XLINKS' MOROCCO-UK POWER PROJECT

Environmental Statement

Volume 3, Chapter 8: Physical Processes

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Glossary

Term	Meaning
Bathymetry	Sub-marine sea bed topography.
Bottom shear stress	Stress exerted by water on the seabed surface.
Cefas Action Levels / Chemical Action Levels	Concentrations used to determine the contaminant loading of a material and its suitability for disposal at sea. Below Action Level 1, contaminant levels are generally considered to be of no concern and, above Action Level 2, materials are generally considered to be unsuitable for disposal at sea.
Coastal water	Water depths between 5 m and 20 m.
D_{50}	Median sediment particle size.
Deep water	Water depths greater than 20 m.
Depth-averaged tidal current velocity	The average velocity, over a vertical profile, in a given location.
Designated site	Areas with protected status due to natural and cultural importance.
Ecologically coherent network	A collection of protected sites planned and managed to deliver more effective benefits than can be delivered by individual sites.
Geomorphological features	Topographic or bathymetric sea bed features.
Geophysical survey	Imaging or mapping using ground-based physical sensing.
H++ scenario	Maximum sea level rise scenario; 1.9m total sea level rise up to 2100.
Horizontal directional drilling	A construction technique whereby a tunnel is drilled underground, and a pipeline or other utility is pulled through the drilled underground tunnel.
Hydrodynamic	The movement and forces exerted by water.
Hydrological effects	Impacts relating to water and its interaction with land/ sediment.
Macrofauna	Organisms that are visible to the naked eye.
Macrotidal regime	A tidal range in excess of 4 m.
Mega-ripple	Mobile, current-generated bedforms with large wavelengths and heights.
Metocean conditions	Changes to the seabed (deepening or raising) leading to changes in tidal current flows and/ or wave conditions (height/ direction).
Metocean data	Data associated with the combined meteorology and oceanography at a certain location.
Morphological changes	Changes to the form or structure of the seabed.
Neap peak flow	Typical maximum current velocity during neap tides (minimum difference between high and low water levels).
Orbital velocity	Local elliptical currents, which reduce with depth, associated with waves moving across the water surface.
Physical processes	Processes such as metocean conditions, seabed geology/morphology, sediment transport, and water quality which could be impacted by the Proposed Development.
Physico-chemistry	The combination of physical and chemical attributes.
Probable Effects Level	Concentration at which a large percentage of benthic organisms will show a toxic response.
Qualifying interest feature	The features of a site that qualify it to be designated.
Scour protection	The protection of sediment against localised erosion e.g. by placing rock.

Term	Meaning
Seabed change	Temporary or permanent lowering or raising of seabed levels, e.g. due to scour protection.
Seabed geology and morphology	The structure (geology) and form (morphology) of the seabed.
Secondary scour	The interaction of flow (i.e. bed currents) around the edge of a structure (e.g. above sea bed level cable protection) resulting in the erosion of the sea bed.
Sediment dispersion	The dilution and settling of sediment as it travels from a source.
Sediment disturbance	Disturbing/ displacing sediment (contaminated or uncontaminated).
Sediment plume	A mobile area of increased suspended sediment concentration, usually generated by activities such as construction or dredging.
Sediment regime	The size, quantity, sorting, and distribution of sediments.
Shallow water	Water depths less than 5 m.
Significant wave height	Average height of the largest 1/3 of waves.
Spring peak flow	Typical maximum current velocity during spring tides (maximum difference between high and low water levels).
Suspended sediment concentration	Concentration of sediment particles entrained within the water column.
Thermocline	Distinct, transition layer based on temperature – generally between the warmer mixed water at the surface and the cooler deep water below.
Threshold Effects Level	Concentration at which a toxic response has started to be observed.
Turbidity	A measure of the level of particles (relative clarity) such as sediment or organic by-products in a body of water.
Water quality	The condition and characteristics of water that determine its suitability for various uses and the health of aquatic ecosystems. Water quality encompasses the chemical, physical, and biological properties of water and the presence of contaminants and pollutants.

Acronyms

Acronym	Meaning
BSI	British Standards Institute
CCME	Canadian Council of Ministers of the Environment
CCRA	Climate Change Risk Assessment
CEFAS ('Cefas')	Centre for Environment Fisheries and Aquaculture Science
CPA	Coast Protection Act 1949
DDV	Drop-down video
DHI MIKE	Danish Hydraulic Institute modelling software
DTM	Digital Terrain Model
DVV	Double Van Veen
EC	European Commission
EMODnet	European Marine Observation and Data Network
FEPA	Food and Environmental Protection Act 1985
FTU	Formazin Turbidity Units
HAT	Highest Astronomical Tide

Acronym	Meaning
HRA	Habitats Regulations Assessment
HW	High Water
LAT	Lowest Astronomical Tide
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multibeam Echosounder
MCAA	Marine and Coastal Access Act 2009
MCZ	Marine Conservation Zone
MHWN	Mean High Water Neap
MLWN	Mean Low Water Neap
MSL	Mean Sea Level
NGR	National Grid Reference
OCC	Offshore Cable Corridor
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PDA	Project Development Area
PEL	Probable Effect Level
PLONOR	Pose Little or No Risk to the Environment
PSU	Practical Salinity Unit
RCP8.5	Representative Concentration Pathway 8.5 (Climate Change Scenario)
ROV	Remotely Operated Vehicle
SBP	Sub-Bottom Profiler
SQG	Sediment Quality Guideline
TEL	Threshold Effect Level
UKHO	United Kingdom Hydrographic Office

Units

Units	Meaning
hrs	Hours
mAOD	Metres above ordnance datum
mCD	Metres relative to chart datum
mg/l	Milligrams per litre
m/s	Metres Per Second (Speed)
Pa	Pascals
$u_{t(z)}$	Bed current speed
µg/l	Micrograms per litre
%	Percentage

8 PHYSICAL PROCESSES

8.1 Introduction

8.1.1 This chapter of the Environmental Statement (ES) presents the findings of the Environmental Impact Assessment (EIA) undertaken for the United Kingdom (UK) elements of Xlinks' Morocco-UK Power Project (the 'Project'). For ease of reference, the UK elements of the Project are referred to in this chapter as the 'Proposed Development'. The ES accompanies the application to the Planning Inspectorate for development consent for the Proposed Development.

8.1.2 This chapter considers the likely impacts and effects of the Proposed Development on physical (coastal and offshore) processes during the construction, operation and maintenance and decommissioning phases. Specifically, it relates to the offshore elements of the Proposed Development seaward of Mean High Water Springs (MHWS).

8.1.3 In particular, this ES chapter:

- identifies the key legislation, policy and guidance relevant to physical processes;
- details the EIA scoping and consultation process undertaken to date for physical processes;
- confirms the study area for the assessment, the methodology used to identify baseline environmental conditions, the impact assessment methodology, and identifies any assumptions and limitations encountered in compiling the environmental information;
- sets out the existing and future environmental baseline conditions, established from desk studies, surveys and consultation;
- details the mitigation and/or monitoring measures that are proposed to prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process;
- defines the project design parameters used to inform for the impact assessment;
- presents an assessment of the likely impacts and effects in relation to the construction, operation and maintenance and decommissioning phases of the Proposed Development on physical processes; and
- identifies any cumulative, transboundary and/or inter-related effects in relation to the construction, operation and maintenance and decommissioning phases of the Proposed Development on physical processes.

8.1.4 The assessment presented should be read in conjunction with the following ES chapters:

- Volume 1, Chapter 2: Policy and Legislation;
- Volume 1, Chapter 3: Project Description;
- Volume 1, Chapter 5: EIA Methodology;

8.1.5 This chapter also draws upon additional information to support the assessment contained within:

- Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance
- Volume 3, Appendix 8.2: Wave and Tidal Conditions
- Volume 3, Appendix 8.3: Sediment Sample Chemistry Results
- Volume 3, Appendix 8.4: GEOxyz Environmental Report

8.2 Legislative and Policy Context

Legislation

8.2.1 The following legislation, relevant to physical processes, has been considered within the assessment process:

International

- The International Convention for the Prevention of Marine Pollution by Ships (MARPOL Convention) 73/78.

National - primary legislation (acts)

- Marine and Coastal Access Act (MCAA) 2009.

National - secondary legislation (regulations)

- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (Statutory Instrument 2003 No. 3242) for England and Wales. Transposition of Directive 2000/60/EC (which repeals EC Directive 2006/7/EC, known as the Bathing Water Directive and ES Directive 2006/113/EC, known as the Shellfish Waters Directive);
- EC Directive 76/464/EC Water pollution by discharges of certain dangerous substances (Dangerous Substances Directive) and Priority Substances Directive (2008/105/EC) – transposed into UK law under the Priority Substances Directive;
- EC Directive 91/271/EC concerning urban waste water treatment – transposed into UK law under the Urban Waste Water Directive;
- EC Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for community action in the field of water policy – transposed into UK law under the Water Framework Directive;
- The Marine Works (EIA) Regulations 2007 (amended 2017); and
- Marine Strategy Regulations 2010.

Planning Policy Context

8.2.2 The Proposed Development would be located within the UK Exclusive Economic Zone (EEZ) offshore waters (beyond 12 nautical miles (nm) from the English coast) and inshore waters, with the onshore infrastructure proposed to be located wholly within Devon, England. As set out in Volume 1, Chapter 1: Introduction, of

the ES, the Secretary of State for the Department for Energy Security and Net Zero (DESNZ) has directed that elements of the Proposed Development are to be treated as development for which development consent is required under the Planning Act 2008, as amended.

National Policy Statements

8.2.3 There are currently six energy National Policy Statements (NPSs), three of which contain policy relevant to the Proposed Development, specifically:

- Overarching NPS for Energy (NPS EN-1) which sets out the UK Government's policy for the delivery of major energy infrastructure (Department for Energy Security & Net Zero 2023a);
- NPS for Renewable Energy Infrastructure (NPS EN-3) (Department for Energy Security & Net Zero 2023b); and
- NPS for Electricity Networks Infrastructure (NPS EN-5) (Department for Energy Security & Net Zero 2023c).

8.2.4 **Table 8.1** sets out key aspects from the NPSs relevant to the Proposed Development, with particular reference to the need for and approach to consenting such infrastructure.

Table 8.1: Summary of relevant NPS policy

Summary of NPS requirement	How and where considered in the ES
NPS EN-1	
'Where relevant, applicants should undertake coastal geomorphological and sediment transfer modelling to predict and understand impacts and help identify relevant mitigating or compensatory measures' (paragraph 5.6.11 of NPS EN-1)	A semi-empirical assessment of sediment transport has been completed in support of this physical processes ES chapter. Refer to Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance for more details on the methodology and findings of this assessment. These methods have been presented, and the Technical Note (Volume 3, Appendix 8.1 of the ES) issued to the Marine Management Organisation (MMO) and Natural England. These consultation bodies have specifically been requested to confirm whether they deem this semi-empirical assessment (which is presented as a worst-case estimate of likely sediment transport distances), as a sufficient level of 'modelling' to inform the ES. Natural England and the MMO have confirmed that methods (subject to minor adaptations to work previously seen) are appropriate (**Table 8.7**).
'The ES should include an assessment of the effects on the coast, tidal rivers and estuaries. In particular, applicants should assess….the impact of the proposed project on coastal processes and geomorphology, including by taking account of potential impacts from climate change. If the development will have an impact on coastal processes the applicant must demonstrate how the impacts will be managed to minimise adverse	The impact of the proposed project on coastal processes and geomorphology has been considered below MHWS (refer to **sections 8.11 to 8.13** of this ES chapter), and takes into account potential impacts as a result of climate change (refer to Future Baseline Conditions section of this ES chapter).

Summary of NPS requirement	How and where considered in the ES
impacts on other parts of the coast' (paragraph 5.6.12 of NPS EN-1)	
'For any projects involving dredging or deposit of any substance or object into the sea, the applicant should consult the MMO and Historic England, or the NRW in Wales' (paragraph 5.6.13 of NPS EN-1)	Consultation with the MMO has taken place, as detailed in **Table 8.7** of this chapter. Consultation that has taken place with Historic England is detailed in Volume 3, Chapter 7: Marine Archaeology and Cultural Heritage of this ES.
'The applicant should be particularly careful to identify any effects of physical changes on the integrity and special features of Marine Protected Areas (MPAs). These could include MCZs, HRA Sites including Special Areas of Conservation and Special Protection Areas with marine features, Ramsar Sites, Sites of Community Importance, and SSSIs with marine features. Applicants should also identify any effects on the special character of Heritage Coasts' (paragraph 5.6.14 of NPS EN-1)	The likely significant effect on designated sites is considered within **sections 8.11** to **8.13** of this ES chapter. Specific Marine Conservation Zone (MCZ) assessment (document reference 7.15) and Habitats Regulations Assessment (HRA) Report to Inform Appropriate Assessment (RIAA) (document reference 7.16) are submitted with the application for DCO.
'Applicants should propose appropriate mitigation measures to address adverse physical changes to the coast, in consultation with the MMO, the EA or NRW, LPAs, other statutory consultees, Coastal Partnerships and other coastal groups, as it considers appropriate. Where this is not the case, the Secretary of State should consider what appropriate mitigation requirements might be attached to any grant of development consent' (paragraph 5.6.16 of NPS EN-1)	Mitigation measures adopted as part of the Proposed Development to reduce the potential for impacts on physical processes are outlined in **Table 8.31** of this ES chapter.
'The Secretary of State should be satisfied that the proposed development will be resilient to coastal erosion and deposition, taking account of climate change, during the project's operational life and any decommissioning period' (paragraph 5.6.17 of NPS EN-1)	The impact of the proposed project on coastal processes and geomorphology has been considered below MHWS (refer to **sections 8.11 to 8.13** of this ES chapter), and takes into account potential impacts as a result of climate change (refer to Future Baseline Conditions section of this ES chapter).
'The Secretary of State should not normally consent new development in areas of dynamic shorelines where the proposal could inhibit sediment flow or have an adverse impact on coastal processes at other locations. Impacts on coastal processes must be managed to minimise adverse impacts on other parts of the coast. Where such proposals are brought forward, consent should only be granted where the Secretary of State is satisfied that the benefits (including need) of the development outweigh the adverse impacts' (paragraph 5.6.18 of NPS EN-1)	The impact of the proposed project on coastal processes and geomorphology has been considered below MHWS (refer to **sections 8.11 to 8.13** of this ES chapter). Overall, it is concluded that there will be no significant effects arising from the Proposed Development on physical processes during the construction, operation and maintenance or decommissioning phases.
NPS EN-5	
The Secretary of State should consider the 'potentially very disruptive effects of undergrounding on…marine environments…' of subsea cables and 'the potentially very disruptive effects…on the seabed…including physical damage to and full loss of seabed habitats' (paragraph 2.9.25 of NPS EN-5)	Refer to **sections 8.11 to 8.13** and Volume 3, Appendix 8.2: Sediment Source Concentrations and Assessment of Disturbance of the ES for the results from the completion of a sediment transport assessment.

