Study Area as defined by the spring tidal excursion distance, does not extend as far as the Milford Haven Inner WFD water body (ID: GB531006114100), and so no impacts are likely to occur. Therefore, this water feature is not considered any further and is included in **Figure 18-2** for context only. Impacts will be assessed on the

[2] https://waterwatchwales.naturalresourceswales.gov.uk/en/ [last accessed February 2024].

Pembrokeshire South and Milford Haven Outer WFD water bodies, and the offshore non-WFD designated marine water.

Bathing Waters

39. Only one designated bathing water site has been identified in the Study Area (see **Table 18-11**).

*Table **Error! No text of specified style in document.**-11. Bathing water sites identified within the Study Area*

Designated bathing water site	Bathing water ID	Year of designation	Annual water quality assessment results
Freshwater West	(ID: 38248)	2012	2023 – excellent; 2022 – excellent; 2021 – excellent; and 2020 – excellent.

40. NRW assess the bathing water quality at sites such as Freshwater West. These frequent assessments measure current water quality and annual ratings classify each site as excellent, good, sufficient, or poor based on measurements of *Intestinal enterococci* and *Escherichia coli* taken over a period of up to four years. Freshwater West has a 2023 classification of excellent (which has been consistent since 2020).

41. NRW further note that trace amounts of litter are regularly observed at visits to Freshwater West, however there is little sewage infrastructure present, likely accounting for the limited sewage related impacts on the bathing water at this location (NRW, 2024).

Erebus Project Information

42. Water quality sampling was not undertaken for the proposed Project. Instead, due to the proposed Project's close proximity with the Erebus project (see **Figure 18-2**).

43. For the Erebus project, water quality samples were collected from 26 sampling stations across the portion of the export cable corridor that intersects WFD water bodies (Marine Space, 2019). Stations were positioned along the centre of the proposed cable route at approximately 500 m intervals with three samples collected per station (at 2 m above the bed, mid-water depth, and 2 m below the water surface). These were analysed to assess concentrations of chlorophyll, total suspended solids, dissolved oxygen, nutrients, hydrocarbons and metals.

44. In all but one case, chlorophyll concentrations were below the limits of detection. Total suspended solid concentrations were low to moderate (range <5 mg/l - 23 mg/l). Note that the WFD (Standards and Classifications) (England and Wales) Directions 2015 classify total suspended sediment concentrations <10 mg/l as clear and 10-100 mg/l as intermediate in terms of their clarity. All total suspended solid samples could therefore be considered 'clear to intermediate'.

45. All dissolved oxygen samples were above the standard corresponding to 'high' under the WFD environmental quality standards (EQS) (i.e. the 5th percentile value for dissolved oxygen concentrations in mg/l were above 5.7.

46. Maximum concentrations of nutrients recorded in the Project Erebus sampling were 0.55 mg/l ammoniacal nitrogen, 0.4 mg/l nitrate, <0.01 mg/l nitrite and 0.13 mg/l phosphate. The ammoniacal nitrogen value corresponds to a classification of 'high' (<1.4 mg/l) for both clear and intermediate turbidity transitional or coastal waters in the WFD EQS (i.e. the WFD

(Standards and Classifications) (England and Wales) Directions 2015). There are no specific EQS for nitrate, nitrite and phosphate.

47. Heavy and trace metal concentrations were consistently low and below the limit of detection in most cases. However, zinc levels were found to exceed the WFD EQS (long term mean 6.8 µg/l) within 3 of 78 samples and cadmium was found to exceed WFD EQS (long term mean 0. 02 µg/l) in one sample. All Polycyclic Aromatic Hydrocarbons (PAHs) were found to be below the laboratory limits of detection.

48. The sampling exercise for Project Erebus indicates that based on the sampling exercise undertaken for the Project, baseline marine water quality across the Study Area is generally good with low levels of chemical contamination. This was consistent with other nearby projects including the Greenlink Interconnector and Atlantic Array, which report that dissolved contaminants off the Pembrokeshire coast and in the Celtic Sea are low or below limits of detection for current analytical tools (RWE, 2013) (Intertek, 2019).

Data Provided by NRW

49. To support the interpretation of the Erebus project water quality data outlined above, a data request was made to NRW on 25/05/2023. A shapefile for the Study Area was provided to NRW and the request for water quality data was made for this location, including the areas of the two WFD water bodies presented in **Table 18-10:**

- Milford Haven Outer WFD water body (ID: GB641008220000); and
- Pembrokeshire South WFD water body (ID: GB611008590003).

50. The parameters relating to water quality that were requested from NRW for all three water bodies and the Study Area included the following:

- Chlorophyll;
- Dissolved Organic Carbons (DOC);
- Phytoplankton;
- Salinity (in situ);
- Total suspended solids / particulate matter;
- Dissolved oxygen;
- Nutrients (including nitrate, nitrite, orthophosphate, silicate, nitrogen, and ammoniacal nitrogen);
- PAHs (including Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Dibenzothiophene Anthracene Fluoranthene Pyrene Benzo[a]anthracene Chrysene Benzo[a]pyrene Indeno[123,cd]pyrene Dibenzo[a,h]anthracene Benzo[ghi]perylene);
- Heavy and trace metals (including: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn)).

51. It should be noted that the data provided by NRW do not cover the exact area of the proposed Project and relates to existing monitoring of the near shore and estuarine areas associated with the three WFD water bodies (see **Figure 18-2**).

52. These monitoring points are therefore more likely to be affected by interactions with the shoreline and runoff from the land.

53. Raw data provided by NRW have been summarised and is available as per **Annex 18A: NRW Water Quality Summary Data** included in this chapter. The data show that the existing water

quality within the Study Area exceeds the WFD saline guidance for levels of copper (see **Figure 18-2**).

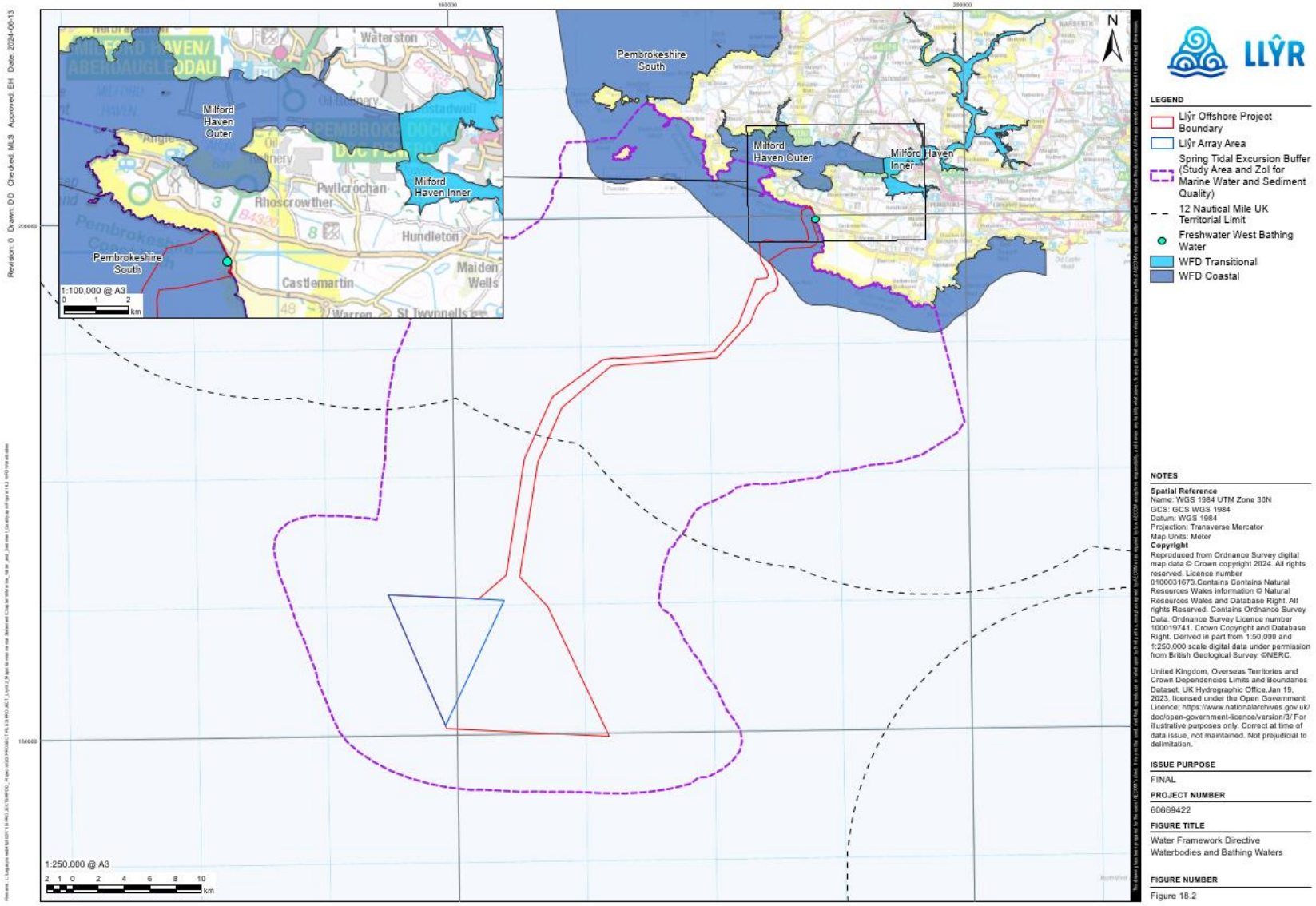

Figure 18-2 WFD water bodies identified within the Study Area

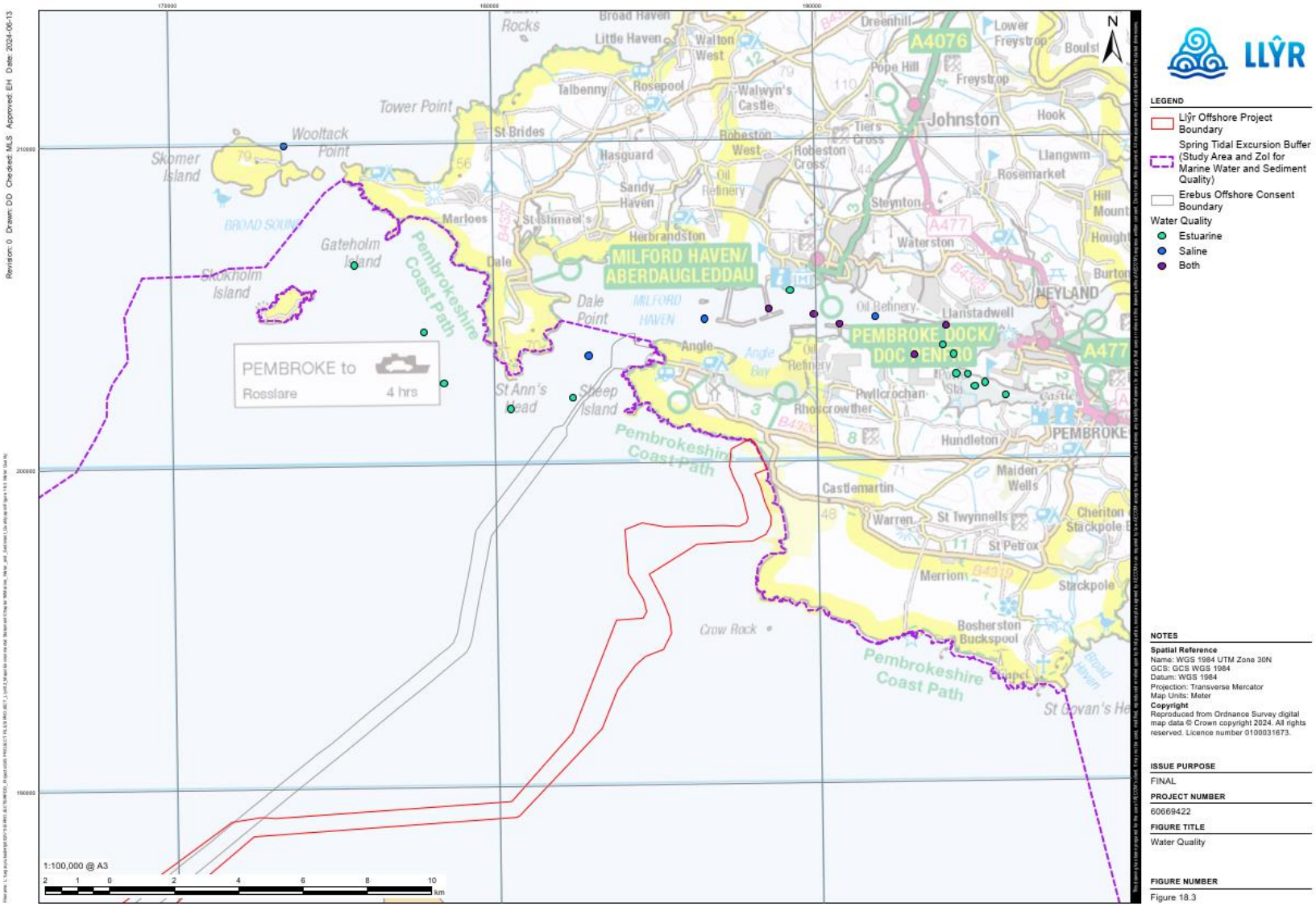

Figure 18-3 Water quality data points provided by NRW

Marine Sediment Quality Baseline

54. The physical properties of different sediment types are typically associated with varying levels of contaminants that might be contained within them. Fine muddy sediments have an increased risk due to their relatively large surface area and greater cation exchange capacity (the soil's ability to hold positively charged ions) compared to coarser sediments.

55. Sediment quality data has been obtained from several sources to inform this assessment. These include:

- Publicly available data from NRW;
- Data from surveys commissioned for the proposed Project; and
- British Geological Survey (BGS, 2024).

NRW Data

56. As outlined in the Erebus ES, concentrations of hydrocarbons such as PAHs vary between sites across the south Pembrokeshire coast (Marine Space Ltd and ITP Energised, n.d.). Overall, the measured levels are considered to have no adverse biological effects for an indefinite period of exposure (MMT, 2019) (based on the Canadian Council of Ministers of the Environment Interim Sediment Quality Guidelines (ISQG)). Sediment quality data was requested and provided by NRW to clarify this conclusion. As depicted in **Figure 18-4,** except for a single monitoring location that is offshore to the northwest of the OfECC, all of the sampling locations in the NRW data are for inshore locations around the margins of Milford Haven. These locations may not be wholly representative of the seabed material along the Offshore Export Cable or Array Area. This has been considered as a limitation for this data in **Section 18.6.1** (however it should be noted that other data sources including sediment sampling undertaken for the proposed Project has been used in combination to inform the baseline).

The parameters requested from NRW for sediment quality data in the Study Area are outlined in the list below:

- Inorganics (including Heavy and Trace metals: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), and Zinc (Zn),Trace Metals);
- Organotins (Tributyltin and dibutylin);
- Polychlorinated biphenyls (PCBs);
- Brominated flame retardants;
- Total hydrocarbon content (THC);
- PAHs (including: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, dibenzothiophene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[a]pyrene, indeno[123,cd]pyrene, dibenzo[a,h]anthracene, and benzo[ghi]perylene);
- Organochlorine pesticides (OCPs);
- Total organic carbon (TOC); and
- Particle size analysis (PSA).

