Spiorad na Mara Offshore Wind Farm

Offshore Project

Environmental Impact Assessment Report

Chapter 10: Marine Sediment and Water Quality, Volume 2a

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10 MARINE SEDIMENT AND WATER QUALITY

10.1 INTRODUCTION

10.1.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) presents the results of the assessment of the likely significant effects of the proposed Spiorad na Mara Offshore Windfarm (hereafter referred to as 'the Offshore Project') with respect to Marine Sediment and Water Quality.

10.1.1.2 This chapter should be read in conjunction with the project description provided in **Chapter 3: Project Description, Volume 1a** and the relevant parts of the following chapters and appendices:

- **Chapter 9: Physical and Coastal Processes, Volume 2a;**
- **Chapter 11: Benthic and Intertidal Ecology, Volume 2a;**
- **Chapter 12: Fish Ecology, Volume 2a;**
- **Chapter 13: Marine Mammals, Volume 2a;**
- **Chapter 16: Shipping and Navigation, Volume 2a;**
- **Chapter 21: Commercial Fisheries, Volume 2a;**
- **Appendix 9.2: Physical Processes Modelling Results Report, Volume 2c;**
- **Appendix 10.1: Water Framework Directive Assessment, Volume 2c.**

10.1.1.3 This technical chapter describes the following:

- Legislation, planning policy and other documentation that has informed the assessment (Section 10.2);
- Outcome of consultation and engagement that has been undertaken to date, including how matters relating to Marine Sediment and Water Quality have been addressed (Section 10.3);
- Scope of the assessment for Marine Sediment and Water Quality (Section 10.4);
- The methods of assessment used for baseline data gathering and impact assessment (Section 10.5);
- Overall baseline (Section 10.6);
- Embedded environmental measures relevant to Marine Sediment and Water Quality and the relevant maximum design scenario (Section 10.7);
- Assessment of Marine Sediment and Water Quality likely significant effects and further mitigation (Section 10.8 to 10.10);
- Assessment of Marine Sediment and Water Quality cumulative effects (Section 10.11 to 10.14);
- A summary of residual effects for Marine Sediment and Water Quality (Section 10.15);
- Information sources and documentation referred to in this chapter (Section 10.1).

10.1.1.4 The chapter is supported by the following appendices and figures:

- **Appendix 10.1, Volume 2c;**
- **Figure 10.1: Marine Sediment and Water Quality Study Area, Volume 2b;**

- **Figure 10.2: Water Framework Directive Protected Areas, Water Bodies, Marine Protected Areas for Marine Sediment and Water Quality, Volume 2b;**
- **Figure 10.3: Seabed and Habitat types from EMODnet, Volume 2b;**
- **Figure 10.4: Locations of successful grab sampling, Volume 2b;**
- **Figure 10.5: Marine Sediment and Water Quality ZoI for CEA, Volume 2b.**

10.2 SUMMARY OF POLICY AND LEGISLATIVE CONTEXT

10.2.1.1 This section outlines the legislation, policy and guidance that is relevant to the assessment of likely significant effects on Marine Sediment and Water Quality associated with the construction, operation, maintenance and decommissioning of the Offshore Project. In addition, other national, regional, and local policies are considered within this assessment where they are judged to be relevant. Further information on policies relevant to the Environmental Impact Assessment (EIA) as a whole is provided in **Chapter 2: Policy and Legislative Context, Volume 1a**.

10.2.1.2 A summary of legislation and policy specifically relevant to Marine Sediment and Water Quality is provided in **Table 10-1**. In some cases, there is a hierarchy of applicable legislation, from international law, implemented by UK Acts, in turn implemented through statutory instruments (including EU Exit legislation defining where European law still applies).

Table 10-1 Relevant legislation and policy for Marine Sediment and Water Quality

Title	Relevance to Marine Sediment and Water Quality
Legislation and Policy	
Convention for the Protection of the Marine Environment of the Northeast Atlantic (OSPAR, 1992)	Contained within the OSPAR Convention are a series of annexes relevant to the Marine Sediment and Water Quality assessment: • Annex I to III: Prevention and elimination of pollution from land-based sources, dumping or incineration and other offshore sources; • Annex IV: Assessment of the quality of the marine environment. The OSPAR Convention is implemented through OSPAR's North East Atlantic Environment Strategy 2030. Some of the relevant strategic objectives (SO) include: • SO 1: Tackle eutrophication through limiting inputs of nutrients and organic matter; • SO 2: Prevent pollution by hazardous substances; • SO 3: Prevent pollution by radioactive substances; • SO 4: Prevent inputs of and significantly reduce marine litter.

Title	Relevance to Marine Sediment and Water Quality
The International Convention for the Prevention of Pollution from Ships (MARPOL) (IMO, 1973)	• The MARPOL convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.
Regulation 37 of Annex I of MARPOL	• A shipboard oil pollution emergency plan (SOPEP) is required to be provided under regulation 37 of Annex 1 to the MARPOL 73/78 (requires all ships of 400 GT or more to carry an approved SOPEP).
EC Directive (2000/60/EC) establishing a framework for community action in the field of water policy (Water Framework Directive (WFD)).	• Sets out a legislative framework for the protection of surface waters, including rivers, lakes, transitional waters and coastal waters, extending to 3 nautical miles (nm) from the shore in Scotland (12 nm for chemical status); • Requires the Scottish Environment Protection Agency (SEPA) to classify water bodies, define objectives and implement a programme of measures to prevent deterioration and achieve good status; • Objectives and measures are implemented through preparation of a River Basin Management Plan (RBMP) for the Scotland River Basin District (RBD). The RBMP sets out a programme of actions for achieving objectives. The RBMP for the Scotland RBD 2021 to 2027 sets outs Actions for Improvement, relating to: – Action to create healthier and more resilient communities; – Water supply and wastewater; – Sustainable and resilient rural land use management; – Removing man-made barriers to fish migration.
EC Directive 2008/105/EC on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC (EQS Directive).	
EU Directive 2013/39/EU amending Directives 2000/60/EC and 2008/105/EC (EQS amendment Directive)	
EC Directive (2008/56/EC) establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive (MSFD))	The Directive requires members to develop national marine strategies to achieve or maintain 'good environmental status' (GES) in the marine environment. Such status should have been achieved by 2020. Defines 11 descriptors for use in determining GES. Descriptors relevant to this technical assessment include: • Descriptor D5 – Human-induced eutrophication; • Descriptor D8 – Concentrations of contaminants; • Descriptor D9 – Contaminants in fish and other seafood. • The targets used to assess progress for eutrophication are:
Marine Strategy Regulations 2010	
Marine Environment (Amendment) (EU Exit) Regulations 2018	

Title	Relevance to Marine Sediment and Water Quality
Marine strategy part three: 2025 UK programme of measures. 2024 (Defra, 2024)	• Nutrient concentrations are below the levels which could lead to harmful eutrophication effects; • Chlorophyll-a concentrations are below levels which could lead to harmful eutrophication effects; • Dissolved oxygen content in coastal waters are above levels which could lead to harmful eutrophication effects. • GES for descriptor D5 (eutrophication) is currently 'achieved' in UK seas. • The targets used to assess progress for contaminants are: – Concentrations of contaminants measured in water, sediment or marine biota comply with appropriate threshold values; – Biological or ecological effects on sea life due to contaminants are below thresholds agreed by OSPAR; – Occurrence and extent of significant acute pollution events are minimised; – The adverse effects of significant acute pollution events on the health of species and on the condition of habitats (such as their species composition and relative abundance) are minimised and, where possible, eliminated. – GES for descriptor D8 (contaminants) is currently 'achieved' in UK seas. • The targets used to assess progress for contaminants in seafood are: – Regulatory levels and a risk assessment. – GES for contaminants in seafood is currently 'achieved' in UK seas.
EC Directive (2006/7/EC) concerning the management of bathing water quality repealing Directive 76/160/EEC.	• Sets water quality standards for designated bathing waters and requires Members States to monitor and assess the bathing water for at least 2 bacterial parameters. In addition, there is a requirement for SEPA to inform the public about bathing water quality and beach management, through bathing water profiles, which provide information to bathers on the risks to bathers' health.
The Bathing Waters (Scotland) Regulations 2008	
Water Environment and Water Services (Scotland) Act 2003	• Sets out arrangements for the protection of the water environment in Scotland. • Establishes RBMPs for each respective RBD.

Title	Relevance to Marine Sediment and Water Quality
The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended)	• Provides a regulatory framework for controlling activities which could have an adverse effect on Scotland's water environment.
The Water Environment (Shellfish Water Protected Areas: Environmental Objectives etc) (Scotland) Regulations 2013	• The Scottish Government designated and protected 84 areas of coastal water or transitional water within the Scottish River Basin District as "Shellfish water protected areas" for the purpose of Part 1 (protection of the water environment) of the Water Environment and Water Services (Scotland) Act 2003. Under this legislation, environmental objectives for bacterial levels in shellfish flesh have been set to prevent deterioration of the shellfish water quality of each shellfish water protected area, and to protect and improve each shellfish water protected area with the aim of achieving good shellfish water quality.
The Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013	
The Scotland River Basin District (Quality of Shellfish Water Protected Areas) (Scotland) Directions 2015	
Scotland's National Marine Plan (Scottish Government, 2015)	• Sets out the plan for Scottish inshore waters (out to 12 nm) and offshore waters (12-200 nm). It applies to both reserved and devolved functions. Applicable policies regarding water quality include: – GEN 12 – Water Quality and Resources: Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply.
Technical Guidance	
Assessment of the environmental impacts of cables (OSPAR, 20099)	• The OSPAR Commission produced this background report which details the scientific background to the environmental impacts of cables.
Department for Business Enterprise and Regulatory Reform Review of Cabling Techniques and Environmental Effects Applicable to the Offshore Wind Farm Industry (BERR, 2008)	• This study provides a guide to the range of types of cables and small diameter pipelines currently installed in the EU shelf marine environment.
CIRIA C744 Coastal and Marine Environmental Site Guide (CIRIA, 2015)	• The guidance provides advice for people working in the coastal and marine environment on how to control impacts potentially arising from construction works.

Title	Relevance to Marine Sediment and Water Quality
COWRIE Coastal Process Modelling for Offshore Wind Farm Environmental Impact Assessment: Best Practice Guidance (COWRIE, 2009)	• This report provides an update to existing best practice guidance on the application and use of numerical models to predict the potential impact from offshore windfarms on coastal processes.
Guidelines for Data Acquisition to Support Marine Environmental Assessments of Offshore Renewable Energy Projects (Judd, 2012)	• This report provides guidelines for data acquisition to support marine environmental assessments for offshore renewable energy projects. • The guidance has been applied in designing and implementing survey programmes to acquire suitable data for the Study Area.
Clearing the Waters for All: Water Framework Directive assessment: estuarine and coastal waters (Environment Agency, 2023)	• An impact that compromises the achievement of a WFD objective or results in the deterioration of status for water is a significant impact and a WFD assessment of the Project should be carried out and form part of the EIA. Guidance produced for projects in England, still provides useful guidance for Scottish projects.
Guidance on Best Practice for Marine and Coastal Physical Processes Baseline Survey and Monitoring Requirements to inform EIA of Major Development Projects (Brooks *et al.*, 2018)	• Provides guidance on marine, coastal and estuarine physical processes EIA baseline surveys and monitoring requirements for major development projects. Produced for Natural Resources Wales but equally applicable in Scotland.
Supporting Guidance (WAT-SG-53) Environmental Quality Standards and Standards for Discharges to Surface Waters (SEPA, 2020)	• This guidance provides information on the environmental and discharge standards for surface waters, based on the latest scientific understanding of the UK Technical Advisory Group (UKTAG) for the WFD.
SEPA's Guidance for Pollution Prevention (SEPA, 2018)	• SEPA provides guidance on the application of the regulations in place in Scotland.
Canadian Sediment Quality Guidelines for the Protection of Aquatic Life: • Introduction – updated 2001; • Protocol 1995; • Summary Tables updated 2002	• There are no established Environmental Quality Standards (EQS) for marine sediment quality for protection of marine life in the UK and the Canadian Guidelines are widely used as a substitute, being one of the few sets of such guidelines available that covers the marine environment. They define interim sediment quality guideline (ISQG) values, a threshold effects level (TEL) and a probable effects level (PEL) for a wide range of chemical parameters in marine sediments.

Title	Relevance to Marine Sediment and Water Quality
Cefas Action Levels (ALs) to determine the suitability of material for at-sea disposal	• Whilst there are no formal EQS for marine sediment quality in the UK, as described above, the 'Cefas ALs' provide values against which material to be disposed of at sea can be considered. • There are two 'levels': AL 1 and 2, against which material can be assessed for a wide range of determinants. Materials with concentrations above AL2 would not usually be approved for sea disposal, while concentrations less than AL1 are of no concern.

10.3 SCOPING AND CONSULTATION

10.3.1 OVERVIEW

10.3.1.1 This section describes the stakeholder engagement undertaken for the Offshore Project. This consists of the outcome of, and response to, the Scoping Opinion in relation to the Marine Sediment and Water Quality assessment, informal consultation and consultation undertaken though the Preliminary Application Consultation (PAC) process (hereafter referred to as the 'formal consultation'). An overview of engagement undertaken for the Project as a whole can be found in Section 5.7 of **Chapter 5: Approach to EIA, Volume 1a** and **Appendix 5.4: Stakeholder Consultation and Engagement, Volume 1c**.

10.3.1.2 Consultation is a key feature of the EIA process and continues throughout the lifecycle of the Offshore Project, from the initial stages through to consent and post consent.

10.3.1.3 Consultation captures all consultation and engagement and has been ongoing with a number of prescribed and non-prescribed consultation bodies and local authorities in relation to Marine Sediment and Water Quality. All consultation to date has been undertaken in line with the process described in **Chapter 5, Volume 1a** and **Appendix 5.4, Volume 1c**. Feedback received during this process has been incorporated into the EIAR wherever possible as appropriate.

10.3.2 EARLY ENGAGEMENT

10.3.2.1 Early engagement was undertaken pre-scoping with a number of consultation bodies in relation to Marine Sediment and Water Quality In accordance with MD-LOT guidance, Spiorad na Mara Limited (hereafter referred to as 'the Applicant') held formal scoping workshops in May and June 2023 to inform the Scoping Report. Further details of the consultation undertaken and the post-workshop feedback can be found in Section 5.3 and Table 5.3-1 of the Scoping Report.

10.3.2.2 As described in Section 5.6 of **Chapter 5, Volume 1a**, early engagement was undertaken with the Marine Directorate - Licensing Operations Team (MD-LOT), Marine Directorate – Science Evidence

Data and Digital, and NatureScot at a workshop specifically covering Marine Water and Sediment Quality on 31 May 2023.

10.3.2.3 This engagement was undertaken to introduce the Project and the proposed approach to scoping the EIA, as well as to obtain early feedback on the acceptability of the proposed approach. Discussion points included the Study Area to be used for Marine Sediment and Water Quality, the impacts that were proposed to be scoped in and out of the EIAR, and the data sources that would be relied upon.

Scoping Opinion

10.3.2.4 The Applicant submitted a Scoping Report (Spiorad na Mara Limited, 2023) and request for a Scoping Opinion to the Marine Directorate Licensing Operations Team (MD-LOT) in September 2023. A Scoping Opinion was received in May 2024. The Scoping Report set out the proposed Marine Sediment and Water Quality assessment methodologies, outline of the baseline data collected to date and proposed, and the scope of the assessment. The comments received in the Scoping Opinion and how these have been addressed in this EIAR are provided in **Appendix 5.2: Response to Scoping Opinion, Volume 1c**.

10.3.2.5 A summary of those responses relevant to Marine Sediment and Water Quality is shown in **Table 10-2**.

Table 10-2 Summary of Scoping Opinion - Marine Sediment and Water Quality

Consultee	Date / Document	Comment	Response/Where this is addressed in the EIAR
MD-LOT	Licensing Operations Team Scoping Opinion, May 2024	The Scottish Ministers advise, in line with the NatureScot representation, that a blue carbon assessment should be undertaken to expand on the information and assessment conducted for benthic ecology to focus on the potential impacts of the Proposed Development on marine sediments.	The blue carbon assessment in relation to blue carbon resource held in coastal vegetated habitats is included in **Chapter 11, Volume 2a** but the assessment of carbon associated with mobilised sediment is estimated in this chapter and feeds into the blue carbon assessment. As the fate of disturbed sedimentary organic carbon is currently unknown, as a precautionary approach, it has been assumed that 100% of the disturbed volume will result in CO_2 emissions to the atmosphere.

Consultee	Date / Document	Comment	Response/Where this is addressed in the EIAR
MD-LOT	Licensing Operations Team Scoping Opinion, May 2024	The Scottish Minsters agree with this proposal and direct the Developer to the SEPA standing advice with particular regard to the Water Framework Directive, Invasive Non-Native Species (INNS), pollution prevention, waste management and dredge spoil and advise that this is fully considered in the EIAR.	WFD, pollution prevention and sediment mobilisation (similar considerations to dredge spoil) are considered in this chapter and supporting appendices (see Section 10.8, 10.9, and 10.10, and **Appendix 10.1, Volume 2c**. INNS are considered in **Chapter 11, Volume 2a**.
MD-LOT	Licensing Operations Team Scoping Opinion, May 2024	Scottish Ministers advised scoping out transboundary impacts within the Scoping Opinion.	Transboundary effects on water and sediment quality have not been considered further.
Urras Sgire Oighreachd Bharabhais Community Company	Licensing Operations Team Scoping Opinion, May 2024	Baseline needs to be established so it can be monitored during, construction, operation and decommissioning.	Baseline sediment particle size and contaminant data were collected as part of a site-specific survey undertaken in October 2023. The water quality baseline has been informed by existing data used for classification of the WFD for coastal water bodies and this has been incorporated into the baseline section of this chapter (see Section 10.6).
Shawbost Community Council	Licensing Operations Team Scoping Opinion, May 2024	The Sea Angling Club, Seatrek and the local fishermen should be consultees.	Contact has already been established with local fishermen. Stornoway Sea Angling Club and Seatrek have been added to the consultee list. Additionally, Stornoway Sea Angling Club, Stornoway Angling Association and the Lewis and Harris Sub Aqua Club were emailed on 12 June 2025 requesting comment on the Offshore Project – No response was provided.

10.3.3 POST SCOPING CONSULTATION

10.3.3.1 Following the receipt of the Scoping Opinion, no further consultation relating to Marine Sediment and Water Quality has been held with stakeholders.

10.4 SCOPE OF THE ASSESSMENT

10.4.1 OVERVIEW

10.4.1.1 This section sets out the scope of the EIA assessment for Marine Sediment and Water Quality. This scope has been developed as the Offshore Project design has evolved and responds to feedback received as set out in Section 10.3.

10.4.2 SPATIAL SCOPE AND STUDY AREA

10.4.2.1 The assessment considers the likely significant effects of the Offshore Project on Marine Sediment and Water Quality receptors within its Zone of Influence (ZoI). The ZoI of the impact assessment will be limited to the spatial extent over which any likely significant effects may occur. This extent has been determined based on the modelled extent of the suspended sediment ZoI which considers the dispersal range of sediments disturbed by potential cable installation options associated with the marine components of the Offshore Project, for example such as jet trenching (see **Appendix 9.2, Volume 2c**). The ZoI encompasses the Array Area and Offshore Cable Area of Search (OCAS) plus the peak spring tidal excursion ellipse, determined in **Appendix 9.2, Volume 2c** to be equal to approximately 6 km, and extending to the level of MHWS at the shore. The ZoI is shown in **Figure 10.1, Volume 2b**.

10.4.2.2 The Study Area in this chapter has been drawn to match the ZoI. The term Study Area has been used when describing the baseline, whereas ZoI has been used when discussing the potential extent of impacts of the Offshore Project.