Summary of NPS requirement	How and where considered in the ES
	Consideration of habitat damage / loss is considered within Volume 3, Chapter 1: Benthic Ecology of the ES.

The National Planning Policy Framework

8.2.5 The National Planning Policy Framework (NPPF) was published in 2012 and updated in 2018, 2019, 2021 and 2023, with an updated draft version released for consultation in August 2024 (Department for Levelling Up, Housing and Communities, 2023). The NPPF sets out the Government's planning policies for England. **Table 8.2** sets out key aspects from the NPPF relevant to this ES chapter.

Table 8.2: Summary of NPPF requirements relevant to this chapter

Policy	Key provisions	How and where considered in the ES
Paragraph 159	Avoid increased vulnerability to the range of impacts arising from climate change. Care should be taken to ensure that risks can be managed through suitable adaption measures.	The potential effects of climate change are considered in the Future Baseline Conditions in **section 8.7** and the impact assessment in **sections 8.11 to 8.13**.
Paragraph 180	…(c) maintaining the character of the undeveloped coast, while improving public access to it where appropriate; (e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality,	The assessment of impacts on e.g. seabed change (e.g. **section 8.11**) will contribute to the maintenance of the offshore and coastal character. Consideration of potential for sediment disturbance, and effects on water quality are considered within this chapter (e.g. **section 8.11**)
Paragraph 191	Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.	Baseline sediment chemistry (including any historic natural and legacy contamination) is characterised within this chapter and assessment of effects on water quality are included (e.g. **section 8.11**). Within this ES, the physical processes changes such as water quality change are also considered pathways to potential impact on other receptors (see e.g. assessment of water quality effects from disturbed sediments on benthic ecology in Volume 3, Chapter 1: Benthic Ecology of the ES).

Marine Policy

UK Marine Policy Statement

8.2.6 The following policy, within the UK Marine Policy Statement, is relevant to physical processes:

- Marine dredging and disposal (UK Marine Policy Statement Section 3.6) – a detailed evaluation of the potential adverse effects of any dredging activity, on the marine ecosystem, should be undertaken (i.e. release of sediments, chemical pollution and morphological changes, hydrological effects and increases in turbidity)

South West Inshore and South West Offshore Marine Plans

8.2.7 **Table 8.3** presents a summary of the specific policies set out in the South West Inshore and South West Offshore Marine Plans (MMO, 2021) relevant to this chapter.

Table 8.3: Summary of inshore and offshore marine plan policies relevant to this chapter

Policy	Key provisions	How and where considered in the ES
SW-CC-2	Proposals in the south west marine plan areas should demonstrate for the lifetime of the project that they are resilient to the impacts of climate change and coastal change.	The potential effects of climate change are considered in the Future Baseline Conditions in **section 8.7** and the impact assessment in **sections 8.11 to 8.13**.
SW-CC-3	Proposals in the south west marine plan areas, and adjacent marine plan areas, that are likely to have significant adverse impacts on coastal change, or on climate change adaptation measures inside and outside of the proposed project areas, should only be supported if they can demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate – adverse impacts so they are no longer significant.	The potential effects of climate change are considered in the Future Baseline Conditions in **section 8.7** and the impact assessment in **sections 8.11 to 8.13**.
SW-WQ-1	Proposals that protect, enhance and restore water quality will be supported. Proposals that cause deterioration of water quality must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate – deterioration of water quality in the marine environment.	Refer to **sections 8.11 to 8.13** and Volume 3, Appendix 8.2: Sediment Source Concentrations and Assessment of Disturbance of the ES for the results of a sediment transport assessment.
SW-MPA-1	Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported. Proposals that may have adverse impacts on the objectives of marine	Refer to **sections 8.11 to 8.13** and Volume 3, Appendix 8.2: Sediment Source Concentrations and Assessment of Disturbance of the ES for the results of a sediment transport assessment.

Policy	Key provisions	How and where considered in the ES
	protected areas must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate – adverse impacts, with due regard given to statutory advice on an ecologically coherent network.	

Local Planning Policy

8.2.8 The onshore elements of the Proposed Development are located within the administrative area of Torridge District Council (and Devon County Council at the County level). The relevant local planning policies applicable to physical processes based on the extent of the study areas for this assessment are summarised in **Table 8.4**.

Table 8.4: Summary of local planning policy relevant to this chapter

Policy	Key provisions	How and where considered in the ES
North Devon and Somerset Shoreline Management Plan 2 (October 2010)		
7c05 Clovelly to Westward Ho! (Seafield House)	Continue to allow existing localised defences to be maintained or replaced if funding is available, to reduce risk of flooding and erosion, and maintain visitor access. If funds are unavailable, then allow natural coastal evolutions to continue through no active intervention.	Refer to **sections 8.11 to 8.13.** Likely no impact as the Proposed Development will use Horizontal Directional Drilling (HDD) to avoid disturbance of the beach and foreshore, including coastal cliffs.

North Devon Biosphere Reserve

8.2.9 The Proposed Development is located within the North Devon Biosphere Reserve, which is recognised under UNESCO's Man and the Biosphere (MAB) Programme and designated as an area for testing and demonstrating sustainable development on a sub-regional scale.

8.2.10 The North Devon Biosphere Reserve consists of three zones; a core zone centred around Braunton Burrows Special Area of Conservation (SAC) / Site of Special Scientific Interest (SSSI), a buffer zone consisting of the Taw Torridge Estuary (as far as Barnstaple and Bideford), and a transition zone formed by the catchment area of the rivers and streams that drain to the North Coast of Devon in addition to an area of sea as far out as Lundy.

8.2.11 The Biosphere Reserve is overseen by the North Devon Biosphere Reserve Partnership, which is a collaboration of 26 partnership organisations who work to deliver sustainable development through direct action, through advocacy and providing advice. The non-statutory 'North Devon Biosphere Reserve Strategy for Sustainable Development 2014 to 2024' (NDB undated) provides a context for stakeholders to deliver programmes and plans in support of the sustainable development of the Biosphere Reserve.

8.2.12 Within the North Devon Biosphere Reserve, non-statutory programmes and plans relevant to physical processes include:

- North Devon Marine Natural Capital Plan
- North Devon Marine Nature Recovery Plan 2022-2027

8.2.13 The extent to which the Proposed Development impacts on the North Devon Biosphere Reserve and its relevant programmes / plans has been considered in this physical processes chapter, and consultation has taken place with the North Devon Biosphere Reserve Partnership during preparation of the ES. **Table 8.5** presents a summary of the specific policies set out in the North Devon Marine Natural Capital plan (North Devon UNESCO Biosphere Reserve, 2020) relevant to this chapter.

Table 8.5: Summary of North Devon Biosphere Marine Natural Capital Plan policies relevant to this chapter

Policy	Description	How and where considered in the ES
Marine Natural Capital Plan PL10: *Support the implementation of management measures that reduce pressure across subtidal sediments*	*Deeper subtidal habitats provide multiple ecosystem service benefits including food provision and water quality. These habitat assets make up a significant proportion of the plan area but very large extents of these deeper offshore habitats are in an impacted condition, both within and outside MPAs, due to previous interactions with abrasive pressure from demersal fishing activities. PL10 recognises that management must consider improving the condition of this habitat.*	**Table 8.31** outlines mitigation measures which have been adopted to reduce the potential for physical processes impacts, including across subtidal sediments. These measures will be secured principally (details in **Table 8.31**) via the final offshore Construction Environmental Management Plan (CEMP), with an outline offshore CEMP submitted as part of the application for DCO (document reference 7.9).

8.3 Consultation and Engagement

Scoping

8.3.1 In January 2024, the Applicant submitted a Scoping Report to the Planning Inspectorate, which described the scope and methodology for the technical studies being undertaken to provide an assessment of any likely significant effects for the construction, operation and maintenance and decommissioning phases of the Proposed Development. It also described those topics or sub-topics which are proposed to be scoped out of the EIA process and provided justification as to why the Proposed Development would not have the potential to give rise to significant environmental effects in these areas.

8.3.2 Following consultation with the appropriate statutory bodies, the Planning Inspectorate (on behalf of the Secretary of State) provided a Scoping Opinion on 7 March 2024. Key issues raised during the scoping process specific to physical

processes are listed in **Table 8.6**, together with details of how these issues have been addressed within the ES.

Table 8.6: Summary of Scoping Responses

Comment	How and where considered in the ES
Planning Inspectorate	
Several aspect chapters in the Scoping Report refer to fixed distance study areas with no explanation as to why these have been selected. The ES should ensure the study area for each aspect reflects the Proposed Development's Zone of Influence (ZoI) and the impact assessment should be based on the ZoI from the Proposed Development with reference to potential effect pathways. Clear justification should be provided to support any distances applied.	Study area justifications are provided at **section 8.4**, with the study area discussed with relevant stakeholders. Note, the chosen physical processes study area is comparable to the study areas for other offshore infrastructure projects, including Rampion, Berwick and West of Orkney wind farms.
The Inspectorate acknowledges that data and knowledge regarding the baseline environment exists for the offshore area in which the Proposed Development would be located. The Inspectorate understands the benefits of utilising this information to supplement site-specific survey data but advises that suitable care should be taken to ensure that the information in the ES remains representative and fit for purpose. The Applicant should make effort to agree the suitability of information used for the assessments in the ES with relevant consultation bodies.	Consultations have been completed and include specific discussion of key methods and datasets – e.g. **Table 8.7**. This chapter includes evidence of agreement, with relevant stakeholders, regarding the suitability of the baseline data used.
The Inspectorate advises that, in addition to the receptors identified in the Scoping Report, the ES should identify, describe and assess any likely significant effects to the following receptors: • Westward Ho! Designated bathing water; • Permitted sites, discharges and/ or abstractions, reflecting data available from the EA's public register; • Jennetts Reservoir and Gammaton Lower Reservoir, in terms of their designated nitrate vulnerable zones; and, • Torridge Estuary designated shellfish water (refer to the Inspectorate's comments at ID 3.10.7 of this Opinion). The Applicant's attention is drawn to the comments of the EA (Appendix 2 of this Scoping Opinion).	This ES chapter includes the Westward Ho! designated bathing water as a receptor (refer to **Table 8.30**). Other receptors listed here are not applicable to the Physical Processes chapter; Permitted sites, discharges and/ or abstractions and Jennetts Reservoir and Gammaton Lower Reservoir are discussed in Volume 2, Chapter 3: Hydrology and Flood Risk of this ES, whilst Torridge Estuary designated shellfish water is assessed in Volume 3, Chapter 2: Fish and Shellfish Ecology of this ES.
The Inspectorate considers that there is a possibility for localised scour due to the presence of the offshore cable and cable protection (if required), which could also result in direct habitat loss. This matter should be considered in the assessment, where likely significant effects could occur, or provide evidence demonstrating agreement with the relevant consultation bodies that significant effects are not likely to occur.	This chapter includes an assessment of secondary (localised) scour, building on recent modelled estimates of bed currents (refer to **section 8.11** and Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of this ES). Methodologies have been agreed with relevant stakeholders.
The Scoping Report states that changes could occur from presence of rock berms, which may be required for cable protection at crossings or in isolated hard seabed areas during operation. The Inspectorate	No likely negative effects on the hydrodynamic regime, as a result of the presence of cable protection, are anticipated. The water depth is considered to be sufficiently great that the effects of