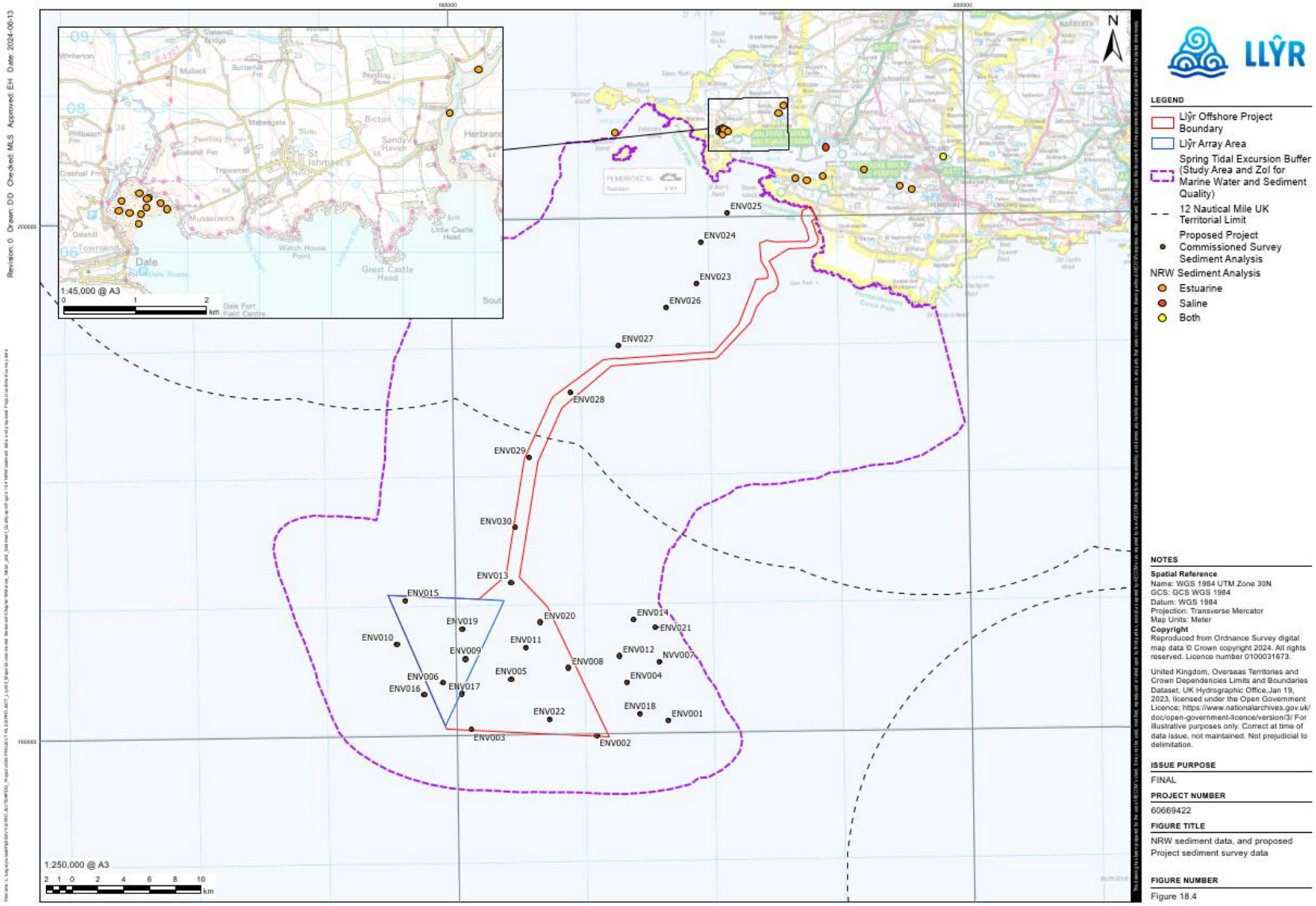

Figure 18-4 Sediment data points from proposed Project sediment sampling campaign, and NRW provided data points

57. Raw data provided by NRW have been summarised and are available in **Annex 18B: NRW Sediment Quality Summary Data**. From the data provided from NRW, only one sampling station (S90090) reports on sediment quality. The sediment at this location (within the Milford Haven Waterway), exceeds Cefas Action Level 1 for several determinands. Cefas Action Level 2, however, is only exceeded for levels of cadmium (with the same being the case for Canadian Sediment Quality Guidelines). This sampling point is located much further up the estuary than where works are proposed to take place, and it is considered likely that raised determinand levels are due to historical industry in this area. Within the Offshore Development Area there is likely to be reduced historical contamination in the sediments, given the distance from the shore, the spatial extent of the array area, and with sediment experiencing a high disturbance level due to ongoing tidal and wave action. Therefore, determinand levels within the Offshore Development Area are lower than those experienced at sampling station S90090.

Proposed Project Data

58. The 2023 Offshore Benthic Characterisation Survey technical report for the proposed Project (see **Appendix 19B**, (Ocean Ecology, 2023)) outlines the sediment sampling campaign that was undertaken. A total of 30 grab samples were taken throughout the Offshore Development Area (see **Figure 6** of **Appendix 19B: Offshore 2023 Benthic Survey**). The sampling points within the Array Area are considered to provide a suitable baseline for marine sediment quality for the assessment.

59. Various sub samples were taken from the 30 master samples, and these sub samples underwent chemical analysis for the following determinands:

- Moisture content;
- TOC;
- Total Organic Matter (TOM);
- Trace and heavy metals;
- PAHs;
- Total Hydrocarbon Content (THC) (including saturates); and
- Polychlorinated biphenyls (PBCs) and organotins.

60. Samples were also analysed for their grain size. Results for grain size are shown in **Figure 10** of **Appendix 19B: Offshore 2023 Benthic Survey**, which show that the majority of sediment across the Offshore Development Area consists of fine gravel (> 2 mm diameter) (and sand (0.63 mm to 2 mm diameter), with a very small proportion being classified as silt and clay (i.e. < 63 µm diameter).

61. Results are available in full detail in **Appendix 19B: Offshore 2023 Benthic Survey**, and are summarised below:

- **TOC:** In general, the highest TOC and TOM content in the sediment was found at stations with the highest mud content (> 20%) (see **Figure 13** of **Appendix 19B: Offshore 2023 Benthic Survey**).
- **Heavy and trace metals**: Eight heavy metals were detected in results from the sampling stations. These included: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickle (Ni), and Zinc (Zn). None of the main heavy and trace metals exceeded reference levels, except for As, which was identified above CEFAS Action Level 1 at four stations (ENV001, ENV007, ENV013, and ENV014) in the east of the Array Area (see **Table 16** of **Appendix 19B: Offshore 2023 Benthic Survey**). It should be noted that

as displayed in **Figure 18-4**, from these four stations, only station ENV013 is contained within the offshore proposed Project boundary. No determinands were identified to be above Cefas Action Level 2. The most abundant metal found was Zn, but this was always present below reference levels. The summary table of results is added in **Table 18-11**. Full results are shown in **Table 16** of **Appendix 19B: Offshore 2023 Benthic Survey**.

- **PAHs**: The only reference level exceeded for PAHs was the Canadian sediment quality threshold effect level (TEL), with napthalene exceeding the TEL reference level at station ENV001 (again, ENV001 is not within the offshore proposed Project boundary).
- **THC**: N-alkanes (saturates) in sediments had carbon chain lengths ranging between C12 and C36, with the dominant chains being C28 for the even numbered chains, and C29 for the odd numbered chains. The highest concentration of total n-alkanes was recorded at station ENV001, being 94.4 µg kg^{-1}. Diatom populations (a type of marine phytoplankton) have been found to be a biogenic source of n-alkanes in aquatic environments especially for n-alkanes C15 – C31, which fits well with C28 and C29 being the most abundant alkanes (Ocean Ecology, 2022).
- **PBCs and Organotins**: Both PCBs and Organotins were below the detection limit at all stations.

Table 18-11: Main heavy and trace metals (mg kg-1) in sediments obtained during sampling survey. Red shading indicates values above Cefas Action level 1 (BDL = Below Detection Limits)[3]

Sampling Station	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
ENV001	27.1	0.1	9.2	5.7	14.9	0.04	6.7	27.7
ENV003	19.3	0.11	12.6	5.3	10.8	0.02	7.6	28.5
ENV005	19.9	0.11	9.9	4.8	11.2	BDL	6.1	26.4
ENV007	27.5	0.15	10	4.2	13.6	BDL	7.2	27.9
ENV010	14.4	0.11	9.5	4.6	7.2	BDL	5.5	19.7
ENV013	21.6	0.08	11.7	5.1	11.4	BDL	6.6	27
ENV014	21.4	BDL	9.6	4.7	12.2	BDL	7	28.2
ENV024	8.6	0.25	3.1	3.6	8.6	BDL	4	16
ENV027	10.9	0.09	7.7	5	8.2	BDL	8.6	23.7
ENV029	13.8	0.05	8.4	3.7	9.8	BDL	7.2	29.8
Min	8.6	0.05	3.1	3.6	7.2	0.02	4	16
Max	27.5	0.25	12.6	5.7	14.9	0.04	8.6	29.8
Mean	18.45	0.12	9.17	4.67	10.79	0.03	6.65	25.49
SE	2/03	0.04	0.81	0.21	0.77	0.01	0.40	1.40

[3] See **Figure 18-4** for locations of sampling points.

CEFAS AL1	20	0.4	40	40	50	0.3	20	130
CEFFAS AL2	100	5	400	400	500	3	200	800
OSPAR BAC	25	0.31	81	27	38	0.07	36	122
OSPAR ERL	8.2*	1.2	81	34	47	0.15	21*	150
TEL	7.24	0.7	52.3	18.7	30.2	0.13	-	124
PEL	41.6	4.2	160	108	112	0.7	-	271

** The ERLs for As and Ni are below the BACs, therefore As and Ni concentrations are usually assessed only against the BAC.*

Sediment Types and Bacteria

62. As outlined in **Section 17.5.1.5** of **Chapter 17: Physical Environment**, seabed sediments off the west coast of Wales are predominantly muddy sandy gravel (BGS, 2017). The seabed in the vicinity of the proposed Project Array Area consists primarily of sand and gravelly sand, which was confirmed during the Preliminary Habitat Assessment undertaken for the proposed Project (Ocean Ecology, 2022) and the Benthic Characterisation Survey (Ocean Ecology, 2023). The seabed sediment inshore and around the South Pembrokeshire coast is characterised by rocky reefs, shoals and sandbanks defined as 'hard substrate' by the BGS. These types of seabed are typically associated with a low level of fine material, which was confirmed during surveys undertaken for the proposed Project (see **Figure 18-5**).

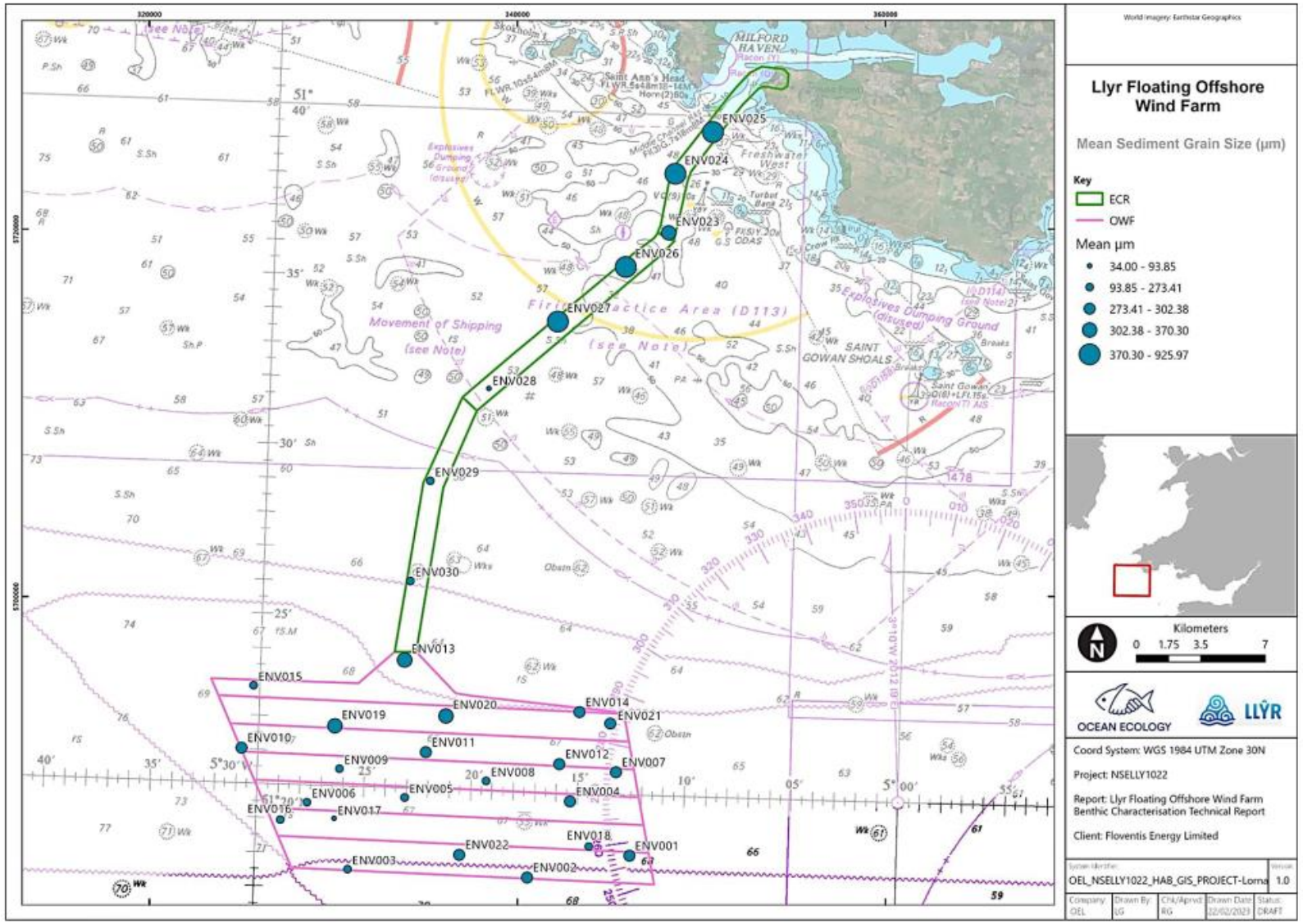

Figure 18-5 Mean grain size (µm) at each sampling station across the survey area

63. Additionally, sediment within the Erebus assessment Study Area (adjacent to Offshore Development Area), 5% fines were assumed as a representative value in the close approaches to Milford Haven (Marine Space, 2019). In the Scoping Opinion response from NRW, it was raised by NRW that the presence of bacteria is typically associated with fine sediments. It can therefore be assumed that the baseline level of bacteria across the Study Area is likely to be low, based on the seabed sediment types present.

Suspended Sediments

64. Depending on the weather conditions, currents, waves, water depth and the local sediment types, suspended sediment concentrations (SSC) vary across the Study Area. **Figure 18-6** displays the spatial distribution of average non-algal Suspended Particulate Matter (SPM) between 1998 and 2015 for most of the UK continental shelf. The largest plume concentrations are associated with large estuaries where the mean values of SPM are above 30 mg/l. Based on the available data (Cefas, 2016), and as outlined in **Chapter 17: Physical Environment** (**Section 18.5.1.5**), sediments local to the Milford Haven area are understood to have a lower suspended sediment load compared to similar UK estuaries, which is likely due to its greater water depths (water depths within the Array Area range from approximately 85 m to 65 m below LAT (**Chapter 17: Physical Environment)**. The SPM associated with the proposed Project has therefore been estimated as approximately 2 – 5 mg/l at the turbine Array Area (with peaks of up to 44 mg/l), with generally higher levels of approximately 5 mg/l in the nearshore regions along the Welsh coast (Cefas, 2016).

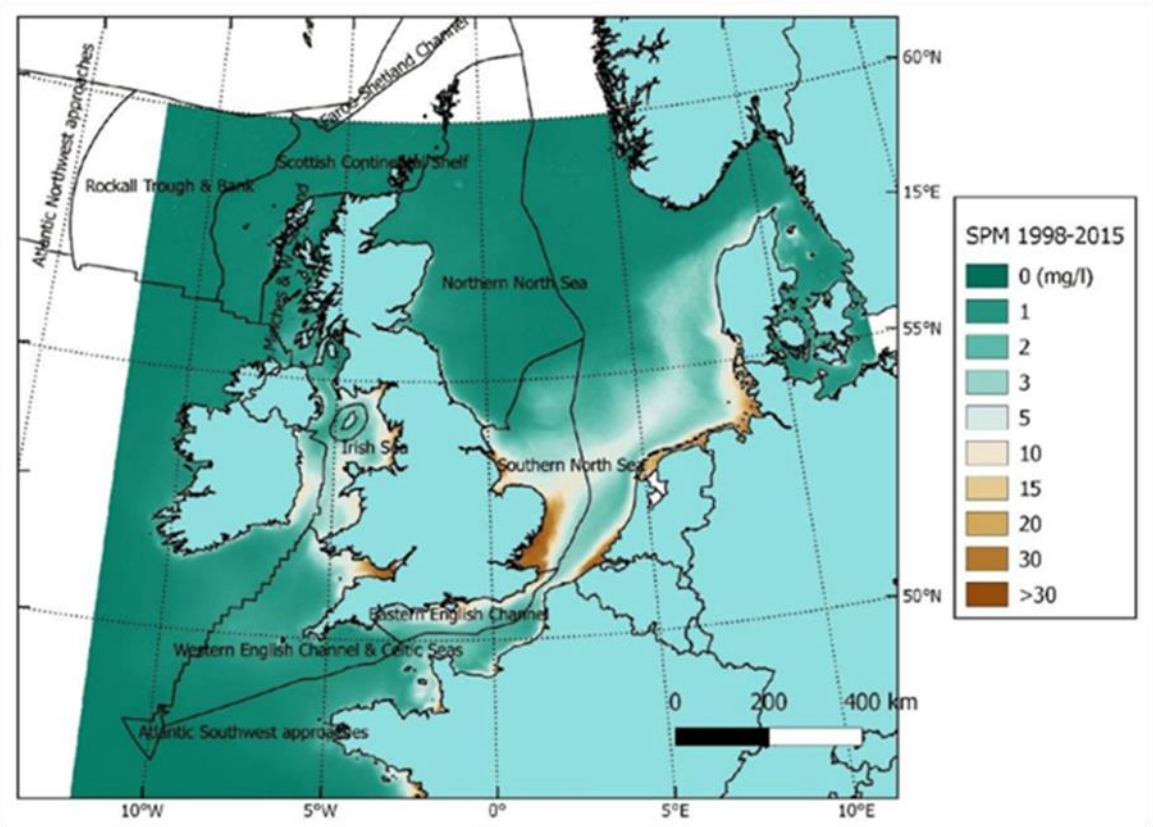

Figure 18-6 Average suspended sediment around the UK (Cefas, 2016)

Sediment Transport

65. The following information relating to sediment transport in the Study Area is taken from **Chapter 17: Physical Environment** to inform the assessment of effects on marine water and

sediment quality. For the assessment of sediment transport refer to **Chapter 17: Physical Environment.**

66. The deposition (settling) of any disturbed sediment in the Study Area will be dependent on the grain size of the disturbed sediment. During the settling process, any sediment plume will be directed away from the point of release by any currents that are present. The distance this sediment is carried is therefore dependent on the flow speed and physical properties of the sediment itself. The maximum near-bed level of SSC is expected to be found where the main body of the settling plume of sediment reaches the seabed.