10.4.2.3 The spatial scope of this assessment encompasses the Array Area and OCAS, as well as additional areas required to capture the relevant receptors within the ZoI. The current Array Area covers an area of 161 km^2, and the OCAS covers 91 km^2, located between the Array Area and the mean high water springs (MHWS) tides, as shown in **Figure 10.1, Volume 2b**.

10.4.2.4 The spatial extent for likely significant effects for Marine Sediment and Water Quality include sea areas that are covered by different regulatory regimes, and therefore target standards, as outlined in **Table 10-3**.

Table 10-3 Different types of sea area within the spatial scope for assessment for Marine Sediment and Water Quality

Spatial zone	Description	Regulatory regime
Offshore Waters	Marine waters within a buffer zone of 6 km around the Array Area and OCAS and more than 3 nm from the territorial waters baseline from which the 12 nm territorial waters seaward boundary is measured. This zone captures the wider offshore environment outside the nearshore territorial water.	Marine Strategy Framework Directive
Inshore Waters	Coastal waters within a buffer zone of 6 km around the Offshore Project Boundary and within 3 nm of the territorial waters baseline. This zone corresponds to Water Framework Directive (WFD) coastal water bodies and represents the nearshore environment most likely to experience direct interaction with the proposed infrastructure.	Water Framework Directive Marine Strategy Framework Directive WEWS Act
Protected Waters (Areas/Habitats) within offshore and inshore waters	Designated sensitive and protected areas with specific water quality criteria, such as Bathing Waters, Shellfish Waters, European sites (Special Area of Conservation (SAC) and Special Protection Area (SPA)) and other marine protected areas.	Habitats Directive Wild Birds Directive Bathing Water Regulations WEWS Act

10.4.3 TEMPORAL SCOPE

10.4.3.1 The temporal scope of the assessment of Marine Sediment and Water Quality is the entire lifetime of the Offshore Project, which therefore covers the construction, operation and maintenance, and decommissioning. The construction phase is anticipated to be between 2028/2029 and 2032/2033, with works being undertaken between April and October each year. The operational lifetime of the Offshore Project is up to 35 years with maintenance assumed to take place throughout, and decommissioning to take place at the end of life.

10.4.4 POTENTIAL RECEPTORS

10.4.4.1 The spatial and temporal scope of the assessment enable the identification of potential receptors which may experience a change as a result of the Offshore Project.

10.4.4.2 The main receptor groups identified within the Study Area that may experience potential significant effects for Marine and Sediment Water Quality are:

- **Marine water quality**: including physical, chemical and biological parameters and WFD waterbodies and protected areas);
- **Marine sediment quality**: including physical parameters. Particle Size Distribution (PSD) and Total Organic Carbon (TOC));
- **Marine sediment contamination**: including heavy and trace metals, Polycyclic Aromatic Hydrocarbons (PAHs), total hydrogen content (THC), Polychlorinated Biphenyl (PCBs), Organotins and organochlorine pesticides);
- **Blue carbon resources associated with marine sediments**: carbon stored within seabed sediments that may be temporarily mobilised or redistributed as a result of seabed disturbance during Offshore Project activities. Within this chapter, blue carbon is considered only in the context of sediment disturbance and sediment quality pathways relevant to marine water quality and sediment quality. Broader blue carbon ecosystems (e.g. seagrass, kelp beds etc) and associated ecological functions are assessed in **Chapter 11, Volume 2a**.

10.4.4.3 Similarly to changes in physical characteristics of the marine environment, changes in water or sediment quality predicted by the EIA can only be assessed directly for significance of effect where there is a water or sediment EQS established for protection of the aquatic environment. In this case, significance of effects on compliance of the receptor with the EQS is assessed in this chapter.

10.4.4.4 Where no EQS is available, changes to sediment or water quality may, nevertheless, have indirect effects on receptors considered in other chapters, for example effects on a biological receptor (e.g. benthic biota or fish) or on a marine user (e.g. human users of bathing waters). These indirect effects are assessed in the following relevant other chapters:

- Benthic and intertidal ecology (**Chapter 11, Volume 2a**);
- Fish ecology (**Chapter 12, Volume 2a**);
- Marine mammals (**Chapter 13, Volume 2a**);
- Other sea users and recreation (**Chapter 20, Volume 2a**)
- Commercial fisheries (**Chapter 21, Volume 2a**).

10.4.5 ACTIVITIES OR IMPACTS SCOPED INTO ASSESSMENT

10.4.5.1 Potential impacts on receptors that have been scoped in for assessment are summarised in **Table 10-4.**

Table 10-4 Activities or impacts scoped into the assessment for Marine Sediment and Water Quality

Receptor	Activity or Impact	Potential Effect
Construction and decommissioning		
Marine sediment quality and marine water quality	**Installation of infrastructure:** Direct seabed disturbance during construction (substrate preparation, installation of infrastructure) temporarily increases suspended sediment into the water column, which is transported and dispersed in suspension by currents and deposited over various distances (tidal excursion and sediment granulometry dependent).	**Seabed disturbance temporarily increasing suspended sediment concentrations in the water column:** Increased suspended solids concentration in the water column representing deterioration of water quality in offshore and inshore waters.
Marine water quality	**Installation of infrastructure:** Direct seabed disturbance during construction (substrate preparation and installation of infrastructure) may release potentially contaminated sediments into the water column. Once suspended, these sediments may be transported and later resettled, potentially leading to the redistribution of contaminants.	**Seabed disturbance mobilising contaminated sediment and releasing contaminants to the water:** Increased concentration of sediment-associated contaminants causing deterioration of water quality in offshore and inshore waters. Potential changes in the quality of sediment in areas where resettlement occurs.
Marine water quality	**Horizonal Directional Drilling (HDD):** Trenchless techniques (such as HDD) are a method of installation for the Offshore Cable at Landfall during the construction phase. This activity can release drilling fluid, muds (muds containing bentonite and drill cuttings), temporarily increasing fine sediment in suspension in the water column.	**Seabed disturbance temporarily increasing suspended sediment concentrations in the water column:** Potential changes in water quality where drilling mud is mobilised. The drilling muds to be used will contain only bentonite and no chemical additives, so release will not contribute any increase in contaminants and thus no deterioration in water quality in offshore and inshore waters.
Blue carbon (held in sediments)	**Construction of the Offshore Project:** could lead to a change in the blue carbon resource in	**Change in blue carbon resource in sediment:** This

Receptor	Activity or Impact	Potential Effect
	the Study Area, from seabed disturbance during construction activities (e.g. drilling of pin piles, cable burial, HDD drill cutting release, HDD exit pit constructions).	has been addressed mainly in **Chapter 11, Volume 2a** but is considered in this chapter in terms of blue carbon resource held in sediments.
Operation and maintenance		
Marine sediment quality and marine water quality	**Maintenance and remedial work:** Direct seabed disturbance during maintenance and remedial work (such as cable repairs or anchor reburial) temporarily increases suspended sediment into the water column, which is transported and dispersed in suspension by currents and deposited over various distances (tidal excursion and sediment granulometry dependent).	**Seabed disturbance temporarily increasing suspended sediment concentrations in the water column:** Increased suspended solids concentration in the water column representing deterioration of water quality in offshore and inshore waters.
Marine water quality	**Maintenance and remedial work:** Direct seabed disturbance during maintenance and remedial work (such as cable repairs or anchor reburial) has the potential to release potentially contaminated sediments and introduce contaminants into the water column. Once suspended, these sediments may be transported and later resettled, potentially leading to the redistribution of contaminants.	**Seabed disturbance mobilising contaminated sediment and releasing contaminants to the water:** Increased concentration of sediment-associated contaminants causing deterioration of water quality in offshore and inshore waters. Potential changes in the quality of sediment in areas where resettlement occurs.
Blue carbon (held in sediment)	**Maintenance and remedial work:** Maintenance activities such as, cable repairs and/or remediation, during the lifetime of the Offshore Project could lead to a change in the blue carbon resource in the Study Area.	**Change in blue carbon resource in sediment:** This has been addressed mainly in **Chapter 11, Volume 2a** but is considered in this chapter in terms of blue carbon resource held in sediments.
Decommissioning		
Marine sediment quality and marine water quality	**Removal of infrastructure:** Direct seabed disturbance during decommissioning (removal of cables and WTG foundations) temporarily increases suspended sediment into the water column, which is transported and dispersed in	**Seabed disturbance temporarily increasing suspended sediment concentrations in the water column:** Increased suspended

Receptor	Activity or Impact	Potential Effect
	suspension by currents and deposited over various distances (tidal excursion and sediment granulometry dependent).	solids concentration in the water column representing deterioration of water quality in offshore and inshore waters.
Marine water quality	**Removal of infrastructure:** Direct seabed disturbance during decommissioning (removal of cables and WTG foundations) may release potentially contaminated sediments into the water column. Once suspended, these sediments may be transported and later resettled, potentially leading to the redistribution of contaminants.	**Seabed disturbance mobilising contaminated sediment and releasing contaminants to the water:** Increased concentration of sediment-associated contaminants causing deterioration of water quality in offshore and inshore waters. Potential changes in the quality of sediment in areas where resettlement occurs.
Blue Carbon (held in sediments)	**Removal of infrastructure:** Decommissioning of the Offshore Project could lead to a change in the blue carbon resource in the Study Area.	**Change in blue carbon resource in sediment:** This has been addressed mainly in **Chapter 11, Volume 2a** but is considered in this chapter in terms of blue carbon resource held in sediments.

10.4.6 ACTIVITIES OR IMPACTS SCOPED OUT OF ASSESSMENT

10.4.6.1 A number of potential impacts have been scoped out from further assessment, resulting from a conclusion of no potential for a likely significant effect. These conclusions have been made based on the knowledge of the baseline environment, the nature of planned works and the wealth of evidence on the potential for impact from such projects more widely. The conclusions follow (in a site-based context) existing best practice. Each scoped out activity or impact is considered in turn in **Table 10-5**.

Table 10-5 Activities or impacts scoped out of assessment for Marine Sediment and Water Quality

Activity or Impact	**Rationale for Scoping Out**
Accidental release of pollutants from vessels leading to deterioration of water and sediment quality. (Construction, Operation and Maintenance, and Decommissioning phases)	The presence of vessels, and plant machinery operating during construction and decommissioning, introduces the risk of accidental release of pollutants from leaks or spills of fuels and lubricants. The Outline Offshore Environmental Management Plan (EMP) (**Table 10-13**, measure M019) includes appropriate measures in accordance with the MARPOL and Shipboard Oil Pollution Emergency Plans to ensure the risk of accidental pollution events are minimised. Therefore, this impact is scoped out of the EIA.
Accidental release of sewage and domestic waste from vessels leading to deterioration of water quality. (Construction, Operation and Maintenance, and Decommissioning phases)	Potential increase of inorganic and organic nutrients in water and sediments, due to release of sewage and domestic waste from vessels during transit and operations, with possible increase of eutrophication events associated with nutrient enrichment. Compliance with the outline OEMP **Table 10-13**, measure M019), including the appropriate measures outlined in accordance with the MARPOL and Shipboard Oil Pollution Emergency Plans will ensure the risk of pollution events are minimised and will not result in a significant effect on Marine Sediment and Water Quality receptors. Therefore, this impact has been scoped out of the EIA.
Accidental release and loss of debris, materials and/or litter from vessels leading to deterioration of water and sediments quality. (Construction and Decommissioning phases)	Potential input of solid materials, litter and debris discarded from vessels may lead to seabed and water column contamination, with possible indirect effects on marine biota. Compliance with the Outline OEMP (**Table 10-13**, measure M019) and the appropriate measures outlined in accordance with the MARPOL and Shipboard Oil Pollution Emergency Plans will reduce the likelihood and minimise the impact of any such releases and will not result in a significant effect on Marine Sediment and Water Quality receptors. Therefore, this impact has been scoped out of the EIA.
Leaching of toxic components from materials or coatings used for marine infrastructure, e.g. WTGs and Offshore Substation Platform (if this option selected). (Operation and Maintenance phase)	The proposed foundation structures will make use of well-tried and tested structure types and materials, with coatings that have been developed to meet the requirements of MD-LOT. Thus, risks of leaching of toxicants will be negligible and this impact has been scoped out of the EIA.

Activity or Impact	Rationale for Scoping Out
Ongoing changes to waves and currents leading to changes in sediment transport and scouring regime leading to potential deterioration in sediment and water quality. (Operation and Maintenance phase)	The presence of subsea infrastructure has the potential to alter local hydrodynamic conditions, which in turn may lead to localised changes in suspended sediment concentrations and siltation rates, with may affect water and sediment quality. However, as detailed in **Chapter 9, Volume 2a**, such effects will be negligible. Therefore, this impact has been scoped out of the EIA. Potential impacts from scour have not been assessed as scour protection will be included as part of the project design to prevent localised seabed change around the turbine foundations and cables, and therefore no further assessment is required.
Presence of marine infrastructure may cause mixing at the thermocline and consequent changes to the thermal stratification regime, with potential effects on water quality. (Operation and Maintenance phase)	This has been examined in **Chapter 9, Volume 2a** which describes stratification in the Study Area as weak and concludes that the effect of the presence of the offshore wind farm on stratification will be negligible in magnitude. Therefore, changes in water quality due to interference with the natural stratification regime will also be negligible and are therefore scoped out of the EIA.
By warming the lower, cooler seawater layer, the thermal emissions from subsea cables have the potential to cause changes to thermal stratification of the water column and/or increases in oxygen demand, potentially resulting in changes in water quality. (Operation and Maintenance phase)	Taking typical thermal losses of up to 164 W/m for each cable (ORE Catapult, 2015), near bed residual current of approximately 0.05 m/s (Scottish Government, 2016) and a 'worst case' scenario of 350 km of subsea cable, the estimated temperature rise in the lower layer of sea stratified at mid-depth is approximately 0.0012 °C. This is negligible and will cause no likely changes in water quality. Therefore, changes in water quality due to energy losses in the subsea cables have been scoped-out of the EIA.
Transboundary effects. (Construction, Operation and Decommissioning phases)	The Offshore Development Area of Search resides entirely within Scottish territorial waters and there is no potential for transboundary impacts to Marine Water and Sediment Quality receptors as a result of construction, operation (and maintenance) and decommissioning activities. Therefore, this impact has been scoped out of the EIA. Furthermore, Scottish Ministers advised scoping out transboundary impacts within the Scoping Opinion.

Activity or Impact	Rationale for Scoping Out
Cumulative effects. (Construction, Operation and Maintenance, and Decommissioning phases)	There is the potential for cumulative effects to arise from the Offshore Project and any proposed nearby development and potentially other infrastructure (see Section 10.13); however, no other projects have been identified whose ZoI for water and sediment quality would overlap with the ZoI of the Project for water and sediment quality. Therefore, this impact is scoped out of the EIA.

10.5 METHODOLOGY FOR BASELINE DATA GATHERING AND IMPACT ASSESSMENT

10.5.1 METHODOLOGY FOR BASELINE DATA GATHERING

Overview

10.5.1.1 Baseline data collection has been undertaken to obtain information across the Study Area as described in Section 10.3.3. The current baseline presented in Section 10.6 sets out data currently available from the Study Area.

Desk study

10.5.1.2 The data sources that have been collected and used to inform this Marine Sediment and Water Quality assessment are summarised in **Table 10-6**.

Table 10-6 Data sources used to inform the EIA for Marine Sediment and Water Quality

Source	Year	Summary	Coverage of Study Area
ABPmer/NOC Atlas of Marine Energy Resources (ABPmer, 2008)	2017	Tides, winds and waves	Full coverage of Study Area
British Oceanographic Data Centre (BODC) – Clean Seas Environmental Monitoring Programme (BODC, 2025)	1989 - 2025	Temperature and salinity data	Full coverage of Study Area
British Geological Survey (2022)	2022	Seabed morphology and bathymetry (INFORMAR), sediment types, Sediment Quality	Full coverage of Study Area
Centre for Environment, Fisheries and Aquaculture Science (Cefas) – Suspended sediment climatologies around the UK (Cefas, 2016a)	2016	Suspended sediments concentrations and distributions	Full coverage of Study Area

Source	**Year**	**Summary**	**Coverage of Study Area**
Cefas – Silva 2016. Monthly average non-algal Suspended Particulate Matter concentrations on the UK shelf waters (Cefas, 2016b)	2016	Survey data on suspended solids around the UK	Full coverage of Study Area
Cefas – Scottish Sanitary Survey Programme. Sanitary survey report Loch Roag (Cefas, 2015)	2012	Environmental survey and water quality data of Loch Roag/*Loch Ròg*	Loch Roag/*Loch Ròg*
EMODnet – EMODnet broad-scale seabed habitat map for Europe 2019 (EUSeaMap) (EMODnet, 2021)	2021	Modelled distribution of EUNIS substrate types	Full coverage of Study Area
ICES – Oceanographic data (ICES, 2016)	2021	Temperature and salinity data	Full coverage of Study Area
Joint Nature Conservation Committee (JNCC) – Coasts and sea of the United Kingdom. Regions 15 & 16: Northwest Scotland (JNCC, 2023)	1997	Overview of environment, geology, and ecology	Full coverage of Study Area
Marine Directorate – Scotland's Marine Atlas: Information for The National Marine Plan (Marine Directorate, 2010a)	2011	Hazardous substances in Scottish seas	Full coverage of Study Area
Marine Directorate – Annual Cycles of Physical, Chemical, and Biological Parameters in Scottish Waters 1960-2010. Shelf waters – West coast – West of Hebrides. (Marine Directorate, 2010b)	2014	Oceanographic data	Full coverage of Study Area
Marine Directorate - Monthly average sea surface temperatures for 13 Scottish Sea Areas (Marine Directorate, 2023a)	2016	Average sea temperatures	Full coverage of Study Area
Marine Directorate - Sedimentary organic carbon quality and reactivity (Marine Directorate, 2023b)	2022	Carbon and organic matter content	Partial coverage of Study area - 3 stations offshore of Lewis/*Eilean Leòdhais* and Harris/*Na Hearadh*
NatureScot - Scottish Natural Heritage (SNH) Trends, The seas around Scotland 2004 (NatureScot 2004)	2004	Overview of the seas around Scotland including ecology	Full coverage of Study Area

Source	Year	Summary	Coverage of Study Area
Oslo-Paris Convention (OSPAR) -Intermediate Assessment 2017. Contaminants assessment (OSPAR, 2017a)	2017	OSPAR region III data on Celtic Seas	Full coverage of Study Area
Robinson A., Eddies in Marine Science - Chapter 7 the northeast Atlantic Ocean (Gould W.) (Robinson, 2022)	1983	Oceanography	Full coverage of Study Area
SEPA - Bathing Waters (SEPA, 2022b)	2025	Designated bathing water locations and status	Full coverage of Study Area
SEPA - Shellfish Waters (SEPA, 2022c)	2025	Designated shellfish waters - location and status	Full coverage of Study Area
SEPA - Atlas of Coastal Classification and Environmental Data (SEPA, 2022d)	2020	Charts and data queries on water bodies and marine environment	Full coverage of Study Area
UKHO (2021)	2025	Hydrographic surveys	Full coverage of Study Area

Site Specific Surveys

10.5.1.3 The surveys that have been undertaken and used to inform this Marine Sediment and Water Quality assessment are summarised in **Table 10-7**.