Comment	How and where considered in the ES
notes the predicted construction timetable and two offshore cable laying phases as described at Paragraphs 4.7.10 to 4.7.12 of the Scoping Report. It appears possible that rock berms would be in place for extended periods of construction activity in advance of the cable becoming operational and that mitigation may also be required during this period. The Inspectorate advises that the potential for change to the hydrodynamic regime due to the presence of cable protection should be assessed for the phases during which it is likely to give rise to significant effects and that the ES should describe any mitigation required and explain how this would be secured in the DCO.	the cable protection at the seabed, on waves and currents, are negligible. Refer to **Table 8.21** and supporting text, for more evidence that this assumption is appropriate.
The Inspectorate considers that there is a possibility for localised scour due to the presence of the offshore cable and cable protection (if required), which could also result in direct habitat loss. This matter should be considered in the assessment, where likely significant effects could occur, or provide evidence demonstrating agreement with the relevant consultation bodies that significant effects are not likely to occur.	This chapter includes an assessment of secondary (localised) scour, building on recent modelled estimates of bed currents (refer to **section 8.11** and Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES). Methodologies have been agreed with relevant stakeholders.
Table 8.3.3 refers to the use or qualitative and/or quantitative modelling; however, no criteria are given as to how the modelling methodology will be decided. The ES should provide details of how the method is chosen, and details of the modelling methodology once undertaken. The Applicant should seek to agree the modelling with the relevant consultation bodies where possible.	A semi-empirical assessment of sediment transport has been completed in support of this physical processes ES chapter. Refer to ES Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance for more details on the methodology and findings of this assessment. These methods have been presented to, and the Technical Note (ES Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance) issued, to the MMO and Natural England. These consultation bodies have confirmed that they deem this semi-qualitative assessment (which are presented as a worst-case estimate of likely sediment transport distances), as a sufficient level of 'modelling' to inform the ES.
The following effects during the operation (excluding repair) and decommissioning (where left in situ) stages: • Physical disturbance of seabed geology and morphology (nearshore only, <20 m depth) • Generation of sediment disturbance (sediment plumes) associated with construction type activities • Increase in contaminants through the suspension of contaminated sediment No explanation is provided in the Scoping Report with regards to why these potential effects are to be scoped out for the operational and decommissioning (where left in situ) stages of the Proposed Development. However, the Inspectorate assumes this is on the basis such impacts are not anticipated	Justification for scoping out these potential effects for the operational and maintenance and decommissioning (where left *in-situ*) phases is included in **paragraphs 8.5.5** and **8.5.6** of this ES chapter.

Comment	How and where considered in the ES
at these stages. On this basis, the Inspectorate is content to scope out these matters for the operation and decommissioning (where left in situ) stages.	
Impacts to metocean processes (deep water, >20m depth) – all stages This matter is proposed to be scoped out on the basis that at 20m and deeper, the water depth is such that the effects of the seabed on waves and currents is negligible, and thus the likely localised changes in bathymetry due to trenching or shallow berms associated with crossing points would not have a direct effect. The Inspectorate notes that metocean processes in the nearshore have been scoped into the impact assessment. On the basis of the above, the Inspectorate is content for this matter to be scoped out of the impact assessment.	Justification for scoping out impacts to metocean processes (deep water, >20m depth) is included in **paragraphs 8.5.5** and **8.5.6** of this ES chapter.
Physical disturbance of seabed geology and morphology (deep water, >20m depth) – all stages The Scoping Report states that although the Proposed Development would result in a physical disturbance of the seabed geology, it is unlikely that the works would affect seabed morphology in deepwater due to the low-energy environment where metocean processes do not normally mobilise seabed sediments. Also, on the basis that the Offshore Cable Corridor has been selected to avoid excessive preparatory works and due to scale of the works in the context of the wider Celtic Sea and English Channel area. On the basis of the above, the Inspectorate is content for this matter to be scoped out of the impact assessment.	Justification for scoping out physical disturbance of seabed geology and morphology (deep water, >20m depth) is included in **paragraphs 8.5.5** and **8.5.6** of this ES chapter.
Impacts on local sediment regimes (deep water, >20m depth) This matter is proposed to be scoped out on the basis that sediment would not travel significant distances and would likely resettle within close proximity to the cable corridor. Therefore, it is considered unlikely there would be any direct effects to local sediment regimes in deep water, as a result of the Proposed Development. On the basis of the above, the Inspectorate is content for this matter to be scoped out of the impact assessment.	Justification for scoping out impacts on local sediment regimes (deep water, >20m depth) is included in **paragraphs 8.5.5** and **8.5.6** of this ES chapter.
Paragraph 8.9.4 describes a study area encompassing the Offshore Cable Corridor with a 1km buffer; however, a 30km buffer is shown on Figure 8.9.1. The ES should make clear the study	The 1 km buffer, mentioned within the ES Scoping text, was an error and the study area, and ZOI, is clearly stated as 30 km within this ES chapter.

Comment	How and where considered in the ES
area for coastal processes, together with the ZoI from the Proposed Development over which potential likely significant effects in respect of physical processes could arise.	
The Scoping Report describes designated sites within and near to the offshore cable corridor; however, the scoping-in table for physical processes does not make clear how information and assessment of any likely significant effects on these sites would be presented in the ES. The ES should include an assessment of likely significant effects to habitats of the designated sites, or appropriate cross-references to information presented in the MCZ and/or Habitat Regulations Assessments (HRA) provided with the DCO application.	The likely significant effects on designated sites is considered within **sections 8.11** to **8.13** of this ES chapter. The methodology for assessing the likely significant effects is detailed within the Impact Assessment Methodology within this report. The physical processes assessments presented in this ES chapter have informed the HRA RIAA (document reference 7.16) and MCZ assessment (document reference 7.15).
The Scoping Report physical processes aspect chapter does not refer to scour or secondary scour, although the potential for scour is described and proposed to be included in the impact assessments for benthic ecology and fish and shellfish ecology. The ES should include an assessment of the impacts associated with changes to seabed from scour, where significant effects are likely to occur. Additionally, the potential impact from secondary scour around cable protection should also be included in the physical processes impact assessment, where likely significant effects could occur. The Applicant should make effort to agree the approach with relevant consultation bodies, including NE and the MMO.	This chapter includes an assessment of secondary (localised) scour, building on recent modelled estimates of bed currents (refer to section 8.11 and Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES). Methodologies have been agreed with relevant stakeholders.
It is not clear whether modelling will be undertaken to inform the physical processes assessment and related assessments for aspects such as benthic ecology and fish and shellfish ecology. The physical processes chapter contains no detail with regards to potential modelling (quantitative or qualitative), although reference is made to potential modelling in the fish and shellfish ecology chapter of the Scoping Report at paragraph 8.3.5.	A semi-empirical assessment of sediment transport has been completed in support of this physical processes ES chapter. Refer to Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES for more details on the methodology and findings of this assessment. These methods have been presented to, and the Technical Note (Volume 3, Appendix 8.1 of the ES) issued, to the MMO and Natural England. These consultation bodies have confirmed that they deem this semi-qualitative assessment (which are presented as a worst-case estimate of likely sediment transport distances), as a sufficient level of 'modelling' to inform the ES.
The Inspectorate notes reference in Table 8.9.6 to a qualitative assessment of the spatial extent of sediment disturbance, and also that a number of aspects also refer to an understanding of sediment plume effects (such as benthic ecology).	A semi-empirical assessment of sediment transport has been completed in support of this physical processes ES chapter. Refer to Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES for more details on the methodology and findings of this assessment.

Comment	How and where considered in the ES
	These methods have been presented to, and the Technical Note (Volume 3, Appendix 8.1 of the ES) issued, to the MMO and Natural England. These consultation bodies have confirmed that they deem this semi-qualitative assessment (which are presented as a worst-case estimate of likely sediment transport distances), as a sufficient level of 'modelling' to inform the ES.
The Applicant's attention is directed to the response of JNCC at Appendix 2 to this Opinion, with reference to the recommendation to undertake sediment plume modelling. The impact assessment should be informed by plume modelling. The ES should clearly describe the modelling undertaken to inform the impact assessment and seek to agree the scope of the physical process modelling with relevant consultation bodies, such as JNCC, NE and the MMO.	A semi-empirical assessment of sediment transport has been completed in support of this physical processes ES chapter. Refer to Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES for more details on the methodology and findings of this assessment. These methods have been presented to, and the Technical Note (Volume 3, Appendix 8.1 of the ES) issued, to the MMO and Natural England. These consultation bodies have confirmed that they deem this semi-qualitative assessment (which are presented as a worst-case estimate of likely sediment transport distances), as a sufficient level of 'modelling' to inform the ES.
The Scoping Report at Section 4.7 states that seabed levelling may be required but the extent is not yet known. This is not subsequently mentioned in the physical processes chapter. The ES should assess any likely significant secondary effects that this may have on changes to the current/flow regime, wave regime and sediment transport regime and any morphological changes. Impacts from dredging and disposal of material should also be assessed, where significant effects are likely to occur. Any disposal method should be described and should include the estimated volume of material to be disposed.	Impacts on current/ flow and wave regimes, as a result of seabed levelling, has been scoped out of this assessment. Justification is included in **paragraphs 8.5.5** and **8.5.6** of this ES chapter. Changes to the sediment transport regime and any morphological changes, as a result of seabed levelling, is considered within the Impact Assessment (refer to **sections 8.11** to **8.13** of this ES chapter).
Environment Agency	
We would expect assessment justifying the offshore cable depth, taking into account wave action and ensuring that the cable depth will not be impacted by mobilisation of the seabed throughout the lifetime of the development.	It is unlikely that the cable depth will be impacted by sediment mobilisation as a result of wave action. The water depth is considered to be significant enough (along the majority of the OCC) that the wave influence at the bed will be insignificant. Refer to **Table 8.21** and supporting text, for more evidence that this assumption is appropriate.
In accordance with paragraph 5.6.7 of National Policy Statement EN-1, the Environmental Statement should 'assess the impact of the proposed project on coastal processes and geomorphology, including taking account of potential impacts from climate change. If the development will have an impact on coastal processes the applicant must demonstrate how the impacts will be managed to minimise adverse impacts on other parts of the coast'. Furthermore, paragraph 5.6.11 states 'the Secretary of State should be satisfied that the	The impact of the proposed project on coastal processes and geomorphology has been considered below MHWS (refer to **sections 8.11** to **8.13** of this ES chapter), and takes into account potential impacts as a result of climate change (refer to Future Baseline Conditions section of this ES chapter). This ES chapter also includes additional detail on how the impacts will be managed to minimise adverse impacts on the coast (within Bideford Bay).

Comment	How and where considered in the ES
proposed development will be resilient to coastal erosion and deposition, taking account of climate change, during the project's operational life and decommissioning period'.	
Hydrology & Flood Risk: the Surf Zone dataset 2019 may also be of use which is available here. https://environment.data.gov.uk/dataset/77e6f743-d708-4909-a80f-9510b7dbaa16. This may also be of relevance to Table 8.9.1 Desk Based baseline data sources – Physical Processes, on page 378 of the scoping report.	This has been incorporated within the Baseline Environment section of this ES chapter (refer to **sections 8.7.4** to **8.7.7**).
Section 8.9.3 Guidance Documents page 375. There may be elements within the Environment Agency's Coastal Standards Technical Report LIT 56561 (2022) which are of use. Particularly regarding future wave conditions and climate change allowances.	This has been incorporated within the Baseline Environment section of this ES chapter (refer to **section 8.7**).
Table 8.9.1 Desk based baseline data sources – Physical Processes page 378. The Coastal Flood Boundary (CFB) 2018 dataset may be of use and provides information on extreme sea levels.	This has been incorporated within the Baseline Environment section of this ES chapter (e.g. **paragraph 8.7.84**).
Table 8.9.1 Desk based baseline data sources – Physical Processes page 378. The NCERM (National Coastal Erosion Risk Mapping) may be of interest. This is currently out for consultation for NCERM2, however, the original NCERM data can be found here: National Coastal Erosion Risk Mapping (NCERM) - National (2018 - 2021) - data.gov.uk	This has been incorporated within the Baseline Environment section of this ES chapter (refer to **section 8.7.30**).
Table 8.9.5 Sea Level Rise Allowance Table. Page 388. No further action required, just to confirm, the sea level rise projections presented in this table look reasonable based on a check of area 51.06-4.25 within the Sea Level anomalies for marine projections UKCP18 dataset.	No further action required.
Natural England	
Please note that impacts from secondary scouring around cable protection should also be factored into both marine processes and benthic assessment.	This chapter includes an assessment of secondary (localised) scour, building on recent modelled estimates of bed currents (refer to **sections 8.11** to **8.13** and Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES). Methodologies have been agreed with relevant stakeholders.

Preliminary Environmental Information Report

8.3.3 The preliminary findings of the EIA process were published in the Preliminary Environmental Information Report (PEIR) on 16 May 2024. The PEIR was

prepared to provide the basis for statutory public consultation under the Planning Act 2008. This included consultation with statutory bodies under section 42 of the Planning Act 2008.

8.3.4 A summary of the key items raised specific to physical processes is presented in **Table 8.7,** together with how these issues have been considered in the production of this ES chapter.

Further Engagement

8.3.5 Throughout the EIA process, consultation and engagement (in addition to scoping and section 42 consultation) with interested parties specific to physical processes has been undertaken.

8.3.6 A summary of the key items raised specific to physical processes is presented in **Table 8.7,** together with how these issues have been considered in the production of this ES chapter.