67. Coarse grained sediments (i.e., sand / gravel) which are known to be present within the Study Area will behave differently to fine grained sediments (i.e., silt / clay) when released into the water column. The disturbance of coarse grained or consolidated material is likely to give rise to high SSCs in the vicinity of the release location but it is also likely to settle out of suspension quickly (in the order of seconds to minutes) so any sediment plumes are likely to be localised. In contrast, fine grained material will tend to remain in suspension for a longer period (in the order of hours to days), potentially resulting in an increase in SSC over a larger area, at a progressively reduced concentration, due to advection and dispersion from the original release location.

68. The exact pattern of re-deposition of sediment to the seabed will depend on the actual combination of operational methods and environmental conditions (such as local seabed topography, slopes, local water depth, etc.) at the time of the event which will be variable.

Designated Sites Baseline

69. There are several designated sites located within the Study Area. These are shown in **Figure 18-7** and are also outlined in **Table 18-12** below. Designated sites considered for the assessment of effects in this chapter include the following:

- Designated bathing waters;
- Shellfish waters;
- Marine Special Areas of Conservation (SACs);
- Marine Special Protection Areas (SPAs);
- Ramsar sites; and
- Marine Conservation Zones (MCZs).

70. As outlined below in **Table 18-12**, only SACs, SPAs and WFD water bodies were identified within the Study Area. No designated shellfish waters or MCZ were identified within the study area. The closest such sites in proximity to the Offshore Development Area are Lower Cleddau (Isaf Cleddau) Shellfish Waters located north of the Study Area and Skomer MCZ (located near St Davids, north west of the Study Area) respectively.

Table 18-12. Designated sites located within the study area for this chapter and their distance from the proposed Project.

Designated site	Distance and direction to closest aspect of Offshore Development Area (km)	% of designated site area that overlaps with the Study Area	Reason(s) for designation
Limestone Coast of South West Wales SAC / Arfordir Calchfaen De Orllewin Cymru	0 km (within Offshore Development Area)	0.35	Vegetated sea cliffs of the Atlantic and Baltic Coasts, fixed coastal dunes with herbaceous vegetation ("grey dunes"), European dry heaths, semi-natural dry grasslands and scrubland facies on calcareous substrates *Festuco-Brometalia* (important orchid sites), caves not open to the public, submerged or partially submerged sea caves, greater horseshoe bat *Rhinolophus ferrumequinum*, early gentian *Gentianella anglica*, Petalwort *Pealophyllum ralfsii*.
Pembrokeshire Marine SAC / Sir Benfro Forol	0 km (within Offshore Development Area)	22.70	Estuaries, large shallow inlets and bays, reefs, sandbanks which are slightly covered by sea water all the time, coastal lagoons, Atlantic salt meadows, submerged or partially submerged sea caves, grey seal *Halichoerus grypus*, shore dock *Rumex rupestris*, sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, Allis shad *Alosa alosa*, Twaite shad *Alosa fallax*, otter *Lutra lutra.*
West Wales Marine SAC / Gorllewin Cymru Forol	0 km (within Offshore Development Area)	7.41	Harbour porpoise *Phocoena phocoena*
Bristol Channel Approaches SAC	2.03 km	1.08	Harbour porpoise *Phocoena phocoena*
Castlemartin Coast SPA	0 km (Offshore Development Area)	10.46	Chough *Pyrrhocorax pyrrhocorax*
Skomer, Skokholm and the Seas of Pembrokeshire SPA	0 km (within Offshore Development Area)	30.97	European storm petrel *Hydrobates pelagicus*, red-billed chough *Pyrrhocorax pyrrhocorax*, short-eared owl *Asio flammeus*, Manx shearwater *Puffinus puffinus*, Altantic puffin *Fratercula*

Designated site	Distance and direction to closest aspect of Offshore Development Area (km)	% of designated site area that overlaps with the Study Area	Reason(s) for designation
			arctica, lesser black-backed gull *Larus fuscus*, seabird assemblage.

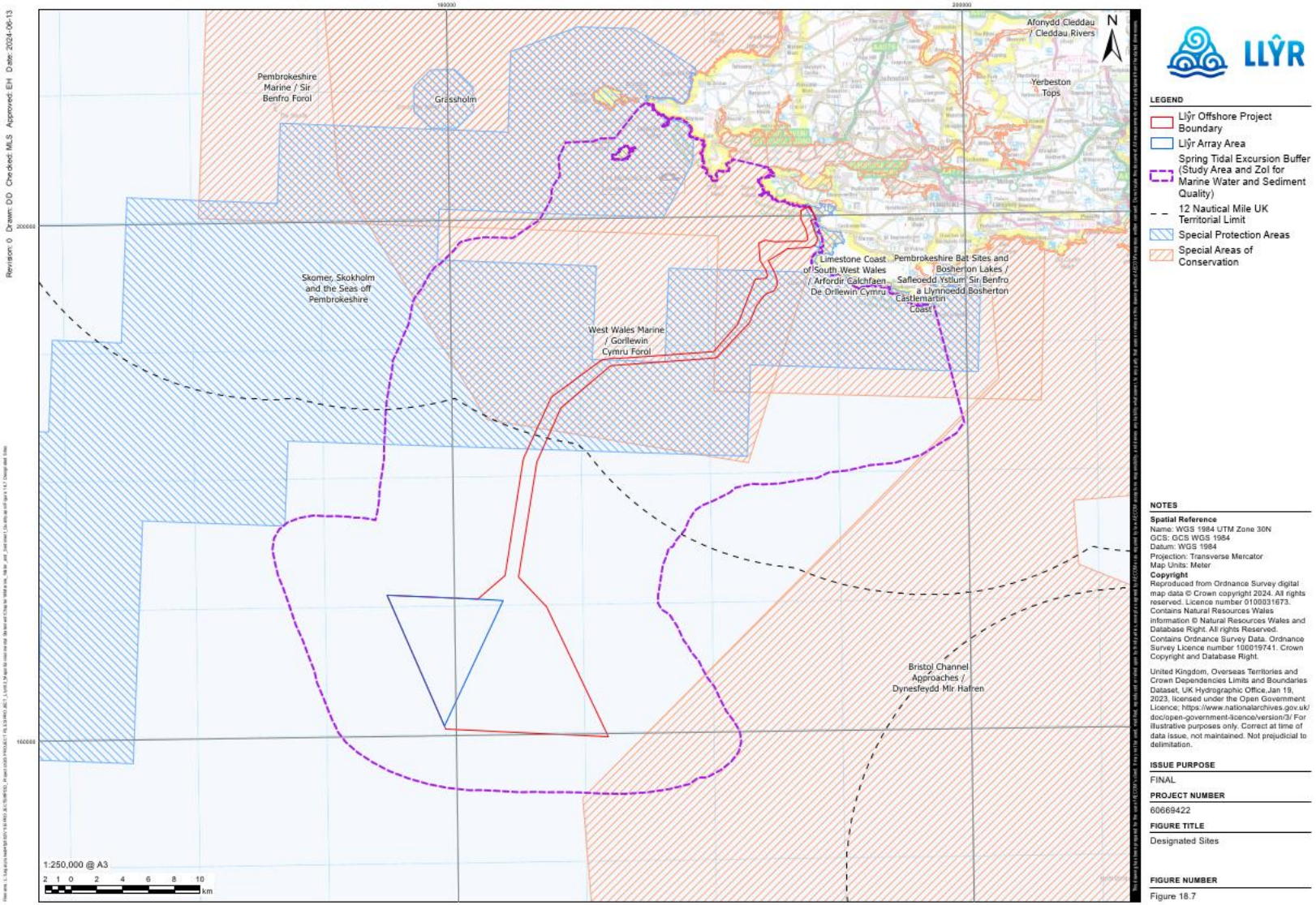

Figure 18-7: Designated sites within the Study Area

18.5.2. Future Baseline

71. This section considers any changes to the baseline conditions described above that might occur over the lifespan of the proposed Project, but in their absence (i.e. if they are not installed).

Marine Water Quality

72. All WFD water bodies identified within the Study Area (Milford Haven Inner, Milford Haven Outer and Pembrokeshire) have a target of Good (Good by 2027 for Milford Haven Inner and Pembrokeshire, and Good by 2033 for Milford Haven outer (based on Cycle 3 information for River Basin Management Plans (RBMP)) (Water Watch Wales, 2022).

73. There is an aspiration that the health of the water environment will continue to improve post 2027 through the action of new legislative requirements and more stringent planning policy. The Environment Act 2021 and the Levelling-Up and Regeneration Act 2023 include measures to address storm sewage discharges and set new requirements on phosphate removal from sewage treatment works serving catchments of more than 2000 people equivalent (PE). There are, however, significant challenges such as adapting to a changing climate and pressures of population growth that could lessen these changes. It is also difficult to forecast these changes with any certainty.

74. The current receptor sensitivity criteria determined for this Chapter (**see Table 18-6**) is largely based on the presence or absence of various attributes (e.g. water body size, designated nature conservation site, WFD designation, or presence of a Bathing Water). For most of these attributes, it is unlikely that they will change in the future. The application of these criteria is therefore not sensitive to more subtle changes or improvements in water quality as may be experienced over time. Thus, no significant changes to current baseline conditions are predicted for the future baseline in the absence of the proposed Project, as the principal reasons for differences in water body importance are unlikely to change. For this reason, the impact assessment within this chapter is undertaken against existing baseline conditions.

Marine Sediment Quality

75. It Is likely that a rise in sea level and increased storminess will lead to the generation of larger waves. Therefore, greater wave energy can more frequently reach the coast which may result in an increase in local erosion rates, which may alter sediment transport around the coastline. However, the composition of sediment fractions and distribution of seabed sediments are developed by historical trends. Climate change is not expected to have any measurable influence on seabed sediment type (fractions) or distribution over the lifetime of the proposed Project (the decommissioning phase is expected to be completed between 2052 and 2053).

18.6 Scope of the Assessment

76. An EIA Scoping Report for the proposed Project was submitted to NRW Marine Licensing Team (MLT) in April 2022. The Scoping Report was also shared with relevant consultees, inviting comment on the proposed approach adopted by the Applicant. A Scoping Opinion was provided to the Applicant by NRW MLT in July 2022. Based on the Scoping Opinion received, and further consultation undertaken, potential impacts on marine water and sediment quality scoped into the assessment are listed below in **Table 18-13**. Following the submission of the Scoping Report to NRW, and receipt of NRW's Scoping Opinion, it is confirmed that no specific impacts relating to marine water and sediment quality have been scoped out of this assessment.

77. As set out in **Section 18.4.1**, this assessment considers the design parameters of the proposed Project which are predicted to result in the greatest environmental impact, known as the 'realistic worst case scenario'. The realistic worst case scenario represents, for any given receptor and potential impact on that receptor, various options in the Design Envelope that would result in the greatest potential for change to the receptor in question. Given that the realistic worst case scenario is based on the design option (or combination of options) that represents the greatest potential for change, confidence can be held that the development of any alternative options within the design parameters will give rise to effects no greater or worse than those included in this impact assessment.

78. Accordingly, the design scenarios identified in **Table 18-13** have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group within the marine water and sediment quality Study Area. These scenarios have been selected from the details provided in **Chapter 04: Description of the Project**.

Table 18-13. Design scenario considered for the assessment

Potential impact	Design scenario (design maximum / worst case)	Justification
Construction (36 months)		
Impact on marine water quality from drilling fluids and drill cuttings (including increased turbidity and potential for spillages).	• Wind turbine generators (WTG): 10 No. Anchorage - drilled piles option: • Pile anchors: 8 per WTG. • Drilled pile diameter: 3.5 m. • Maximum depth: 55 m. • Anchor/pile footprint (total): 1,200 m^2. • Maximum footprint of drill arisings: 42,300 m^3 (maximum height of 1m per drill). • Drilling fluid to be used: a drilling fluid that is considered to 'Pose Little or No Risk' to the environment (PLONOR) will be used. Anchorage – drag embedment anchor option: • Embedment anchors: 8 per WTG. • Maximum diameter: 6 m. • Maximum depth: 25 m. • Anchor footprint (total): 6,120 m^2.	This presents the maximum number of piles / embedment anchors required for anchorage and associated maximum depth and footprint of drill arisings (the realistic worst case). This provides an understanding of the possible drilling fluids and associated properties if spilt into the marine environment during the works, which could have subsequent effects on marine water and sediment quality. Generation of drill cuttings can result in the mobilisation of sediment in the water column, which depending on the particle size may have local impacts or potentially to create a plume. The release of sediment may also be associated with chemical compounds held within it, that might be toxic in the water environment.
Accidental spillages of fluids leading to water quality deterioration.	• Construction works will be focused on the proposed location of new infrastructure in the Array Area and Offshore Export Cable Route, but generally there is a risk of a chemical spillage occurring anywhere within the Offshore	Vessels create risk of accidental pollution incidents. This is the maximum number of vessels expected to be operating simultaneously in the Offshore Development Area and thus represents the worst case.

Potential impact	Design scenario (design maximum / worst case)	Justification
	Development Area total footprint. • Maximum number of vessels at any time in the Study Area: 12	
Potential direct disturbance to marine sediments leading to mobilisation of contaminated sediments and a deterioration in water quality (e.g. through cable installation).	Inter Array Cabling (IAC): • Array area footprint: 45 km^2. • IACs required: 11 cables. • IAC total cable length on seabed: 17.1 km • Cable diameter: 200 mm. • Maximum footprint of touchdown movement for each IAC: 4,000 m^2. • Target burial depth: 1.2 m (where technically possible) • Maximum trench width: 25 m. • Cable Protection required: 20% (3,420 m length equating to 17,100 m^2). OffECC cabling: • Export cable length: up to 49 km (per cable). • Total cable length (for 2 circuits): up to 98 km. • Number of trenches: 2. • OfECC disturbance width: up to 25 m width (per cable). • Length of cable protection required: 2,400 m of each cable (4.9%). Within nearshore area up to 22.4% or 11,000 m of each cable will also be protected using iron articulated pipe protection. • Target burial depth: generally 1.2 m, but 1.5 m for up to 1.7 km parallel to coast from HDD exit point, and 2 m depth for 4.5 km along the eastern edge of Turbot Bank. • Preferred burial method: Jet trenching. HDD drilling at landfall: • Duct diameter: 900 mm. • HDD length: 1,500 m. • HDD exit point water depth: 3m to 8m LAT. • HDD drill cutting volume: 1,700 m^3.	These values present the worst case for potential area of seabed within which works may happen and that may be disturbed as a result of the construction activities. This represents the maximum design scenario for the proposed Project (i.e. maximum area and maximum installation activities). It is considered that no other scenario proposed in **Chapter 4: Description of the Proposed Project** could give rise to increased impacts to marine water and sediment quality.