Table 10-7 Site surveys undertaken for Marine Sediment and Water Quality

Survey Type	Scope of Survey	Coverage of Study Area
Spiorad na Mara Offshore Wind Farm Subtidal Environmental Baseline Survey, 2024. See **Appendix 11.1: Subtidal Environmental Baseline Survey, Volume 2c**	Sampling was conducted between the 17 and 27 October 2023. The survey involved co-located Drop-Down Camera (DDC) and grab stations and additional DDC transects, sediment particle size distribution (PSD), and chemical contaminant analysis. 55 DDC stations were sampled (550 still images and 70 videos), and 11 grab samples were analysed for macrobenthos and PSD analysis and 7 samples for full analysis (including chemical contaminants).	Full coverage within the Offshore Project Boundary.
Geotechnical Survey	Borehole samples were undertaken within the Offshore Project Boundary (including Array Area and the OCAS) to understand the size and distribution of sediment.	Exact location of boreholes used for the assessment are in **Plate 3-20** in Section 3.4.1 of

Survey Type	Scope of Survey	Coverage of Study Area
		Appendix 9.2, Volume 2c.
Spiorad Na Mara MetOcean Reports (SV1, SV2, SV3), (Partrac Ltd, 2024a; Partrac Ltd, 2024b; Partrac Ltd, 2024c).	Partrac Ltd were contracted to undertake Metocean monitoring at 2 site locations off Lewis/*Eilean Leòdhais*. Data was collected between January 2023 and July 2024. Conductivity, Temperature, Depth (CTD) data was collected using RBR sensors.	Partial coverage of Study Area - Instruments were deployed at 4 mooring locations within the Array Area. The exact locations of the metocean data survey can be found in **Plate 2-1** of **Appendix 9.1, Volume 2c.**

10.5.2 DATA LIMITATIONS AND ASSUMPTIONS

10.5.2.1 Due to the predominance of rock substrate across the Study Area, it was not possible to collect grab samples covering the full spatial extent of the Study Area. Hard substrates generally exhibit a lower potential for contaminant accumulation because they do not bind or retain contaminants to the same extent as soft sediments. Furthermore, mobilisation of particles of the size >64 mm (as defined in the Wentworth scale) are too large for natural hydrodynamics and wave conditions to suspend and if disturbed will settle without being advected. Only 7 stations were successfully sampled and analysed for TOC, heavy and trace metals, PAHs and total hydrocarbon content (THC), organotins, and organochlorine pesticides (OCP).

10.5.2.2 Chemical monitoring data for water quality is not available within the Array Area, the nearest monitoring data is within 5 km of the Array Area. This is within the ZoI determined by the peak spring tidal excursion ellipse (6 km), this data is therefore considered to be applicable to the Offshore Project. Furthermore, as agreed during scoping discussions with the relevant stakeholders (see Section 5.7 of Chapter 5, Volume 1), site specific water-quality monitoring was not required to inform the assessment.

10.5.2.3 The availability of data relevant for the characterisation and assessment of Marine Sediment and Water Quality is such that, despite some minor data limitations, it is considered that a thorough and meaningful characterisation for the purposes of EIA has been undertaken. As such, the available evidence base is sufficiently robust to underpin the assessment presented here and an overall high confidence is placed on the assessment.

10.5.3 METHODOLOGY FOR ENVIRONMENTAL IMPACT ASSESSMENT

Introduction

10.5.3.1 The project-wide generic approach to assessment is set out in **Chapter 5, Volume 1a**. The following sections provide the assessment methodology used to assess the potential impacts on Marine Sediment and Water Quality only.

10.5.3.2 A matrix approach as described in **Chapter 5, Volume 1a** has been used to determine the significance of effects, by comparing impact magnitude against receptor value and sensitivity.

10.5.3.3 This methodology has been used to assess the construction, O&M, and decommissioning phases of the Offshore Project.

10.5.4 IMPACT ASSESSMENT CRITERIA

Magnitude

10.5.4.1 EQS of various types have been used for interpreting baseline data and assessing effects of predicted contaminant concentrations.

10.5.4.2 In relation to marine water quality, EQSs represent legally derived thresholds intended to protect aquatic ecological receptors established under the Water Framework Directive and human receptors under the Bathing Waters Directive. Comparing measured and modelled results against these thresholds provides a consistent, precautionary basis for determining whether the Offshore Project could contribute to deterioration in water quality or pose a risk to sensitive species or people. Where statutory EQS have been established, these provide a basis for assessment of significance of changes to water quality resulting from the Offshore Project.

10.5.4.3 EQS for marine water quality are defined in The Scotland River Basin District (Standards) Directions 2024 (Scottish Government, 2024). In relation to the parameters considered in this chapter, EQS are expressed either as an annual average (AA) or as a maximum allowable concentration (MAC). In the case of an AA EQS, individual values in a baseline dataset may be higher than the EQS without affecting compliance, provided the average value does not exceed the AA EQS. In contrast, an EQS expressed as a MAC should not be exceeded by any individual data point.

10.5.4.4 In the case of marine sediments, no EQS have been formally established in the UK and a variety of threshold values have been developed. Sediment contaminant data have been compared with the following thresholds in this assessment:

- OSPAR background levels (BAC), developed to indicate if contaminant concentrations in marine sediment and biota are at near-background levels for naturally occurring substances or close to zero for man-made substances;
- OSPAR environmental assessment criteria (EAC), threshold values developed by the OSPAR Commission and ICES to assess the ecological significance of hazardous substance

concentrations in marine sediment and biota; concentrations below the EAC should not cause chronic effects in sensitive marine species or pose unacceptable risks to the environment;

- NOAA effects range low (ERL), defined as the lower tenth percentile of the data set of concentrations in sediments which were associated with biological effects
- Canadian Ministers of the Environment standards, including:
  - Interim sediment quality guidelines (ISQG), equivalent to the threshold effects level (TEL) below which adverse effects on aquatic life are expected to occur rarely;
  - The probable effects level (PEL), above which effects are expected to occur frequently;
- Cefas action levels (AL1 and AL2), developed for assessing suitability of dredged material for disposal; concentrations below AL1 are regarded as acceptable; material with contaminant levels between AL1 and AL2 requires further project-specific consideration.

10.5.4.5 Definitions of the magnitude levels for Marine Sediment and Water Quality are given in **Table 10-8**.

Table 10-8 Definitions of magnitude of impact for Marine Sediment and Water Quality.

Value	**Definition**
High	Wide spatial extent with large magnitude compared to the natural variability and with a continuous effect extending into the long-term. Long-term or permanent and irreversible breaches of EQS values for water quality, which leads to a downgrading of WFD/MSFD status/potential. Large, long-term and permanent change to parameters defining chemical status and/or change to physico-chemical elements supporting the biological elements, which leads to a downgrading of WFD/MSFD status/potential.
Medium	Regional spatial extent with moderate magnitude compared to the natural variability, frequently occurring in the short- or medium-term. Local spatial extent with moderate magnitude compared to natural variability, occurring frequently over a long-term timescale. Measurable long-term change in water quality that uses much of the available headroom to the EQS, but without breaching EQS values; or medium-term and reversible breaches of EQS values, which do not actually lead to a downgrading of WFD/MSFD status/potential. Measurable long-term change to parameters defining chemical status and/or change to physico-chemical elements supporting the biological elements, which does not actually lead to a downgrading of WFD/MSFD status/potential.

Value	Definition
Low	Local or regional spatial extent with low magnitude, frequently occurring over a short or medium timescale. Measurable change in water quality, but with significant headroom to the EQS limit still available; or short-term and reversible breaches of EQS values, and no change to WFD/MSFD status. Measurable change to parameters defining chemical status and/or change to physico-chemical elements supporting the biological elements, which does not actually lead to a downgrading of WFD/MSFD status.
Negligible	Local spatial extent, with magnitude comparable to natural variability, occurring infrequently over a short or medium timescale. No measurable change in water quality, and no breach of relevant EQS values, and no change to WFD/MSFD status. No measurable change to parameters defining chemical status and/or change to physico-chemical elements supporting the biological elements, and no change to WFD/MSFD status.

Sensitivity (and value)

10.5.4.6 The sensitivity of a receptor is dependent upon its adaptability (the degree to which a receptor can avoid or adapt to an effect), tolerance (the ability of a receptor to absorb stress or disturbance without changing character) and recoverability (the temporal scale and extent to which a receptor will recover following an effect).

10.5.4.7 In addition, for some assessments the 'value' of a receptor may also require consideration in the assessment where relevant, for instance if a receptor is designated or has an economic value.

10.5.4.8 The sensitivity and value are combined, using expert judgement as required, to provide a score for use in the significance assessment matrix presented in **Table 5.2** in **Chapter 5, Volume 1a**. The definitions of sensitivity/value levels for Marine Sediment and Water Quality, using a 4-point scale, and definitions of the sensitivity/value levels are provided in **Table 10-9**.

Table 10-9 Definitions of sensitivity / value levels for Marine Water and Sediment Quality

Sensitivity / Value	Definition
High	**Vulnerability:** WFD surface water body (or part thereof) with overall 'High' or 'Good' ecological status/potential or MSFD sea area (or part thereof) with 'Good' environmental status. **Recoverability:** The receptor cannot, or has a very low capacity to, adapt to or tolerate the impact. Recovery of water quality will take in excess of a year.

Sensitivity / Value	Definition
	Value: Water or sediment quality conditions supporting a nature conservation site that is part of the national site network (SPA and SAC) or Ramsar sites, where water and/or sediment quality is an important factor in maintaining the site's conservation objectives. Water or sediment quality conditions supporting designated use, such as a designated bathing water or shellfish water.
Medium	**Vulnerability:** WFD surface water body (or part thereof) with overall 'Moderate' or lower status/potential or MSFD sea area (or part thereof) failing to meet 'Good' environmental status criteria for at least 1 MSFD objective. **Recoverability:** Receptor has limited capacity to absorb the impact. Recovery takes more than a spring-neap tidal cycle. **Value:** Water or sediment quality conditions supporting a site of special scientific interest (SSSI) or marine protected area (MPA), where water and/or sediment quality is an important factor in maintaining the site's conservation objectives. Water or sediment quality conditions supporting designated use, such as cooling water abstraction or general amenity use.
Low	**Vulnerability:** Non-reportable WFD surface water body (or part thereof) or MSFD sea area (or part thereof) failing to meet 'Good' environmental status criteria for more than one MSFD objective. **Recoverability:** Receptor has a reasonable capacity to absorb the impact. Recovery takes place within two semidiurnal tidal cycles. **Value:** Water or sediment quality conditions supporting a site with a local conservation designation where water and/or sediment quality is an important factor in maintaining the site's conservation objectives.
Negligible	**Vulnerability:** Non-reportable WFD surface water (or part thereof) or MSFD sea area (or part thereof) failing to meet 'Good' environmental status criteria for any MSFD objectives. **Recoverability:** Receptor has high capacity to absorb the impact. Recovery takes place immediately or within a semidiurnal tidal cycle. **Value:** Water or sediment quality conditions supporting undesignated ecosystems or those with low sensitivity to water quality changes.

Significance

10.5.4.9 Following the identification of sensitivity and the magnitude of the impact, it is possible to determine the significance of the effect. The matrix provided in **Table 5.2** in **Chapter 5, Volume 1a** is used as a framework to aid in determination of significance in the impact assessment. Significance has not been determined for impacts on marine sediment due to the absence of an EQS for this receptor. In the case of marine sediments where no EQS Significance of indirect effects of changes in water or sediment quality on other receptors are assessed under the chapters dealing with those receptors.

10.6 BASELINE CONDITIONS

10.6.1 CURRENT BASELINE

10.6.1.1 The Isle of Lewis/*Eilean Leòdhais* is the largest and most northerly island in the Outer Hebrides/*Na h-Eileanan Sia* (Western Isles). The west of the island is directly exposed to North Atlantic currents and therefore is influenced by the Gulf Stream, which carries warmer waters, originating from a subtropical gyre, northwards into the northeast Atlantic and the Western Isles. This creates a relatively mild and wet climate, with strong prevailing south westerly winds (Neill *et al.*, 2017).

10.6.1.2 The shelf seawaters west of the Isle of Lewis/*Eilean Leòdhais* and the Isle of Harris/*Na Hearadh* are generally well mixed, but can be seasonally weakly stratified, owing to depths >120 m. They are influenced by enhanced wind-driven turbulence (affected by seasonal variation in atmospheric influence), strong tidal currents, and high wave energy driven by the waves propagating from the North Atlantic (JNCC, 1997; Neill *et al.*, 2017; ABPmer, 2017). Wave monitoring offshore of the Isle of Lewis/*Eilean Leòdhais* has measured peak wave heights of ≥10 m, in 60 m water depths (Vogler and Morrison, 2013; Neill *et al.,* 2017).

10.6.1.3 The northeastern Atlantic Ocean is characterised by semidiurnal tides. Tides propagate northwards, up the western edge of the continental shelf, then turn eastwards across the northern extent of Scotland/*Alba* (Neill *et al.*, 2017). The mean tidal range around the Isle of Lewis/*Eilean Leòdhais* is typically ~4 m (JNCC, 1997; Neill *et al.*, 2017), and maximum spring tidal currents travel at ~0.5 m/s (see UK Admiralty Chart 2635).

10.6.1.4 Refer to **Chapter 9, Volume 2c** for additional baseline information on the modelled physical processes baseline for the Offshore Project.

Water Quality

Physicochemical Parameters

Total Suspended Sediment and Turbidity

10.6.1.5 Total suspended sediment data for the northeast of the Isle of Lewis/*Eilean Leòdhais,* located within the Offshore Project Boundary show low TSS concentrations with average concentrations of <1 mg/l (average between 1998-2015) (Cefas, 2016b). In winter, which typically results in higher TSS and turbidity events due to storm events causing increase in natural seabed disturbance events, TSS and turbidity remain low with concentrations of TSS <5 mg/l[1] and turbidity ≤3 NTU (Ghohin, 2011; Silva, 2016.)

Dissolved Oxygen

10.6.1.6 Shelf sea surface waters are generally found to be oxygen rich, with concentrations averaging 6-8 mg/l (Lozier *et al.,* 1995), corresponding to 90-106% saturation, affected by seasonal variation in temperature and algal growth which influence oxygen solubility and concentrations (Marine Directorate, 2014).

Salinity and Temperature,

10.6.1.7 Time series data (1960-2010) of temperature and salinity data collected from the west coast of the Outer Hebrides/*Na h-Eileanan an Iar* have been utilised (Marine Directorate, 2014). The northeast Atlantic waters around the Western Isles are characterised by yearly average sea surface temperatures ranging between 6-15°C, and an average sea surface salinity of ~35 salinity units (season dependent) (Lozier *et al.,* 1995; JNCC, 1997; OSPAR, 2000; Marine Directorate, 2016).

10.6.1.8 Salinity and temperature data collected from within the Array Area is presented in **Table 10-10**. Salinity ranged from 34.59 psu to 35.03 psu while temperature ranged from 7.72 ºC to 12.93 ºC. Both sets of data were found to be consistent with the time series data summarised in paragraph 10.6.1.7.

Table 10-10 Summary of Salinity and Temperature data collected between January 2023 until July 2024 within the Array Area .

	Minimum			**Mean**			**Maximum**		
Parameter	**Oct - Dec 2023**	**Jan - May 2024**	**May - Jul 2024**	**Oct - Dec 2023**	**Jan - May 2024**	**May - Jul 2024**	**Oct - Dec 2023**	**Jan - May 2024**	**May - Jul 2024**
Salinity (PSU)	34.59	34.42	34.48	34.87	34.78	34.66	35.01	35.03	34.89
Temperature (˚C)	9.33	7.72	9.1	10.93	8.53	10.92	12.42	9.62	12.93

Nutrients and Contaminants

10.6.1.9 Nutrient and contaminants data are scarce; however, the water quality of the sea around the Isle of Lewis/*Eilean Leòdhais* is generally excellent, due to the limited land-based anthropogenic influence with low urbanisation and limited industrial and farming development (SEPA, n.d). The location of the island on the margin of the North Atlantic, is also beneficial to water quality, as the high energy environment facilitates the dispersion and dilution of any nutrient enrichment (confirmed by consistently low average Chl-a concentrations see paragraph 10.6.1.10) or anthropogenic compounds discharged in the area (NatureScot, 2004; Marine Directorate, 2010).

Biological Parameters

Chorophyll a

10.6.1.10 Publicly available data available for the wider North Atlantic shelf sea basin, which utilises satellite imagery (Ghohin, 2011; OSPAR, 2017), shows that during the productive season for phytoplankton (spring bloom April-June data), within the ZoI, monthly average chlorophyll-a (Chl-a) concentration reaches a maximum of 5 µg/l in coastal areas, below the excess concentrations found during peak eutrophication events in the southern North Sea (Ghohin, 2011; OSPAR, 2017a).

Water Framework Directive

10.6.1.11 Marine surface waters are classified under the Scotland RBMP under the Water Environment and Water Services (Scotland) Act 2003. The key objectives of the WFD are to employ the RBMP to protect and, where necessary, restore water bodies to reach good status, and to prevent deterioration. There are 5 classifications of water status as defined under the WFD: High, Good, Moderate, Poor, and Bad. Good status means both good chemical and good ecological status (DGfE, 2023). Potential impacts to onshore surface and groundwaters are covered within the Onshore application.

10.6.1.12 The southwest corner of the Array Area, the OCAS and landfall are located within a WFD designated coastal water body as shown in **Figure 10.2b**, **Volume 2b**. The coastal water body is:

- Gallan Head/*Àird Uig* to Butt of Lewis/*Rubha Robhanais*, ID 200476, Water Classification Status: High.

10.6.1.13 A WFD groundwater body (Lewis to Harris Groundwater Body, reference 150030) is present in the terrestrial area up to MHWS. The Offshore Project Boundary is wholly marine and lies seaward of MHWS; as such, it does not spatially overlap the WFD groundwater body. As all project activities are marine-based and do not involve abstraction from or discharge to groundwater, there is no pathway for effects on groundwater quality. Groundwater is therefore not considered further within this chapter.

10.6.1.14 The Array Area is located in the proximity (~5 km southwest) of an additional coastal water body, namely:

- Loch Roag/Loch Ròg, ID 200205, Water Classification Status: Good.

10.6.1.15 There are no WFD designated Bathing Waters within the vicinity of the Offshore Project. The closest designated site is located over 80 km from the Offshore Project, at Achmelvich/*Achadh Mhealbhaich*, on the coast of mainland Scotland/*Alba*.

10.6.1.16 The closest Shellfish Water protected area is located within Loch Roag/*Loch Ròg,* 12.5 km from the Offshore Project and therefore outside of the 6 km buffer area and not assessed as a potential receptor for Marine Sediment and Water Quality in the EIA.

10.6.1.17 A standalone WFD compliance assessment has been prepared for the Offshore Project and is presented in **Appendix 10.1, Volume 2c**.

Sediment Quality

Physical Parameters

10.6.1.18 A desktop review of regional seabed sediment data sets which are based on regional sampling data sets and modelling indicate seabed sediments within the Array Area and OCAS range from coarse sediment within the Array Area and rock and other hard substrates within the OCAS (EMODnet, 2019; BGS, 2015; BGS, 2020).

10.6.1.19 To assist with classifying surface seabed sediments further within Offshore Project Boundary site specific geophysical surveys were undertaken through the collection of Side Scan Sonar (SSS) and Multi Echo Beam Sounder (MBES) data. This data was then ground-truthed through collection of underwater video and physical grab samples as part of the marine environmental baseline survey (see **Appendix 11.1, Volume 2c**).

10.6.1.20 Based on this analysis it was identified that the majority of the Array Area and OCAS was circalittoral rock consisting of boulders, stones and pebbles. Areas of the Offshore Project Boundary that differed to this included coarse sediments in the eastern / central section of the Array Area. Muddy sand was identified in the southwest of the Array Area. Within the OCAS, outcropping bedrock was identified within northeastern areas and rocky geogenic reef in shallower subtidal and intertidal areas extending parallel to the coast (see **Figure 51 and Figure 53, Appendix 11.1, Volume 2c**).