Table 8.7: Summary of consultation relevant to this chapter

Date	Consultee and type of response	Issues raised	How and where considered in the ES
March 2024	Marine Management Organisation consultation meeting	Presented results from semi-qualitative assessment of sediment transport along the Offshore Cable Corridor, in response to comments received as part of the ES Scoping Opinion. Technical note subsequently shared with Cefas for comment on methodologies.	Refer to Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES for more details on the methodology and findings of this assessment.
March 2024	Natural England consultation meeting	Presented results from semi-qualitative assessment of sediment transport along the Offshore Cable Corridor, in response to comments received as part of the ES Scoping Opinion. Feedback from Natural England's Physical Processes technical expert—following review of the associated Technical Note (c.f. Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance)— confirmed methods as appropriate, i.e. a sufficient level of 'modelling' to inform the ES.	Refer to ES Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES for more details on the methodology and findings of this assessment.
April 2024	JNCC consultation meeting	Presented results from semi-qualitative assessment of sediment transport along the Offshore Cable Corridor, in response to comments received as part of the ES Scoping Opinion. Feedback from JNCC —following review of the associated Technical Note (c.f. Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance)—confirmed	Refer to Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES for more details on the methodology and findings of this assessment.

Date	Consultee and type of response	Issues raised	How and where considered in the ES
		methods as appropriate, i.e. a sufficient level of 'modelling' to inform the ES.	
June 2024	Cefas consultation meeting	Presented results from semi-qualitative assessment of sediment transport along the Offshore Cable Corridor, in response to comments received as part of the ES Scoping Opinion. Feedback from Cefas Physical Processes technical expert – following review of the associated Technical Note (c.f. Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance)—confirmed hydrodynamic modelling not necessary. Key concerns related to the source function and quantities of scour protection needed.	Refer to Volume 3, Appendix 8.1 High Level Assessment of Sediment Disturbance of the ES for more details on the methodology and findings of the (updated) assessment, which includes consideration of the source function and secondary scour.
July 2024	Cefas/ MMO PEIR response	Further comments relating to estimates of the volumes of disturbed sediment and the consideration of secondary scour. A number of queries relating to the sediment grab samples, including the extent of chemical characterisation.	Refer to Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES for details on the methodology and findings of the sediment disturbance assessment. The Appendix includes consideration of: the suspended sediment uplift associated with different disturbance activities; the volume and transport of sediment; and worst case assessment of secondary scour. An initial meeting with the MMO took place on 17/10/24 to discuss the MMO (Section 42) sediment chemistry comments. A subsequent meeting was arranged with Cefas as MMO's technical advisors on 8/11/24 to further discuss the existing sediment chemistry characterisations and analysis methods used by the laboratory when testing baseline grab samples. The key outcomes of this meeting, detailing how limitations have been addressed and confirmation that sediment testing is adequate for the purposes of this EIA, are summarised in the

Date	Consultee and type of response	Issues raised	How and where considered in the ES
			'November 2024 / Cefas & MMO' Consultee response/issue in this table (below). In summary, following review of the laboratory sediment chemistry data (which in places did not employ testing methods recommended by MMO guidance), it was agreed, that with targeted additional testing of the retained samples (to provide additional validation data and increase confidence) the dataset would be sufficient to support marine licensing. The current data are thus deemed suitable for the purposes of this ES. The supplementary data will be provided and discussed with Cefas/MMO beyond the date of submission for DCO (beyond finalisation of this ES chapter) but prior to any issue of an associated Deemed Marine Licence.
July 2024	Environment Agency PEIR response	Comments relating to the avoidance of negative impacts on geomorphology and natural processes, notably around coastal landfall infrastructure. Furthermore, the Environment Agency raised concerns relating to leaving the landfall ducting in place during decommissioning, which may result in it becoming exposed.	Refer to **sections 8.11** to **8.13** for discussion on the avoidance of negative impacts of geomorphology and natural processes. Refer to **section 8.13** for discussion on likelihood of landfall ducting being exposed following decommissioning and likely impacts.
July 2024	Natural England PEIR response	Request for a more detailed seabed mobility assessment, to include maximum sediment plume concentrations, extent and persistence, as well as changes to bed levels. Results to be shown on a map.	Refer to Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES for more details on the methodology and findings of this assessment, which includes plume concentrations, extent and persistence, likely changes to bed levels, and figures showing the maximum modelled sediment dispersion distances.
		Natural England advocate the use of the joint JNCC and Natural England subsea cable best practice advice (Natural England and JNCC, 2019)	This report has been used to provide advice, with regards to best practice when subsea cabling, within this ES chapter.

Date	Consultee and type of response	Issues raised	How and where considered in the ES
		'Natural England advises the amendment of the description of 'Surrounding sub-tidal sea bed' to refer specifically to seabed morphology as well. We also advise the amendment of the description of 'Surround coastline' to include consideration of shore platform downwearing/ damage and coastal retreat.'	The descriptions of the sub-tidal seabed and surrounding coastline have been amended as per Natural England request. Refer to **Section 8.5**. Following a review of the Shoreline Management Plan Review (SMP2), it is understood that in the baseline scenario the cliffs (and rocky shore platform) are geologically resistant to erosion which occurs very slowly (NDASCAG, 2010). The SMP2 also states that 'Cliff recession and instability of the cliff face brought about by weathering, is generally slow and provides a limited supply of coarse sediment'. Relative to the design life of the Proposed Development, no impacts to the rocky shore platform at (and around) the location of the proposed landfall , such as down wearing, damage and coastal retreat, are expected. Within the inshore area (water depths <10m) the proposed cable will not impact metocean conditions since it is installed beneath the seabed using HDD. Therefore, no change to wave height, period and direction are anticipated. The baseline weathering and erosion regime occurs very slowly along this stretch of shoreline and no change resulting from the Proposed Development is anticipated.
		Natural England advises that sediment disturbance or seabed change should be scoped into the assessment for operational phase. We also advise that this issue should be considered further following the completion of the scour assessment in the updated Physical Processes chapter in the ES.	Sediment disturbance or seabed change has been scoped into the assessment for the operational and maintenance phase and has been considered further following the completion of the scour assessment. Refer to **Section 8.11**.
		Natural England advises that Operation and Maintenance activities and their potential effects should remain scoped into the assessment for	Cable repair and maintenance, cable remedial burial, maintenance of external cable protection and new external cable protection have been scoped into the

Date	Consultee and type of response	Issues raised	How and where considered in the ES
		the lifetime of the development, including: -Cable repair and maintenance -Cable remedial burial -Maintenance of external cable protection -New external cable protection	assessment for the lifetime of the development. Refer to **Section 8.11**.
		Natural England advises consideration (but not exclusively) is given to the following to inform potential- mitigation measures: - Cable burial risk assessment - Scour management and cable protection plan - Hierarchy approach – avoid minimise mitigate impacts on MPAs - Re-routing to avoid UXOs - Consideration of angles at which cables approach the coast and/or interact with sediment transport pathways - Consideration of cable crossing and aligning the route to minimise the number of crossings within sensitive areas.	-An outline Cable Burial Risk Assesment (CBRA) is presented as Volume 1, Appendix 3.4: Cable Burial Risk Assessment of the ES. -A specific scour management and cable protection plan has not been prepared on the basis that it is deemed unnecessary, based on the expectations of the outline CBRA (Volume 1, Appendix 3.4: Outline Cable Burial Risk Assessment of the ES) and the results of the scour assessment within Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES. Note, operational and maintenance phase surveys (routine post installation cable inspection surveys) will identify any areas of local scour. -A hierarchy approach has been adopted to development of Proposed Development mitigation, principal to which is avoidance. MPAs have been avoided where possible. -UXO survey, removal (if required), and associated licensing will be undertaken separate to this ES. -The potential impact on geomorphology processes have been assessed in this chapter (e.g. **Section 8.12**). -As above the OCC route has avoided MPAs where possible. Location of crossings relative to habitats is presented in Volume 3, Chapter 1: Benthic Ecology of the ES.

Date	Consultee and type of response	Issues raised	How and where considered in the ES
		Natural England advises that the next step is for this study to be taken further to assess the worst-case scenario in terms of maximum sediment plume concentration, extent and persistence, as well as associated changes in bed level (i.e. deposition footprint). It is important to present this information to show potential impacts to relevant MPAs, sensitive features, habitats and physical process receptors.	A maximum sediment plume concentration, and associated changes in bed level (averaged across the plume extent) are included within Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES.
		Natural England advises that a more detailed seabed mobility assessment is included within the application.	A more detailed seabed mobility assessment has been completed as part of Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES.
		Natural England would want to see the form and extent of mobile bedforms and a map showing the location of these.	Refer to Volume 3, Figure 8.10 of the ES.
		Natural England advises sediment transport pathways within the study area should be considered and included on a map, especially those closer to landfall.	Sediment transport pathways have been considered within Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES; the results of which can be found on Volume 3, Figure 8.9 of the ES.
		Natural England highlights that exit pits may be-problematic at depths shallower than 10m water depth,- especially if cable protection is required. Natural England advises that further consideration of cable protection may be required. We advise that this protection is included in the assessment.	Based on the results from the outline CBRA, (Volume 1, Appendix 3.4 of the ES), cable protection associated with the cable trenching is not anticipated within Bideford Bay. Local protection at the HDD exit pits will be provisioned by use of either low profile concrete mattresses, or placed rock below seabed level and not expected to impede local mobile sediments. (**Section 8.11** & **Section 8.12**).
July 2024	Public PEIR response	Comment relating to the requirement for specific measures to manage sediment plumes, as a result of construction activities i.e. silt curtains, timing of works.	Refer to Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES for discussion of specific measures to be incorporated within scheme to manage impacts

Date	Consultee and type of response	Issues raised	How and where considered in the ES
			associated with sediment plumes. Specifically, it is proposed that construction activities within Bideford Bay (including construction of the HDD exit pits) should not be undertaken during peak spring tides to limit potential for sediment transport.
October 2024	MMO	Discussion of MMO Section 42 consultation responses – in particular regarding the details of the baseline sediment chemistry analysis data.	MMO advised that technical discussions with MMO technical advisors Cefas (specifically sediment chemistry experts) should be undertaken (c.f. November meeting directly below).
November 2024	MMO and Cefas	A number of queries relating to the sediment grab samples, including the extent of chemical characterisation.	A meeting took place with Cefas as MMO's technical advisors on 8/11/24 to further discuss the Proposed Development's sediment chemistry characterisations, specifically the laboratory analyses undertaken on the baseline sediment grab samples. The key outcomes of this meeting are summarised below: • The advanced state of the EIA studies including characterisation of sediment types (in particular particle size, and organic concentrations), current movements and sediment dispersal potential along the Offshore Cable Corridor provides a detailed background and context for consideration of chemical contamination risk. In other words the risk of contamination along the Offshore Cable Corridor is in general low. • The particle size analysis laboratory methods were confirmed to be consistent with MMO method recommendations (undertaken using approved laboratory and appropriate methods). • The chemistry analyses were undertaken using an appropriate MMO approved laboratory, however in places the methods were not precisely as recommended by MMO guidance (MMO, 2018)

Date	Consultee and type of response	Issues raised	How and where considered in the ES
			• It was noted that the metals analysis was undertaken using strong acid digest, which in-effect constitutes a precautionary approach. Cefas noted that this is acceptable. They also noted that they would have expected the laboratory to report zinc. Post meeting, further interpretation of the original metals analysis has been commissioned to extract zinc data, which will be presented as supplementary information (post DCO application). Cefas noted that 2010 data from a capital dredge at Appledore Shipyard inside the Torridge Estuary, found zinc data of 72 mg/kg (well below AL1). Levels in Bideford Bay would be expected to be lower and considering the low Total Organic Carbon levels, zinc is not expected to be elevated or of concern (with regards marine licensing implications). • Analysis for organotin compounds was omitted from the sediment analysis. Following the meeting, the laboratory have confirmed that sample volume has been retained and samples stored in amber glass jars and kept frozen. Cefas noted that it would be worth retesting them even though it is outside of the standard holding time window (analysis has been commissioned post meeting). TBT concentrations from the Appledore dredge samples (desk based background data) are 0.077 mg/kg and 0.002 mg/kg (below AL1) and concentrations would be expected to have further reduced in recent years given the effects of the TBT ban. Thus organotins are not expected to be elevated or of concern (with regards marine licensing implications)

Date	Consultee and type of response	Issues raised	How and where considered in the ES
			• Analysis for PCBs was previously omitted from the sediment analysis. In the light of the low levels of fines and Total Organic Carbon recorded, and the absence of any sources past or current posing a high risk of PCB releases, it was suggested that risk of PCB contamination is low, and if necessary (on account of sample volume) TBT analysis should be prioritised (post meeting organotin analysis commissioned – dependent on sample volume). Cefas stated that retesting is acceptable subject to the same criteria being met as for TBT, i.e. samples have been stored frozen, in the dark, in glass containers and not thawed out frequently. Following the meeting, the laboratory has confirmed that samples have been retained in amber glass jars and kept frozen. PCBs are not expected to be elevated or of concern (with regards marine licensing implications). • Cefas agreed that any chemical re-analysis of samples should focus on the Section 1 (Bideford Bay) samples only, as this is the zone with the highest proportion of fines, the greatest potential for transport (transport of any disturbed sediments – as confirmed by sediment dispersal assessments; c.f. Appendix 8.1:Sediment source concentrations and assessment of disturbance, of this ES), and the greatest potential for inshore historic contaminant inputs from the Taw/Torridge Estuary. • The analyses of PAHs, TPHs and TOC were discussed, with no additional testing recommended.