Potential impact	Design scenario (design maximum / worst case)	Justification
	• Distance between HDD (offshore) exit points: 50 m approximate. Sandwave levelling (if required): • Area of seabed requiring levelling: 621,060 m^2. • Volume of material that will be subject to levelling (for 2 cables): 900,520 m^2. • Length of levelling: 10,351 m.	
Operation and maintenance (30 years)		
Accidental spillages of fluids leading to water quality deterioration.	• Offshore maintenance will be undertaken by Crew Transfer Vessel (CTV), or Service Operation Vessels (SOV) and potentially a helicopter. The CTV will dock and access will be via ladders on the substructure, while the use of SOV will use a walk to work system and the helicopter will hoist personnel directly onto the nacelle. • Vessel visits per turbine per year: 12. • WTGs may have diesel generators to provide power during commissioning and during maintenance. Generators are also typically used for back-up power supply on the floating offshore wind platform supporting the turbines. • Each WTG contains components that will require lubricating oils, hydraulic oils and coolants for its operation. Examples include grease, synthetic oil / hydraulic oil, nitrogen, transformer silicon / oil, suphur hexafluoride and water /glycerol. • The nacelle, tower, and rotor will be designed and constructed to contain leaks, thereby reducing the risk of spillage into the marine environment.	Vessels create risk of accidental pollution incidents. This is the maximum number of vessels expected to be operating in the Offshore Development Area and thus represents the worst case. Indicative use of fuels are also indicated, with the inclusion of diesel generators on the WTGs representing a worst case.
Ongoing disturbance of seabed sediments into the operation and	Mooring System (based on worst case Catenary Spread):	Dynamic cables in contact with the seabed can lead to ongoing sediment disturbance at the

Potential impact	Design scenario (design maximum / worst case)	Justification
maintenance phase (e.g. from anchor chain disturbance or scour). This could disturb contaminated sediments, increase suspended sediment concentrations (and hence turbidity) and cause a deterioration in water quality.	• Number of moorings: 8 per turbine. • Length of moorings / dynamic cables in contact with the seabed: 150 m • Total swept area for mooring chains: 34,880 m^2. • Total footprint of clump weights: 8000 m^2. 2m x 2m x 1m high each Cable Protection: • Maximum seabed footprint of static IACs requiring cable protection (per cable): 17,100 m^2. • Maximum seabed footprint of OfECC requiring cable protection (per cable): 24,000 m^2 (i.e. 12,000 per cable). • IAC and OfECC cable protection type: rock placement, concrete mattresses, sand grout bags, articulated iron pipe. • Protection width: 5 m • Protection height: 1.5 m • There are 5 No. crossings of other cables. Concrete mattresses assumed to be used. Refer to **Chapter 4: Description of the Proposed Project** for all types of potential protection. Scour Protection: • Scour protection footprint per anchor: 310 m^2. • Height of scour protection per anchor: 1 m. • Volume of scour protection in the Array Area: 24,800 m^2.	seabed level. The worst case is provided for total swept area by the mooring system and cable and scour protection. It is considered that no other scenario proposed in **Chapter 4: Description of the Proposed Project** could give rise to increased impacts to marine water and sediment quality.
Changes to bacteria activity levels at the seabed due to installation of transmission infrastructure which may heat surrounding sediments.	Operational temperature increase around cable: 2.5°C.	This determines the worst case anticipated temperature change around the cable, which influences the likelihood of increases / changes to existing bacteria levels (contained in seabed sediments) which can impact marine water quality.
Requirement for cable repair or maintenance leading to resuspension of potentially	Once buried, submarine cables are unlikely to require routine maintenance and there should be no need for scheduled repair or	A worst-case scenario of five cable repairs has been determined for the operational life of the project. It is assumed that periodic ROV

Potential impact	Design scenario (design maximum / worst case)	Justification
contaminated sediments, increased suspended sediment concentrations (and hence turbidity) and a deterioration in water quality.	replacement. However, it is likely that regular inspection surveys will be undertaken of both dynamic and buried cables. Periodic ROV visual inspections will be undertaken of the integrity and condition of the subsea cables to ensure these remain buried and undamaged. Dynamic cables will also be periodically inspected which will include buoyancy aid checks, monitoring for cable fatigue and monitoring of cable touch down points to check for any seabed scouring. Where cable failure or exposure has been identified, NRW will be notified in advance of any maintenance or rectification work and all work will be carried out in compliance with the relevant legislation.	visual inspection will be regularly undertaken but that any physical works would be agreed with NRW prior to commencing activities.
Decommissioning (2 years)		
Accidental spillages of fluids leading to water quality deterioration.	Maximum number of vessels at any time in the Study Area: 12 (assumed consistent with construction)	Vessels create risk of accidental pollution incidents. This is the maximum number of vessels expected to be operating simultaneously in the Offshore Development Area and thus represents the worst case.
Removal of infrastructure (e.g. piles and cable protection) may produce additional suspended particles (and hence turbidity) which could be contaminated and lead to a reduction in water quality.	There is assumed to be total removal of infrastructure including the buried cables and cable protection as a worst case.	Complete removal of all infrastructure would cause the most sediment disturbance and is thus the reasonable worst case. It is considered that no other scenario could give rise to increased impacts to marine water and sediment quality.

18.6.1. Assessment Assumptions and Limitations

79. The following assumptions and limitations are made in relation to the assessment of marine water and sediment quality set out within this chapter:

- Third party and publicly available information is assumed correct at the time of publication;
- Surveys have been commissioned for the proposed Project to obtain baseline data for marine sediment quality. However, no surveys were commissioned specifically for the proposed Project for marine water quality. Instead, publicly available data sets from NRW and third parties has been used. As outlined in **Section 18.5.1** the publicly available data for marine water quality is not obtained from the Offshore Development Area, but from other areas nearby. There will be a degree of similarity between both areas in terms

of water quality, but it should be noted that there are likely to be slight variations between results used to inform the assessment and actual on-site conditions. This has been considered within the assessment. Any water quality sampling also only reflects the conditions at the time of the sampling, and thus provides an indication of quality only;

- In addition to the baseline data obtained for marine sediment quality (obtained from the surveys commissioned for the proposed Project), marine sediment data has also been provided by NRW. Both datasets have been used to provide a wider understanding of sediments within the Study Area and adjacent waters. Out of the data provided by NRW, only one sampling station (S90090) reports on sediment quality. The other stations report only on grain size of the sediment. The data from sampling station S90090 will not be representative of the whole Study Area. However, additional data supplements this (particularly the sediment sampling campaign undertaken for the proposed Project (see **Section 18.5.1**);
- The NRW sediment data covers only a small portion of the coastline adjacent to the Study Area (see **Figure 18-4**). None of the data points provided by NRW are taken within the Study Area itself and so a degree of variation is expected between the results used and those that exist on site. However, due to the areas within the Offshore Development Area being more exposed than the estuarine and coastal areas in which NRW data is provided from, it is anticipated that the concentrations of determinands in the Study Area are likely to be lower than those identified at the NRW testing sites. This is due to the distance to coastal, shoreline and land based activities, the greater exposure from wind, waves and tidal movements within the Study Area which will likely disperse any determinands throughout the water column. However, additional data supplements this (particularly the sediment sampling campaign undertaken for the proposed Project (see **Section 18.5.1**);
- To supplement data from NRW and the surveys commissioned for the proposed Project, information from the nearby Erebus project ES has been used (Marine Space, 2019). The Erebus project partially follows the same OfECC as the proposed Project, and its array area is also situated adjacent to the Array Area for the proposed Project. It should be noted that the raw data used to inform the Erebus assessment was not published. As a result, reliance on the interpretations made in the relevant ES chapters has been made instead. It is assumed for the purposes of this ES that these interpretations are accurate; and
- Sediment sampling was undertaken for the proposed Project. The results from this are presented in **Appendix 19B**: **Offshore 2023 Benthic Survey** (Ocean Ecology, 2023). A total of 30 sediment samples were taken across the Offshore Development Area. However, as discussed in **Section 18.4.4**, since these samples were taken, the Offshore Development Area has been refined. Some of these samples are therefore outside of the Array Area but are still contained within the Study Area (see **Figure 18-4**). However, due to their proximity to the offshore proposed Project development area, this is considered to remain representative of the wider baseline conditions.

18.7 Embedded Mitigation, Management Plans and Good Practice

80. As part of the project design process, a number of designed-in measures have been proposed to reduce the potential for impacts on marine water quality, which may be impacted by changes in sediment quality (see **Table 18-14**).**Error! Reference source not found.**The design of the proposed Project therefore includes embedded mitigation measures and reference to various management plans that will be produced as conditions of consent, and which will further mitigate potential impacts. This approach has been employed to demonstrate

commitment to mitigation measures by including them in the design of the proposed Project and as such these measures have been considered within the assessment presented in **Section 18.8** below. Assessment of importance/sensitivity, magnitude and therefore significance includes the implementation of these measures.

Table 18-14: Mitigation measures, management plans and best practice adopted as part of the proposed Project

Embedded Mitigation Measures, Management Plans and Best Practice	Justification
Design Embedded Measures	
Construction Environmental Management Plan (CEMP) – adoption of a CEMP and good practice measures during construction	Prior to construction starting, a Construction Environmental Management Plan (CEMP) will be prepared by the Contractor. An Outline CEMP is presented in **Appendix 4A: Outline CEMP**. detailing mitigation measures to be adopted during construction, including those relating to pollution prevention. The CEMP would outline the measures necessary to avoid, prevent and reduce adverse effects where possible upon the marine water environment. The Final CEMP would be supported by a Water Quality and Pollution Management Plan, detailing in further detail the measures required to protect the water environment.
	The CEMP will need to be reviewed, revised and updated as the project progresses towards construction to ensure all potential impacts and residual effects are considered and addressed as far as practicable, in keeping with available good practice at that point in time.
	Best practice guidance will be adopted and outlined in the CEMP. This would include Guidance for Pollution Prevention (GPP) (Netregs, n.d.): • GPP1: General guide to preventing pollution (October 2020); • GPP2: Above ground oil storage tanks (January 2018); • GPP5: Works and maintenance in or near water (February 2018); • GPP6: Working at construction and demolition sites (2012); GPP21: Pollution incidence response planning (June 2021). • GPP22: Dealing with spills; and • GPP26: Safe storage – drums and intermediate bulk containers. Additional good practice would include CIRIA C744 (2015) Coastal and marine environmental site guide (second edition).

Embedded Mitigation Measures, Management Plans and Best Practice	Justification
	Fuel, equipment and construction materials will be stored appropriately to minimise the risk of pollution which could adversely affect marine water and sediment quality. The following measures will be implemented to prevent spillage of hazardous materials: • Storage of all chemicals in secure designated areas with impermeable bunding (generally to 110% of the volume); • Double skinning of pipes and tanks containing hazardous materials; • Development of a Spill Response Plan and provision and maintenance of spill response equipment; • Completion of a COSHH assessment for hazardous materials; • Development of a COSHH Register documenting materials stored and handling requirements; • Segregation of COSHH raw material stores and COSHH waste stores; • Protection of hazardous materials in locked containers to minimise the ingress of rainwater and secure them against accidental damage; • Staff training in the use of spill kits and the correct disposal of used material; • Maintenance of a log of any incidents; and • Inspection of all construction plant and machinery daily to check for fuel and oil leaks.
	A water quality monitoring programme will be in place pre-construction and during the construction phase. This will ensure that mitigation measures are operating as planned, are preventing pollution, and in a pollution event ensuring that quick identification and implementation of appropriate action in line with the Emergency Response Plan. The monitoring will involve a combination of daily observations and monitoring, and regular water quality sampling on a periodic basis, or ad-hoc (depending on circumstances). The exact programme is to be determined by the Principal Contractor in consultation with NRW and other relevant stakeholders. This requirement is secured within **Appendix 4A: Outline CEMP**.
	Disposal of sewage and other waste will be undertaken in a manner which complies with all regulatory requirements, including but not limited to the IMO MARPOL requirements.

Embedded Mitigation Measures, Management Plans and Best Practice	Justification
Drilling and piling – to follow good practice protocols	Offshore drilling, piling and dredging for foundation (anchor) installation, trenching for cable burial, and HDD are common marine activities with associated good practice protocols. Mitigation of unnecessary environmental impact is usually embedded in this process, in the design, selection and function of the equipment, and the normal usage methodology and protocols.
Drilling fluid – to be suitably selected to minimise environmental damage	HDD drilling fluids will be tested and selected to curtail environmental damage and potential leakage. This chiefly includes using biodegradable substances that 'Pose Little or No Risk to the Environment' (PLONOR) and adequate contamination testing and drilling fluid disposal.
Cable Burial Risk Assessment – to minimise sediment disturbance where possible	A Cable Burial Risk Assessment (CBRA) will be produced post-consent which will detail the minimum burial depths of the offshore export cables throughout the offshore export cable routes, and indicative proposed locations where the target depth of burial may not be achievable and external protection is expected to be required. The CBRA will also detail which type of cable protection measure would be located at which locations and will seek to minimise the amount of sediment disturbance to as little as possible.
Disturbance from cable protection and scour protection installations – to be minimised through good engineering design practice	Scour protection and other protection measures for buried or seabed surface laid infrastructure are common infrastructure in the marine environment. The engineering design of such protection (in terms of the armour unit or clast material and dimensions, and the overall shape and structure of the protection), will take account of the environmental setting it is being located in. Good engineering design practice will actively minimise the potential for local sediment erosion (causing scour), accretion (causing burial) and general interaction with ambient flows (to minimise the potential for erosion of the protective clasts and thus increases in suspended sediment concentrations).
Adoption of appropriate third party vessel communication and management to reduce risk of accidents and collisions which may lead to spillage	Effective communication between vessels in the area throughout all stages of the proposed Project (pre lay surveys, installation, maintenance, and operation) using Notices to Mariners, Kingfisher Bulletins, Navigational Telex (NAVTEX), and NAVAREA warnings. This will reduce the likelihood of accidents or collisions at sea, which could

Embedded Mitigation Measures, Management Plans and Best Practice	Justification
and deterioration of water quality.	result in fuel spills, adversely affecting marine water quality.
Installation vessel requirements to reduce risk of accidents and collisions which may lead to spillage and deterioration of water quality.	500 m safety distances will be adopted around installation vessels. The presence of a guard vessel around the installation area perimeter will be required. All vessels will follow all international regulations governing safety at sea: • International Regulations for Preventing Collisions at Sea 1972 (COLREGS) • International Convention for the Safety of Life at Sea 1974 (SOLAS) • All vessels will follow the International Convention for the Prevention of Pollution from Ships (MARPOL). This will include shipboard oil pollution emergency plans (SOPEP). All of these measures will reduce the likelihood of accidents or collisions at sea, which could result in fuel spills, adversely affecting marine water quality.
Site and routing selection and design to minimise potential for disturbance	Taking account of, and avoiding, potential hazards such as bathymetric features including rocks and sandbanks, shipping lanes and military exercise areas wherever possible will reduce the potential for spills or leaks occurring into the marine environment from collision with vessels (which can adversely affect marine water quality). Sensitive ecological, physical, and archaeological receptors within the Offshore Development Area will also be considered. This will be informed by pre installation surveys (see below).
	Surveys will follow NRW guidance including 'Guidance on Best Practice for Marine and Coastal Physical Processes Baseline Survey and Monitoring Requirements to Inform EIA of Major Development Projects'.
Project Design	Ensure the seaworthiness of the turbine and substructure transport to the Array Area, which will subsequently reduce the likelihood of spills or leaks occurring in the marine environment (which can adversely affect marine water quality). This will include a check of towing calculations, condition and specification of the towing equipment, emergency procedure by a Marine Warranty Surveyor. Above all suitable weather and sea state should

Embedded Mitigation Measures, Management Plans and Best Practice	Justification
	be present for the transportation and installation of the turbines (windspeed 17 m/s or less, wave height less than 5 m in height).
Appropriate excavation techniques to minimise adverse effects such as increased turbidity	To prevent disturbance by suspended sediment on benthic habitats in the jet trenching phase of cable installation 'OSPAR Commission Guidelines on Best Environmental Practice' in Cable Laying and Operation must be adhered to. This includes to minimise the number of export cables that require trenching, avoiding sensitive benthic habitats in the route design wherever possible.
Management Plans	
Water Quality and Pollution Management Plan	The measures in this plan will be put in place to prevent pollution to the water environment. Despite some of these measures being aimed at terrestrial water bodies, due to connectivity to the marine environment these measures are also deemed relevant to preventing adverse effects on marine water quality.
Marine Pollution Contingency Plan	Outlines procedure to protect personnel working on the proposed Project and to safeguard the marine environment. Further details have been provided the **Appendix 4A: Outline CEMP.**
Decommissioning Environmental Management Plan	Under Section 105 of the Energy Act 2004 (as amended) (UK Parliament, 2004), developers of offshore renewable energy projects are required to prepare a Decommissioning Programme for approval by the Regulator and a Section 105 notice is issued to developers by the Regulator following receipt of consent. Developers are then required to submit a detailed plan for the decommissioning of the project, including anticipated costs and financial securities. The decommissioning strategy will consider: • The Best Practicable Environmental Option, which is the option that delivers the most benefit or least damage to the environment at an acceptable cost, both in the short and long term. This involves balancing the reduction in environmental risk with practicability and the cost of reducing the risk: • Safety of surface and subsurface navigation; • Other uses of the sea; and • Health and safety considerations.

18.8 Assessment of Environmental Effects

81. The impacts and effects (both beneficial and adverse) associated with the construction, operation and maintenance and decommissioning of the proposed Project are outlined in the sections below. The assessments consider the embedded mitigation measures described in **Section 18.7**.

18.8.1. Construction Effects

Changes in Turbidity

82. During the construction phase, several activities will occur that could lead to disturbance of sediment, resulting in changes in SCC and therefore increased turbidity. These include:

- Pre-installation clearance activities (e.g. sandwave levelling);
- IAC and OfECC cable burial activities;
- Anchor (drilling for pile anchors) and mooring line installation activities;
- HDD activities (including excavation of seaward duct seaward of MLWS in water of 3 m to 8 m LAT depth and 1,250 m^3 of drill arisings); and
- Installation of cable protection and scour protection.

83. The maximum design parameters relating to these activities is outlined in **Table 18-13.** Changes in turbidity occurring because of the proposed Project construction activities present a possibility of altering marine water quality. Details on the changes in SSC below have been taken from **Chapter 17: Physical Environment** (notably **Section 17.8**).

84. Changes in SSC will settle downwards in the water column at a rate depending on upon the sediment grain size. During this settling process, the sediment plume (area of increased turbidity) will be dispersed laterally by turbulent diffusion. Coarser grained material will settle out of suspension quickly (in the order of seconds to minutes), whilst fine grained material will remain in suspension for longer periods of time (hours to days).