10.6.1.21 From collection of sediment samples from boreholes as part of the Project's geotechnical survey it was identified that in the northeast of the Array Area there are fine to coarse sands and gravels mixed throughout the seabed. In the southwest of the Array Area there are gravelly sands and clays in the upper 3 m of the seabed with some gravel present alongside the sands and clays deeper than 3 m and in the OCAS there are fine to coarse gravels in the upper 2.5 m of the seabed with sandy silt present alongside gravels deeper than 2.5 m.

<u>Particle Size Distribution</u>

10.6.1.22 Surface sediments samples collected for PSD analysis within Offshore Project Boundary which were limited due to the prevalence of hard rocky substrates were relatively homogenous with high sand content across all but 1 station which had a higher gravel content – see **Figure 9-4 and Figure 9-5, Volume 2b**. This station was located slightly further towards the centre of the Array Area than the other grab stations located in this region and may represent an area of transition between soft and hard substrate. The mean proportion (± SE) of sands across all stations was 90 % (± 5 %), the mean (± SE) gravel and mud content across the Study Area was 9 % (± 5 %) and 0.3 % (± 0.03 %) respectively.

Total Organic Carbon

10.6.1.23 Total Organic Carbon (TOC) data from a low number of samples collected by Marine Directorate (2022) offshore of the Isle of Lewis/*Eilean Leòdhais* and the northern area of the Isle of Harris/*Na Hearadh*, indicate that the percentage of organic carbon (TOC) in these sediments ranged from 0.27% in sandy, deeper stations (~94 m), to 1.37% in mud to muddy sand sediments in stations ~50 m deep. The percentage of TOC ranged from 0.7% in sandy sediments (depth ~40 m) to 9.9% in sediments composed of mud to muddy sand (depth 50 m) (Marine Directorate, 2022). From sediment samples collected as part of the Subtidal Environmental Baseline Survey, TOC was comparable to regional surveys described above, ranging from 0.26% to 0.47%. The mean (± SE) TOC across the Project Study Area was 0.38%±0.02%.

Chemical Parameters

Heavy and Trace Metals

10.6.1.24 A total of 8 heavy and trace metals were analysed from sediment samples collected within Offshore Project Boundary during the Marine Environmental Baseline Survey (**Appendix 11.1**). These were: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni) and zinc (Zn), all expressed as total metal concentrations in the sediment.

10.6.1.25 Data for the 8 main heavy and trace metals (dry-weight concentration, mg kg^{-1}) are shown in **Table 10-11,** together with adopted threshold levels. These include Cefas AL. Material with contaminant levels between AL1 and AL2 require further project-specific consideration. **Table 10-11** also includes OSPAR defined BAC and effects range low (ERL) concentrations (defined as the lower tenth percentile of the data set of concentrations in sediments which were associated with biological effects).

10.6.1.26 Canadian sediment quality guidelines are also shown. These include ISQG designed to be protective of aquatic life, which are equivalent to TEL, below which adverse effects on aquatic life are expected to occur rarely. PEL, above which effects are expected to occur frequently, are also shown.

10.6.1.27 Concentrations of Pb ranged from 3 mg kg^{-1} at station ST023, to 4.9 mg kg^{-1} at station ST004, with a mean (± SE) concentration across all stations of 3.69 mg kg^{-1} ± 0.23 mg kg^{-1}. These concentrations are below all threshold levels including CEFAS AL1 (50 mg kg^{-1}).

10.6.1.28 Concentrations of Cu ranged from 2.8 mg kg^{-1} at station ST035 to 25 mg kg^{-1} at station STAD008, with a mean (± SE) concentration across of all stations of 8.27 mg kg^{-1} (± 2.97 mg kg^{-1}). These concentrations are below all threshold levels except for 1 exceedance of TEL at station STAD008.

10.6.1.29 Concentrations of Cr ranged from 2.8 mg kg^{-1} at station ST035 to 23.1 mg kg^{-1} at station STAD008, with a mean (± SE) concentration across of all stations of 7.96 mg kg^{-1} (± 2.48 mg kg^{-1}). These concentrations are below all threshold levels.

10.6.1.30 Concentrations of Cd ranged from 0.17 mg kg^{-1} at station STAD005, to 0.06 mg kg^{-1} at station ST023, with a mean (± SE) concentration across all stations of 0.10 $mgkg^{-1}$ (± 0.01). These concentrations were below all threshold levels , except for 1 exceedance of the TEL at station STAD005.

10.6.1.31 Concentration of As ranged from 2.9 mg kg^{-1} at station STAD005 to 5.7 mg kg^{-1} at station ST003, with a mean (± SE) concentration across all stations of 5.01 mg kg^{-1} (±0.34). These concentrations are below all threshold levels.

10.6.1.32 Concentrations of Hg were below the limit of detection (LoD) at all stations, with the exception of station STAD005, which was below all threshold levels.

10.6.1.33 Concentrations of Ni ranged from 7.7 mg kg^{-1} at station ST004 to 58.2 mg kg^{-1} at station STAD008 with a mean (± SE) concentration across all stations of 19.8 mg kg^{-1} ± 6.4 mg kg^{-1}. Stations ST023 and STAD008 both exceeded CEFAS action level 1 (AL1) with STAD008 also exceeding the OSPAR BAC for this contaminant. No other threshold levels were exceeded but it is noted that the highest Cr and Cu concentrations coincided with the highest Ni concentrations at these stations. There are no known point sources of industrial pollution and the reason for the isolated elevated concentrations cannot be determined confidently. In addition, elevated metal sediment concentrations do not necessarily imply toxicity to benthic communities (Rees *et al.*, 2007) as the bioavailability of these metals is more important than simply concentration levels. Despite the elevated Ni concentrations recorded at 2 stations, the levels are considered too low to pose any ecological concern across the Study Area as a whole.

10.6.1.34 Concentrations of Zn ranged from 9.7 mg kg^{-1} at station ST023 to 30.6 mg kg^{-1} at station STAD008. The mean (± SE) concentration of Zn across all stations was 13.9 mg kg^{-1} ± 2.5 mg kg^{-1}. These concentrations are below all threshold levels.

Table 10-11 Summary of heavy and trace metal concentrations (mg kg^{-1}) across the Array Area for Marine Sediment and Water Quality

Station	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
ST003	5.7	0.11	4.2	3.2	3.5	< 0.01	9.8	10
ST004	5.6	0.07	4.3	3.9	4.9	< 0.01	7.7	10.7
ST023	5.3	0.06	10.7	14.7	3	< 0.01	**28.5**	9.7
ST035	5.2	0.1	3.7	2.8	3.9	< 0.01	13.3	12.1
STAD005	2.9	0.17	5	5.3	3.2	0.01	12.4	13.9
STAD007	4.8	0.11	4.7	3	3.3	< 0.01	8.4	10
STAD008	5.6	0.09	23.1	25	4	< 0.01	**58.2**	30.6
Min	2.9	0.06	3.7	2.8	3	<0.01	7.7	9.7
Max	5.7	0.17	23.1	25	4.9	0.01	58.2	30.6
Mean	5.01	0.10	7.96	8.27	3.69	<0.01	19.76	13.86
Standard error	0.34	0.01	2.48	2.97	0.23	-	6.43	2.64
CEFAS AL1	20	0.4	40	40	50	0.3	20	130

Station	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
CEFAS AL2	100	5	400	400	500	3	200	800
OSPAR BAC	25	0.31	81	27	38	0.07	36	122
Effect Range Low (ERL)	8.2*	1.2	81	34	47	0.15	21*	150
Threshold Effect Level (TEL)	7.24*	0.7	52.3	18.7	30.2	0.1	-	124
Probable Effect Level (PEL)	41.6	4.2	160	108	112	0.7	-	271

*The ERL and TELs for As and Ni are below the OSPAR BACs, As and Ni concentration are only assessed against the BAC as opposed to other threshold levels. Red shading indicates concentrations above CEFAS action level 1 (AL1). Note that OSPAR has not developed EAC levels for metals in sediment and currently uses ERL levels instead.

Total hydrocarbon content

10.6.1.35 The total THC in sediment samples collected across the Array Area was less than the LoD at stations, with the exception of 2. At these stations, total THC concentrations were 2.96 mg kg^{-1} and 1.01 mg kg^{-1} respectively. These values are below the background value of 6.89 mg kg^{-1} for THC in the North Sea (UKOOA 2001). There are no specific threshold values for THC, which is a term used for a variety of different mixtures of compounds based on extractability during analysis; therefore, while it can provide a useful indicator of serious oil pollution, caution should be exercised in comparison with thresholds at concentrations near background levels.

10.6.1.1 Polycyclic Aromatic Hydrocarbons

10.6.1.2 Data collected from OSPAR, on hazardous substances in the Irish and Scottish West Coast area (OSPAR, 2017b), show mean concentrations of polycyclic aromatic hydrocarbons (PAH) in sediments to be significantly below background assessment concentrations (BAC) (concentrations close to zero for manmade substances - OSPAR Hazardous Substances Strategy aim).

10.6.1.3 From sediment samples collected as part of the subtidal environmental baseline survey all the PAHs concentrations were measured below the LoD. Ratios of hydrocarbons are typically used to assess the source origin of hydrocarbons and gain a better understanding of whether these contaminants are derived from anthropogenic activities or are of natural origin. However, as hydrocarbons were below the LoD at all stations this assessment could not be carried out, overall indicating that hydrocarbon concentrations across the Study Area are of no concern.

Polychlorinated biphenyls

10.6.1.4 All analysed PCBs were below the LoD at all stations across the Offshore Project Boundary.

10.6.1.5 Additionally, OSPAR (2017c) data show concentrations of polychlorinated biphenyls (PCB) below the environmental assessment criteria (EAC) (thus at levels that should not cause chronic effects in sensitive marine species) but above the BAC.

Organotins

10.6.1.6 Dibutyltin (DBT) and tributylin (TBT) concentrations were below the LoD at all stations across the Offshore Project Boundary.

Organochlorine pesticides

10.6.1.7 OCP concentrations were less than the LoD at all stations across the Offshore Project Boundary.

Blue Carbon Receptors

10.6.1.8 Blue carbon refers to coastal and marine ecosystem's ability to absorb and store carbon dioxide from the atmosphere. Plants, calcifying organisms and sediment all play a role in capturing and storing carbon, both in the short-term (for example, plants) and long-term (for example, reefs and deep-sea sediments). A major threat to long-term carbon storage is any activity that disrupts the surface layers of sediment such as the installation of subsea cables and infrastructure. Such activities can result in release of carbon dioxide to the atmosphere, with associated adverse effects of this greenhouse gas on climate change.

10.6.1.9 Blue carbon reserves in the marine environment fall into 2 categories: seabed sediments and marine biota, especially coastal vegetated habitats.

10.6.1.10 This section provides an overview of the blue carbon potentially stored within seabed sediments. Which informs the impacts assessment of the Offshore Project on blue carbon stored within coastal vegetated habitats and other biota in Chapter 11, Volume 2a.

10.6.1.11 Sediments act as long-term carbon sinks, where organic material derived from planktonic production, detritus and terrestrial inputs becomes incorporated into the seabed. The stability of this carbon pool is strongly influenced by sediment type, depositional regime, hydrodynamic conditions and disturbance history. Fine-grained, low-energy environments typically support higher rates of carbon burial, whereas coarser, mobile substrates tend to hold comparatively lower concentrations of organic carbon.

10.6.1.12 Across the Array Area, the seabed is largely made up of Circalittoral fine sand' or 'Circalittoral muddy sand', while the OCAS is largely made up of circalittoral rock (see Chapter 11, Volume 2a) resulting in moderate to low natural carbon storage potential. The mean concentration of TOC in the sediments sampled across the Array Area and OCAS was 0.38% (see paragraph 10.6.1.23). This value has been used combined with the predicted total amount of sediment predicted to be mobilised, to assess the amount of sediment-associated blue carbon that will be mobilised from the seabed by the Offshore Project. As sediments are predominantly sandy, the proportion of inorganic carbon has been assumed to be negligible.

10.6.2 FUTURE BASELINE

10.6.2.1 Determining the future baseline draws upon information about the likely future use and management of the Offshore Project Boundary in the absence of the Offshore Project and any other proposed developments (consented or proposed) that may act cumulatively with the Offshore Project to affect Marine Sediment and Water Quality.

10.6.2.2 Future baseline conditions for the Marine Sediment and Water Quality assessment will be primarily driven by climate change, including sea temperature and salinity changes, and extremes of weather.

10.6.2.3 The UK Climate Projections (UKCP18) future climate projections data depict a wide spread of future changes in mean surface wind speed, however, there is large uncertainty in projected changes in circulation over the UK and natural climate variability contributes to much of this uncertainty. It is therefore difficult to represent regional extreme winds and gusts within regional climate models.

10.6.2.4 The Met Office has undertaken Outer Hebrides specific analysis of future high winds and storms. It is anticipated that on average, there will be 9 additional days per year of storms by the end of the century. This indicates an average of 31 wet, windy days and impactful weather conditions in winter, and increased uncertainty in storm frequency and magnitude. The biggest changes are expected to be for the 'middling' storm events, rather than 'significant' storm events. Wind speeds in these events are likely to remain largely the same as current events (Outer Hebrides Community Planning Partnership Climate Change Working Group, 2022). These changes could influence water and sediment quality by increasing sediment resuspension, turbidity, and nutrient redistribution, potentially affecting contaminant dispersion.

10.6.2.5 Globally, sea surface temperatures (SST) have increased significantly over the past century. The UKCP18 projections for Stornoway/*Steòrnabhagh* (Isle of Lewis/*Eilean Leòdhais*) include projections of summer SST increases of 2.6-3.4°C and winter SST increases of 1.6–2.9°C, by 2080 compared to the 1981–2000 baseline. These projections are based on high-resolution (2.2 km) UKCP Local models, regridded to 5 km for regional analysis. Such changes could increase the risk of harmful algal blooms, as well as the intensity, duration, and spatial extent of phytoplankton blooms.

10.6.2.6 On the basis of available evidence, in the absence of the Offshore Project and allowing for climate change effects, the future baseline for Marine Sediment and Water Quality over the lifetime of the Offshore Project is likely to be different from the current baseline in terms of both sea surface temperatures, and storm conditions, affecting compliance with existing water quality standards. These factors are likely to increase natural sediment resuspension and turbidity events, resulting in higher background levels of TSS and associated nutrient and contaminant redistribution. Therefore, the proportional contribution of the Offshore Project to overall TSS levels would be reduced because future baseline conditions are expected to have more frequent natural sediment disturbance.

10.7 BASIS FOR ENVIRONMENTAL IMPACT ASSESSMENT

10.7.1 MAXIMUM DESIGN SCENARIO

10.7.1.1 Assessing using a parameter-based design envelope approach means that the assessment considers a maximum design scenario whilst allowing the flexibility to make improvements in the future in ways that cannot be predicted at the time of submission in the consent applications. The assessment of the maximum adverse scenario for each receptor and for each topic establishes the maximum potential adverse impact. Therefore, as a result, impacts of greater adverse significance would not arise should any other development scenario (as described in **Chapter 3, Volume 1a**) to that assessed within this Chapter be taken forward in the final scheme design.

10.7.1.2 The maximum parameters and assessment assumptions that have been identified to be relevant to Marine Sediment and Water Quality are outlined in **Table 10-12** and are in line with **Chapter 3, Volume 1a**.

10.7.1.3 Although pre-construction surveys may involve some limited and temporary interactions with the marine environment, the potential impacts of any such activities fall well within the MDS parameters assessed for this chapter. The MDS includes activities_such as WTG foundation drilling and grouting, and Offshore Cable installation which represent a conservative upper bound on seabed disturbance, and vessel presence. These MDS activities therefore encompass the environmental footprint of pre-construction survey methods, which are significantly lower in magnitude, duration, and spatial extent.

10.7.1.4 For this reason, the potential environmental interactions of pre-construction surveys are not separately assessed, as they are already inherently accommodated within the worst-case assumptions underpinning the MDS for this topic.

10.7.1.5 The difference in timing between pre-construction surveys and construction activities does not affect the assessment because the MDS represents the maximum magnitude of change, independent of phasing or scheduling. The pre-construction surveys occur over a much shorter duration and at materially lower intensities than the MDS bounding activities and therefore do not introduce any temporal additive effects beyond those already assessed.

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Table 10-12 Maximum parameters and assessment assumptions for impacts on Marine Sediment and Water Quality

Offshore Project Activity/Impact	Maximum Design Scenario	Maximum assessment assumptions	Justification
Construction			
Installation of infrastructure: Direct seabed disturbance during construction (substrate preparation, installation of infrastructure): • temporarily increases suspended sediment into the water column, which is transported and dispersed in suspension by currents and deposited over various distances (tidal excursion and sediment granulometry dependent). • may release potentially contaminated sediments into the water column. Once suspended, these sediments may be transported and later resettled, potentially leading to the redistribution of contaminants.	**WTG Foundation Installation:** **Scenario 2 (60 WTGs and 12 Array Cables to Landfall):** the installation of up to 60 multi-leg jacket foundations with pin piles via drilling and grouting within the Turbine Area to support up to 60 WTGs. **Number of piles per WTG and spacing:** Each multi-leg jacket pile foundation will have up to 4 legs (1 pin pile per leg), each spaced 30-55 m apart at seabed level and 15-35 m apart at MSL. **Pin pile diameter:** Each pin pile will have a maximum diameter of up to 5 m. **Drilling depth:** Pin piles will be drilled below the seabed to a depth of 15-120 m, depending on location within the Turbine Area (i.e. whether it is inside or outside of the buried channel). **Volume of drill arisings:** Per pin pile is assumed to be 588 m^3, and 141,120 m^3 for all 60 turbine multi-leg jacket foundations (assuming a 30 m average depth per drill event). **Construction programme:** Maximum duration of offshore construction is up to 5 years between 2028/2029 and 2032/2033, with work programmed within the Turbine Area between April and October, totalling 14 months of active work. Working hours are expected to be 24 hours, 7 days a week.	**Drilling of Pin Piles to Install WTG Foundations modelling:** modelling results of pin pile drilling activities to install WTG Foundations are presented in **Appendix 9.2, Volume 2c** and were used to inform this impact assessment. **Volume of drill arisings:** 4 piles per foundation are modelled in one location; with a volume of 1,374 or 2,356 m^3/pile/day (for foundation depths of 70 m and 120 m, respectively). **Concurrent pile drilling events:** The model assumes that 3 pile drilling events will occur concurrently. **Maximum pile depth assumption:** Maximum depth of piles within the buried channel (deeper sections of seabed substrate within the Turbine Area) is 120 m and elsewhere within the Turbine Area it is 70 m. **Tidal modelling assumption:** A neap-spring tidal cycle is modelled with pile installation at the northeastern/southwestern extents of the Turbine Area. **Sediment release:** Sediment plumes associated with foundation installation construction activities are assumed to be limited to 2 m from the seabed (see justification in Section 2.3.3.2, **Appendix 9.2, Volume 2c**).	**Scenario 2 (60 WTGs and 12 Array Cables to Landfall):** represents the largest spatial extent of infrastructure and greatest volume of potential sediment disturbance during the construction phase. **Number of piles per WTG and spacing:** The resolution of the model mesh is not small enough for a spacing of sediment sources 30-55 m apart to influence the results. Therefore, spacing parameters were not included in the model, this ensures a reasonable computational run time. **Concurrent pile drilling events:** 3 piles are modelled simultaneously, with the single remaining pile for this location modelled on its own, which represents the maximum design scenario. **Maximum pile depth and diameter assumption:** Maximum pile depths and diameter have been modelled to ensure a worst-case volume of sediment disturbance. **Volume of drill arisings:** Maximum design scenario volume of drill arisings per pin pile value is based on a 30 m average embedment depth. Modelling has used depths of 70 m and 120 m to reflect the maximum depths pin piles will be buried e.g. in the buried channel representing worst case. **Tidal modelling assumption:** A neap-spring tidal cycle has been modelled to allow for an adequate range of tidal levels and current representation in the modelling exercise. Modelled locations at the edge of the Turbine Area shows the maximum extent of sediment disturbance outside the Offshore Project Boundary. **Sediment release:** Sediment disturbed by project construction activities is assumed to be released from within 2 m of the seabed. This assumption enables a conservative assessment of the concentration of the total suspended sediments and subsequent sediment deposition thickness (see Section 2.3.3, **Appendix 9.2, Volume 2c**).
	Offshore Cable Installation: **Scenario 2 (60 WTG and 12 Array Cables to Landfall):** the installation of 12 66 kV Array Cable to Final WTG (within Array Area) and 12 66 kV Array Cables to Landfall (within OCAS) via jet trenching.	**Array Cable burial modelling:** modelling results of Array Cable burial via jet trenching are presented in **Appendix 9.2, Volume 2c** and were used to inform this impact assessment.	**Scenario 2 (60 WTGs and 12 Array Cables to Landfall):** equates to the greatest length (350 km) of Array Cables to be installed and greatest area of potential sediment disturbance during the construction phase.