Date	Consultee and type of response	Issues raised	How and where considered in the ES
			In summary, following review of the laboratory sediment chemistry data (which in places did not employ testing methods recommended by MMO guidance), it was agreed, that with targeted additional testing of the retained samples (to provide additional validation data and increase confidence) the dataset would be sufficient to support marine licensing. The current data are thus deemed suitable for the purposes of this ES. The supplementary data will be provided and discussed with Cefas/MMO beyond the date of submission for DCO (beyond finalisation of this ES chapter) but prior to any issue of an associated Deemed Marine Licence.

8.4 Study Area

8.4.1 The physical processes study area comprises the Offshore Cable Corridor (that extends from MHWS at the landfall to the EEZ boundary) with a 30 km buffer area (Volume 3, Figure 8.1 Physical Processes Assessment Study Area of the ES). This was a maximum, conservative distance that was determined by plotting tidal ellipses from tidal speed and direction data and calculating the maximum distance of tidal excursion. The study area is shown to be sufficiently precautionary given the subsequent maximum extent of sediment transport across the entire OCC (approx. 7 to 15km).

8.4.2 The study area accounts for the potential local and regional effects on hydrodynamics and sedimentary processes. Outside of this buffer distance, it is unlikely that any direct impacts upon physical processes will be attributable to the Proposed Development.

8.4.3 For the purposes of the assessment of impacts, the study area has been divided into three sub-areas. The extent of these sub-areas is based on water depth (relative to Ordnance Datum) and are as follows:

- shallow water: water depth less than -5 mAOD;
- coastal water: water depths between -5 mAOD and -20 mAOD; and
- deep water: water depth greater than -20 mAOD.

8.4.4 The definitions of shallow, coastal and deep water are aligned with the CIRIA definitions within the CIRIA Rock Manual (C683) (CIRIA, 2007).

8.5 Scope of the Assessment

8.5.1 The scope of this ES has been developed in consultation with relevant statutory and non-statutory consultees as detailed in **Table 8.6** and **Table 8.7**. A range of potential impacts on physical processes have been identified, which may occur during the construction, operation and maintenance, and decommissioning phases of the Proposed Development.

8.5.2 Taking into account the scoping and consultation process, **Table 8.8** summarises the impacts considered as part of this assessment.

8.5.3 Following receipt of the Scoping Opinion, the potential effects scoped into the assessment have been confirmed as follows:

- Changes to metocean conditions i.e. currents and waves (referred to as 'impacts on local metocean processes' in the EIA Scoping Report). Applies to nearshore only, in water depths of less than 20m.
- Sediment disturbance or seabed change (referred to as 'physical disturbance of seabed geology and morphology, impacts on sediment regimes and the generation of sediment plumes' in the EIA Scoping Report).
- Changes to water quality (referred to as 'potential for an increase in physical, chemical and biological contaminants through the suspension of contaminated sediment' in the EIA Scoping Report).
- Secondary (localised) scour, around protection at cable crossings.

8.5.4 The potential effects have been updated subsequently, following e.g. comments received from Natural England in response to the PEIR chapter, relating e.g. to the inclusion of sediment disturbance or seabed change for the operational and maintenance phase.

Table 8.8: Impacts considered within this assessment

Activity	Impacts scoped into the assessment
Construction Phase	
Route preparation, i.e. clearance of uneven seabed.	Sediment disturbance or seabed change.
Laying of cables including cable burial, placement of additional protection where burial is not possible and excavation of HDD exit points.	Changes to water quality.
Placement of scour protection and/or additional rock at cable crossings.	Secondary (localised) scour.
Operational and Maintenance Phase - normal	
HDD exit point	Changes to metocean conditions.
Placement of scour protection and/or additional rock at cable crossings.	Sediment disturbance or seabed change. Changes to water quality Secondary (localised) scour
Operational and Maintenance Phase – repair activities only	
Cable repair and maintenance	Sediment disturbance or seabed change.
Cable remedial burial	
Maintenance of external cable protection	Changes to water quality.
New external cable protection	Secondary (localised) scour.
Decommissioning Phase - removal	
Removal of all cables	Sediment disturbance or seabed change; Changes to water quality.
Decommissioning Phase – *in situ*	
HDD crossing	Sediment disturbance or seabed change. Secondary (localised) scour.

8.5.5 Impacts that are not likely to result in significant effects have been scoped out of the assessment. A summary of the impacts scoped out, together with justification for scoping them out is presented in **Table 8.9**.

Table 8.9: Issues scoped out of the assessment

Activity	Impact	Justification
Construction Phase		
Route preparation, i.e. localised clearance of uneven seabed.	Changes to metocean conditions	Construction phase activities will be localised and short-term which are deemed negligible in the context of metocean conditions operating on a much greater spatial (regional) and temporal (multi-tide and seasonal) scale. Consideration of potential for short-term met-ocean change is included in the operational phase discussions around 'Changes to Metocean Conditions' c.f. **Section 8.12**.
Laying of cables.	Changes to metocean conditions	
Placement of scour protection and/ or additional rock at pipeline or cable crossings.	Changes to metocean conditions	
Operation and Maintenance		
Maintenance activities only (similar to construction phase methodologies).	Changes to metocean conditions	Operation and maintenance phase activities will be localised and short-term which are deemed negligible in the context of metocean conditions operating on a much greater spatial (regional) and temporal (multi-tide and seasonal) scale.
Placement of very small quantities of plastic in the marine environment (concrete scour mattress ties).	Changes to water quality	Pre-cast concrete mattresses may include small quantities of integrated plastic. These plastic components may be used as handles / fixing points and are standard design features for concrete mattresses used in the marine environment. The type of plastic will be suitably robust and resistant to deterioration i.e. appropriate for long-term deployment (50+ years minimum) in the marine environment. Mattresses will be covered with rock protection or sediments, which will further reduce potential for deterioration. There is not considered therefore to be potential for associated risks to water quality and any associated impacts are scoped out of this assessment.
Decommissioning Phase		
Removal of all cables	Changes to metocean conditions	Disturbance associated with decommissioning phase activities will be localised and short-term which are deemed negligible in the context of metocean conditions operating on a much greater spatial (regional) and temporal (multi-tide and seasonal) scale.
Decommissioning leaving *in situ* (excl. HDD crossing)	Changes to metocean conditions Sediment disturbance or seabed Changes to water quality	

8.5.6 Changes to metocean conditions have been scoped out of all phases, where depths are greater than 20m. This is on the basis that the water depth is sufficient for the effects on the seabed, from waves and currents, to be negligible (even where localised, temporary and/ or permanent localised changes to the bathymetry are proposed – via placement of rock). Refer to **Table 8.21** for more evidence that this assumption is appropriate. This approach is consistent with that presented at Scoping and PEIR stages. However, for depths shallower than 20m, an assessment of changes to metocean conditions is included for the operational and maintenance phase.

8.6 Methodology

Relevant Guidance

8.6.1 Guidance documents relevant to the assessments undertaken for physical processes include the following:

- Environmental impact assessment for offshore renewable energy projects. Guide (BSI, 2015);
- Guidelines for the use of metocean data through the life cycle of a marine renewable energy development (C666) (Copper, Saulter & Hodgetts, 2008);
- Offshore Windfarms: Guidance note for Environmental Impact Assessment in Respect of FEPA and CPA requirements. (Cefas, 2004);
- Guidance on Best Practice for Marine and Coastal Physical Processes Baseline Survey and Monitoring Requirements to Inform EIA of Major Development Projects Report No 243. 2018 (Brooks, Whitehead, Lambkin, 2018);
- Natural England and JNCC (2019). Natural England and JNCC advice on key sensitivities of habitats and Marine Protected Areas in English Waters to offshore wind farm cabling within Proposed Round 4 leasing areas. September 2019.
- South West Inshore and South West Offshore Marine Plan (Defra, 2021);
- Clearing the Waters for All (Environment Agency, November 2017);
- Advice Note Eighteen: Water Framework Directive (The Planning Inspectorate, June 2017);
- CIRIA Rock Manual (C683) (CIRIA, 2007);
- Planning Practice Guidance (PPG) – Flood Risk and Coastal Change; and
- Planning Practice Guidance (PPG) – Water supply, wastewater and water quality.

Methodology for Baseline Studies

Desk Studies

8.6.2 To inform this ES chapter, a high-level desk-based assessment has been conducted for physical processes receptors using a range of existing metocean, sediment and water quality data (**Table 8.10**).

Table 8.10: Desk based baseline data sources – Physical processes

Source	Summary
CIRIA Rock Manual (C683).	Design manual for the use of rock in coastal and shoreline engineering.
Soulsby (1997) Dynamics of Marine Sands.	Presents methods for calculating the various hydrodynamic and sediment dynamic quantities necessary for marine sediment transport applications.
European Marine Observation and Data Network (2023) EMODnet Map Viewer.	The European Marine Observation and Data Network. Used to view freely available Digital Terrain Model (DTM) for the European sea regions. DTM is based upon a collection of bathymetry surveys, Composite DTMs and Satellite Derived Bathymetry.
UK Renewables Atlas (n.d.).	Tidal Range, Tidal currents, Waves, Winds. Shapefile for download for Tides, Wind and Waves (tiles around UK).
Navionics ChartViewer. Navionics (2023).	Freely available electronic navigation charts of marine areas around the world.
National Tide and Sea Level Facility.	Tidal water levels from point locations within the study area.
UK Hydrographic Office (n.d.) Admiralty Total Tide. Version 19.	Provides accurate tidal height and tidal stream predictions for more than 7000 ports and 3000 tidal streams worldwide.
WSP Severn Estuary Regional MIKE Model.	Wave and hydrodynamic model of the Severn Estuary (covering Bristol Channel and Celtic Sea to Lands End) created by WSP. Used to calculate size of wind-generated waves and swell.
Coastal Observatory (2024). South West Coastal Monitoring.	Provides long-term coastal monitoring data for the south west coast of England.
British Geological Survey (BGS) GeoIndex Offshore	Mapping showing the marine geoscience data held within the National Geoscience Data Centre, primarily shallow geology and geophysics data.
Halcrow (2010) North Devon Shoreline Management Plan 2.	Shoreline Management Plan for North Devon written by Halcrow for the North Devon and Somerset Coastal Advisory Group. Identifies the most sustainable approach to managing flood and coastal erosion risks in the short, medium and long term.
Uncles and Stephens (2007) SEA 8 Technical Report – Hydrography.	Provides a high-level overview of the hydrography in the SEA8 area which covers UK waters including the Bristol Channel, Celtic Sea and English Channel.
OSPAR Commission (2000) Quality Status Report 2000 – Region III Celtic Seas.	Report produced by the Convention for the Protection of the Marine Environment in the North Atlantic, who are required to undertake regular assessments of the quality status of the marine environment.
OSPAR (2017). Intermediate Assessment 2017	This report details human pressures on the North East Atlantic, their effects and the implications for biological diversity of this marine area. It also provides an update to previous assessment work.
Cefas (2016) Suspended Sediment Climatologies around the UK	In 2016, Cefas mapped the spatial distribution of average annual suspended sediment concentrations across the UK continental shelf, between 1998 and 2015. Results are contained within this report.
Environment Agency (2023) Catchment Data Explorer.	Database which includes information on the water quality status of water bodies within England.

Source	Summary
Environment Agency (2023) Water Quality Archive.	Provides data on water quality measurements at sampling points around England, including within coastal and estuarine waters.
Met Office (2024) UK Climate Projections.	Provides a set of tools and data that show how the UK climate may change in the future.
Environment Agency (2022) Flood Risk Assessment: Climate Change Allowances.	Details when and how local planning authorities, developers and their agents should use climate change allowances for the preparation of Flood Risk Assessment for Planning Applications and Development Consent Orders (DCO) for nationally significant infrastructure projects.
LMR Drilling UK Ltd (2023). Cable Landfall HDDs Feasibility Report.	Report provides a review of information available to assess the feasibility and challenges associated with HDDs at the specific project landfall location.

8.6.3 As part of the desk-based assessment for the physical processes chapter and to support the assessment of likely impacts, a semi-empirical analysis has been undertaken to predict construction activity related sediment disturbance and distribution. More detail regarding the methodology and results can be found in Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES.

Site-Specific Surveys

8.6.4 In addition to the data sources identified above, the following site-specific surveys have informed the baseline assessment for physical processes (**Table 8.11**).

Table 8.11: Site specific surveys – Physical Processes

Source	Summary
Geophysical surveys	Geophysical surveys, completed between August and October 2023, including collection of seabed data using a multibeam echosounder (MBES), sidescan sonar, magnetometer and Sub-bottom Profiler (SBP) Shallow and Deep SBP Dura Spark 400 for seismic data. The sidescan sonar and bathymetry from the MBES were interpreted to inform the survey plan for drop-down video (DDV) and grab surveys.
Subtidal DDV surveys	Seabed video footage was acquired, between September and October 2023, to ground truth all sediment grab locations, features of interest and to facilitate a habitat assessment. A total of 61 camera transects were acquired across the survey area using a STR Seabug system mounted on a camera sled or a Freshwater Lens system.
Subtidal Grab surveys	51 sediment grab stations were sampled along the UK section of the Offshore Cable Corridor in November 2023. The majority of stations were sampled with a Double Van Veen (DVV) grab (2 x 0.1 m^2) with stations with coarser sediments sampled with a 0.01 m^2 mini-Hamon grab. Samples were acquired to provide data on physico-chemistry and macrofauna at sampling stations.