85. As outlined in Figure 10 of **Appendix 19B** (Ocean Ecology, 2023), a very small proportion of the seabed sediments across the Offshore Development Area consists of fines (fines are classified in the report as grain sizes of < 63 µm). Therefore, it is assumed that 0 m to 50 m from any area of disturbance will be the zone with the highest SSC increase (tens to hundreds of thousands of mg/l) lasting for the duration of active disturbance plus up to 30 minutes following end of disturbance, and fine sediment is unlikely to deposit in measurable thickness. 50 m to 500 m would see a zone of measurable SSC increase (hundreds to low thousands of mg/l) lasting for the duration of active disturbance plus up to 30 minutes following end of disturbance. Again, fine sediment is unlikely to deposit in measurable thickness. 500 m to the extent of the tidal excursion buffer would experience zones of lesser (but measurable) SSC (in the zone of tens to low hundreds of mg/l), with no measurable thickness of sediment deposition. Within six to 24 hours after the end of the disturbance activity there would be no measurable local increase in SSC, with no measurable change from the baseline SSC after 24 to 48 hours following the cessation of activities.

86. Considering the mitigation measures outlined in **Section 18.7**, the sediment plume extent will be largely restricted to localised areas within one tidal excursion limit (the Study Area) depending on where the exact activity is taking place. Beyond the Study Area, there would be no expected impact or change to SSC. It should also be noted that these effects would be short term.

Magnitude of Impact

87. Due to the change in SSC being minor in nature (the main zone of SSC increase would be in the region of 0 m – 50 m from the disturbance itself, and the temporary nature of any effect (no measurable changes are likely to be detected within the Study Area after 48 hours of activity cessation), and the implementation of mitigation measures, the magnitude of any impact is considered to be **negligible**.

Importance of the Receptor

88. Due to the large scale of the water receptors within the Study Area (e.g. Pembrokeshire South WFD waterbody), it is considered that they have reasonable capacity to absorb change (e.g., these receptors will likely have increased capacity for dilution and flushing of any suspended sediments, or associated contaminants). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the sensitivity of these receptors is **high**.

Significance of the Effect

89. The importance of marine waters in the Study Area is **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will be **minor adverse** to the coastal waterbody (including Pembrokeshire South WFD waterbody), which is not significant in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7**. A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Effect

90. No significant effect was identified because of increased turbidity on water quality receptors, and no further mitigation is specified.

Release of Existing Chemical Contaminants from Sediments

91. During the construction phase, several activities will be occurring that could lead to the release of contaminants, which could alter marine water quality. These activities include:

- Pre-installation clearance activities (e.g. sandwave levelling);
- IAC and OfECC cable burial activities;
- Anchor (drilling for pile anchors or installation of drag embedment anchors) and mooring line installation activities;
- HDD activities (including excavation of duct seaward of MLWS and 1,700 m^3 of drill arisings); and
- Installation of cable protection and scour protection.

92. As outlined in the NRW data presented in **Annex 18B: NRW Sediment Quality Summary Data** and summarised in **Section 18.5.1**, sediments within the estuary near to the Offshore Development Area have been found to exceed Cefas Action Level 1 for a number of contaminants and in one instance, to exceed Cefas Action Level 2 for Cadmium. However, as these sediments are not included within the Offshore Development Area, there will not be any disturbance to them during the construction phase. Additional survey data gathered for the proposed Project presented in **Appendix 19B: Offshore 2023 Benthic Survey** and summarised in **Section 18.5.1** shows that sediments within the offshore area closer to and within the Offshore Development Area have identified several determinands at trace level. Levels of As were concluded to exceed Cefas AL1 to the east of the array area at four locations (ENV001,

ENV007, ENV013, and ENV014) (noting that ENV013 is the only station to be situated within the offshore proposed Project development area.

93. The activities outlined above will likely lead to the disturbance of sediments, creating an increase in turbidity and potentially releasing contaminants contained within the sediments. Contaminants partition between aqueous (pore water, overlying water) and solid phases (sediment, suspended particulate matter and biota). The portioning behaviour and spatial distribution of sediments depends on hydrodynamics, biogeochemical processes and environmental conditions (e.g. pH, salinity, temperature, redox) of the individual system. Seabed disturbance can result in contaminant remobilisation and thereby exposure to a different chemical environment which could result in desorption and transformation of contaminants into more bioavailable or toxic chemical forms. It is important to note that natural activities (wind energies, daily tidal currents and storms) in coastal areas also have the capacity to remobilise contaminated sediments, with potential to release contaminants from sediment and sediment pore water to the water column (Eggleton and Thomas, 2004).

94. As detailed in the assessment above for 'changes in turbidity', any turbidity plumes (and therefore the release of any associated contaminants) are short-lived and highly localised in nature (limited to the Study Area only). Once the activities that result in the disturbance of sediments cease, contaminant release will stop and there will be no further associated release. As outlined in **Section 18.5.1**, it is anticipated that any elevated levels of contaminants will rapidly disperse within the Study Area due to tidal action. As outlined in **Section 18.5.1**, according to NRW data water quality in the area is generally good but does exceed the WFD saline EQS for several chemicals. Therefore, due to the short-lived nature of any contaminant release associated with the proposed Project, and the fast dispersion of any raised levels within the marine environment, activities outlined above are not considered to contribute towards increasing the levels of any of these chemicals which already exist in raised levels.

Magnitude of Impact

95. Due to the temporary and localised nature of any impacts and the fact that these will rapidly disperse through the water column, and the implementation of mitigation measures, the magnitude of impact is **negligible.**

Importance of the Receptor

96. Due to the large scale of the water body receptors within the Study Area (e.g. Pembrokeshire South WFD waterbody), it is considered that they have reasonable capacity to absorb change (e.g., changes in levels of contaminants). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

Significance of the Effect

97. The sensitivity of marine sediments is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will, be of **minor adverse** significance, which is not significant in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7.** A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Effects

98. No significant effect was identified, because of increased turbidity on water quality receptors and no further mitigation is specified.

Release of Bacteria from the Sediments

99. During the construction phase, several activities will be occurring that could lead to the release of bacteria from the seabed. The release of bacteria present within the seabed could alter marine water quality. These activities include:

- Pre-construction clearance activities (e.g. sandwave levelling);
- IAC and OfECC cable burial activities;
- Anchor (drilling for pile anchors or installation of drag embedment anchors) and mooring line installation activities;
- HDD activities (including excavation of duct seaward of MLWS and 1,700 m^3 of drill arisings); and
- Installation of cable protection and scour protection.

100. Typically, bacteria strongly associate with particulate matter present in marine environments. This association tends to be greatest in fine textured sediments and is strongly influenced by the type and quantity of clay minerals and organic matter present. Natural Resources Wales also reaffirmed during consultation that the presence of bacteria is typically associated with fine sediments. Binding to particle surfaces promotes the persistence of bacteria in the environment by offering physical and chemical protection from biotic and abiotic stresses (Hassard et al., 2016). The release of particle-bound bacteria (and viruses) into the water column during sediment resuspension events could represent a risk to water quality and thereby ecological receptors. This could occur during sediment resuspension events. Turbulence in the environment results in mixing, an increase in oxygenation, bubble generation, and shear stress, which increases detachment rates of bacteria from sediment and is dependent on bacterial shape and strain, and biofilm cohesive strength. The release or resuspension of bacteria from biofilms within sediments is dependent on a combination of physicochemical forcing and biotic factors which could impact particulate loading to the water column. However, the scientific literature indicates that process level understanding of bacterial-sediment interactions remains relatively poorly understood (e.g. Hassard et al., 2016).

101. As outlined in **Section 18.5.1**, it is likely that there are minimal levels of bacteria contained within the sediments across the Study Area due to the limited level of fines identified (most sediments identified across the Offshore Development Area were coarse in grain size). On this basis, the temporary disturbance of sediments from the above activities is unlikely to promote increased bacteria growth to any level that differs significantly from the existing conditions experienced throughout the site, due to the limited potential for bacteria across the Offshore Development Area (based on the nature of the substrate). Consequently, there would not be anticipated to be any heightened risk to ecological receptors through deterioration of water quality.

102. As outlined above, any plumes of increased SSC (and therefore the release of any associated bacteria, should conditions be appropriate) would be short-lived and highly localised in nature (limited to the Study Area only). Once the activities that result in the disturbance of sediments cease, contaminant release will stop and there will be no further associated release.

103. As a result of the above, disturbance to the seabed from construction activities is unlikely to cause measurable changes in bacteria activity or contaminant concentrations across the Offshore Development Area.

Magnitude of Impact

104. Due to the limited potential for bacteria to be released into the water column (due to the limited fine sediment across the Study Area), as well as the temporary and localised nature of any impacts and the fact that these will rapidly disperse through the water column, combined with the implementation of mitigation measures (e.g. appropriate excavation techniques to minimise adverse effects relating to sediment resuspension), the magnitude of impact is considered to be **negligible**.

Importance of the Receptor

105. Due to the large scale of the water body receptors within the Study Area (e.g. Pembrokeshire South WFD waterbody), it is considered that they have reasonable capacity to absorb the expected relatively limited change in bacteria activity levels. However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

Significance of the Effect

106. The importance of marine water and sediment quality is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will be of **minor adverse** significance, which is not significant in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7.** A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Effects

107. No significant effect was identified, and as a result no further mitigation is specified.

Risk of Pollution Events

108. During the construction phase, several activities will be occurring that will require works in the marine environment, which could involve the use of marine vessels. As a worst case there could be 12 vessels operating simultaneously in the Study Area. This poses a risk of potential pollution events in the marine environment. The release of pollution during the construction phase could alter marine water quality and marine sediment quality. These activities include:

- Pre-construction clearance activities (e.g. sandwave levelling);
- IAC and OfECC cable burial activities;
- Anchor (drilling for pile anchors or installation of drag embedment anchors) and mooring line installation activities;
- HDD activities (including excavation of duct seaward of MLWS and 1,700 m^3 of drill arisings); and
- Installation of cable protection and scour protection.

109. The proposed Project requires the use of marine vessels to facilitate construction activities. Vessels will comprise a mixture including (but not limited to); survey vessels, Remotely Operated Vessels (ROVs), dedicated cable laying vessels, support vessels, and tugboats. This creates the potential for ships and hydraulic equipment to discharge contaminants into the sea during the construction phase. For example, this includes possible fuel or hydraulic leaks. Any changes in water quality creates the potential to cause non-compliance with WFD requirements including chemical and biological elements.

110. It is considered that for any fuel or hydraulic leak into the marine environment, this would be generally limited to the tidal excursion distance (the Study Area) as this is the approximate distance over which water is advected during one flood or ebb tide. Meaning that outside of this area, any leak or spill is dispersed widely enough through the environment that levels would not cause adverse effects. From analysis of baseline water quality data (see **Section 18.5.1**), there are several instances where EQS are exceeded for the area. When considering the rapid dispersal of any minor spill within the area, it is unlikely that any leak or spill of a scale associated with the proposed Project would worsen levels of existing chemicals in the area, nor prevent WFD objectives in the area from being achieved.

111. Any vessels used for the proposed Project will need to comply with all maritime legislation and guidance including the IMO MARPOL regulations and will have suitable waste disposal facilities on board. Vessels will also be required to follow the Work Boat Code (Maritime & Coastguard Agency, 2014).

Magnitude of Impact

112. The risk of adverse impacts on water quality receptors in the Study Area from possible construction phase pollution events in the marine environment will be negligible in magnitude. This is because good practice mitigation measures will be implemented as set out in **Section 18.7,** including spillage prevention measures as outlined in the Outline CEMP **Appendix 4A: Outline CEMP.** The impact could be acute but would be temporary and short term in nature. Additionally, any spill from vessels used for the proposed Project would be limited to the capacity of the vessel itself (with vessels likely to be survey vessels, ROVs, dedicated cable laying vessels, support vessels, and tugboats).

Importance of the Receptor

113. Due to the large scale of the water body receptors within the Study Area, it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality associated with pollution events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

Significance of the Effect

114. The importance of marine water is considered to be **high** and the magnitude of the impact is assessed as **negligible** (taking into account the likelihood of the event occurring and the mitigation measures that are proposed in **Section 18.7.** Therefore, the effect would be **minor adverse**, which is **not significant** in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7.** A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Effects

115. No significant effect was identified, and as a result no further mitigation is specified.

Risk of Drilling Fluid Leaks

116. During the construction phase, two HDD ducts will be drilled in the marine environment with exit points 50 m apart. Seward of MHWS, the ducts would have a maximum length of 1,500 m. These would then continue landwards of MLWS beneath Freshwater West.

117. To facilitate the HDD process, drilling fluids will be required, which will help to lubricate the drilling elements of the HDD activity (Alther, 2004). During the drilling process, it is possible

for drilling fluids and associated additives to leach into the marine environment by moving out of naturally occurring fractures and fissures within the rock layers being drilled (Kang & McLaughlin, 2016).

118. The release of HDD drilling fluids during the construction phase could alter marine water and marine sediment quality. For example, when bentonite is used alongside other drilling additives, this suspension can act as a flocculant (Akther, et al., 2008), binding particles of suspended sediment together, which causes increases in SSC and localised increases in sediment deposition from the settlement of these flocculated clumps of sediment.

119. If drilling fluids did leach into the marine environment, they would be entering an extremely large coastal water body which is tidally influenced (see **Chapter 17: Physical Environment**), meaning that any fluids or additives would be rapidly dispersed within the environment (with any levels being negligible outside of the Study Area due to the tidal excursion limit). Therefore, only receptors (e.g. ecological and designated sites) in the immediate locality of the breakout points would receive a greater impact.

120. Drilling fluids and additives for the proposed Project will be chosen from the OSPAR List of Substances / Preparations Used and Discharged Offshore which are Considered to Post Little or No Risk to the Environment (PLONOR). All drilling fluids and additives used for the proposed Project will also be biodegradable.

121. When considering the potential leaching of drilling fluids and associated additives, these impacts will be extremely localised and close to the point of breakout. Industry best practice will be incorporated into the HDD methodology which would reduce the risk of drilling fluid leaks. This would involve reviewing existing project data (such as ground investigation data) to determine the optimum drill alignment and profile to minimise the changes of breakout and drilling fluid leaks. It is also recommended for the removal of cuttings from the HDD process to be undertaken (if left within boreholes, cuttings form obstacles during the drilling process and increase the risk of breakout (Marine Space, 2019). In addition to the above preventative measures, preparations will be made for quick action and responses to occur in the event of a drilling fluid leak (to reduce the magnitude of any event that might still occur). For example, spills kits will be kept onboard all vessels and staff trained in how to use these. Additionally, surface conditions will be monitored so that any breakout events are identified, meaning suitable action can be taken (e.g., ceasing all drilling works immediately). Additionally, best practice measures for dealing with spills will be implemented, which involve containing spills with sandbags and removed using a submersible pump connected to a suitable holding container.

122. Given the mitigation measures (see **Section 18.7**), it is considered that any resulting effect would be minimal in comparison to the large area of water body present and the assumption that tidal movements would rapidly disperse any localised sediment deposition. Therefore, it is not considered that effects would be of a scale that would contribute towards worsening or preventing improvement of the WFD status of any water bodies present.

Magnitude of Impact

123. Impact magnitude is **negligible** due to the localised and temporary nature of the impact (whilst noting that the impact may result in slight, temporary changes from the baseline in these localised areas), and the implementation of embedded mitigation measures.

Importance of the Receptor

124. Due to the large scale of the water bodies within the Study Area, it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from pollution

events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is considered to be **high**.

Significance of the Effect

125. The importance of marine water is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will be of **minor** adverse significance, which is **not significant** in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7.** A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Effects

126. No significant effect was identified, and as a result no further mitigation is specified.

18.8.2. Operation and Maintenance (O&M) Effects

Changes in Turbidity

127. During the operation and maintenance phase, several activities will be occurring that could lead to changes in turbidity. The changes in turbidity could alter marine water quality. These activities include:

- Cable maintenance activities;
- Seabed scour around new and permanent structures; and
- Ongoing movement of dynamic cables across the seabed.

128. Submarine cables do not require routine maintenance; however, it is likely that regular inspection surveys will be undertaken. These inspections will consist of visual inspections of the integrity and condition of the subsea cables, using a ROV along the cable route. In the event of cable failure or exposure, the cable would either be reburied, or additional protection measures would be installed to maintain the burial condition of the cable. This is likely to result in localised disturbance to the seabed sediment, depending on where the maintenance activities take place.

129. Additionally, during the operational phase, it is possible that scour may occur around new permanent structures on the seabed, such as anchorage for the turbines or scour or cable protection measures (with 17,100 m^2 of cable protection required for IACs, 24,000 m^2 for OfECC, plus 24,800 m^2 of scour protection in the array area). Scour could occur because of local flow interaction between the body and surface of the cable protection berm, and any near-bed current and wave action. However, the potential for cable protection to cause larger scale changes to the tidal, wave or sediment transport regimes is very limited (see **Chapter 17: Physical Processes**).