Offshore Project Activity/Impact	Maximum Design Scenario	Maximum assessment assumptions	Justification
	Array Cables: • Array Cables to Final WTG have a maximum length of 160 km; • Array Cables to Landfall have a maximum length of 190 km; • Maximum length of Array Cables is therefore 350 km and maximum diameter of 300 mm. **Installation method:** • Assumes 60% of cable length (210 km) requires installation via jet trenching; • Jetting trench has a maximum width of 7 m and depth of 2 m. Seabed disturbance footprint from jet trenching is anticipated to be approximately 1.47 km^2. **Seabed Preparation:** • Assumes 60% of cable length (210 km) requires boulder clearance to facilitate jet trenching; • Boulder clearance width of 15 m. • Seabed disturbance footprint from boulder clearance is anticipated to be approximately 3.15 km^2.	**Sediment release:** Assumes Array Cables will be installed at 300 m/hr with 20% of sediment released into the water column.	**Installation method:** jet trenching is the worst-case cable installation method as the sediment release is likely to be at a greater height above the seabed (than the other Array Cable burial methods) where current speeds are higher (see paragraph 9.7.1.2 in **Chapter 9, volume 2a** for further details). **Jet trenching extent:** Jet trenching 60% of the cable length represents a worst case-scenario as it is the maximum amount of jet trenching that could be undertaken to install the Array Cables. **Sediment release:** Speed and percent of sediment released are reasonable worst-case values based on similar assessments. See Table 2-3 in **Appendix 9.2, Volume 2c** for details on sediment mass flux in different locations within the Study Area. **Seabed preparation:** The potential impacts of seabed preparation activities, including boulder clearance using a boulder plough or boulder grab, were considered as part of the identification of the maximum design scenario for the Physical and Coastal Processes assessment. These activities were reviewed alongside the full range of potential cable installation methods. As outlined in Section 9.7.1.2 of **Chapter 9, Volume 2a**, a comparison of ploughing, jetting and mechanical cutting indicated that jet trenching would result in the greatest sediment disturbance and seabed change, due to the volume of sediment mobilised. On this basis, jet trenching was selected as the basis for the modelling assessment as it represents a conservative worst-case scenario for sediment mobilisation associated with either cable installation or seabed preparation activities. The potential impacts of seabed preparation are therefore inherently encompassed within the modelling of jet trenching, which captures the upper bound of sediment disturbance and seabed change that could reasonably arise from these activities. Separate modelling of seabed preparation is not required, as it would not result in impacts greater than those already assessed under the maximum design scenario.
	Number of Exit Pits: Excavation of up to 13 HDD exit pits by rock cutting or grinding. **Sediment volume:**	**HDD activities modelling:** Modelling results of HDD activities are presented in **Appendix 9.2, Volume 2c** and were used to inform this impact assessment.	**Number of Exit Pits:** 13 exit pits equates to 1 per each of the 12 Array Cables and an additional contingency exit pit to account for exit pit collapse, reflecting the maximum number of exit pits the Offshore Project may construct.

Offshore Project Activity/Impact	Maximum Design Scenario	Maximum assessment assumptions	Justification
	• Maximum volume of sediment excavated per HDD Exit Pit: 75 m length x 5 m width x 3.5 m depth = 1,312.5 m^3. • Maximum volume of sediment excavated from all 13 exit pits is 17,062.5 m^3.	**Sediment types:** Assessment considers range of sediment sizes which could be released by rock cutting or grinding.	**Sediment volume:** Represents greatest volume of sediment that could be released into the water column during the excavation of a single exit pit. The HDD drill cutting release models a similar volume of sediment release for fine sediment in the same location and likewise with Array Cable trenching for coarse sediment. **Sediment types:** The methods (cutting or grinding) for constructing the HDD exit pit construction may release fine or coarse sediment in to the water column. There is also uncertainty around sediment properties in the Exit Pit Area and therefore it is appropriate to assess a range of sediment sizes. Coarse and fine sediments behave in different ways and so represent a worst-case for different situations (for example finer sediments can be advected over a greater distance by currents, however coarser sediments will settle in smaller areas with larger deposition thicknesses).
Horizonal Directional Drilling: Trenchless techniques (such as HDD) are a method of installation for the Offshore Cable at Landfall during the construction phase. This activity can release drilling fluid, muds and very low levels of bentonite into the water column. This activity can release drilling fluids (muds), containing bentonite and drill cuttings, increasing fine sediment in suspension in the water column.	**Number of bores and volume:** Up to 13 bores drilled with a maximum volume of 1,285 m^3 per bore. **Number of rigs:** 2 drill rigs **Drill release duration:** 24 hours working, 7 days a week. **Drill fluid density:** Volume of suspended cuttings varies dependent on drilling fluid density.	**HDD activities modelling:** modelling results of HDD activities are presented in **Appendix 9.2, Volume 2c** and were used to inform this impact assessment. **Single bore modelled:** Single representative modelled at a central point within the Landfall Exit Pit Area. **Tidal modelling assumption and drill release duration:** Drill releases of entire bore over 1 hour at a peak spring tide and during slack water on a neap tide. **Drill fluid density:** Assumed 27% cuttings in a very dirty drilling fluid.	**Number of bores and volume:** Represents maximum number of bores and volume per bore reflecting worst case scenario. **Number of rigs and single bore modelled:** Whilst the Project Design Envelope allows for concurrent HDD activities, works will be managed so that break out activities will occur sequentially (i.e. 1 break out activity is undertaken at once). Although there will be up to 13 HDD bores, only 1 activity has been modelled in a central location to provide a representative drill release scenario. **Tidal modelling assumption:** The modelled release point at mid-tide on a peak spring has the potential to transport the sediment plume furthest. This is a worst-case impact in terms of extent. The HDD release at slack water on a neap tide is also modelled which will likely result in a higher SSCs. However, this will likely be over a smaller area. **Drill release duration:** Release over 1 hour is a reasonable worst-case for SSCs. **Drill fluid density:** 27% represents worst case drill cutting percent.
Construction of the Offshore Project: could lead to a change in the blue carbon resource in the Study Area, from seabed disturbance during construction activities (e.g. Drilling of pin piles, cable burial, HDD drill cutting release, HDD exit pit constructions).	**Volume of disturbed sediment:** Total sediment volume disturbed by construction activities (WTG foundation installation, burial of Array Cables to Final WTG and Array Cables to Landfall, and HDD exit pit construction) could be up to 738,303.5 m^3 (see **Table 10-15**). The maximum design scenarios used for this assessment are identical to those Offshore Project	The maximum assessment assumptions are identical to those detailed for the Offshore Project Activity/Impact *'Seabed disturbance temporarily increasing suspended sediment and resettlement'* and *'Seabed disturbance releasing contaminated sediment'* detailed in the construction phase.	**Volume of disturbed sediment:** Maximum volume of sediment that could be disturbed by project primary construction activities (WTG foundation installation, burial of Array Cables to Final WTG and Array Cables to Landfall, and HDD exit pit construction).

Offshore Project Activity/Impact	Maximum Design Scenario	Maximum assessment assumptions	Justification
	Activity/Impact *'Seabed disturbance temporarily increasing suspended sediment and resettlement'* and *'Seabed disturbance releasing contaminated sediment'* detailed in the construction phase.		
Operation and Maintenance			
Maintenance and remedial work: Direct seabed disturbance during maintenance and remedial work (such as cable repairs or anchor reburial): • temporarily increases suspended sediment into the water column, which is transported and dispersed in suspension by currents and deposited over various distances (tidal excursion and sediment granulometry dependent). • has the potential to release potentially contaminated sediments and introduce contaminants into the water column. Once suspended, these sediments may be transported and later resettled, potentially leading to the redistribution of contaminants. • could lead to a change in the blue carbon resource in the Study Area.	**Total short-term seabed disturbance from all components of the Offshore Project: 27,610,800m^2 (27.610km2):** Maintenance activities includes major/minor component replacement and repairs, scheduled inspections and unscheduled maintenance of offshore infrastructure, with repairs and replacement required on an ad hoc basis. It is estimated that the maintenance activities will require: **WTG short term disturbance:** • Major component replacements: up to x3 per WTG over lifetime (180 total) • Minor component replacements: up to x10 per WTG per year (21,000 total) • Seabed disturbance per replacement using Jack Up Vessel: Area of spun cans (280 m2) x number of positions (2) = 560 m^2; • Total short term seabed disturbance of WTGs: 21,180 x 560 m^2 = **11,860,800 m^2 (11.86 km^2).** **Array Cables short term disturbance:** • Repair and replacement of Array Cables required: up to 9 times during lifetime • Seabed disturbance for Array Cables (as per construction): 1,750,000 m^2 (1.75 km^2); • Total short term seabed disturbance of Array Cables: 9 x 1,750,000 m^2 = **15,750,000 m^2 (15.750 km^2).** No modelling has been done for SSC during the O&M phase, but levels are expected to be similar or lower than during construction (see **Chapter 9, Volume 2a**). This is because the construction phase involves more intensive, concurrent activities (i.e. drilling WTG foundations and jet trenching cables). It	N/A	**Maintenance activities:** Maintenance activities are expected to occur with a lower intensity than activities undertaken during construction. It is assumed that Array Cables will require reburial/protection up to 6 times across the Offshore Project lifetime, and will be repaired or replaced up to 9 times across the Offshore Project lifetime. As such, construction activities are assumed to represent a maximum design scenario. No modelling has been done for SSC during the O&M phase, but levels are expected to be equal to or lower than during construction (see **Chapter 9, Volume 2a**). This is because the 'multiple activities' modelling scenario, during the construction phase, simulated a maximum suspended sediment concentration during drilling of 4 WTG foundations (each with 4 piles), and burial of cables (assuming drilling and cable burial activities happen sequentially) per month. It is not expected that such large-scale works will be undertaken during the O&M phase. Therefore, temporary increase in suspended sediment concentrations and sediment deposition during operation and maintenance will be of lower magnitude and frequency than that of construction.

Offshore Project Activity/Impact	Maximum Design Scenario	Maximum assessment assumptions	Justification
	is not expected that such large-scale works will be undertaken during the O&M phase.		
Decommissioning			
Removal of infrastructure: Direct seabed disturbance during decommissioning (removal of cables and WTG foundations): • temporarily increases suspended sediment into the water column, which is transported and dispersed in suspension by currents and deposited over various distances (tidal excursion and sediment granulometry dependent). • may release potentially contaminated sediments into the water column. Once suspended, these sediments may be transported and later resettled, potentially leading to the redistribution of contaminants. • change in the blue carbon resource in the Study Area, which is present in the vicinity mainly as carbon in sediments.	The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment. Activities equivalent to or less than the Construction phase. This is because, unlike construction, seabed clearance is not expected to be required for foundation installation or along cable routes. Any seabed clearance during decommissioning is likely to be limited to the placement of jack-up vessel legs. The assumptions for the construction phase therefore apply. At this stage it is unconfirmed whether any components would remain in-situ. As such, under the maximum design scenario for increases in SCC and associated deposition during decommissioning it has been assumed that all infrastructure would be removed. **Decommissioning programme:** Maximum duration is up to 5 years.	N/A	**Construction phase maximum design scenario:** Decommissioning activities are expected to occur with a lower intensity than those during construction, as such, construction activities represent a maximum design scenario.

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10.7.2 EMBEDDED MITIGATION MEASURES

10.7.2.1 As part of the Offshore Project design process, a number of embedded mitigation measures have been adopted to reduce the potential for impacts on Marine Sediment and Water Quality, and these have evolved over the development process as the EIA has progressed and in response to consultation.

10.7.2.2 The embedded mitigation measures also include those that have been identified as good or standard practice and include actions that would be undertaken to meet existing legislation requirements. As there is a commitment to implementing the embedded mitigation, and also to various standard sectoral practices and procedures, they are considered inherently part of the design of the Offshore Project and are set out in this EIAR.

10.7.2.3 **Table 10-13** sets out the relevant embedded mitigation measures within the design and how these affect the marine sediment and water quality pathways assessed within this chapter.

Table 10-13 Relevant embedded mitigation measures for Marine Sediment and Water Quality

ID	Environmental Measure Proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to Marine Sediment and Water Quality assessment
M002	A Cable Installation Plan will be produced to confirm routing, method of installation and aspects such as target Depth of Burial and need for/location of/type of external cable protection. This Plan will also contain the outputs of a formal Cable Burial Risk Assessment (CBRA). Data from the project-specific geophysical surveys will be used to identify the preferred route, with the use of natural crevasses or channels within the bedrock proposed, where feasible, and areas of thicker Quaternary sediments identified (to maximise opportunities for cable burial).	Pre Construction, construction	Secured in the Section 36 Consent and/or Marine Licence conditions. Details will be provided within the Cable Installation Plan.	Informs the routing, installation methods and burial trench dimensions used in the assessment of seabed disturbance, sediment mobilisation and associated effects on marine sediment quality and marine water quality receptors.

ID	Environmental Measure Proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to Marine Sediment and Water Quality assessment
M004	Accidental release of construction material and/or litter to be addressed via the development of procedures to retrieve the accidental deposit of an object at sea.	Construction and Decommissioning.	To be secured through a condition of the Section 36 consent and/or Marine Licence.	Limits accidental release of construction material and/or litter that could otherwise affect marine sediment quality or marine water quality receptors.
M005	Relevant best practice techniques for seabed excavations, employed through all phases of the Project, and suspended solids monitoring to aid responsible management of excavation activities.	Construction.	To be secured through a condition of the Section 36 consent and/or Marine Licence.	Minimises increase of suspended sediment concentrations during seabed preparation and installation of infrastructure, thereby reducing potential effects on marine water quality and sediment quality receptors.

ID	Environmental Measure Proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to Marine Sediment and Water Quality assessment
M019	A final Offshore Environmental Management Plan (OEMP) will be developed prior to commencement of construction (building on Outline Offshore EMP, Volume 3) in compliance with legislative requirements and/or best practice standards and guidance and adhered to.	Pre-Construction and Construction.	Secured in the Section 36 Consent and/or Marine Licence via the condition for an OEMP to be submitted to MD-LOT for approval.	Provides a framework for pollution prevention and control measures that minimises the risk of sediment disturbance and accidental release of contaminants, protecting marine water quality and sediment quality receptors.
M020	A Decommissioning Plan will be developed prior to the construction of the Project in compliance with legislative requirements and/or best practice standards and guidance and adhered to.	Decommissioning.	Secured in the Section 36 Consent and/or Marine Licence via the condition for a Decommissioning Plan to be submitted to MD-LOT for approval and the Energy Act 2004.	Informs the decommissioning programme to limit seabed disturbance and associated effects on marine sediment quality and marine water quality receptors.

ID	Environmental Measure Proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to Marine Sediment and Water Quality assessment
M021	Adherence to requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78/. Best practice techniques employed through all phases of the Project, and measures provided in a Marine Pollution Contingency Plan (MPCP) (see Outline MPCP, Volume 3). All vessels associated with the Project will comply with IMO/MCA codes for prevention of oil pollution and, where appropriate, will have onboard Shipboard Oil Pollution Emergency Plans (SOPEPs) (i.e. vessels over 400 gross tonnes (GT)).	Construction and Decommissioning, Operation and Maintenance.	Secured in the Section 36 Consent and/or Marine Licence conditions. Details will be provided within the MPCP.	Minimises risk of accidental release of pollutants from vessels that could otherwise adversely affect marine water quality and sediment quality receptors.
M025	A final Operational & Maintenance (O&M) Plan (building on Outline Operational & Maintenance Plan, Volume 3) will be developed in compliance with legislative requirements and/or best practice standards and guidance prior to the operation of the Project and adhered to.	Operational and Maintenance.	Secured in the Section 36 Consent and/or Marine Licence via the condition for an EMP to be submitted to MD-LOT for approval.	Outlines O&M activities and associated controls to minimise seabed disturbance and protect marine sediment quality and marine water quality receptors.

ID	Environmental Measure Proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to Marine Sediment and Water Quality assessment
M030	Suitable implementation and monitoring of subsea cable burial, scour protection and cable protection in line with MGN 654 (via burial, or external protection where adequate burial depth as identified via risk assessment is not feasible). Surveys will be coordinated with the fishing industry, and results will be shared to inform ongoing coexistence.	Pre-Construction, Construction, Operation and Maintenance and Decommissioning	To be secured through a condition of the Section 36 consent and/or Marine Licence.	Reduces seabed disturbance associated with cable installation, protection and maintenance, thereby limiting potential effects on marine sediment quality and marine water quality receptors.
M031	A Marine Pollution Contingency Plan (MPCP) will be developed prior to commencement of construction (building on **MPCP, Volume 3**) in compliance with legislative requirements and/or best practice standards and guidance and adhered to.	Pre-Construction, Construction, Operation and Maintenance and Decommissioning	Secured in the Section 36 Consent and/or Marine Licence via the condition for an MPCP to be submitted to MD-LOT for approval.	Provides procedures to prevent and respond to accidental pollution events, protecting marine sediment quality and marine water quality receptors.
M054	To limit physical disturbance to the seabed, vessels will minimise the use of anchors, prioritising the use of dynamic positioning, where possible. This protocol will be of particular consideration around sensitive habitats.	Construction, Operation and Maintenance and Decommissioning	To be secured through a condition of the Section 36 consent and/or Marine Licence.	To minimise disturbance to the seabed that could result in impacts to marine sediment and water quality.

10.8 ASSESSMENT OF EFFECTS: CONSTRUCTION PHASE

10.8.1 SEABED DISTURBANCE TEMPORARILY INCREASING SUSPENDED SEDIMENT CONCENTRATIONS

10.8.1.1 During construction there is potential for sediment disturbance leading to changes in suspended sediment concentrations and transport. The maximum design scenarios relating to sediment disturbance during the construction phase are presented in **Table 10-12**. This includes the following activities:

- Seabed preparation;
- Cable installation using a jet trencher (within the Array Area and OCAS);
- Drilling of the turbine jacket pile foundations;
- HDD drill cutting release and HDD exit pit construction.

10.8.1.2 The maximum design scenario for WTG installation assumes the use of jacket foundations, and drill and grout pin pile installation process. This method would involve sediment disturbance during installation of pin piles on each leg. The maximum design scenario for cable installation assumes that 12 Array Cables to Landfall will be installed by jetting. Jetting would cause localised and short-term increases in suspended sediment, see **Table 10-12**, for the maximum parameters.