Impact Assessment Methodology

Overview

8.6.5 The approach to determining the significance of effects is a two-stage process that involves defining the magnitude of the impact and the sensitivity of the

receptor. This section describes the criteria applied in this chapter to assign values to the magnitude of impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in Volume 1, Chapter 5: EIA methodology of the ES.

Receptor Sensitivity/Value

8.6.6 The criteria for defining sensitivity in this chapter are outlined in **Table 8.12**. To incorporate value into the assessment, it has been included as part of the sensitivity criteria outlined in **Table 8.13**. It should be noted, however, that conservation value and high sensitivity are not necessarily linked for a particular effect. For example, a receptor could be of international or national importance (e.g. an interest feature such as outcropping strata for a geological protected site) but have a low or negligible physical/ecological sensitivity to an impact (such as short-term and localised suspended sediment increases) and vice versa. Consequently, when determining the sensitivity level taken forward to assessment, site-specific considerations and professional judgement have been considered.

Table 8.12: Value criteria for physical processes receptors

Sensitivity	Definition
Very High	Very high importance and rarity, international scale and very limited potential for substitution.
High	High importance and rarity, national scale and limited potential for substitution
Medium	High or medium importance and rarity, regional scale, limited potential for substitution
Low	Low or medium importance and rarity, local scale
Negligible	Very low importance and rarity, local scale

8.6.7 The criteria for defining sensitivity in this chapter are outlined in **Table 8.13** below. Sensitivity has been considered as required when assessing effects, and information relating to sensitivity of receptors to impacts has been clearly indicated in the assessment narrative where appropriate.

Table 8.13: Sensitivity criteria for physical processes receptors

Sensitivity	Definition
Very High	**Vulnerability**: The receptor cannot tolerate the impact. **Recoverability**: The effect on the receptor is anticipated to be permanent. **Value**: The receptor is of international value.
High	**Vulnerability**: The receptor cannot or has very low capacity to tolerate the impact. **Recoverability**: Partial recovery is only likely to occur after about 10 years and full recovery may take over 25 years. **Value**: The receptor is of international or national value.
Medium	**Vulnerability**: The receptor has limited capacity to tolerate the impact. **Recoverability**: Only partial recovery is likely within 5 years and full recovery is likely to take up to 10 years. **Value**: The receptor is of national or regional value.
Low	**Vulnerability**: The receptor has a reasonable capacity to tolerate the impact. **Recoverability**: Full recovery will occur but will take many months (or more likely years) but should be complete within about five years. **Value**: The receptor is of regional or local value.

Sensitivity	Definition
Negligible	**Vulnerability**: The receptor has a high capacity to tolerate the impact. **Recoverability**: The receptor is anticipated to recover immediately (seconds to days). **Value**: The receptor is of regional or local value.

Magnitude of Impact

8.6.8 The criteria for defining magnitude in this chapter are outlined in **Table 8.14**.

Table 8.14: Impact magnitude criteria

Magnitude of impact		Definition
High	Adverse	• Large far-field spatial extent with scale of change greater than the natural variability with a continuous signal extending long-term. • Major deterioration of WFD status or deterioration of one or more of the WFD quality elements. • Major pollution of waterbody.
	Beneficial	• Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality.
Medium	Adverse	• Near-field spatial extent with scale of impact with the same order as the natural variability, frequently occurring in the long-term; or immediate spatial extent (the Offshore Route Corridor) with scale of change greater than the natural variability, occurring frequently over a short timescale. • Some contribution or reduction of pollution entering feature, but insufficient to change WFD classification. • Moderate pollution of waterbody.
	Beneficial	• Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Low	Adverse	• Near-field spatial extent with scale of impact smaller than the natural variability, frequently occurring over a short/temporary timescale. • Minor risk of pollution, minor temporary changes in water quality such that ecology is temporarily affected. Equivalent to a temporary minor, but measurable, change within WFD status class. • Minor pollution of waterbody.
	Beneficial	• Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	Adverse	• Immediate spatial extent, with scale of impact smaller than the natural variability, occurring infrequently over a short/ temporary timescale. • Negligible risk of pollution. Risk of pollution from spillages <0.5% annually.
	Beneficial	• Very minor benefit to, or positive addition of one or more characteristics, features or elements.
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.	

Significance of Effect

8.6.9 The significance of the effect upon physical processes has been determined by taking into account the sensitivity of the receptor and the magnitude of the impact. The method employed for this assessment is presented in **Table 8.15**. Where a range of significance levels is presented, the final assessment for each effect is based upon expert judgement.

8.6.10 In all cases, the evaluation of receptor sensitivity, impact magnitude and significance of effect has been informed by professional judgement and is underpinned by narrative to explain the conclusions reached.

8.6.11 For the purpose of this assessment, any effects with a significance level of minor or less are not considered to be significant in terms of the EIA Regulations.

Table 8.15: Assessment Matrix

Sensitivity of Receptor	Magnitude of Impact			
	Negligible	Low	Medium	High
Negligible	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	Negligible or Minor	Minor	Moderate	Moderate or Major
High	Minor	Minor or Moderate	Moderate or Major	Major
Very High	Minor	Moderate or Major	Major	Major

8.6.12 Where the magnitude of impact is 'no change', no effect would arise.

8.6.13 The definitions for significance of effect levels are described as follows:

- Major: These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category. Effects upon human receptors may also be attributed this level of significance.
- Moderate: These beneficial or adverse effects have the potential to be important and may influence the key decision-making process. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse or beneficial effect on a particular resource or receptor.
- Minor: These beneficial or adverse effects are generally, but not exclusively, raised as local factors. They are unlikely to be critical in the decision-making process but are important in enhancing the subsequent design of the project.
- Negligible: No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.
- No change: No loss or alteration of characteristics, features or elements; no observable impact in either direction.

Assumptions and Limitations of the Assessment

Grab Samples

8.6.14 The physico-chemical data, obtained for the 51 grab samples (as described in the baseline environment description, at **paragraph 8.7.65**), does not contain data for Zinc, Dibutyltin, Tributyltin, Total Hydrocarbon Content, or Polychlorinated Biphenyls, which are recommended as part of typical MMO recommended marine licensing analysis suites e.g. for comparison against Chemical Action Levels ('Cefas Action Levels').

8.6.15 As noted in **Table 8.7**, an initial meeting with the MMO took place on 17/10/24 to discuss their Section 42 comments, including comments on the extent of the sediment chemistry analyses. A subsequent meeting took place with Cefas, as the MMO's technical advisors, on 8/11/24 to further discuss the existing sediment chemistry characterisation and the analysis methods used by the laboratory when testing baseline grab samples. Following the Cefas discussions the baseline sediment chemistry characterisation is confirmed as appropriate for marine licensing purposes, subject to some limited additional validation testing. A summary of the key actions and further confirmations, to be reported post-submission, are provided below (refer to **Table 8.7** for further details):

- Further interpretation of the original metals analysis has been commissioned to extract zinc data for completeness, which will be presented to the MMO as supplementary information (post DCO application), c.f. **Table 8.7**;
- Analysis of retained Bideford Bay samples will be undertaken for organotins, (e.g. TBT) and presented to the MMO as supplementary information (post DCO application), c.f. **Table 8.7**;
- If sufficient sample volume is available (priority to be given to organotins analysis if sample volume is restrictive), retained Bideford Bay samples will be analysed for PCBs, c.f. **Table 8.7**.

8.6.16 It was agreed that subject to the targeted additional testing of the retained samples above (to provide additional validation data and increase confidence in conclusions), the dataset is sufficient to support marine licensing. The current data are thus deemed suitable for the purposes of this ES. The supplementary data will be provided and discussed with Cefas/MMO beyond the date of submission for DCO (beyond finalisation of this ES chapter) but prior to any issue of any associated Deemed Marine Licence.

Metocean Measurements

8.6.17 No project specific metocean data have been collected. The analysis within this ES chapter relies upon readily available metocean data, which is considered sufficient for giving a high-level understanding of the baseline metocean processes (notably waves and currents) across the expansive Proposed Development area.

8.6.18 These data have been presented to the MMO and Natural England as part of interim discussions around the sediment disturbance assessment approach. Natural England and the MMO/ Cefas have confirmed that they are happy with the approach (including metocean data used to inform the assessment) subject to the minor updates/ clarifications that have now been incorporated into the sediment

disturbance assessment (see Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES).

Sediment Transport

8.6.19 An analysis of sediment transport has been undertaken using semi-empirical methods and readily available metocean data, each of which have some inherent limitations.

8.6.20 The approach is based on 2D depth-averaged tidal current velocities (converted to bed velocity using semi-empirical relationships) and a combination of modelled and measured wave data (where available) near the Offshore Cable Corridor.

8.6.21 This high-level analysis suggests that disturbed sediment (as a result of activities associated with the construction of the Proposed Development) is only transported significant distances (up to 15.2 km within Bideford Bay and up to 7.5 km west of the Isles of Scilly) from the point of disturbance during peak spring tide currents, which occur for less than 3% of the month. Associated results should thus be viewed as highly precautionary.

8.6.22 For typical tidal conditions (i.e. mean spring and neap tides) which occur more frequently, the disturbed sediment (as a result of activities associated with the construction of the Proposed Development) is transported over shorter distances (between 3.5 and 12.6 km for mean spring tides and between 0 and 5 km for mean neap tides.

8.6.23 For more information, please refer to Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES.

8.6.24 These methods have been presented to the MMO (and Cefas) and Natural England to confirm whether they deem the semi-qualitative assessment (which are presented as a worst-case estimate of likely sediment transport distances), as a sufficient level of 'modelling' to inform the ES.

8.6.25 Natural England and the MMO/ Cefas have confirmed that they are happy with the approach (including metocean data used to inform the assessment) subject to the minor updates/ clarifications that are now included as part of the revised ES (and appendix).

8.7 Baseline Environment

Desk Study

8.7.1 Information on physical processes within the study area was collected through a detailed review of existing studies and datasets. These are summarised in **Table 8.16**.

Table 8.16: Summary of desk study sources used

Title	Source	Year	Author
EMODnet Map Viewer (Interactive map viewer of seabed habitats)	https://emodnet.ec.europa.eu/geoviewer/	2023	European Marine Observation and Data Network
Navionics ChartViewer (Navigation charts of marine areas)	https://webapp.navionics.com/#boating	2023	Navionics
UK Renewables Atlas (Freely available, tide, current, waves and wind data)	https://www.renewables-atlas.info/explore-the-atlas/	2024	ABPMer
National Tide and Sea Level Facility (Tidal water levels)	https://ntslf.org/	2024	National Tide and Sea Level Facility
Admiralty Total Tide (Tidal height and tidal stream predictions)	n/a	n.d.	UK Hydrographic Office
Severn Estuary Regional MIKE Model (WSP wave and hydrodynamic model)	n/a	2024	WSP
South West Coastal Monitoring (Long term coastal monitoring data for the south west)	https://southwest.coastalmonitoring.org/	2024	Coastal Observatory
GeoIndex Offshore (Offshore geology)	https://www.bgs.ac.uk/map-viewers/geoindex-offshore/	2024	BGS
North Devon Shoreline Management Plan 2 (Identifies approaches to managing flood and coastal erosion risks in North Devon)	https://southwest.coastalmonitoring.org/projects/shoreline-management-plans/ndascag-smp2/	2010	Halcrow
SEA 8 Technical Report – Hydrography (High level overview of hydrography in the Bristol Channel and Celtic Sea)	https://assets.publishing.service.gov.uk/media/5a79ff7f40f0b66eab998ff5/SEA8_TechRep_Hydrography.pdf	2007	Uncles and Stephens
Quality Status Report 2000 – Region III Celtic Seas (Overview of water quality status of Celtic Sea)	https://qsr2010.ospar.org/media/assessments/QSR_2000_Region_III.pdf	2000	OSPAR Commission
Intermediate Assessment 2017 (Update to Quality Status Report 2000)	https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/introduction/ospar-and-intermediate-assessment-2017/	2017	OSPAR Commission
Suspended Sediment Climatologies around the UK (Mapping of average annual suspended sediment concentrations around UK)	https://assets.publishing.service.gov.uk/media/5a80b954e5274a2e8ab51cc7/CEFAS_2016_Suspended_Sediment_Climatologies_around_the_UK.pdf	2016	Cefas
Catchment Data Explorer (Water quality status of UK WFD waterbodies)	https://environment.data.gov.uk/catchment-planning/	2023	Environment Agency
Water Quality Archive (Water quality measurements at sampling points)	https://environment.data.gov.uk/water-quality/view/sampling-point/SW-72910055	2023	Environment Agency

Title	Source	Year	Author
UK Climate Projections (Tools and data to show how UK climate may change)	https://www.metoffice.gov.uk/research/approach/collaboration/ukcp	2024	Met Office
Flood Risk Assessment: Climate Change Allowances (Details how climate change allowances should be used)	https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances	2022	Environment Agency
Xlinks Cable Landfall HDDs Feasibility Report. (Review of HDD methodology and identifies mitigations where required)	n/a	2023	LMR Drilling UK Ltd
The Rock Manual (Design manual for use of rock in coastal environment)	n/a	2007	CIRIA
Dynamics of Marine Sands (Design manual for sediment movement)	n/a	1997	Soulsby
Hydrology and Flood Risk: the Surf Zone dataset	https://environment.data.gov.uk/dataset/77e6f743-d708-4909-a80f-9510b7dbaa16	2019	Environment Agency
Coastal Standards Technical Report (LIT 56561)	n/a	2022	Environment Agency
Coastal Flood Boundary dataset	https://www.data.gov.uk/dataset/645536e9-159d-4d96-9170-54410694b1e2/coastal-design-sea-levels-coastal-flood-boundary-estuary-boundaries-2018	2018	Environment Agency
National Coastal Erosion Risk Mapping	https://www.data.gov.uk/dataset/7564fcf7-2dd2-4878-bfb9-11c5cf971cf9/national-coastal-erosion-risk-mapping-ncerm-national-2018-2021	2024	Environment Agency
UKSeaMap: the mapping of seabed and water column features of UK seas	https://hub.jncc.gov.uk/assets/07a4513b-f04a-41c2-9be2-4135a14d0d15	2006	JNCC
Stratified and non-stratified areas in the North Sea: Long-term variability and biological and policy implications.	Journal of Geophysical Research: Oceans	2015	Van Leeuwen et al.