130. The purpose of cable protection is to maintain stable cover to protect the buried asset over the lifetime of the proposed Project. By design, it aims to minimise the risk of scour associated with both the Offshore Export Cable and the protection itself. Berm dimensions (5 m base width x (assumed) 1.5 m height and sloped sides) typically (by design) result in slope angles less than the angle of repose for sand and a small overall height relative to the water depth, which limits the potential for form-related flow disturbance and scour, even when currents are perpendicular to the berm. Turbulence may become locally elevated in water flowing close to the surface of the berm, which may result in a limited depth and extent of secondary scour (order of a few tens of centimetres deep and up a few metres from the berm).

131. The presence of the floating platforms during the operational phase has the potential to cause changes to the local seabed level (scour) because of local flow interaction between the near-bed elements of the foundation moorings and electrical cables, and any near-bed current and wave action.

132. The main body of the floating platform is in the upper water column and is too distant from the seabed to cause a change in the near-bed local flow field or, therefore, any local scour. Where the moorings meet the seabed, the moorings will comprise large chain links (dimensions assumed up to 1 m) with a maximum of 25 clump weights per line. The maximum seabed footprint of the clump weights (per mooring line) would be 100 m^2.

133. Buried sections of the chain, clump weights, buried sections of pile anchors (suction or piled) and any embedment anchors (also completely buried) will not interact at all with the local flow field and so will not cause any scour. Where the chain links and clump weights are partially or completely exposed, increased flow turbulence may cause local scour in proportion to the size of the object, (order of a few tens of centimetres deep and up a few metres from the obstacle).

134. Exposed ends of drilled anchors (up to 3.5 m diameter, assumed up to 4 m above seabed) may cause a greater depth of local scour in proportion to their diameter; however, the limited height of these obstacles disrupts and limits the patterns of flow acceleration that can form, reducing the likely maximum dimensions of scour to the order of a few metres depth and up to ten metres extent, which is less than would be expected from a full water column height obstacle.

135. Localised sections of mooring chain may occasionally move in response to the movement of the semi-submersible floating platform, the 'swept area' is assumed to be up to 700 m^2 for each foundation and 7,000 m^3 in total (for ten foundations). The total swept area for mooring chains across the Array Area would be 34,880 m^2. The frequency and distance of movement for individual moorings will depend on the mooring configuration and the scale and direction of the force being applied to the floating platform. The movement of the chain over or through the seabed is expected to be generally slow (not causing energetic sediment resuspension) and may include both lateral and vertical movement.

136. This action may cause a 'ploughing' or 'sweeping' of sediment, redistributing sediment volume locally into linear accumulations with a maximum height proportional to the dimensions of the chain and clump weights (up to 2 m high). The net effect may be an area of disturbed seabed morphology in the swept area (up to approximately 700 m^2 per foundation in a sector or arc shaped pattern) and therefore increased turbidity. Any patterns formed will be continuously and gradually redistributed back towards a natural state by ambient sediment transport processes. The nature of the seabed sediments and the rate of sediment transport through the affected area are unlikely to be changed by this process.

137. Overall, it is considered that turbidity changes in the operational phase will be less than those considered in the construction phase as activities are reduced in scale (limited to ad-hoc maintenance) and are focused in areas where cable and scour protection are installed, as well as the anchorage for the WTGs. Considering the mitigation measures outlined in **Section 18.7** (including appropriate engineering design), the sediment plume extent will be largely restricted to localised areas within one tidal excursion limit (the Study Area) depending on where the exact activity is taking place.

Magnitude of Impact

138. The area over which these types of impact will take place is highly localised, although may occur for longer periods (i.e. throughout operation) than those effects identified during

construction. The magnitude is therefore considered to be **negligible** with the application of good practice mitigation (e.g. appropriate engineering design) as set out in this chapter.

Importance of the Receptor

139. Due to the large scale of the water bodies within the Study Area, it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from pollution events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

Significance of the Effect

140. The importance of marine water is **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will be **minor** adverse, which is not significant in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7.** A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Risk

141. No significant effect was identified, and as a result no further mitigation is specified.

Release of Chemical Contaminants from Sediments

142. During the operation and maintenance phase, several activities will be occurring that could result in the release of contaminants, which could alter marine water quality. These activities include:

- Cable maintenance activities;
- Seabed scour around new and permanent structures; and
- Ongoing movement of dynamic cables across the seabed.

143. These activities could all result in sediment disturbance throughout the operational phase as has been highlighted above in more detail in relation to changes in turbidity during operation. Sediment disturbance could be accompanied by release of contaminants (as was described in more detail about construction).

144. Disturbance to seabed sediments (and associated release of contaminants) in the operation and maintenance phase will be less than those considered in the construction phase as activities are reduced in scale (limited to ad-hoc maintenance). Disturbance would be focused in areas where cable and scour protection are installed, as well as the anchorage for the WTGs. Contaminant release from these sources has the potential to occur over a longer-time period than for construction (i.e. for the duration of the operational phase) albeit intermittently. It is anticipated that any elevated levels of contaminants will rapidly disperse within the Study Area due to tidal action. As outlined in **Section 18.5.1**, according to NRW data water quality in the area is generally good but does exceed the WFD saline EQS for several chemicals. Given the fast dispersion of any raised levels within the marine environment, activities outlined above are not considered to contribute towards increasing the levels of any of these chemicals which already exist in raised levels.

Magnitude of Impact

145. The area over which these types of impact will take place is considered to be highly localised but, may occur intermittently throughout the operation and maintenance phase. Given the potential for dilution and dispersal in the affected waterbody, the magnitude is **negligible** with

the application of good practice mitigation (e.g. appropriate engineering design of cable and scour protection) as set out in this chapter.

Importance of the Receptor

146. Due to the large scale of the water bodies within the Study Area, they have reasonable capacity to absorb change (e.g., changes in water quality from pollution events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

Significance of the Effect

147. The importance/sensitivity of marine water is **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will be of **minor** adverse significance, which is **not significant** in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7**. A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Risk

148. No significant effect was identified, and as a result no further mitigation is specified.

Release of Bacteria from Sediments

149. During the operation and maintenance phase, several activities will be occurring that could lead to the release of bacteria from the seabed. The release of bacteria present within the seabed could alter marine water quality. These activities include:

- Cable maintenance activities;
- Seabed scour around new and permanent structures;
- Ongoing movement of dynamic cables across the seabed; and
- Operational temperature increases of the cables.

150. During the operation and maintenance phase, activities such as cable maintenance, seabed scour, and ongoing movement of dynamic cables will likely result in the localised disturbance of seabed sediments, releasing bacteria that may be present in the seabed. The mechanisms for these impacts have been outlined above in relation to changes in turbidity. In **Section 18.5.1**, the presence of bacteria across the Offshore Development Area is low due to the limited fine sediment present throughout the area. As a result, bacteria release from disturbed sediment in the operational phase is considered to limited, and this was discussed in more detail above in relation to construction. However, bacteria can also be generated during the operational phase because of the operational cables that will be present.

151. The offshore export cables and IACs that are laid for this project will emit heat in the operational phase, as they become warmer in comparison to the surrounding environment during the transfer of electricity from the Array Area to the onshore substation (Emeana, et al, 2016). These increases in temperature can modify chemical and physical properties of the seabed substratum, such as the oxygen concentration profile which can indirectly lead to increases in bacterial activity (Taormina, et al, 2020). This can subsequently result in a deterioration in water quality.

152. The assessment in this chapter is based on a maximum of 2.5°C change (**Section 18.5**) as this is in line with the measured observations for the Nysted offshore windfarm (Meißner et al., 2006) and recent assessment of Project Erebus (Marine Space, 2019).

153. When considering the minimum burial depth of the offshore export cables and IACs (target depth of 1.2 m below the seabed surface with a minimum of 0.8 m) and that any areas where this is not possible the cable will be covered with cable protection (such as the placement of rock, or concrete mattresses) it is likely for temperature changes to be extremely localised. Boehlert et al (2010), suggest that these increases in temperature are anticipated to occur in the sediments within a few centimetres of the cable itself (Boehlert et al, 2010).

154. Therefore, it is possible that bacterial activity may increase because of the operation of the proposed Project, but this would be to a scale that is extremely localised. As outlined above for the construction phase, levels of bacteria across the site are generally low due to the low levels of fines present throughout the Study Area. Additionally, any bacterial growth will be associated with strains already present in the local environment (i.e., new strains will not be introduced because of the operation of the proposed Project) (Marine Space, 2019). It is assumed that the local environment is therefore already tolerant to bacteria present because of historic exposure.

Magnitude of Impact

155. Bacterial impacts could occur throughout the operational phase through sediment disturbance around mooring lines, cable and scour protection, and heating associated with electricity transmission. However, given the nature of the substrate in the Study Area (i.e. limited fine sediment) and the fact that any impacts would be highly localised, the magnitude of impact is **negligible** with the application of good practice mitigation as set out in this chapter (e.g. appropriate engineering design of cable and scour protection).

Importance of the Receptor

156. Due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

Significance of the Effect

157. The importance of marine water is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will be of **minor** adverse significance, which is not significant in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7**. A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Risk

158. No significant effect was identified, and as a result no further mitigation is specified.

Risk of Pollution Events

159. During the operation and maintenance phase, cable maintenance activities may be required. This would result in the use of marine vessels, which poses a risk of potential pollution events in the marine environment. The release of pollution during the operational phase could alter marine water quality and marine sediment quality.

160. The number of vessels required, and period for these vessels to be in the Offshore Development Area during the operational phase is considered to be less than that of the

construction phase. This is due to the installation being much larger in nature than ad-hoc maintenance and repair anticipated for the operational phase. It is estimated that during operation there will be a requirement for vessels to visit each WTG 12 times per year. Therefore, the likelihood of a pollution event occurring from vessels is reduced compared to the construction phase.

161. Each WTG contains components that will require lubricating oils, hydraulic oils and coolants for its operation. Examples include grease, synthetic oil / hydraulic oil, nitrogen, transformer silicon / oil, suphur hexafluoride and water / glycerol. To mitigate the risk of pollution events, the nacelle, tower, and rotor will be designed and constructed to contain leaks, thereby reducing the risk of spillage into the marine environment.

Magnitude of Impact

162. The area in which these types of impact will take place over is highly localised, resulting in very short-term changes should a pollution event occur. The magnitude is therefore considered to be **negligible**. The impact could be acute but would be temporary and short term in nature. Additionally, any spill from vessels used for the proposed Project would be limited to the capacity of the vessel itself (with vessels likely to be survey vessels, ROVs, dedicated cable laying vessels, support vessels, and tugboats).

Importance of the Receptor

163. Due to the large scale of the water bodies within the Study Area, it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from pollution events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the sensitivity of these receptors is **high**.

Significance of the Effect

164. The importance of marine water is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will be **minor** adverse, which is not significant in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7**. A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Risk

165. No significant effect was identified, and as a result no further mitigation is specified.

18.8.3. Decommissioning Effects

166. The decommissioning process will largely mirror the installation processes during the construction phase in reverse, with the entire decommissioning phase expected to be completed within a 12-month period between the years of 2052 and 2054. This will involve the complete removal of all infrastructure as a worst case. It should be noted that the decommissioning process for the proposed Project will be consulted upon and agreed via the production of a Decommissioning Programme.

Changes in Turbidity

167. During the decommissioning phase, several activities will be occurring that could lead to changes in turbidity. The changes in turbidity could alter marine water quality. These activities include:

- Removal of WTG mooring/anchoring systems;

- Removal of cable protection; and
- Removal of IACs and Offshore Export Cables from the seabed.

168. The removal of WTG mooring/anchoring systems is expected to result in some localised seabed disturbance accompanied by temporary increases in SSC. For the purposes of the EIA and to provide a worst-case assessment, it has been assumed that all infrastructure will be removed from the intertidal zone and seabed during decommissioning. It is probable that equipment like that used to install the infrastructure, could be used to reverse the burial process and installation process. Accordingly, the area of seabed impacted during the removal of the proposed Project infrastructure would be like the area impacted during construction.

169. For all the above, the changes in SSC and accompanying changes to bed levels associated with decommissioning activities are expected to be no greater than that associated with construction. Further information is provided in the construction phase assessment (**Section 18.8.1**). In addition, all activities would take place in accordance with a Decommissioning Strategy (see **Table 18-17**).

Magnitude of Impact

170. As with construction, impacts related to turbidity would be temporary. Due to the likely change in SSC being minor in nature (the main zone of SSC increase would be in the region of 0 m – 50 m from the disturbance itself, and the temporary nature of any effect (no measurable changes are likely to be detected within the Study Area after 48 hours of activity cessation), and the implementation of mitigation measures (e.g. good practice measures as outlined in a Decommissioning Strategy), the magnitude of any impact is considered to be **negligible**.

Importance of the Receptor

171. Due to the large scale of the water bodies within the Study Area, it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from pollution events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

Significance of the Effect

172. The importance of marine water is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will be of minor adverse significance, which is **not significant** in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7**. A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Risk

173. No significant effect was identified, and as a result no further mitigation is specified.

Release of Chemical Contaminants from Sediments

174. During the decommissioning phase, several activities will be occurring that could result in the release of contaminants. The changes in levels of contaminants could alter marine water quality. These activities include:

- Removal of WTG mooring/anchoring systems;
- Removal of cable protection; and
- Removal of IACs and Offshore Export Cables from the seabed.

175. It is considered that disturbance to seabed sediments (and associated release of contaminants) in the decommissioning phase will be similar to that considered in the construction phase as activities are similar in nature (but anticipated to occur in reverse order). It is not considered that the existing levels of contaminants in the seabed of the Offshore Development Area will change considerably from the construction phase to the decommissioning phase. Therefore, the same assumptions about the release of contaminants apply to the decommissioning phase as those outlined in **Section 18.8.1**.

Magnitude of Impact

176. The area in which these types of impact will take place over is highly localised, resulting in very short-term changes. The magnitude is therefore considered to be **negligible** with the application of good practice mitigation as set out in this chapter (e.g. good practice measures as outlined in a Decommissioning Strategy).

Importance of the Receptor

177. Due to the large scale of the water bodies within the Study Area, it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from pollution events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the sensitivity of these receptors is **high**.

Significance of the Effect

178. The importance of marine water is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will be of **minor** adverse significance, which is not significant in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7.** A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Risk

179. No significant effect was identified, and as a result no further mitigation is specified.

Release of Bacteria from Sediments

180. During the decommissioning phase, several activities will be occurring that could lead to the release of bacteria from the seabed. The release of bacteria from seabed sediments can affect water quality. These activities include:

- Removal of WTG mooring/anchoring systems;
- Removal of cable protection; and
- Removal of IACs and Offshore Export Cables from the seabed.

181. Existing bacteria levels within the seabed sediments are not considered to differ between the construction and decommissioning phases. The levels of seabed disturbance (and associated bacteria release) are similar between the construction and decommissioning phases due to the similar nature of activities taking place. Therefore, the sensitivity and magnitude of effect will be the same as that outlined in **Section 18.8.1**.

Magnitude of Impact

182. The area in which these types of impact will take place is considered to be highly localised and would be short-term in nature. The magnitude is therefore considered to be **negligible** with the application of good practice mitigation as set out in this chapter.

Importance of the Receptor

183. Due to the large scale of the water bodies within the Study Area, it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from pollution events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the sensitivity of these receptors is **high**.

Significance of the Effect

184. The importance/sensitivity of marine water is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will be of **minor adverse significance**, which is **not significant** in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7**. A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Risk

185. No significant effect was identified, and as a result no further mitigation is specified.

Risk of Pollution Events

186. During the decommissioning phase, works will need to take place in the marine environment to remove the cables and cable protection measures, which will require the use of vessels. It is estimated that a maximum of 12 vessels would be in the Study Area simultaneously as a worst case (equivalent to the construction phase). This poses a risk of potential pollution events in the marine environment. The release of pollution during the decommissioning phase could alter marine water quality and marine sediment quality.

187. The same requirements for vessels will be followed as those outlined in **Section 18.8.1** for the construction phase.

Magnitude of Impact

188. The area in which these types of impact will take place over is highly localised, resulting in very short-term changes. The magnitude is therefore considered to be **negligible** with the application of good practice mitigation as set out in this chapter. The impact could be acute but would be temporary and short term in nature. Additionally, any spill from vessels used for the proposed Project would be limited to the capacity of the vessel itself (with vessels likely to be survey vessels, ROVs, dedicated cable laying vessels, support vessels, and tugboats).

Importance of the Receptor

189. Due to the large scale of the water bodies within the Study Area, it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from pollution events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

Significance of the Effect

190. The importance of marine water is considered to be high and the magnitude of the impact is assessed as **negligible**. Therefore, the effect will be of minor adverse significance, which is **not significant** in EIA terms. Note that professional judgment has been used to decide between a negligible/minor effect as outlined in **Table 18-7**. A minor adverse effect is considered the worst case and is appropriate given the ecological designations associated with the water body.

Further Mitigation and Residual Risk

191. No significant effect was identified, and as a result no further mitigation is specified.

18.8.4. Summary of Residual Environmental Effects

192. This chapter of the ES has assessed the potential environmental effects on marine water and sediment quality, including the risk from mobilising sediments and any chemical compounds or bacteria present in those sediments, as well as the risk of potential pollution events during the construction, operation and maintenance, and decommissioning phases of the proposed Project.

193. **Table 18-15** summarises the impact assessment undertaken and confirms the significance of any residual effects.