10.8.1.3 The Array Cables to Landfall will be connected to the Onshore Landfall Area using trenchless techniques such as HDD below the shallow subtidal and intertidal sections of the landfall. HDD can release drilling fluids (muds, including bentonite) into the water column and increase fine sediment resuspension. Bentonite is used during drilling, suspended in a fluid medium (usually seawater), to lubricate and cool the drill bit and remove cuttings from the drill hole. It has been assumed that the drilling will only contain bentonite and no polymer additives. On this basis, the only impacts from its release into the water column are from temporarily increased suspended sediment concentration (Clem, & Doehler, 1961).

10.8.1.4 Mobilised sediment from substrate preparation and infrastructure installation may be transported by wave and tidal action in suspension in the water column. A MIKE21 Particle Tracking (PT) model was used to predict the extent of sediment mobilisation as a result of infrastructure installation from drilling of pin piles to install WTG foundations, Array Cable to Final WTG burial, Array Cable to Landfall burial and HDD Exit Pits were included as sediment sources in the model (see **Appendix 9.2, Volume 2c**). The 'multiple activities' modelling scenario simulated a maximum suspended sediment concentration during drilling of 4 WTG foundations (each with 4 piles), and burial of cables (assuming drilling and cable burial activities happen sequentially) per month. As well as impacts associated with interactions between different activities, impacts that may arise from multiple Array Cables to Landfall being in close proximity (150 m) to each other within the OCAS were also modelled. Multiple HDD activities (HDD exit pit construction and HDD drill cutting release) were also quantitatively assessed within the Exit Pit Area to determine maximum suspended sediment concentrations arising during sequential HDD Exit Pit construction and HDD drill cutting release, in a single location and multiple locations. For the full methodology and model assumptions refer to **Appendix 9.2, Volume 2c**).

10.8.1.5 The magnitude of impact is based on the criteria detailed in **Table 10-8**. A description of the likely magnitude of impact on receptors caused by each identified impact is given in the following paragraphs.

Magnitude

Preparation of the Seabed

10.8.1.6 Seabed preparation will comprise the clearing of large boulders that could obstruct WTG/OSP foundation installation and the installation of Offshore Cables and geotextile or gravel mattress installation. Seabed preparation, in particular boulder clearance using ploughing methods will cause seabed disturbance potentially leading to increase suspended sediment concentration and transport within the water column. Any increases in suspended sediment concentrations and transport are expected to be temporary and short lived, with concentrations returning to background levels relatively quickly.

Drilling of pin plies to install WTG Foundations - Turbine Area

10.8.1.7 This process would cause localised and short-term increases in suspended sediment concentration at the point of installation at the seabed and sediment would be redeposited at locations determined by tidal currents, as detailed in **Chapter 9, Volume 2a**. Based on the maximum design scenario detailed in **Table 10-12** and the sediment transport assessment (**Appendix 9.2, Volume 2c**), the following distances and concentrations are relevant:

- Suspended sediments resulting from the drilling of pin piles in the southwest of the Turbine Area have the potential to travel approximately 12-15 km centred around the pile location with a concentration generally less than 40 mg/l;
- Suspended sediments resulting from the drilling of pin piles in the central and northeast sections of the Turbine Area travel <3 km from the pile location with a concentration up to 5 mg/l away from the pile drilling location.

10.8.1.8 Refer to **Appendix 9.2, Volume 2c** for a detailed assessment of the suspended sediment concentration modelling outputs.

Cable Installation – Array Area and Offshore Cable Area of Search

10.8.1.9 The southwest of the Array Area comprises finer sediment than the rest of the Array Area and is therefore most at risk of elevated suspended sediment levels, as finer sediments are more likely to be transported than coarser sediments because this requires less energy. Based on the maximum design scenario detailed in **Table 10-12** and the sediment transport assessment (**Appendix 9.2, Volume 2c**), the following distances and concentrations are relevant:

- Suspended sediments resulting from the Array Cables to Final WTG installation, in the southwest section of the Array Area, have the potential to travel approximately 10 km centred around the cable route with a concentration around 100 mg/l within 1 km of the cable and 5 mg/l within 10 km;
- Suspended sediments with a concentration of approximately 200-300 mg/l resulting from the Array Cables to Final WTG installation, in the central (buried channel) section of the Array Area, travel <500 m from the cable route;

- Suspended sediments with a concentration of approximately 200-300 mg/l resulting from the Array Cables to Final WTG installation, in the northeast section of the Array Area, travel <500 m from the cable route;
- Suspended sediments resulting from the burial of Array Cables to Landfall in the OCAS travel <200 m from the cable route with concentrations above 350 mg/l.

10.8.1.10 The impacts of cable burial activities from adjacent cables may occur within the OCAS as this is where Array Cables to Landfall will be located in close proximity to each other (in comparison to the Array Cables to Final WTGs). In the case of suspended sediment concentrations, maximum values occur at the location of the cable burial and decrease rapidly with distance in the direction of the tidal current. Assuming that cables are buried equally spaced at 150 m across the width of the OCAS (2 km), the impacts of adjacent cables are not expected to be greater than the maximum impacts along the individual cables. This is based on the model between Landfall and the Array Area indicating a potential zone of influence of approximately 100 m centred on the cable burial route (see **Appendix 9.2, Volume 2c**).

10.8.1.11 Refer to **Appendix 9.2, Volume 2c** for a detailed assessment of the suspended sediment concentration modelling outputs.

Multiple Activities (drilling of pin piles to install WTG Foundations – Turbine Area and burial of Array Cables to Final WTG – Array Area)

10.8.1.12 In addition to the activities considered individually above, multiple activities have also been assessed and modelled to determine maximum suspended sediment concentration and sediment deposition thickness concentration arising during the drilling of pin piles and cable burial activities. These activities, which have been assumed to occur sequentially within the Array Area, have been modelled as a maximum design scenario (see paragraph 9.7.1.5 and Section 4.6 of **Appendix 9.2, Volume 2c** for further details).

10.8.1.13 The maximum suspended sediment concentration during drilling of 4 WTG foundations (each with 4 piles), and burial of cables (assuming drilling and cable burial activities happen sequentially) per month, was modelled in the southwest Array Area, buried channel and northeastern area of the Array Area.

10.8.1.14 Overall, the combined extent of suspended sediment concentrations is mainly constrained to the Turbine Area, however the SSC plume does extend outside the Turbine Area by approximately 3 km in the southwest corner of the Turbine Area (see **Plate 4-32** in **Appendix 9.2, Volume 2c**).

10.8.1.15 When considering the drilling of pin piles to install WTG Foundations and burial of Array Cables to Final WTG, the worst-case scenario in terms of increase in suspended sediment concentration results from the southwest drilling of piles to install WTG foundations and sequential Array Cables to Final WTG burial, reaching up to 450 mg/l for a brief period (less than hour) within 500 m. This will exceed the 25 mg/l threshold for around 3 days and exceed the background concentration of 0.5 mg/l for around 13 days.

10.8.1.16 The modelling demonstrates the influence of sediment size on the plume extent; the sediment particle size in the southwest Array Area is significantly smaller which settles more slowly and therefore is transported further by currents, see **Appendix 9.2, Volume 2c** for a detailed assessment of the modelled outputs.

10.8.1.17 Whilst suspended sediment from the southwest Array Area is transported with the tide, the spatial extent is largely confined to the southwest of the Array Area, and the maximum suspended sediment concentrations are associated with the cable route. Timeseries plots of suspended sediment concentration, including sediment resuspension, demonstrate how sediment is remobilised by currents, but also demonstrate that the maximum suspended sediment concentrations persist only for a short time (hours) (see **Appendix 9.2, Volume 2c**, for a thorough analysis of modelling outputs).

HDD Exit Pit Construction

10.8.1.18 A maximum design scenario HDD exit pit construction release sediment model was completed to quantify the increase to suspended sediment, refer to **Appendix 9.2, Volume 2c** for the detailed model assumptions. Based on the outputs of sediment plume modelling of Array Cable to Landfall burial and release of drill cutting activities, the maximum suspended sediment concentrations caused by HDD exit pit construction are expected to range between 350 mg/l (within 200 m of HDD Exit Pit Construction) and 1000 mg/l (within 1 km of HDD exit pit construction) for coarse and fine sediment respectively.

10.8.1.19 Suspended sediment concentrations are expected to be elevated above baseline condition for up to 2 days for the full range of sediment sizes.

HDD Drill Cutting Release

10.8.1.20 A maximum design scenario HDD drill cutting release sediment model was completed to quantify the increase to suspended sediment. The modelling determined that the peak suspended sediment concentration reached ~275 mg/l on a mid-spring flood tide release and ~650 mg/l on a neap tide slack water release (without sediment resuspension). With sediment resuspension, the peak reached 400 mg/l on a mid-spring flood tide. These peaks last for around 1-2 hours only and are quickly dispersed and diluted; therefore, peak time-series SSC concentrations are used to inform the assessment, rather than highly localised short-duration maxima shown on spatial plots. (see **Appendix 9.2, Volume 2c**).

Multiple Activities (HDD drill cutting release and HDD Exit Pit Construction)

10.8.1.21 Multiple activities to assess cumulative SSC and associated deposition resulting from sequential HDD exit pit construction and release of drilling fluid from HDD has also been quantitatively assessed (see Section 4.6.2 in **Appendix 9.2, Volume 2c**). This is based on the maximum design scenario for each activity detailed in **Table 10-12.**

10.8.1.22 If multiple HDD construction activities occur within 2 days, then there could be accumulation of suspended sediment within 1 km of the activities. Suspended sediment concentrations are expected to return to baseline conditions within 2 days of a construction activity taking place. This is based on a worst-case assumption that the activities are aligned in the direction of the tidal current (i.e. the direction where sediment advection distances are the largest).

Summary

10.8.1.23 The scale of the impact on water quality from seabed preparation, export cable burial, drilling of pin piles, HDD drill cutting release and HDD Exit Pit construction will be localised as the OCAS is made up of coarser sediments that settle out quickly. Whilst suspended sediment concentrations will extend beyond the natural variation experienced in background conditions, suspended sediments in the water column are anticipated to return to baseline conditions within days of the disturbance due to dispersion and dilution. Therefore, any impact will be temporary and localised, and as a result the magnitude of impact is determined to be Low.

Sensitivity or value of receptor

10.8.1.24 Similarly to changes in physical characteristics of the marine environment, changes in water or sediment quality predicted by the EIA can only be assessed directly for significance of effect where there is a water or sediment EQS established for protection of the aquatic environment. As there is no generally applicable EQS for suspended sediment concentration in coastal waters, no assessment of significance is made here, as there are effectively no receptors against which to assess this parameter.

Significance of effect

10.8.1.25 Although there are no specific EQS for suspended sediments in marine waters, a value of 25 mg/l was formerly applied in the Freshwater Fish Directive (78/659/EEC) for migratory salmonid fish. As this is not a formal EQS, no assessment of significance is made here but potential effects on salmon are assessed against this criterion in **Chapter 12, Volume 2a** and other indirect effects of changes in sediment concentrations in the water column or resettlement are addressed in other relevant chapters.

Further environmental mitigation and residual effect

10.8.1.26 No additional Marine Sediment and Water Quality mitigation is considered necessary at this stage because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 10-13**) cannot be assessed due to the absence of an applicable EQS for suspended sediment concentration in coastal waters.

10.8.2 SEABED DISTURBANCE RELEASING CONTAMINATED SEDIMENT

10.8.2.1 Mobilisation of sediment into the water column will result in any contaminants present in the sediment also being mobilised. Concentrations of contaminants in sediments in the area sampled are set out in Section 10.6.1. Introduction of contaminants into the water column could result in breaches of EQS values. However, it should be noted that elevated contaminant concentrations do not necessarily imply toxicity, as the bioavailability of these contaminants is more important than simply concentration levels.

10.8.2.2 The maximum design scenario relating to changes in suspended sediment concentration and transport due to seabed preparation, HDD and installation of infrastructure (drilling of pin piles, cable burial and HDD Exit Pit construction) during the construction phase are presented in **Table 10-12**. Note that introduction of suspended sediment through release of drilling muds has not been considered, as these muds comprise uncontaminated bentonite and will not result in increased concentrations of contaminants for which EQS have been established in sea water.

10.8.2.3 The magnitude of impact is based on the criteria detailed in **Table 10-8**. A description of the likely magnitude of impact on receptors caused by each identified impact is given in the following paragraphs.

Magnitude

10.8.2.4 Elevated suspended sediment concentrations resulting from seabed preparation, HDD and installation of infrastructure (drilling of pin piles, cable burial and HDD Exit Pit construction) in areas of soft sediment will be temporary and short-lived as assessed in Section 10.8.1. On this basis, the appropriate water-column EQS values used to assess contaminant concentrations arising from sediment mobilisation are the maximum allowable concentrations (MAC), although MAC EQS have not been established for all parameters. For metals present in the sediment, EQS values are shown in **Table 10-14**, which shows MAC EQS values for seawater, as well as annual average (AA) EQS applicable within WFD coastal water bodies (Scottish Government, 2024). These EQS used to assess compliance of the coastal water body as a whole, extending to 12 nautical miles from shore in the case of priority substances. Coarser substrate types such as boulders, cobbles and gravels, which occur over much of the Array Area and OCAS will not be mobilised during construction activities.

10.8.2.5 Concentrations of seabed sediments mobilised into the water column by construction works have been modelled (see **Appendix 9.2, Volume 2c)** and results reported in **Chapter 9, Volume 2a**. The modelling predicts a maximum plume concentration as a result of combined WTG pile drilling and Array Cable installation of 450 mg/l for a brief period (less than hour) within 500 m of the activity in the southwest part of the turbine area (see **Chapter 9, Volume 2a,** Section 9.8).

10.8.2.6 Within the OCAS, the highest predicted concentration in the plume from cable burial is for modelled Scenario 3, where the predicted maximum 200 m from the activity is 350 mg/l. Although concentrations up to 840 mg/l were predicted close to the activity, these would occur for less than 15 minutes in an area of <10 m^2 before the sediment settled out (see **Chapter 9, Volume 2a, Section 9.8**), so even for the whole of the cable installation activity these short-lived concentration spikes would make a negligible contribution to annual average concentrations of suspended sediment across the WFD coastal water body.

10.8.2.7 Therefore, for the purposes of predicting a conservative 'worst-case' concentration of sediment-derived contaminants in the water column, the maximum concentration of suspended sediment mobilised from the seabed has been taken as 450 mg/l, corresponding to the highest modelled SSC associated with repeated construction activities (drilling of piles to install WTG foundations and sequential burial of array cables) in the Array Area (see **Chapter 9, Volume 2a**, paragraph 9.8.1.19; and **Appendix 9.2, Volume 2c**). The equivalent contaminant concentrations in the water column have been calculated using this SSC value and both the mean and maximum metal concentrations measured in seabed sediments from grab sampling (Section 10.6.1), by multiplying 450 mg/l by the sediment contaminant concentration (converted to µg/mg) to derive water-column concentrations (µg/l). This provides estimates of water-column contaminant concentrations based on both average and maximum sediment contaminant levels while applying the maximum SSC used in the assessment, representing an extreme worst-case. .

10.8.2.8 Higher SSC peaks are reported for HDD activities (e.g. peak time-series values up to ~650 mg/l for drill cutting release and up to ~1,000 mg/l for HDD exit pit construction very close to the source); however, these are highly localised and short-duration and are associated with discrete landfall HDD activities that occur sequentially and less frequently. In addition, drilling fluids are assumed to comprise uncontaminated bentonite with no chemical additives and therefore do not contribute an increase in concentrations of contaminants for which water-column EQS are established. Accordingly, the 450 mg/l bounding SSC used in the assessment provides an appropriate conservative basis for estimating sediment-derived contaminant concentrations for EQS compliance assessment. Baseline concentrations of total suspended solids are very low in comparison (<1 mg/l average) and have been disregarded in the calculation.

10.8.2.9 Comparison of predicted concentrations in the water based on maximum concentrations in sediment with MAC EQS established for Pb, Ni and Hg shows that none of these metals will breach the EQS value at the maximum predicted suspended sediment concentration arising from the offshore project. Note that these three metals are priority substances and contribute to WFD chemical status, where the requirement for compliance extends to the limit of territorial waters (12 nautical miles from the shore). Cadmium is also a priority substance, but no MAC-EQS has been established.

Table 10-14 Sediment contaminant EQS and concentrations corresponding to 450 mg/l suspended solids (all metal concentrations in µg l^{-1})

Parameter	AA EQS	MAC EQS	Concentration in water based on mean sediment concentration	Concentration in water based on max sediment concentration
As	25	-	2.25	2.57
Cd *	0.2	-	0.045	0.077
Cu	3.76	-	3.72	11.25
Pb *	1.3	14	1.66	2.21
Hg *	-	0.07	0.0045	0.0045
Ni *	8.6	34	8.89	26.19

Parameter	AA EQS	MAC EQS	Concentration in water based on mean sediment concentration	Concentration in water based on max sediment concentration
Zn	7.9	-	6.28	13.77

* - priority substance

10.8.2.10 Where MAC EQS have not been established the water column concentrations based on a maximum suspended sediment concentration of 450 mg/l and the mean sediment metal concentration have been compared with the AA EQS. Where this shows compliance (as for As, Cd, Cu and Zn), this indicates that no exceedance of EQS values will occur in WFD coastal water bodies (extending 3 nm from shore) , where these EQS are applicable. As the so it can be concluded that there will be no breach of EQS compliance.

10.8.2.11 Note that comparison of water column contaminant concentrations with the AA-EQS represents a highly precautionary approach, as:

- All the EQS values descried in **Table 10-14** are for dissolved metals while sediment results are for total metals; in practice a high proportion of the metal will remain bound to the sediment and will not become dissolved in the water before the sediment resettles to the seabed;
- Elevated concentrations of suspended sediment will occur for short time periods only, whereas the AA-EQS apply to average contaminant concentrations over a complete year;
- The maximum concentrations of suspended sediment used in the calculation will occur only near the seabed and not through the water column;
- The AA-EQS are used in classifying the status of the water body as a whole, while elevated concentrations of suspended sediment will occur in only a small proportion of the coastal water body (or its extension to 12 nautical miles from shore for priority substances) at any one time.

10.8.2.12 With the exception of the 2 elevated Ni results, **Table 10-11** shows that the sediment is not contaminated with respect to sediment quality guidelines, so its resettlement in a slightly displaced location will not cause any change in sediment quality. For metals where a maximum allowable concentration (MAC) EQS is available (e.g. lead), compliance has been assessed against the MAC rather than the annual average EQS, and no exceedance is predicted. Nickel is widely used in stainless steels, and such components are common on vessels and in fishing gear; therefore, although the origin of the high nickel concentrations in these specific samples cannot readily be ascertained, it is possible that they resulted from presence of small particles arising from corrosion of vessel-derived debris. The remaining samples show concentrations of nickel below the BAC threshold, indicating absence of more widespread contamination of sediments by nickel, as would be the case if the nickel was derived from past discharge of contaminated effluent into the coastal water body.

10.8.2.13 As there will be no exceedance of water column EQS for WFD coastal water bodies or failure of compliance with sediment quality guidelines as a result of the construction works for the Offshore Project, magnitude of impact is considered **Negligible**.

10.8.2.14 This level of compliance with EQS can also be taken as indicating that effects on achievement of compliance with Descriptor 8 of the MSFD. Therefore, the magnitude of impact is also considered **Negligible.**

Sensitivity or value of receptor

10.8.2.15 The sensitivity described for each receptor is based on the criteria provided in **Table 10-9**.

10.8.2.16 Construction activities have the potential to impact marine waters. The Array Area is located within offshore marine waters, whilst the OCAS is located in both offshore and inshore marine waters. To define the sensitivity of marine water quality, the presence of WFD water bodies can be used, as compliance with EQS is required within them.