8.7.2 In the context of Physical Processes characterisation (and impact consideration), the Offshore Cable Corridor has been divided into three sub-lengths. The sub-lengths are based on the water depth (relative to ordnance datum) and are as follows:

- shallow water: water depths less than -5 mAOD;
- coastal water: water depths between -5 mAOD and -20 mAOD; and
- deep water: water depth greater than -20 mAOD.

8.7.3 The definitions of shallow, coastal, and deep water are aligned with the CIRIA definitions within the CIRIA Rock Manual (C683) (Ciria, 2007).

Bathymetry

8.7.4 Bathymetry data for the Offshore Cable Corridor was obtained from WSP's Severn Estuary Regional MIKE Model, which uses a combination of measured data and data from online sources including the EMODnet online portal.

8.7.5 Generally, the seabed rises from the EEZ boundary towards the UK coast at Cornborough. Typical water depths in deep water are approximately 90 m, with maximum water depths of approximately 130 m experienced to the west of the Isles of Scilly/near to the EEZ boundary. Within Bideford Bay, water depths are typically less than 20 m (coastal/shallow waters).

8.7.6 The seabed typically has a shallow, uniform slope with typical gradients of 1:60 in shallow waters (in agreement with the Environment Agency's Surfzone Digital Elevation Model, up to 0.3 km from landfall), 1:500 in coastal waters (up to 10 km from landfall), and 1:3500 in deep water.

8.7.7 There are no unusual or irregular bathymetric/morphological features of significant interest on the seabed within this area. The primary bedforms are in sandy areas (which is applicable to most of the offshore cable corridor) and comprise sand ripples and megaripples (refer to Volume 3, Figure 8.10: Seabed Features of the ES). These bedforms were observed across much of the survey area, the distribution and orientation of which largely reflected recent storm conditions.

Metocean Conditions

Water Levels

Shallow and Coastal Waters

8.7.8 Measured water level data was obtained from Admiralty Total Tide for Clovelly, located within Bideford Bay, approximately 10 km to the west of the Offshore Cable Corridor (**Table 8.17**). Bideford Bay is subject to a macrotidal regime, with a tidal range of up to 7.4 m.

Table 8.17: Standard Tidal Elevations at Clovelly (51°00'N, 04°24'E)

Tidal State	Elevation (mCD)	Elevation (mAOD)
Highest Astronomical Tide (HAT)	9.2	4.8
Mean High Water Springs (MHWS)	8.3	3.9
Mean High Water Neaps (MHWN)	6.3	1.9
Mean Low Water Neaps (MLWN)	2.7	-1.7
Mean Low Water Springs (MLWS)	0.9	-3.5
Lowest Astronomical Tide (LAT)	0.1	-4.3

8.7.9 Extreme water levels have been extracted from the Environment Agency's Coastal Design Sea Levels (2018) (Chainage 218), and uplifted to a baseline year of 2032 and 2083 (in line with the operational design life) using the Upper End estimates for climate change (**Table 8.18**).

Table 8.18: Extreme Sea Levels, Environment Agency Coastal Design Sea Levels, Chainage 218

	Water Level (2032) (mAOD)	Water Level (2083) (mAOD)
Mean High Water Springs	4.1	4.7
Highest Astronomical Tide	5.0	5.6
1 in 1 year extreme sea level	5.1	5.8
1 in 50 year extreme sea level	5.6	6.2
1 in 100 year extreme sea level	5.6	6.3

Deep Water

8.7.10 Measured water level data was obtained from Admiralty Total Tide for various offshore locations within the Celtic Sea (**Table 8.19**). Whilst not directly within the Offshore Cable Corridor, the measured water level data gives an indication of the tidal regime within the Celtic Sea.

Table 8.19: Standard Tidal Elevations (Deep Water)

Tidal State	50 55N 05 00W (mCD)	50 15N 06 10W (mCD)	49 40N 07 00W (mCD)	48 48N 07 01W (mCD)
HAT	8.3	7.0	5.9	5.4
Mean Sea Level (MSL)	4.1	3.35	2.96	2.60
LAT	0.2	0.1	0.2	0.0

Waves

8.7.11 The ABPmer Renewables Atlas was used to obtain annual and seasonal average wave heights along the Offshore Cable Corridor (**Table 8.20**).

Table 8.20: Annual and Seasonal Average Wave Heights (ABPmer, 2024)

	Annual Wave Height (m)	Spring Wave Height (m)	Summer Wave Height (m)	Autumn Wave Height (m)	Winter Wave Height (m)
Bideford Bay	1.43	1.36	1.04	1.50	1.85
North Devon/ Cornwall Coast	1.84	1.75 – 1.84	1.04	1.91 – 2.15	2.36
Celtic Sea & Isle of Scilly's	2.37	2.21 – 2.31	1.38 – 1.53	2.15 – 2.42	2.68 – 3.08

8.7.12 More detailed analysis was undertaken using measured and modelled wave data, obtained from a range of sources in and around the study area (refer to Volume 3, Figure 8.5: Location of Water Level Data of the ES, for locations). **Table 8.21** summarises typical wave heights and directions of the eight locations analysed. For more detail, please refer to Volume 3, Appendix 8.2: Wave and Tidal Conditions of the ES.

Table 8.21: Summary of Wave Heights and Directions

Name	Measured/ Modelled	Water Depth (Seabed Level, mAOD)	Typical Significant Wave Heights (m)	Largest Significant Wave Height (m)	Wave Height that will 'feel' the seabed (m)	Dominant Wave Direction
Bideford Bay (shallow water)	Modelled	-6	0.0 - 2.5	4.1	0.6	WNW
Bideford Bay (coastal water)	Measured	-15	0.5 - 4.5	6.9	1.5	W
Bristol Channel (deep water)	Modelled	-60	0.0 - 5.5	9.0	6	WSW
North Cornwall Coast (deep water)	Modelled	-75	0.0 - 6.0	9.9	7.5	WSW
Perranporth (coastal water)	Measured	-21	0.5 - 5.0	7.7	2.1	W
Wave Hub (deep water)	Measured	-55	0.5 - 4.5	10.1	5.5	W
SW Model Western Extent (deep water)	Modelled	-80	0.0 - 6.5	11.0	8.0	WSW
Isles of Scilly (deep water)	Measured	-95	1.0 - 6.0	13.5	9.5	WNW

8.7.13 Overall, the largest waves at each of the measured/modelled locations predominantly originate from west / west-south-westerly directions. The largest modelled / recorded significant wave heights increase as the distance offshore from Bideford Bay increases. This is to be expected since the offshore locations are more exposed to Atlantic swells.

8.7.14 The Soulsby method (Soulsby, 1987) has been used to calculate the depth at which the effects of the bottom orbital velocity of a wave will be felt. It can be seen that, at the locations along the Offshore Cable Corridor shown in **Table 8.20** (modelled data), the effects of the waves will only be felt on the seabed during extreme events.

Currents

Shallow and Coastal Waters

8.7.15 According to data within the North Devon and Somerset Shoreline Management Plan (SMP), currents within Bideford Bay are moderate, ranging between 0.5 and 1 m/s during peak tidal periods (unconfirmed whether this relates to surface or depth-averaged currents, or some other definition).

8.7.16 ABPmer's UK Renewables Atlas which gives spring peak flows as between 0.36 m/s and 0.67 m/s and neap peak flows of between 0.23 m/s and 0.45 m/s which are slightly lower than those extracted from the SMP.

8.7.17 Tidal currents were also extracted from the DHI Global Tide model. Depth-averaged spring peak velocities within Bideford Bay were larger, in the region of 1.14 m/s and depth-averaged neap peak currents were calculated as 0.57 m/s. These are comparable to the current velocities provided within the SMP.

8.7.18 For more information on tidal currents, refer to Volume 3, Appendix 8.2: Wave and Tidal Conditions of this ES.

8.7.19 Tidal stream data have been extracted from the UKHO Admiralty Total Tide software, to the north of Hartland Point at 51°03.13'N 4°33.97'W, and can be found in **Table 8.22**. Currents are higher at Hartland Point as measured data are around the headland.

Table 8.22: Tidal Streams (51°03.13'N 4°33.97'W)

Time	Direction (Deg)	Spring Rate (m/s)	Neap Rate (m/s)
-6	355	1.56	0.78
-5	066	3.11	1.36
-4	059	5.05	2.33
-3	060	5.05	2.33
-2	057	4.86	2.33
-1	061	3.30	1.56
HW	050	1.17	0.58
1	257	2.72	1.36
2	240	5.44	2.52
3	228	5.83	2.72
4	233	5.23	2.52
5	239	3.50	1.56
6	264	1.17	0.58

Deep Water

8.7.20 According to Uncles and Stephens (2007), tidal currents within the Celtic Sea/Bristol Channel Approaches include the North Atlantic Drift, which brings warm water from the Gulf Stream into the area. Currents can vary in strength and direction throughout the year but are typically 0.6 m/s during a spring tide.

8.7.21 According to ABPmer's UK Renewables Atlas, typical spring peak flows are in the region of 0.6 m/s, in agreement with Uncles and Stephens (2007). However, faster spring peak flows, located within the study area, are located around Lands End (approximately 0.81 m/s – 1.23 m/s) and the Isles of Scilly (approximately 0.83 m/s). Data extracted from the DHI Global Tide model broadly agrees, with depth-averaged spring tides between 0.64 and 0.97 m/s.

8.7.22 Typical neap peak flows typically between 0.26 m/s and 0.47 m/s along the offshore cable corridor (extracted from the DHI global model), increasing to 0.58 m/s near to Lands End and 0.52 m/s to the north of the Isles of Scilly (extracted from the UK Renewables Atlas).

8.7.23 For more information on tidal currents, refer to Volume 3, Appendix 8.2: Wave and Tidal Conditions of this ES.

8.7.24 Tidal stream data have been extracted from UKHO Admiralty Total Tide, to the north of St Ives at 50°19.03'N 5°52.06'W and to the west of the Isles of Scilly at 49°50.54'N 7°02.45'W. The data are presented in **Table 8.23** and **Table 8.24**.

Table 8.23: Tidal Streams (51°03.13'N 4°33.97'W)

Time	Direction (Deg)	Spring Rate (m/s)	Neap Rate (m/s)
-6	289	0.21	0.10
-5	337	0.31	0.15
-4	025	0.51	0.262
-3	040	0.72	0.36
-2	046	0.67	0.31
-1	057	0.21	0.10
HW	139	0.31	0.15
1	168	0.36	0.21
2	202	0.46	0.21
3	227	0.57	0.26
4	235	0.51	0.26
5	239	0.41	0.21
6	268	0.21	0.10

Table 8.24: Tidal Streams (49°50.54'N 7°02.45'W)

Time	Direction (Deg)	Spring Rate (m/s)	Neap Rate (m/s)
-6	283	0.31	0.15
-5	332	0.31	0.15
-4	007	0.46	0.26
-3	024	0.62	0.31
-2	044	0.62	0.31
-1	067	0.62	0.31
HW	087	0.46	0.26
1	133	0.31	0.15
2	183	0.46	0.21
3	203	0.62	0.31
4	233	0.62	0.31
5	251	0.57	0.31
6	271	0.36	0.21

Seabed Geology and Sediment Transport

Shallow and Coastal Waters

Geology and Geomorphology

8.7.25 The Culm Measures geological formation is found within Bideford Bay. This consists of a sequence of layers of shale and sandstone, and slate, limestone and chert, with the occasional presence of soft coal.

8.7.26 Much of the seabed is covered in thin, mobile sediments, typically sands or thin spreads of gravel, less than 1 m thick (Halcrow, 2010). The thickness of the

sediments decreases eastwards, towards the Bristol Channel as tidal current speeds increase.

8.7.27 BGS Offshore Geo index mapping, obtained by LMR Drilling UK Ltd for the 'Xlinks Cable Landfall HDDs Feasibility Report' (LMR 2023), indicates superficial deposits of Marine Sediments. No mapping is available for the bedrock, however it is assumed that it will be similar to that found onshore – predominantly Bideford Formation – Mudstone and Siltstone, with some areas of Bideford Formation – Sandstone.

8.7.28 Within Bideford Bay, the quaternary deposits have a thickness of <5 m (up to 830 m from the shoreline) and, after that, a thickness of 5 – 20 m.