18.9 Summary of Additional Mitigation Measures

194. As outlined above, no significant residual effects were identified and as a result, no additional mitigation measures are required.

18.9.5. Monitoring

195. No monitoring is proposed for the effects identified on marine water and sediment quality.

18.10 Summary of Effects and Conclusions

196. This section summarises the residual significant effects of the proposed Project on marine water and sediment quality following the implementation of mitigation.

Table 18-15. Assessment summary

Potential Impact	Receptor	Receptor Sensitivity	Magnitude of impact	Significance of effect	Additional Mitigation	Residual Significance of Effect
Construction						
Changes in turbidity	Marine water and sediment quality within the Study Area	High	Negligible	Minor **Not Significant**	None required	Minor **Not Significant**
Release of contaminants from sediments		High	Negligible	Minor **Not Significant**	None required	Minor **Not Significant**
Release of bacteria from sediments		High	Negligible	Minor **Not Significant**	None required	Minor **Not Significant**
Risk of pollution events		High	Negligible	Minor **Not significant**	None required	Minor **Not significant**
Drilling fluid leaks		High	Negligible	Minor **Not significant**	None required	Minor **Not significant**
Operation and Maintenance						
Changes in turbidity	Marine water and sediment quality within the Study Area	High	Negligible	Minor **Not Significant**	None required	Minor **Not Significant**
Release of contaminants from sediments		High	Negligible	Minor **Not Significant**	None required	Minor **Not Significant**
Release of bacteria from sediments		High	Negligible	Minor **Not Significant**	None required	Minor **Not Significant**
Risk of pollution events		High	Negligible	Minor **Not significant**	None required	Minor **Not significant**
Decommissioning						

Potential Impact	Receptor	Receptor Sensitivity	Magnitude of impact	Significance of effect	Additional Mitigation	Residual Significance of Effect
Changes in turbidity	Marine water and sediment quality within the Study Area	High	Negligible	Minor / negligible **Not Significant**	None required	Minor **Not Significant**
Release of contaminants from sediments	Marine water and sediment quality within the Study Area	High	Negligible	Minor / negligible **Not Significant**	None required	Minor **Not Significant**
Release of bacteria from sediments	Marine water and sediment quality within the Study Area	High	Negligible	Minor / negligible **Not Significant**	None required	Minor **Not Significant**
Risk of pollution events	Marine water and sediment quality within the Study Area	High	Negligible	Moderate / minor **Not significant**	None required	Minor **Not significant**

18.11 Cumulative Effects of the Project

18.11.1. Introduction

197. Cumulative effects are those effects upon receptors arising from the proposed Project alongside all existing, and/ or reasonably foreseeable projects, plans and activities that result in cumulative effects with any element of the proposed Project. Existing projects are generally considered as part of the baseline and as such are considered within the impact assessment presented in **Section 18.8** above.

198. This section assesses potential cumulative effects on marine water and sediment quality from identified projects, plans and activities that have the potential to act cumulatively with the proposed Project.

199. The Planning Inspectorate (PINS) Advice 17: Cumulative Effects Assessment (2019) suggests that cumulative effects assessment (CEA) follows a four-stage process. The aim of this approach is to accurately determine relevant projects and associated relationships with scoped in receptors identified in the ES, to be included within the interproject CEA.

18.11.2. *The approach to the assessment of cumulative effects is detailed in **Appendix 5B: Approach to Cumulative Effects Assessment** and is also summarised in **Table 18-16.***

Table 18-16. PINS advice 17 stages of the CEA process

CEA Stage	Activity
Stage 1	Determine a zone of influence (ZoI) via desk study for each topic receptor scoped into the ES. This will establish a *long list* of projects within each ZoI that will be shortlisted in Stage 2. This list of plans and projects/activities is drawn up through a desk study of planning applications, development plan documents, relevant development frameworks and any other available sources to identify 'other development' within the ZoI. Information on each project (location, development type, status, etc.) is documented, along with the certainty or tier assigned to the 'other development' (i.e. confidence it will take place in the current form and when it will take place in relation to the project). PINS notes that the project should then consult with the relevant planning authority/ authorities and statutory consultees regarding the long list.
Stage 2	Screening of the long list identified in Stage 1, to establish a short list for the CEA. Screening is based on the criteria presented in the scoping report and subsequent comments by the regulator and statutory consultees. PINS has provided inclusions/ exclusion threshold criteria, against which the potential for 'other development to give rise to significant cumulative effects by virtue of overlaps in temporal scope, the scale and nature of the 'other developments' and /or receiving environment, or any other relevant factors is assessed. From this assessment, a shortlist of 'other developments' to be included in the CEA is produced. It is noted that documented information on each of the 'other developments' is likely to be high level at this stage, outlining the key issues to take forward.
Stage 3	Gathering of all information available on short listed projects generated in Stage 2. At this stage all available data and information about the shortlisted projects that will be included in the CEA is collected to inform the assessment. This should utilise the most current information for each project in the public domain, and assess the assumptions and limitations of the information collected on each shortlisted project.
Stage 4	Each of the shortlisted projects are reviewed in turn by the different topics to assess whether cumulative effects may arise and the nature of those effects (i.e. beneficial or adverse). The significance of the effects on environmental receptors

CEA Stage	Activity
	is established within each ES technical chapters. Where significant adverse cumulative effects are identified, mitigation measures are also considered within the CEA alongside the mechanism to secure that mitigation, e.g. consent condition requirements.

18.11.3. Scope of Cumulative Effects Assessment for Marine Water and Sediment Quality Impacts

200. The following impacts have been scoped into the CEA for marine water and sediment quality. These are the impacts identified when considering the proposed Project alone, thus, there is a possibility that these could be increased should the impacts coincide with those of external projects that might overlap temporally or spatially and have identified similar such effects, and therefore need to be assessed further in the CEA.

Construction

- Changes in turbidity – there is potential for increased turbidity plumes due to combined project activities (i.e. those of the proposed Project and other projects scoped in for assessment);
- Release of contaminants from sediments – there is potential for increased concentrations of contaminants in the water column due to combined project activities;
- Release of bacteria from sediments – there is potential for increased bacteria release due to combined project activities;
- Risk of pollution events – there is increased risk of pollution events where there are combined project activities (e.g. more vessels in the Study Area); and
- Drilling fluid leaks – there is increased risk of drilling fluid leaks where there are other projects drilling within the Study Area.

Operation and Maintenance

- Changes in turbidity – there is potential for increased turbidity plumes due to combined project activities;
- Release of contaminants from sediments – there is potential for increased concentrations of contaminants in the water column due to combined project activities;
- Release of bacteria from sediments – there is potential for increased bacteria release due to combined project activities; and
- Risk of pollution events – there is increased risk of pollution events where there are combined project activities (e.g. more vessels in the Study Area).

Decommissioning

- Changes in turbidity – there is potential for increased turbidity plumes due to combined project activities;
- Release of contaminants from sediments – there is potential for increased concentrations of contaminants in the water column due to combined project activities;
- Release of bacteria from sediments – there is potential for increased bacteria release due to combined project activities; and
- Risk of pollution events – there is increased risk of pollution events where there are combined project activities (e.g. more vessels in the Study Area).

201. **Table 18-17** presents the short list of projects identified and included within the CEA that are relevant to the assessment of effects on marine water and sediment quality. These are the

projects identified from the long list as considered to be present within the Study Area (within the distance of one spring tidal ellipse from the proposed Project) and for which there could be temporal overlap. The approach to the assessment of cumulative effects is detailed in **Appendix 5B: Approach to Cumulative Effects Assessment**. The Study Area reflects the maximum spatial extent of potential effects identified within this chapter (**see Figure 18-8**). Hence, plans or projects with potential to overlap spatially with this ZoI have been subject to the cumulative assessment.

Table 18-17 List of projects considered for the marine water and sediment quality cumulative effects assessment

Project Name/Developer	Project Type	Tier and Status	Approx. distance from the proposed Project	Construction Timeframe
Erebus Project	This project involves the installation of a 100MW wind energy testing and demonstration project 45 km offshore.	Tier 1: Installation of the Erebus project will commence in 2027. As the proposed Project's commissioning period is between 2026 – 2027, there is potential for the construction phases to overlap briefly. The operational phase would also overlap. Therefore, this project **will be** considered for cumulative effects.	5 km north west of proposed Project Array	June 2026 – October 2026
Llyr 2 Floating Offshore Wind Project	This project will follow on from the proposed Project and will involve the creation of a floating offshore wind farm of up to 10 turbines. The Project submitted a scoping report in April 2022. An Environmental Statement has yet to be submitted.	Tier 2: Llyr 2 is expected to be constructed across 2027-2028. There is potential for the construction phases to overlap. The operational phase would also overlap and would commence for Llyr 2 in 2029. Therefore, this project **will be** considered for cumulative effects.	0 km	2027 / 2028
Milford Haven dredge disposal	This project involves the disposal of dredged material off the coast of Milford Haven. No information is provided on where material being	Tier 1: No information is provided on the timescales for this project and so a worst-case scenario is assumed in that both the installation period of the proposed	4 km north east of the export cable	TBC

Project Name/Developer	Project Type	Tier and Status	Approx. distance from the proposed Project	Construction Timeframe
	disposed of has come from.	Project and the active use of the disposal site overlap (i.e. operation). Therefore, this project **will be** considered for cumulative effects.		
South Pembrokeshire Wave Demonstration Zone	This project involves the installation of a floating slack moored wave energy converter. The device is fixed to an anchor buoy. The project has submitted an EIA Screening report to the authorities, but the application is yet to be submitted and installation has not yet begun.	Tier 3: No information is provided on the installation timescales for this project and so a worst-case scenario is assumed in that installation periods may overlap. Therefore, this project **will be** considered for cumulative effects.	10 km north east of the export cable	2025
The Crown Estate – Commercial Celtic Sea Leasing Round 5.	Offshore Wind Leasing Round 5 seeks to establish a new floating wind sector in the Celtic Sea off the coasts of South Wales and South West England	Tier 3: Projects to be taken forward are yet to be determined. The contracts which The Crown Estate expects to enter into as a result of the Celtic Sea Floating Offshore Wind Leasing Round 5 (“Round 5") will grant new seabed rights to developers for the development of new floating wind farms within three project development areas, each of which has a maximum potential energy generation capacity of 1.5GW (meaning a combined maximum potential energy generation capacity of 4.5GW	Not known pending the outcome of Leasing Round 5.	TBC

Project Name/Developer	Project Type	Tier and Status	Approx. distance from the proposed Project	Construction Timeframe
		across all 3 project development areas). No information is available regarding which projects will be taken forward and so the Commercial Celtic Sea Leasing Round **will not be** considered for cumulative effects.		

202. The following projects listed below will be considered in the assessment of cumulative effects due to their location within the Study Area and construction and operational periods potentially overlapping with the construction and operational period of the proposed Project. The projects identified for the CEA are shown in **Figure 18-8**.

- Llyr 2;
- Erebus project;
- Milford Haven dredge disposal; and
- South Pembrokeshire Wave Demonstration.

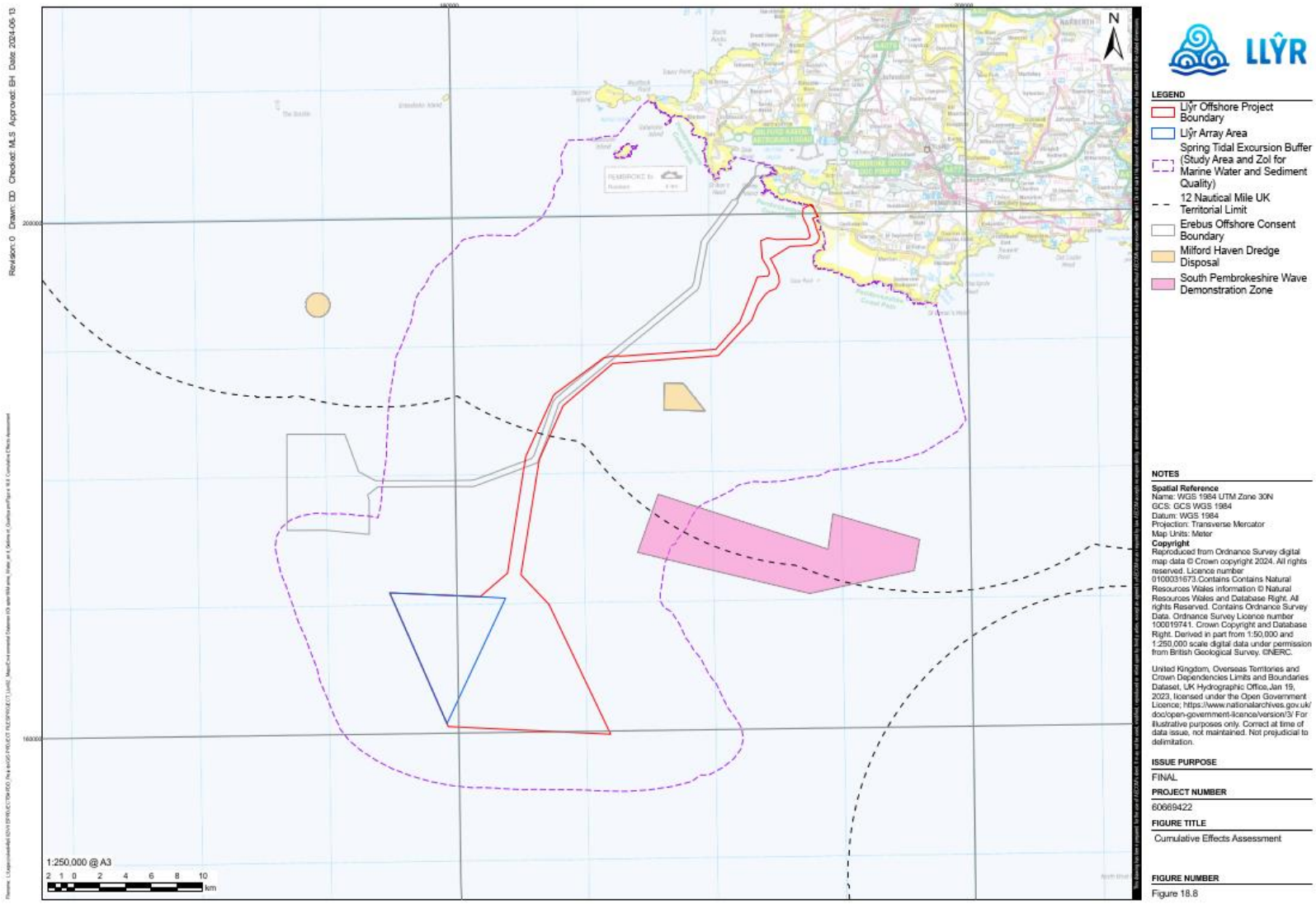

Figure 18-8: External projects considered for the CEA for marine water and sediment quality.

18.11.4. *Cumulative Effect Assessment*

Construction

Changes in Turbidity, Release of Contaminants and Bacteria from Sediments

203. As outlined in **Section 18.8.1**, the extent of any effects from changes in turbidity and release of contaminants and bacteria from sediments will be limited to the extent of the Study Area. The projects identified for cumulative assessment are in the Study Area, and therefore, there is potential for cumulative effects to occur in relation to changes in turbidity, contaminant release and bacteria release from these other developments. Nonetheless, it is considered that any impact would be limited to the Study Area given the mitigation measures that are in place, with no measurable change beyond the Study Area above existing baseline levels of SSC, contaminants and bacteria.

204. As outlined in **Section 18.8.1**, the greatest area of sediment disturbance from the proposed Project is highly localised given the proposed mitigation (see **Section 18.7**), and so turbidity effects would only be measurable within 100 m of the works themselves and not significant at the waterbody scale where there is a large capacity to absorb change (in turbidity, contaminants and bacteria). This is in part down to the limited amount of fine sediment across the Study Area. The closest project's export cable corridors would either follow (Llyr 2) or partially overlap (Erebus) with the proposed Project's OfECC, with other projects being located between 12 – 18 km away from the Offshore Development Area and thereby having limited potential for cumulative impacts.

205. The magnitude of any cumulative impact during construction for all identified potential impacts would therefore be **negligible**. Additionally, the construction periods of both the proposed Project and the Erebus project are only anticipated to overlap for a period of one month, reducing the potential for any cumulative effect to occur and the duration within which it would occur.

206. While the coastal waterbody does have a reasonable capacity to absorb change (e.g., changes in water quality from increased SSC, release of contaminants and bacteria), due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

207. The importance of the marine water body is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the cumulative effect of changes in turbidity, contaminant release and bacteria release on marine water and sediment quality is **minor** and **not significant**.