10.8.2.17 The OCAS overlaps with the Gallan Head/*Àird Uig* to Butt of Lewis/*Rubha Robhanais* WFD coastal water body (ID: 2004760). This water body is of overall 'High' ecological status and is therefore of **High** sensitivity/value.

10.8.2.18 The Turbine Area is located entirely within offshore marine waters and is of **Low** sensitivity/value as there is no overlap with WFD designated water bodies.

Significance of effect

10.8.2.19 With a **Negligible** magnitude of effect and **High** sensitivity receptors, significance of changes in contaminant concentrations in water and sediment due to substrate preparation and installation of infrastructure is rated as **Negligible** and not significant.

Further environmental mitigation and residual effect

10.8.2.20 No additional Marine Sediment and Water Quality mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 10-13**) is not significant in EIA terms.

10.8.3 CHANGE IN BLUE CARBON RESOURCE IN SEDIMENT

10.8.3.1 The degree to which seabed habitats can trap organic carbon is dependent on grain size, long-term stability, and degree of shelter from waves and currents (Laffoley, 2020). Greater carbon storage is associated with fine sediments because their small particle size and low permeability create oxygen poor conditions that slow the breakdown of organic matter. These sediments also have a high surface area, allowing more carbon to bind and be buried making them effective long term carbon sinks in marine environments. In highly dynamic shallow water sandy seabed ecosystems, waves and currents are a significant source of natural disturbance and may continually change seabed contours and mix sediments. Deep sea sediment stores are likely to be more stable and thus hold a larger reservoir of carbon. However, blue carbon habitats can become carbon sources if damaged by human activities. For example, exposing deeply buried sediments to oxygen triggers the aerobic microbial breakdown of ancient, stored carbon.

10.8.3.2 The maximum design scenario relating to changes in suspended sediment concentration and transport due to seabed preparation, HDD and installation of infrastructure (drilling of pin piles, cable burial and HDD Exit Pit construction) during the construction phase are presented in **Table 10-12.**

10.8.3.3 The magnitude of impact is based on the criteria detailed in **Table 10-8**. A description of the likely magnitude of impact on receptors caused by each identified impact is given in the following paragraphs.

Magnitude

10.8.3.4 Sediment may be mobilised or displaced directly through construction activities. The total volume of seabed sediment directly disturbed by the construction activities has been modelled and is displayed in **Table 10-15**.

Table 10-15 Volume of sediment disturbed by construction activities

<table>
<tr><th>Activity</th><th>Location</th><th>Number of components</th><th>Sediment density (dry)(kg/m³)</th><th>Total volume disturbed (m³)</th></tr>
<tr><td rowspan="3">Drilling piles for WTG foundations</td><td>Southwest</td><td>76 piles</td><td>1,640</td><td>104,424</td></tr>
<tr><td>Buried Channel</td><td>68 piles</td><td>1,655</td><td>160,208</td></tr>
<tr><td>Northeast</td><td>96 piles</td><td>1,655</td><td>131,904</td></tr>
<tr><td rowspan="2">Array cable to final WTG (cable burial)</td><td>Southwest</td><td rowspan="2">160 km</td><td>1,640</td><td>63,000</td></tr>
<tr><td>Buried Channel & Northeast</td><td>1,655</td><td>147,000</td></tr>
<tr><td>Array Cable to Landfall (cable burial)</td><td>OCAS</td><td>190 km</td><td>1,800</td><td>98,000</td></tr>
<tr><td>HDD Exit Pit construction</td><td>HDD Exit Pit Area</td><td>13 pits</td><td>648</td><td>17,062.5</td></tr>
<tr><td colspan="4">TOTAL</td><td>721598.5</td></tr>
</table>

10.8.3.5 Using the total volume of sediment disturbed, the mean sediment density and mean TOC across the Study Area, a theoretical maximum amount of CO_2 that could be released can be calculated using the equation below[1].

$$CO2 = V \, x \, \rho \, x \, TOC \, x \, R \, x \, \frac{44}{12}$$

10.8.3.6 The following values were used to calculate a theoretical amount of CO_2 that could be released:

[1] **V** = Total volume of sediment disturbed (m^3)
ρ = Sediment bulk density (kg/m^3)
TOC = Total organic carbon content (as a decimal, e.g. 2% = 0.02)
R = Remineralization efficiency (fraction of organic carbon converted to CO_2)
44/12 = Molecular weight ratio of CO_2 to C

- Total sediment volume disturbed = 721598.5 m^3;
- Mean sediment bulk density = 1,417.625 kg/m^3;
- Mean proportion of TOC 0.0038;
- Remineralisation efficiency of 1 (100%).

10.8.3.7 Using these values a total of 14,583.15 tonnes of CO_2 could theoretically be released as a result of sediment disturbance. This estimate represents a conservative upper bound of potential CO_2 emissions from sediment disturbance, assuming uniform sediment properties and complete exposure. In reality, spatial variability in organic carbon content, sediment density, and biogeochemical conditions across the Study Area would influence CO_2 released. Furthermore, on advice from NatureScot, the estimate assumes that the entire carbon content of the sediment volume of 721598.5 m^3 contributes uniformly to CO_2 release. In practice, the near surface sand layers are likely to be non-reactive and to remain in place and only a portion of this volume is likely to be oxidised so as to cause release of CO_2.

10.8.3.8 The principal concern in relation to conversion of blue carbon to CO_2 is the release of this CO_2 to the atmosphere and its effect on global warming This is therefore a relevant receptor, as well as the blue carbon resource itself.

10.8.3.9 With 190 km of cable, 60% of which is buried and a 7 m wide trench, the area affected by sediment disturbance in the OCAS will be small (0.80 km^2), representing 0.2% of the water body area, and the proportion of the MSFD water body (the Irish Sea) affected by sediment disturbance in the Turbine area will be even smaller. When considered alongside the low background TOC content of sediments across the Array Area and OCAS, and the temporary and reversible nature of any sediment disturbance, the magnitude of impact on blue carbon is assessed as **Low.** Although the worst-case estimate gives a high upper limit for potential CO_2 release, the conservative assumptions used, the rapid settling of disturbed sediments, and the small area affected mean that the actual impact on blue carbon stores is expected to be minor and not significant at the scale of the wider offshore environment.

10.8.3.10 The potential release of 14,583 tonnes of CO_2 may also be considered in the context of greenhouse gas emissions from UK as a whole, which were estimated for 2022 as 375,929 kt CO_2 equivalent per annum (see **Chapter 8, Volume 1**), with emissions for Scotland for the same period estimated as 38,855 kt. With offshore construction predicted to last for 5 years, total UK emissions at this rate during the construction period would be 1,879,645 kt, of which the emissions resulting from blue carbon release from the Offshore Project spread over five years would comprise 0.00077%, while emissions from Scotland over the same period would be 194,275 kt, with emissions resulting from blue carbon release from the Offshore Project comprising 0.0075%. Thus release to the atmosphere of CO_2 from mobilisation of blue carbon due to the Offshore Project will be negligible compared with overall CO_2 emissions. As described in **Chapter 7, Volume 1**, CO_2 emissions from the Project will be offset by the production of green energy by the Project, leading to a reduction in CO_2

emissions from fossil fuel power generation. Thus the magnitude of effect in terms of greenhouse gas emissions will also be **Low**.

Sensitivity or value of receptor

10.8.3.11 The sensitivity described for each receptor is based on the criteria provided in **Table 10-9**.

10.8.3.12 Seabed sediments, if undisturbed can store carbon for thousands of years or more. This store is vulnerable to disturbance, and any disturbance could result in a reduction or changes to sequestration processes and associated carbon stores. Carbon stores in sediments can form over millennia, and as a result any potential impacts on sediment stores are effectively irreversible.

10.8.3.13 Despite the differences in the likely carbon storage potential of substrates within each of the Study Areas, a precautionary approach to the valuation of seabed carbon stores has been adopted such that all sediments are considered to be of **High** sensitivity.

Significance of effect

10.8.3.14 With a **Low** magnitude of change and **High** sensitivity receptors, significance of effect in blue carbon resource in sediments is rated as **Minor** and not significant in relation to sediment-bound carbon. Note that the overall assessment including blue carbon in biota is included in **Chapter 11, Volume 2a**.

Further environmental mitigation and residual effect

10.8.3.15 No additional Marine Sediment and Water Quality mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 10-13**) is not significant in EIA terms.

10.9 ASSESSMENT OF EFFECTS: OPERATION AND MAINTENANCE

10.9.1 SEABED DISTURBANCE TEMPORARILY INCREASING SUSPENDED SEDIMENT CONCENTRATIONS

10.9.1.1 During Operation and Maintenance there is potential for sediment disturbance leading to changes in suspended sediment concentrations and transport, with potential associated effects on mobilisation of sediment contaminants into the water column and releases of blue carbon. The maximum design scenario relating to changes in suspended sediment concentration and transport due to maintenance activities, such as repair, replacement or reburial of cables, are presented in **Table 10-12**.

10.9.1.2 The magnitude of impact is based on the criteria detailed in **Table 10-8**. A description of the likely magnitude of impact on receptors caused by each identified impact is given in the following paragraphs.

Magnitude

10.9.1.3 Repair, replacement or reburial of the Array Cables to Final WTG or Array Cables to Landfall during maintenance and remedial work, that may be needed over the operational lifetime of the Offshore Project has the potential to cause temporary physical disturbance to the seabed, leading to re-mobilisation of seabed sediments, and subsequent impacts on marine waters (both inshore and offshore).

10.9.1.4 The disturbance areas for reburial and repair of cables are likely to be confined in comparison to construction activities. It is acknowledged that reburial and repair works could occur on multiple occasions, which may result in a greater frequency of localised sediment disturbance events compared to the construction phase. However, each event will be over a smaller spatial and temporal scale than the construction phase of the Offshore Project, thus reducing the magnitude of impact.

10.9.1.5 Whilst no modelling has been undertaken to quantify the impacts of sediment resuspension during maintenance activities, the spatial footprint of these works would be considerably smaller than that of construction, and the duration and intensity of disturbance would also be substantially lower. On this basis, any sediment plumes generated during maintenance or remedial activities are expected to be limited in extent and short-lived. The magnitude of impact associated with these activities in terms of changes in suspended sediment concentrations, is therefore assessed as **Negligible** in each case**.**

Sensitivity or value of receptor

10.9.1.6 As described earlier, no conclusion on the sensitivity of the receptor can be made where there is no water or sediment EQS established for protection of the aquatic environment.

Significance of effect

10.9.1.7 As there are no formally adopted standards for concentrations of suspended sediment in the sea, no assessment of significance of effect is made in relation to the changes described here. Indirect effects of changes in sediment concentrations in the water column are addressed in other relevant chapters.

Further environmental mitigation and residual effect

10.9.1.8 No additional Marine Sediment and Water Quality mitigation is considered necessary at this stage because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 10-13**) cannot be assessed for significance in EIA terms.

10.9.2 SEABED DISTURBANCE RELEASING CONTAMINATED SEDIMENT

10.9.2.1 Mobilisation of sediment into the water column will result in any contaminants present in the sediment also being mobilised. Assessment of the potential impacts of the mobilisation of sediment contamination during the construction phase is presented in 10.8.2 with EQS for sediment contaminants in **Table 10-14.**

Magnitude

10.9.2.2 Direct seabed disturbance during maintenance and remedial works such as cable replacements has the potential to release contaminated sediments into the water column. Transported sediment may re-settle elsewhere resulting in new areas of contamination.

10.9.2.3 No exceedances of sediment quality guidelines were anticipated during the construction phase and effects were considered to be negligible. Given that sediment mobilisation due to operation and maintenance activities will be less than during the construction stage and will be temporary and short-lived effects are also considered to be **Negligible**.

Sensitivity or value of receptor

10.9.2.4 The sensitivity of the marine environment to the mobilisation of contaminated sediment during operation and maintenance is considered **Low**, as baseline sediment quality indicates no widespread contamination and no exceedances of sediment quality guidelines were predicted during the construction phase.

Significance of effect

10.9.2.5 Given the **Low** sensitivity of the receiving environment and the negligible magnitude of effect, the overall effect of seabed disturbance releasing contaminated sediment during operation and maintenance is considered not significant.

10.9.2.6 No additional mitigation measures are required for seabed disturbance releasing contaminated sediment during operation and maintenance, as no exceedances of sediment quality guidelines were predicted during the construction phase and sediment mobilisation during operation and maintenance will be of a smaller scale and duration. Embedded environmental measures set out in Section 10.7 will continue to apply. Given the low sensitivity of the receiving environment and the negligible magnitude of effect, the residual effect is considered Not Significant.

Further environmental mitigation and residual effect

10.9.2.7 No additional Marine Sediment and Water Quality mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 10-13**) is not significant in EIA terms.

10.9.3 CHANGE IN THE CARBON RESOURCE IN SEDIMENT

10.9.3.1 Assessment of sediment disturbance leading to change in the blue carbon resource is set out in Section 10.8.3.

Magnitude

10.9.3.2 Maintenance activities such as cable repairs and/or remediation during the lifetime of the Offshore Project could lead to a change in the blue carbon resource in the Study Area. Sediment mobilised or displaced during maintenance and remedial work will be less than that identified during the construction phase and will take place over the same or lesser temporal and spatial scale. Section 10.8.3 concludes that the potential release of blue carbon from construction activities does not outweigh the significant climate benefits of the project as a whole. The magnitude of effect is considered **Low**.

10.9.3.3 As with construction, this level of compliance with EQS can also be taken as indicating that impacts on achievement of compliance with Descriptor 6 of the MSFD will also be **Negligible** in magnitude.

Sensitivity or value of receptor

10.9.3.4 The sensitivity described for each receptor is based on the criteria provided in **Table 10-9**.

10.9.3.5 Seabed sediments, if undisturbed can store carbon for thousands of years or more. This store is vulnerable to disturbance, and any disturbance could result in a reduction or changes to sequestration processes and associated carbon stores. Carbon stores in sediments can form over millennia, and as a result any potential impacts on sediment stores are effectively irreversible.

10.9.3.6 Despite the differences in the likely carbon storage potential of substrates within each of the Study Areas, a precautionary approach to the valuation of seabed carbon stores has been adopted such that all sediments are considered to be of **High** sensitivity.

Significance of effect

10.9.3.7 With a **Low** magnitude of change and **High** sensitivity receptors, significance of change in blue carbon resource in sediments is rated as **Minor** and not significant.

Further environmental mitigation and residual effect

10.9.3.8 No additional Marine Sediment and Water Quality mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 10-13**) is not significant in EIA terms.

10.10 ASSESSMENT OF EFFECTS: DECOMMISSIONING PHASE

10.10.1.1 The scope of the decommissioning works will follow the guidance found in Marine Directorate (2022) Offshore renewable energy: decommissioning guidance for Scottish Waters Guidance Notes (Scottish Government) or the guidance outlined in the Scottish part of the Renewable Energy Zone under The Energy Act 2004: Guidance notes for industry (in Scotland/*Alba*). Decommissioning activities will comply with all relevant legislation at that time.

10.10.1.2 At the end of the operational lifetime of the Offshore Project, it is expected that WTGs and the OSP (if required) will be completely removed from the seabed. Decommissioning activities within the Offshore Project Boundary are expected to follow the reverse of the construction phase of the Offshore Project, with some infrastructure left in place, with surface infrastructure likely to be fully removed utilising similar types and number of vessels and equipment. The offshore decommissioning options for the cables and subsurface foundation infrastructure will be discussed with stakeholders and regulators at the point of decommissioning, however, sections may be left in situ to avoid unnecessarily disturbing the seabed.

10.10.1.3 During decommissioning (removal) there is potential for changes in suspended sediment concentrations due to foundation and infrastructure removal and a deterioration in water quality associated with the release of sediment bound contamination.

10.10.1.4 The maximum design scenarios relating to these potential impacts during the decommissioning phase are the same as those during the construction phase, as presented in **Table 10-12**. For the purposes of the assessment, the maximum design scenario assumes removal of offshore infrastructure where this represents the greatest potential for seabed disturbance and associated suspended sediment generation. Key decommissioning activities could include:

- removal of WTG and substructures (decommissioning - removal or partial removal);
- removal of cables (decommissioning - removal);
- HDD Exit Pits (decommissioning – left in-situ).

10.10.1.5 HDD Exit Pits are not given further consideration as their decommissioning as they will have been formed in bedrock or sediment and infilled and are assumed to remain in situ following construction; as a result, no additional seabed disturbance or sediment mobilisation is anticipated during the decommissioning phase, and there is therefore no pathway to marine sediment or water quality receptors.

10.10.1.6 In respect of blue carbon, sediment mobilised or displaced from the removal of WTGs and cables has the potential to release carbon stored in sediments. As specific methods for decommissioning will be determined closer to the time, the maximum design scenario for construction is applied. This is because the activities will be similar, albeit of lesser footprint to those associated with the construction phase and therefore represents a precautionary approach.

10.10.1 SEABED DISTURBANCE TEMPORARILY INCREASING SUSPENDED SEDIMENT CONCENTRATIONS

10.10.1.1 Assessment of sediment disturbance leading to changes in suspended sediment concentrations and transport during the construction phase is set out in section 10.8.1. As specific methods for decommissioning will be determined closer to the time, the maximum design scenario for construction is applied. This is because the activities will be similar, albeit of lesser footprint to those associated with the construction phase and therefore represents a precautionary approach.

Magnitude

10.10.1.2 The maximum design scenarios relating to sediment disturbance during the construction phase, and utilised for the decommissioning phase assessment, are presented in **Table 10-12**.

10.10.1.3 The scale of the impact from the decommissioning of WTGs and cables, will be comparable to or less than that of construction and will be relatively localised as the Study Area is made up of coarser sediments that settle out quickly. Whilst suspended sediment concentrations will extend beyond the natural variation experienced in background conditions, suspended sediments in the water column are likely to return to baseline conditions within days of the disturbance due to dispersion and dilution (see Section 10.8.1.6). Therefore, any impact will be temporary and localised, and as a result the magnitude of impact is determined to be **Low**.

Sensitivity or value of receptor

10.10.1.4 Similarly to changes in physical characteristics of the marine environment, changes in water or sediment quality predicted by the EIA can only be assessed directly for significance of effect where there is a water or sediment EQS established for protection of the aquatic environment. As there is no generally applicable EQS for suspended sediment concentration in coastal waters, no assessment of significance is made here, as there are effectively no receptors against which to assess this parameter.

Significance of effect

10.10.1.5 Although there are no specific EQS for suspended sediments in marine waters, a value of 25 mg/l was formerly applied in the Freshwater Fish Directive (78/659/EEC) for migratory salmonid fish. As this is not a formal EQS, no assessment of significance is made here but potential effects on salmon are assessed against this criterion in **Chapter 12, Volume 2a** and other indirect effects of changes in sediment concentrations in the water column or resettlement are addressed in other relevant chapters

Further environmental mitigation and residual effect

10.10.1.6 No additional Marine Sediment and Water Quality mitigation is considered necessary at this stage because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 10-13**) cannot be assessed for significance in EIA terms.

10.10.2 SEABED DISTURBANCE RELEASING CONTAMINATED SEDIMENT

10.10.2.1 Assessment of sediment disturbance leading to changes in suspended sediment concentrations and transport during the construction phase is set out in Section 10.8.1. As specific methods for decommissioning will be determined closer to the time, the maximum design scenario for construction is applied. This is because the activities will be similar, albeit of lesser footprint to those associated with the construction phase and therefore represents a precautionary approach.

Magnitude

10.10.2.2 Elevated suspended sediment concentrations resulting from the removal of WTGs and cable removal will be similar, or lesser than those identified for construction and will be temporary and short-lived. Section 10.8.2.13 concludes that construction activities will not give rise to exceedance of water column EQS for WFD coastal water bodies or failure of compliance with sediment quality guidelines. The magnitude of effect is considered **Negligible**.