Pollution Events (Including Drilling Fluid Leaks)

208. The proposed Project and closest external projects (Milford Haven dredge disposal and Erebus project) will require the use of marine vessels. These projects will overlap, creating the possibility for two pollution events to occur in proximity at the same time which could lead to cumulative effects. The proposed Project and Erebus would only overlap by one month and both projects have suitable mitigation in place to prevent pollution events occurring. Similar measures would be in place for the Milford Haven dredge disposal and so the likelihood of such a pollution event occurring is low, and the magnitude of any impact is **negligible**. With other projects being located 10+km away from the Offshore Development Area and given the

mitigation in place, it is again considered that there is limited potential for a cumulative impact with these other developments and that the magnitude of any impact would be **negligible.**

209. Both the proposed Project and the Erebus project involve HDD activities (it is assumed that no other external projects identified and scoped in involve HDD activities). This means there is potential for drilling fluid leaks to occur at both project locations. As outlined in the assessment of effects considered alone for the proposed Project, any leaks would be rapidly dispersed within the environment due to the distance from the proposed Project to external projects (due to tidal action). Additionally, when considering the mitigation in place for both projects and the preventative measures for HDD drilling fluid leaks any cumulative impacts would be **negligible** in magnitude.

210. Due to the large scale of the receptors (marine water body) within the Study Area, it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from pollution events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

211. The importance of the marine water body is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the cumulative effect of pollution events on marine water and sediment quality is **minor** and **not significant**.

Further Mitigation and Residual Risk

212. No significant effect was identified, and as a result no further mitigation is specified.

Operation and Maintenance

Changes in Turbidity, Release of Contaminants and Bacteria From Sediments

213. There is potential for cumulative effects to occur in relation to changes in turbidity, contaminant release and bacteria release during operation and maintenance of the proposed Project. However, operational activities for the proposed Project will be extremely limited (in terms of their duration, extent and level of disturbance) and ad-hoc. This will result in only a minor change in turbidity and contaminant levels (see **Section 18.8.2**). Due to the reduced levels of activity for the proposed Project during the operation and maintenance phase for both the proposed Project and the other identified developments, any resulting cumulative impact is **negligible** in magnitude given the mitigation in place (see **Section 18.7**) and less than that could occur during construction.

214. With regard to bacteria, operational temperature increases will result in negligible effects when considered alone for the proposed Project. As outlined in **Section 18.8.1**, temperature changes from any active cables are anticipated to be restricted to within a few centimetres of the surrounding sediments. The closest external projects (Erebus project and Llyr 2) will also involve the use of operational cables which will emit heat in the operation and maintenance phase. However, given the very localised nature of the effect for the proposed Project and other projects any cumulative impact would be **negligible** in magnitude.

215. Due to the large scale of the receptors within the Study Area (marine water body), it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from increased SSC, release of contaminants and bacteria). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

216. The importance of marine water quality is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the cumulative effect of changes in turbidity on marine water and sediment quality is **minor** and **not significant**.

Further Mitigation and Residual Risk

217. No significant effect was identified, and as a result no further mitigation is specified.

Pollution Events

218. Operation and maintenance phase cumulative effects relating to pollution events are less likely to occur than for the construction phase. This is due to less vessels being on site and less work being undertaken in the operation and maintenance phase at the Offshore Development Area proposed Project array area (limited to cable maintenance when required only). The operation and maintenance phase of the proposed Project still overlaps with the operation and maintenance phase of the closest external projects (Erebus project and Llyr 2). Therefore, the potential for this to happen still exists (but is reduced in likelihood). Therefore, cumulative impacts will have a **negligible** magnitude**.**

219. Due to the large scale of the receptors (marine water body) within the Study Area, it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from pollution events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

220. The importance of marine water and sediment quality is considered to be **high** and the magnitude of the impact is assessed as **negligible**. Therefore, the cumulative effect of pollution events on marine water and sediment quality is **minor** and **not significant**.

Further Mitigation and Residual Risk

221. No significant effect was identified, and as a result no further mitigation is specified.

Decommissioning

Changes in Turbidity, Release of Contaminants and Bacteria From Sediments

222. For the purposes of the EIA and to provide a worst-case assessment, it has been assumed that all infrastructure from the proposed Project will be removed during decommissioning. It is probable that equipment like that used to install the infrastructure could be used to reverse the construction process during decommissioning. Accordingly, the area of seabed impacted during decommissioning would be like the area impacted during construction. While there is potential for cumulative effects to occur in relation to changes in turbidity, contaminant release and bacteria release, the impacts of decommissioning activities are expected to be no greater than that associated with construction for the proposed Project.

223. Decommissioning activities for the proposed Project will take place after 30 years and therefore would follow the decommissioning period of the Erebus project (after 25 years of operation) but may overlap with Llyr 2. There may also be potential for overlap with decommissioning of the other identified developments although full details of the decommissioning timescales are unclear.

224. Aside from Erebus and Llyr 2, the closest projects are located over 10 km away from the proposed Project, and as such it is assumed less likely for cumulative effects to take place with due to distance and the nature of the projects as well as the mitigation that would be in place. Therefore, any resulting cumulative impact is **negligible** in magnitude for changes in turbidity, contaminant release and bacteria release.

225. Due to the large scale of the receptors within the Study Area (marine water body), it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from increased SSC and contaminants, bacterial release or growth). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

226. The importance of marine water quality receptors is considered to be **high** and the magnitude of the impact is assessed as **negligible** for changes in turbidity, contaminant release, and bacteria release. Therefore, the cumulative effect of changes in turbidity, on marine water and sediment quality is **negligible** and **not significant**.

Further Mitigation and Residual Risk

227. No significant effect was identified, and as a result no further mitigation is specified.

Pollution Events

228. Decommissioning activities for the proposed Project will take place after 30 years and thus would follow decommissioning of the Erebus project but may overlap with Llyr 2. The potential for cumulative impacts will be reduced from that of the construction phase due to reduced activity levels on site (with Erebus having been decommissioned). Aside from Erebus and Llyr 2, the closest projects are located over 10 km away from the proposed Project, and as such it is considered less likely for cumulative pollution related incidents to take place due to distance and the nature of the projects. Therefore, any resulting cumulative impact is **negligible** in magnitude.

229. Due to the large scale of the receptors (marine water body) within the Study Area, it is considered that they have reasonable capacity to absorb change (e.g., changes in water quality from pollution events). However, due to the designations contained within the receptors themselves (including national designations (WFD water bodies) and European designated status (SACs, SPAs, Ramsars, etc.), the importance of these receptors is **high**.

230. The sensitivity of marine water and sediment quality is considered to be **high** and the magnitude of the effect is assessed as **negligible**. Therefore, the cumulative effect of pollution events on marine water and sediment quality is **minor** and **not significant**.

Further Mitigation and Residual Risk

231. No significant effect was identified, and as a result no further mitigation is specified.

18.12 Inter-related Effects of the proposed Project

232. The term 'Inter-related' considers the environmental interactions ('inter-relationships') with other receptors within the proposed Project. These are referred to in the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 and further described in **Chapter 31: Inter-related Effect Assessment.**

233. As set out in PINS Advice Note 17 (PINS), 2019, *inter-related -project effects*, or 'interrelationships between topics', derive from combinations of different project specific impacts which, when acting together on the same receptor, could result in a new or different effect, or an effect of greater significance than the project effects, when considered in isolation.

234. Inter-related Effects Comprise the Following:

235. *Project lifetime effects*: effects that have the potential to occur during more than one phase of the proposed Project (i.e. construction, operation and maintenance and decommissioning)

and to interact in a way that could potentially create a more significant effect than if it was assessed in isolation.

236. *Receptor-led effects*: effects that have the potential to interact, spatially and temporally, to create inter-related effects on a receptor.

237. **Chapter 31: Inter-related Effects Assessment** details the approach to the inter-related effects assessment and includes a description of the likely inter-related effects that may occur because of the proposed Project on marine water quality.

18.12.1. Inter-related Project Lifetime Effects

238. Inter-related effects that may occur throughout the project lifetime on marine water and sediment quality are detailed in **Table 18-18.**

Table 18-18 Inter-related project lifetime effects assessment – marine water and sediment quality

Development Phase	Nature of inter-related effect	ES Reference	Inter-related effects assessment
Construction, operation and decommissioning	Deterioration of water quality due to changes in turbidity	**Chapter 17: Physical Environment Chapter 18: Marine Water and Sediment Quality**	The assessment concludes that these impacts across all phases of the proposed Project would be of **minor** to **minor / negligible** adverse significance, which is **not significant** in EIA terms. The majority of these impacts are predicted to occur as a result of interactions to marine physical processes (considered in **Chapter 17: Physical Environment**). As outlined in **Chapter 18: Marine Water and Sediment Quality**, standard control measures will be adhered to (see **Section 18.7**). In addition, the Project's CEMP and Water Quality and Pollution Management Plan will be adhered to. As a result, it is not expected that these impacts will result in inter-related effects of greater significance, through combined project phases, than those assessed in isolation.
	Deterioration of water quality due to release of contaminants	**Chapter 18: Marine Water and Sediment Quality**	
	Deterioration of water quality due to drilling fluid release	**Chapter 18: Marine Water and Sediment Quality**	
	Deterioration of water quality due to pollution events	**Chapter 18: Marine Water and Sediment Quality**	
	Deterioration of water quality due to release of bacteria	**Chapter 18: Marine Water and Sediment Quality**	

18.12.2. *Inter-related Receptor-Led Effects*

239. It is considered possible for spatial and temporal interactions to occur between the impacts identified for marine water and sediment quality. However, although these potential

combined effects may arise (e.g. contaminants released in the same location as a pollution event occurring, or changes in turbidity to take place), it is predicted that this will not be more significant than the assessment of individual impacts when considered alone in isolation. This is due to the localised nature of the impacts when considering the scale and recoverability of the receptors.

18.13 Transboundary Effects

240. A transboundary effect refers to the impacts or effects of a project that extend beyond the boundaries of the United Kingdom and have the potential to affect the environment of other countries within the European Economic Area (EEA). These effects can occur either from the proposed Project on its own or when combined with the effects of other projects or activities in the wider geographical area.

241. In terms of the impacts on marine water receptors, impacts will be localised to the extent of the Study Area. Given the intervening distance to neighbouring EEA states, there is no potential for transboundary impacts and resultant effects to occur.

18.14 References

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Annex 18A Natural Resources Wales Water Quality Data Summary

Water quality sampling results obtained from Natural Resources Wales (2023) are compared to Environmental Quality Standards (EQS) where available in the table below. Where saline EQS are unavailable, water quality sampling results have instead been compared to freshwater EQS.

		Estuarine					Saline							
Chemical	Unit	Mean	Min	Max	90th %tile	10th %tile	Mean	Min	Max	90th %tile	10th %tile	Detection Limit	WFD EQS fresh water[4]	WFD EQS Saline[5]
Chlorophyll	µg/l	2.06	0.333	25.8	3.68	0.5404	1.82	0.125	26.2	3.52	0.5	0.5		
Suspended Solids	mg/l	5.40	3	8.2	7.56	3.4	3.54	3	11	4.7	3	3	10	
Turbidity	FTU	13.95	1.5	104.4	27.13	3.73	8.05	0.1	75.5	15.18	2.3			
Ammoniacal Nitrogen	mg/l	0.082	0.007	0.72	0.1006	0.01944	0.077	0.007	0.86	0.44	0.007	0.02	1.1	
Nitrite	mg/l	0.0086	0.0007	0.139	0.0155	0.004	0.007	0.0007	0.085	0.02	0.001614	0.02		
Nitrogen	mg/l	0.50	0.007	1.7	0.974	0.1	0.28	0.007	2.2	0.7	0.02614	0.7		
Orthophosphate	mg/l	0.02	0.002	0.11	0.03	0.01	0.02	0.002	0.08	0.02384	0.0071	0.01		
Copper	mg/l	0.63	0.253	1.3	0.894	0.4248	0.58	0.2	1.51	0.8055	0.391	0.2	1	2.76
Lead	µg/l	0.05	0.04	0.148	0.057	0.04	0.05	0.04	0.269	0.05652	0.04	0.04	1.2	
Mercury	µg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.024	0.01	0.01	0.01	0.07	
Nickel	µg/l	0.53	0.3	2.37	0.815	0.3	0.90	0.3	110	0.6503	0.3	0.3	4	
Zinc	µg/l	2.21	0.554	28.5	2.361	0.7775	1.65	0.4	11.6	2.568	0.7842	1	10.9	6.8
Fluoranthene	ng/l	1.76	1	5.83	3.037	1	1.06	1	1.89	1	1	1	0.0063	
Benzo(a)pyrene	ng/l	1.57	1	8.09	2.637	1	1	1	1	1	1	1	0.00017	
Indeno(123,cd)pyrene	ng/l	1.52	1	7.01	2.581	1	1	1	1	1	1	1	0.00017	
Benzo(ghi)perylene	ng/l	1.56	1	7.78	2.688	1	1	1	1	1	1	1	0.00017	

[4] Blank cells indicate that there is no EQS for that determinant.

Legend:

	EQS exceeded
	EQS not exceeded

	Estuarine		Saline		
Chemical	**Site**	**Maximum value**	**Site**	**Maximum value**	**Unit**
Chlorophyll	**S39659**	25.8	**S39658**	26.2	µg/l
Suspended Solids	**S39451**	8.2	**S2220033**	11	mg/l
Turbidity	**S83623**	104.4	**S39683**	75.5	FTU
Ammoniacal Nitrogen	**S39659**	0.72	**S39683**	0.86	mg/l
Nitrite	**S39659**	0.139	**S39684**	0.085	mg/l
Nitrogen	**S83623**	1.7	**S39685**	2.2	mg/l
Orthophosphate	**S83623**	0.11	**S39685**	0.08	mg/l
Copper	**S83623**	1.3	**S39204**	1.51	mg/l
Lead	**S39202**	0.148	**S39683**	0.269	µg/l
Mercury			**S39205**	0.024	µg/l
Nickel	**S39202**	2.37	**S39204**	110	µg/l
Zinc	**S39202**	28.5	**S39204**	11.6	µg/l
Fluoranthene	**S83623**	5.83	**S39685**	1.89	ng/l
Benzo(a)pyrene	**S83623**	8.09			ng/l
Indeno(123,cd)pyrene	**S83623**	7.01			ng/l
Benzo(ghi)perylene	**S83623**	8.11			ng/l

Annex 18B Natural Resources Wales Water Quality Data Summary

Sediment quality sampling results provided by Natural Resources Wales (2023) have been compiled and summarised in the table below and are presented against the CEFAS Action Levels.

		Estuarine					Saline					CEFAS	
Chemical	**Unit**	**Mean**	**Min**	**Max**	**90th %tile**	**10th %tile**	**Mean**	**Min**	**Max**	**90th %tile**	**10th %tile**	**Action Level 1[5]**	**Action Level 2**
TOC (Total Organic Carbon)	%	1.60	1.22	2.47	1.93	1.30	1.26	0.45	2.47	1.86	0.68		
Arsenic	mg/kg	12.88	11.00	17.10	15.30	11.36	11.84	9.40	15.50	13.16	10.48	20	100
Cadmium	mg/kg	1.47	0.13	12.70	1.99	0.14	0.14	0.09	0.27	0.19	0.12	0.4	5
Chromium	mg/kg	90.98	73.00	130.00	119.20	73.45	93.01	73.80	148.00	106.00	78.54	40	400
Copper	mg/kg	25.44	16.00	42.30	35.34	17.28	29.27	21.20	42.60	35.82	23.44	40	400
Lead	mg/kg	29.92	25.50	36.70	32.92	27.39	31.71	23.60	53.10	39.40	24.88	50	500
Mercury	mg/kg	0.08	0.06	0.12	0.10	0.06	0.08	0.05	0.24	0.13	0.05	0.3	3
Nickel	mg/kg	37.01	23.20	63.80	60.20	24.01	44.81	31.40	74.80	59.98	35.26	20	200
Zinc	mg/kg	99.28	17.60	159.00	127.50	76.55	105.93	83.90	149.00	130.20	88.04	130	800
Napthalene	µg/kg	54.14	35.20	84.00	68.24	39.52	63.81	36.70	86.90	77.64	55.42	100	
Phenanthrene	µg/kg	197.29	92.90	395.00	271.70	137.99	189.47	136.00	253.00	228.00	144.80	100	
Anthracene	µg/kg	51.20	22.60	109.00	76.00	32.56	46.63	31.80	61.90	59.70	37.14		
Fluoranthene	µg/kg	319.80	152.00	606.00	443.10	233.00	304.07	218.00	433.00	392.80	229.80	100	
Pyrene	µg/kg	262.00	128.00	487.00	370.00	178.40	244.73	174.00	346.00	321.20	185.20	100	
Benzo(a)anthrene	µg/kg	191.53	85.30	367.00	278.80	129.13	180.60	132.00	251.00	239.80	143.60	100	
Chrysene	µg/kg	201.00	107.00	377.00	269.00	143.90	201.53	153.00	268.00	266.20	157.80	100	
Benzo(a)pyrene	µg/kg	191.40	102.00	354.00	256.80	136.20	188.60	142.00	262.00	241.00	153.80	100	
Indeno(1,2,3-cd)pyrene	µg/kg	124.84	58.50	252.00	162.00	81.18	150.13	116.00	208.00	182.40	121.40	100	
Benzo(g,h,i)perylene	µg/kg	132.41	65.10	247.00	157.90	97.41	146.67	116.00	197.00	176.40	117.80	100	

[5] Blank cells indicate that there is no Action Level for that determinant.

Legend:

	Sediment quality result exceeds Action Level 2
	Sediment quality result is below Action Level 2