10.10.2.3 As with construction, this level of compliance with EQS can also be taken as indicating that effects on achievement of compliance with Descriptor 8 of the MSFD will also be **Negligible** in magnitude.

Sensitivity or value of receptor

10.10.2.4 The removal; of WTG and cables has the potential to impact marine waters. The Array Area is located within offshore marine waters, whilst the OCAS is located in both offshore and inshore marine waters. To define the sensitivity of marine water quality, the presence of WFD water bodies can be used, as compliance with EQS is required within them. The OCAS overlaps with the Gallan Head/*Àird Uig* to Butt of Lewis/*Rubha Robhanais* WFD coastal water body (ID: 2004760). This water body is of overall 'High' ecological status and is therefore of **High** sensitivity/value.

10.10.2.5 The Array Area is located entirely within offshore marine waters and is of **Low** sensitivity/value as although there is overlap with WFD designated water bodies, the absence of designated Bathing Waters, shellfish waters, or nutrient-sensitive zones within the Array Area limits its sensitivity.

Significance of effect

10.10.2.6 With a **Negligible** magnitude of change and **High** sensitivity receptors, significance of changes in contaminant concentrations in water and sediment due to substrate preparation and installation of infrastructure is rated is rated as **Negligible** and not significant.

Further environmental mitigation and residual effect

10.10.2.7 No additional Marine Sediment and Water Quality mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 10-13**) is not significant in EIA terms.

10.10.3 CHANGE IN BLUE CARBON RESOURCE IN SEDIMENT

10.10.3.1 Assessment of sediment disturbance leading to change in the blue carbon resource is set out in Section 10.8.3. As specific methods for decommissioning will be determined closer to the time, the maximum design scenario for construction is applied. This is because the activities will be similar, albeit of lesser footprint to those associated with the construction phase and therefore represents a precautionary approach.

Magnitude

10.10.3.2 Sediment mobilised or displaced from the removal of WTGs and cable removal will be similar, or lesser than that identified, and will take place over the same or lesser temporal and spatial scale. Section 10.8.3 concludes that the potential effects of blue carbon resulting from construction activities are localised, temporary and limited in magnitude. On this basis, the magnitude of effect during decommissioning is considered **Low**.

10.10.3.3 As with construction, this level of compliance with EQS can also be taken as indicating that impacts on achievement of compliance with Descriptor 6 of the MSFD will also be **Negligible** in magnitude.

Sensitivity or value of receptor

10.10.3.4 The sensitivity described for each receptor is based on the criteria provided in **Table 10-9**.

10.10.3.5 Seabed sediments, if undisturbed can store carbon for thousands of years or more. This store is vulnerable to disturbance, and any disturbance could result in a reduction or changes to sequestration processes and associated carbon stores. Carbon stores in sediments can form over millennia, and as a result any potential impacts on sediment stores are effectively irreversible.

10.10.3.6 Despite the differences in the likely carbon storage potential of substrates within each of the Study Areas, a precautionary approach to the valuation of seabed carbon stores has been adopted such that all sediments are considered to be of **High** sensitivity.

Significance of effect

10.10.3.7 With a **Low** magnitude of change and **High** sensitivity receptors, significance of change in blue carbon resource in sediments is rated as **Minor** and not significant.

Further environmental mitigation and residual effect

10.10.3.8 No additional Marine Sediment and Water Quality mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 10-13**) is not significant in EIA terms.

10.11 ASSESSMENT OF COMBINED EFFECTS

10.11.1.1 The combined effects assessment considers likely significant effects from multiple impacts and activities from the construction, operation and maintenance, and decommissioning phases of the Offshore Project on the same receptor, or group of receptors. The overall method following in identifying and assessing potential Combined Effects in relation to the offshore environment is set out in **Chapter 5, Volume 1a**.

10.11.1.2 Combined effects could potentially arise in one of two ways. The first type of combined effect is a Project lifetime effect, where multiple phases of the Project (construction, operation and maintenance, and decommissioning) interact to create a potentially more significant effect on a receptor than in one phase alone.

10.11.1.3 The second type of combined effect is receptor-led effects. Receptor-led effects are where effects from different environmental aspects combine spatially and temporally on a receptor. These effects may be short-term, temporary, transient, or longer-term.

10.11.1.4 Receptor-led effects have been considered, where relevant, in this chapter for potential interactions between Marine Sediment and Water Quality and the following environmental aspects:

- Benthic Ecology;
- Fish Ecology;
- Marine Mammals;
- Commercial Fisheries;
- Other Sea Users;
- Socio-economics.

10.11.1.5 Full results of the Project lifetime effects and receptor-led effects assessment can be found in **Chapter 23: Combined and Whole Project Effects Assessment, Volume 2a**.

10.12 CONSIDERATION OF ONSHORE TRANSMISSION WORKS PROJECT

10.12.1.1 A separate application for the Project's onshore elements (the OTW Project) that includes all infrastructure landwards of Mean Low Water Springs (MLWS) within the Onshore Transmission Works Boundary will be made, under the Town and Country Planning (Scotland) Act 1997 to Comhairle nan Eilean Siar (CnES). The OTW Project EIAR will provide a full description of the onshore elements of the Project landward of MLWS, and include an assessment of the associated likely significant effects.

10.12.1.2 This EIAR has considered the additive interactions between the Offshore Project and OTW Project to understand if there is the potential for any change to the assessment outcomes as a result of both elements of the Project. The approach to identify and consider potential interactions between the Offshore Project and OTW Project is set out in **Chapter 5, Volume 1a** and key design parameters associated with the OTW Project are summarised in **Chapter 3**, **Volume 1a**.

10.12.1.3 The potential for effects identified in **Table 10-4** to interact with effects associated with the OTW Project on a common receptor included within the marine sediment and water quality assessment (i.e. receptors which have the potential to experience effects from both projects) has been considered. However, the Zone of Influence associated with Marine Sediment and Water Quality is limited spatially to the marine environment and only has the potential to cause an effect on receptors which are in the marine environment. The only activity to occur between MHWS and MLWS is associated with HDD and cable installation that will occur under the seabed. The works above the seabed associated with this (i.e. HDD Exit Pit construction and cable pull through vessel activities) are considered within this chapter already. As the works between MHWS and MLWS are below the seabed there is no potential for impact to Marine Sediment and Water Quality receptors. Further to this, it has been assumed that there will be no impact to onshore rivers/water bodies due to the OTW Project following the incorporation of mitigation measures. For example, this could include the use of HDD techniques for installation of the Onshore Cable below a watercourse. Following consideration of the OTW Project and likely ZOI and influence on common receptors, there are no pathways that have the potential to effect Marine Sediment and Water Quality receptors. As a result of this, there is no impact pathway that could result in additional interactions to receptors considered within the Marine Sediment and Water Quality assessment. As a result of this, there is no pathway for these effects to interact in addition to the OTW Project and this is not considered further.

10.13 ASSESSMENT OF CUMULATIVE EFFECTS

10.13.1 APPROACH

10.13.1.1 A cumulative effects assessment (CEA) examines the potential for impacts of the Offshore Project in addition with 'Other Developments' (including the OTW Project) on the same single receptor or resource and the contribution of the Offshore Project to those impacts. The overall method following in identifying and assessing potential cumulative effects in relation to the offshore environment is set out in **Chapter 5, Volume 1a**.

10.13.1.2 The offshore screening approach is based on the Planning Inspectorate's Advice Note Nine (Planning Inspectorate, 2018) and Advice Note Seventeen (Planning Inspectorate, 2024), with relevant components of the RenewableUK (RenewableUK, 2013) accepted guidance, which includes aspects specific to the marine elements of an offshore wind farm, addressing the need to consider mobile wide-ranging species (foraging species, migratory routes etc).

10.13.1.3 The conclusions of the assessment of the Offshore Project and any additional effect arising from the OTW Project as identified in this chapter have been considered in this CEA. However, given the assumed mitigation and conclusion drawn within Section 10.12 there are no material additional impacts resulting from the OTW Project.

10.13.2 CUMULATIVE EFFECTS ASSESSMENT

10.13.2.1 For Marine Sediment and Water Quality, a ZoI has been applied to ensure direct and indirect cumulative effects can be appropriately identified and assessed. As per Section 10.4, the ZoI encompasses the Array Area and OCAS plus the peak spring tidal excursion ellipse, determined in **Appendix 9.2, Volume 2c** to be equal to approximately 6 km, and extending to the level of MHWS at the shore. The ZoI was determined The Marine Sediment and Water Quality ZoI is shown in **Figure 10.1, Volume 2b.**

10.13.2.2 A short list of Other Developments that may interact with the Project ZoIs during their construction, operation, or decommissioning is presented in **Appendix 5.4: Cumulative effects assessment shortlisted developments, Volume 1c**. This list has been generated applying criteria set out in **Chapter 5, Volume 1a** and has been collated up to the finalisation of the EIA through desk study, consultation, and engagement.

10.13.2.3 Only those Other Developments in the short list that fall within the Marine Sediment and Water Quality ZoI have the potential to result in cumulative effects with the Project on Marine Sediment and Water Quality. All Other Developments falling outside the Marine Sediment and Water Quality ZoI are excluded from this assessment.

10.13.2.4 On the basis of the above, there are no Other Developments that need to be scoped into the Marine Sediment and Water Quality CEA. This includes Other Developments which are proposed or under construction at the time of writing this chapter.

10.14 TRANSBOUNDARY EFFECTS

10.14.1.1 Transboundary effects occur when a development in one European Economic Area (EEA) State impacts the environment of another EEA State(s). A screening of potential transboundary effects was undertaken within the **Scoping Report**.

10.14.1.2 As per **Table 10-5**, assessment of transboundary effects is scoped out for the Offshore Project and not considered further here.

10.15 SUMMARY OF RESIDUAL EFFECTS

10.15.1.1 **Table 10-16** presents a summary of the assessment of significant impacts, any relevant mitigation measures, and residual effects on Marine Sediment and Water Quality receptors.

Table 10-16 Summary of residual effects

Activity and impact	Receptor	Magnitude of impact	Receptor and sensitivity or value	Embedded Mitigation Measures	Significance of effect (significance)	Further environmental mitigation	Significance of residual effect (significance)
Construction							
Seabed disturbance temporarily increasing suspended sediment concentrations (drilling of pin piles, cable burial, HDD drill cutting release, HDD exit pit constructions)	Marine sediment and marine water quality	Low	N/A	M002, M005, and M030	Significance assessed in other chapters in relation to effects on biological receptors	N/A	N/A
Seabed disturbance releasing contaminants in sediment (drilling of pin piles, cable burial, HDD drill cutting release, HDD exit pit constructions).	Marine water quality	Negligible	High	M002, M005, and M030	Not significant	N/A	N/A
Seabed disturbance during construction activities (drilling of pin piles, cable burial, HDD exit pit constructions) releasing blue carbon.	Blue carbon (held in sediments)	Low	High	M002, M005, and M030	Not significant	N/A	N/A
Operation and maintenance							
Maintenance and remedial work temporarily increasing suspended sediment concentrations	Marine sediment and marine water quality	Negligible	N/A	M025	Significance assessed in other chapters in relation to effects on biological receptors	N/A	N/A
Maintenance and remedial work releasing contaminants in sediment	Marine water quality	Negligible	High	M025	Not significant	N/A	N/A
Maintenance and remedial work releasing blue carbon	Blue carbon (held in sediments)	Negligible	High	M025	Not significant	N/A	N/A
Decommissioning							
Seabed disturbance from infrastructure removal temporarily increasing suspended sediment concentrations (removal of cables and WTG foundations)	Marine sediment and marine water quality	Low	N/A	M020	Significance assessed in other chapters in relation to effects on biological receptors	N/A	N/A
Seabed disturbance from infrastructure removal releasing contaminated sediment (removal of cables and WTG foundations).	Marine water quality	Negligible	High	M020	Not significant	N/A	N/A
Seabed disturbance from infrastructure removal releasing blue carbon	Blue carbon (held in sediments)	Low	High	M020	Not significant	N/A	N/A

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10.16 GLOSSARY OF TERMS AND ABBREVIATIONS

10.16.1.1 A list of key terms and acronyms used in this chapter are provided in **Table 10-17** and **Table 10-18**.

Table 10-17 Acronyms and abbreviations

Term	Definition
AL	Action Level
BAC	Background Assessment Concentration
BODC	British Oceanographic Data Centre
CBRA	Cable Burial Risk Assessment
CEA	Cumulative Effects Assessment
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
Chl-a	Chlorophyll-a
CTD	Conductivity, Temperature, Depth
DBT	Dibutyltin
DDC	Drop Down Camera
EAC	Environmental Assessment Criterion
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMP	Environmental Management Plan
EQS	Environmental Quality Standard
ERL	Effects Range Low
GES	Good Environmental Status
gS	Gravelly Sand
HDD	Horizontal Directional Drilling
IMO	International Maritime Organisation
INNS	Invasive Non-Native Species
ISQG	Interim sediment quality guideline value
JNCC	Joint Nature Conservation Committee
LoD	Limit of Detection
MARPOL	International Convention for the Prevention of Pollution from Ships
MAC	Maximum Allowable Concentrations
MCA	Maritime and Coastguard Agency
MD-LOT	Marine Directorate - Licensing Operations Team
MHWS	Mean High Water Spring
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
NM	Nautical Mile
NTU	Nephelometric Turbidity Units
OEMP	Offshore Environmental Management Plan
OCP	Organochlorine Pesticides

Term	Definition
OSPAR	The Convention for the Protection of the Marine Environment of the North East Atlantic
PAC	Preliminary Application Consultation
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated biphenyls
PEL	Probable Effect Level
PSD	Particle Size Distribution
PT	Particle Tracking
RBD	River Basin District
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage - NatureScot
SO	Strategic Objective
SOPEP	Shipboard Marine Pollution Emergency Plans
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
SST	Sea Surface Temperature
TBT	Tributyltin
TEL	Threshold effect level
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon
WFD	Water Framework Directive
UKTAG	UK Technical Advisory Group
UXO	Unexploded Ordnance
ZoI	Zone of Influence

Table 10-18 Glossary

Term	Meaning
Action level	Sediment contaminant concentration levels established by the Centre for Environment and Aquaculture Science in the UK as guidelines for assessing suitability of dredged material for sea disposal
the Applicant	Spiorad na Mara Limited (the Project owner)
Array Area	Total area within which offshore wind turbine generators (WTGs), associated foundations, Array Cables and Offshore Substation Platform (OSP) (if required) will be located.
Array Cables	The offshore cables that connect the Wind Turbine Generators (WTGs) to each other and terminate at the Offshore Substation Platform (OSP), (if required)
Array Cables to Landfall	The offshore cables that connect the Wind Turbine Generators (WTGs) to Landfall

Term	Meaning
Background assessment concentration	A statistically derived value used to determine if a measured concentration of a substance in the marine environment is "near background" for naturally occurring substances or "close to zero" for man-made substances
Blue carbon	Carbon sequestered in biological material and sediments in the sea
Combined Effects	Combined effect of the individual development on one particular receptor; for example noise, dust and visual. This includes Project-Lifetime Effects and Receptor-Led Effects
Cumulative Effects	Considers the likely significant effects of multiple impacts and activities from several developments with insignificant impacts individually but which together represent a significant cumulative effect
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria
Effects range low	Guideline value used by OSPAR as a proxy for assessing the ecological significance of contaminant concentrations in sediment, defining it as the 10th percentile of concentrations associated with observed biological effects
EIAR	The Environmental Impact Assessment Report (EIAR) prepared to assess the likely significant effects of the Project on the environment.
Embedded or 'Designed-in' Mitigation	Mitigation measures to avoid or reduce environmental effects that are directly incorporated into the preferred design for the Project. This can include standard practice in accordance with or without guidance. Embedded Mitigation is considered as part of the impact assessment, before effect significance is identified
Environmental assessment criterion	Concentration threshold for a hazardous substance, derived by OSPAR from monitoring data in the OSPAR Maritime Area, to protect marine ecosystems from chronic effects and unacceptable risks. EACs are and are used in assessments to determine the environmental status of substances in biota and sediments. Where EAC are not yet defined, proxies such as ERL) values are used for others, such as heavy metals in sediment
Environmental quality standard	In the water context, a value of a concentration or other parameter used in compliance assessment and defined to ensure protection of the water environment generally or in relation to a specific use when compliance is achieved
Export Cables	The offshore cables connecting the Offshore Substation Platform (OSP) to Landfall
Horizontal Directional Drill (HDD)	A trenchless crossing engineering technique using a drill steered underground without the requirement for open trenches. This method

Term	Meaning
	is able to carry out the underground installation of pipes and cables with minimal surface disruption.
Impact	Change that is caused by an action; for example, land clearing (action) during construction which results in habitat loss (impact)
Interim sediment quality guideline	Guidelines for sediment quality designed to be protective of aquatic life, developed by the Ministers of the Environment in Canada and widely used in the absence of similar UK guidelines
Landfall	This consists of works from offshore Horizontal Directional Drill (HDD) exit pits to onshore at the Transition Joint Bays (TJB). The infrastructure and installation methods associated with the Landfall involves both onshore and offshore components.
Landfall Substation	The optional onshore substation located on the west side of the Isle of Lewis. Includes the platform, buildings and associated components which allows the voltage to be increased to meet onward transmission requirements
Offshore Cables	Electrical and communication cables located within the Offshore Cable Area of Search and Array Area.
Offshore Cable Area of Search (OCAS)	The area within which the offshore cable infrastructure between the Array Area and Landfall will be located.
Offshore Landfall Area	The area below Mean High Water Springs (MHWS) within the Offshore Cable Area of Search that includes works associated with the Horizontal Directional Drill (HDD) installation, including HDD exit pit(s) and offshore cable connection to the onshore (TJB)
Offshore Project	The offshore components of the Spiorad na Mara offshore wind farm (the Project) located seaward of Mean High Water Springs (MHWS). The Offshore Project is the subject of this application.
Offshore Project Boundary	The 'red line boundary' encompassing the Offshore Project.
Offshore Substation Platform (OSP)	The optional offshore substation located within the Array Area. Includes the platform and associated components which allows the voltage to be increased to meet onward transmission requirements.
Probable effect level	Probable effect levels are levels of contaminants in sediments above which effects are expected to occur frequently. There were developed by the Ministers of the Environment in Canada
Project	The Spiorad na Mara offshore wind farm development. This term describes the whole development, including all offshore and onshore components.
Project Boundary	The 'red line boundary' encompassing all offshore and onshore components of the Project.
Project Design Envelope	A description of the range of possible components that make up the Project design options under consideration when the exact engineering parameters are not yet known.
Scoping Opinion	A report presenting the written opinion of the Scottish Ministers, with input from Comhairle nan Eilean Siar for the OTW, as to the scope and

Term	Meaning
	level of detail of information to be provided in the Environmental Impact Assessment (EIA) for the Project.
Study Areas	Study Areas are determined for each technical discipline and are described within each technical chapter.
Territorial waters	The sea area within 12 nautical miles of a baseline established round the shore.
Threshold effect level	Threshold effects levels are levels below which adverse effects on aquatic life are expected to occur rarely. They are equivalent to the ISQG and were developed by the Ministers of the Environment in Canada
Turbine Area	A reduced area within the Array Area where above water surface infrastructure would be located i.e. Wind Turbine Generators (WTG) or Offshore Substation Platform (OSP). This area has been developed and refined through stakeholder consultation and environmental assessment.
Wind Turbine Generator (WTG)	The wind turbines that generate electricity consisting of tubular towers and blades attached to a nacelle housing mechanical and electrical generating equipment
Zone of influence	The zone within which potential effects on marine water and sediment quality may occur as a result of the construction, operation and/or decommissioning of the Project.

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