8.7.29 A borehole (BH-51N005W_470) is located approximately 4 km to the north west of the proposed HDD location. The borehole shows sand and pebbles, with slate chippings, to a depth of 2 m, below which there is 2-3 m of clay with pebbles, which overlay grey shale bedrock.

8.7.30 The Environment Agency's National Coastal Erosion Risk Mapping (NCERM) was used to understand the geomorphology within the Study Area. Abbotsham Cliffs, located at the location of the proposed HDD exit point, shows the anticipated erosion extents and rates for the short term (0 – 20 years), medium term (20 – 50 years) and long-term (50 – 100 years). The erosions rates, alongside the Shoreline Management Plan 2 Policies are shown in **Table 8.25** below for the 95th percentile confidence levels.

Table 8.25: NCERM Mapping for Feature ID 81073, Environment Agency (2024)

Epoch	Erosion Rate	SMP2 Policy
Short Term	10.6	No active intervention
Medium Term	26.5	No active intervention
Long Term	53	No active intervention

Sediment Transport

8.7.31 Halcrow (2010) suggest the following broad description of sediment processes: 'sediment transport within Bideford Bay is largely self-contained within the bay. Mud and fine sand, eroded from the sandstone and shale cliffs, are transported in a clockwise direction, westwards towards Hartland Point, located at the western entrance to the bay. Hartland Point is a prominent headland which provides dominant control over the whole of Bideford Bay. Sediment is then transported beyond Hartland Point by tidal currents, and then returned and deposited back within Bideford Bay. Within Bideford Bay, wave induced transport [excluding the effects of currents] only occurs during storm events.'.

Deep Water

Geology

8.7.32 BGS Offshore Geo index mapping indicates superficial deposits of predominantly Marine Sediments (Gravelly Sands), with pockets of Gravel (notably around Lundy Island and off the north coast of Devon) and Rock (around Lands' End).

8.7.33 Bedrock of Devonian and Carboniferous Rock – Mudstone and Sandstone and Limestone is found along most of the Offshore Cable Corridor.

Sediment Transport

8.7.34 Maximum bottom shear stresses of 0.5 and 2 Pascals are predicted along the North Cornwall/Devon Coast, within the Bristol Channel approaches (Uncles and Stephens, 2007). This roughly equates to depth-averaged velocities (assuming an average water depth of 90 m along the offshore cable corridor) of 0.5 m/s to 1 m/s.

8.7.35 Within the Celtic Sea itself, the maximum bottom shear stresses predicted are between 0.25 and 0.5 Pascals (Uncles and Stephens, 2007). These low bed shear stresses are typically considered suitable for the movement of fine sediments only. This roughly equates to depth-averaged velocities (assuming an average water depth of 90m along the offshore cable corridor) of 0.4 m/s to 0.5 m/s.

8.7.36 The currents calculated by Uncles and Stephens (2007) are comparable to the depth-averaged currents extracted from the DHI global model; velocities were between 0.62 m/s and 1.2 m/s (equating to bed currents between 0.11 m/s and 0.39 m/s). Refer to Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of this ES.

8.7.37 Within the Bristol Channel, sediment transport is generally along the north coast, towards the Celtic Sea. Sediment transport within the Celtic Sea is typically towards the Atlantic Ocean except for around the northern extents of the Isles of Scilly, where sediment transport is towards Lands' End (**Plate 8.1**).

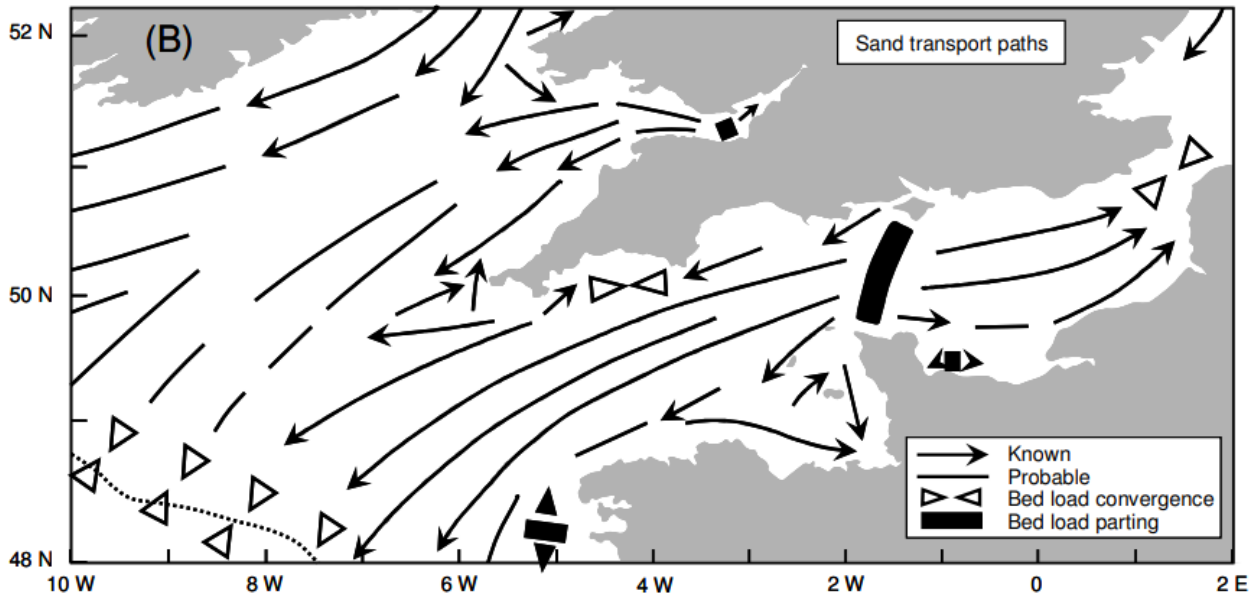

Plate 8.1: Sediment Transport Paths in the SEA 8 Region (Uncles and Stephens, 2007)

Water Quality

Suspended Sediment Concentrations

8.7.38 **Plate 8.2** shows the varying background surface suspended sediment (particulate matter) concentrations along the Offshore Cable Corridor. These data have been extracted from the Cefas dataset 'Monthly average non-algal suspended particulate matter concentrations' (Cefas, 2016)

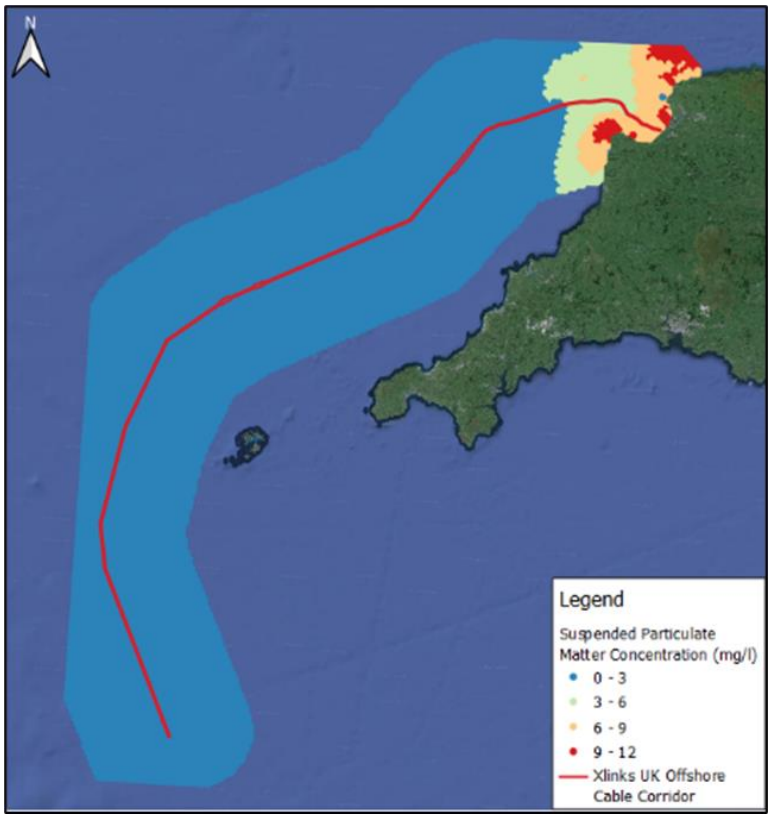

Plate 8.2: Monthly Average Suspended Particulate Matter Surface Concentrations 1998-2015

8.7.39 **Table 8.26** shows the same data in terms of the minimum, maximum, and average suspended sediment concentrations for shallow waters (<5 m depth), coastal waters (5-20m depth), and deep waters (>20 m depth) along the OCC.

Table 8.26: Suspended Sediment Concentrations by Water Depth

Water Depth	Minimum Concentration (mg/l)	Maximum Concentration (mg/l)	Average Concentration (mg/l)
Shallow (<5 m)	1.8	11.5	8.5
Coastal (5m – 20 m)	5.3	11.3	8.4
Deep (>20 m)	0.6	11.6	1.5

8.7.40 This modelled dataset uses monthly average sediment concentrations based on a satellite derived algorithm. This means that the values represent surface concentrations and do not show the likely variation of sediment concentrations at depth within the water column. Additionally, as the data is derived from satellite imagery, some weather conditions such as clouds make data capture more difficult, and maximum (short-term peak) concentrations are likely to be missed. Therefore, these results likely underestimate the background sediment concentrations along the OCC, particularly background concentrations at depth, and concentrations in shallow and coastal waters where wave action would be expected to mobilise significant volumes of sediment.

Physical Characteristics

8.7.41 The seabed sediments, along the Offshore Cable Corridor, are typically gravelly sand (EMODnet, 2024). Finer sands are present within Bideford Bay and around the western extents of the Isles of Scilly. Rocky outcrops are identified to the north of Land's End.

8.7.42 The site-specific surveys allowed a further detailed physical characterisation of sediments along the Offshore Cable Corridor – c.f. 'Site-specific surveys' section below.

Contaminants

8.7.43 Inputs affecting the water quality of the Celtic Sea include discharges to coastal waters from industrial and municipal outfalls, the dumping of waste at sea, mariculture and oil, typically from shipping and oil and gas installations.

8.7.44 Reports produced in the 1990's (OSPAR Commission, 2000) indicated that the presence of some heavy metals, including Cadmium, Mercury and Zinc, and Polychlorinated Biphenyls (PCBs), are decreasing within the Celtic Sea. However, inputs of Lead appeared to have risen slightly, whilst Copper inputs remain unchanged.

8.7.45 Estimates of concentrations of water quality contaminants within the study area are detailed below (OSPAR Commission, 2000):

- Cadmium: typically, in the region of 0.01 – 0.03 µg/l. The highest concentrations of 0.34 µg/l, within the Celtic Sea/Bristol Channel, can be found in the Severn Estuary, upstream of the Proposed Development. This is likely as a result of historic smelting activities near Bristol.
- Mercury: typically, between 0.2 – 0.5 µg/l, similar to background levels within the Atlantic Ocean.
- Levels of PCBs found in sandy sediments are typically below detection limits (between 0.2 – 0.5 µg/kg).
- Polycyclic Aromatic Hydrocarbons (PAHs) are low or undetectable (maximum concentration of 15 ng/l).
- Levels of Total Hydrocarbons are typically between 0.3 – 6.4 µg/l.
- An Interim Quality Status Report (OSPAR, 2017) states that since the 2010 report, concentrations of contaminants have decreased, especially PCBs. Furthermore, whilst concentrations of contaminants have continued to remain below levels likely to harm marine species, they have not yet reduced to

background levels (where specified). However, concerns remain in some areas over high levels of mercury, lead and CB118 (a toxic PCB congener) and locally increasing concentrations of PAH's and cadmium in open waters.

Stratification

8.7.46 Stratification is a naturally occurring seasonal hydrodynamic feature, relating to the distribution of sea water temperature and salinity within the water column, driven by gravity. Typically, hotter air temperatures in the summer can warm the water in the upper parts of the water column resulting in temperature differences with the bottom layers. The temperature can vary by up to 10 degrees. The differences in water temperatures results in a difference in densities within the water column; the warmer water is more buoyant, than the denser colder water. There is typically a steep gradient separating the two layers. The water column may be vertically mixed in one area and stratified in an adjacent area.

8.7.47 Stratification is more prevalent in deep water as, in shallow water, turbulence created by wind, waves and evaporation at the water surface combined with bottom friction at the bed can induce mixing of the two layers (i.e. forcing the cold water to rise and/ or the warm water to sink).

8.7.48 According to Uncles and Stephen (2007), the thermocline within SEA8 (within which the Proposed Development is located) firstly forms to the south of Ireland and then spreads eastwards, across the Celtic Sea, towards the mouth of the Bristol Channel. It takes about a month for the thermocline to extend as far south as the English Channel. The 'retreat' of the thermocline happens in reverse, and by December the Celtic Sea is vertically mixed (i.e. the temperature of the water is the same throughout the water column).

8.7.49 The UKSeaMap project (Connor et al., 2007) developed maps to show the seasonal ecological character of the water column, including surface to bed temperature difference. This study was updated by Van Leeuwen et al. (2005) to apply five 'regimes' i.e. is the water column at various locations permanently stratified, seasonally stratified etc. **Plate 8.3** shows the seasonal water column structure around the UK.

8.7.50 Typically, in the Spring, Autumn and Winter, the shelf water along the Offshore Cable Corridor is well-mixed, with weakly stratified shelf water in the Summer. However, stratified shelf water is likely in the Summer and Winter months from Lands End to the Isles of Scilly.

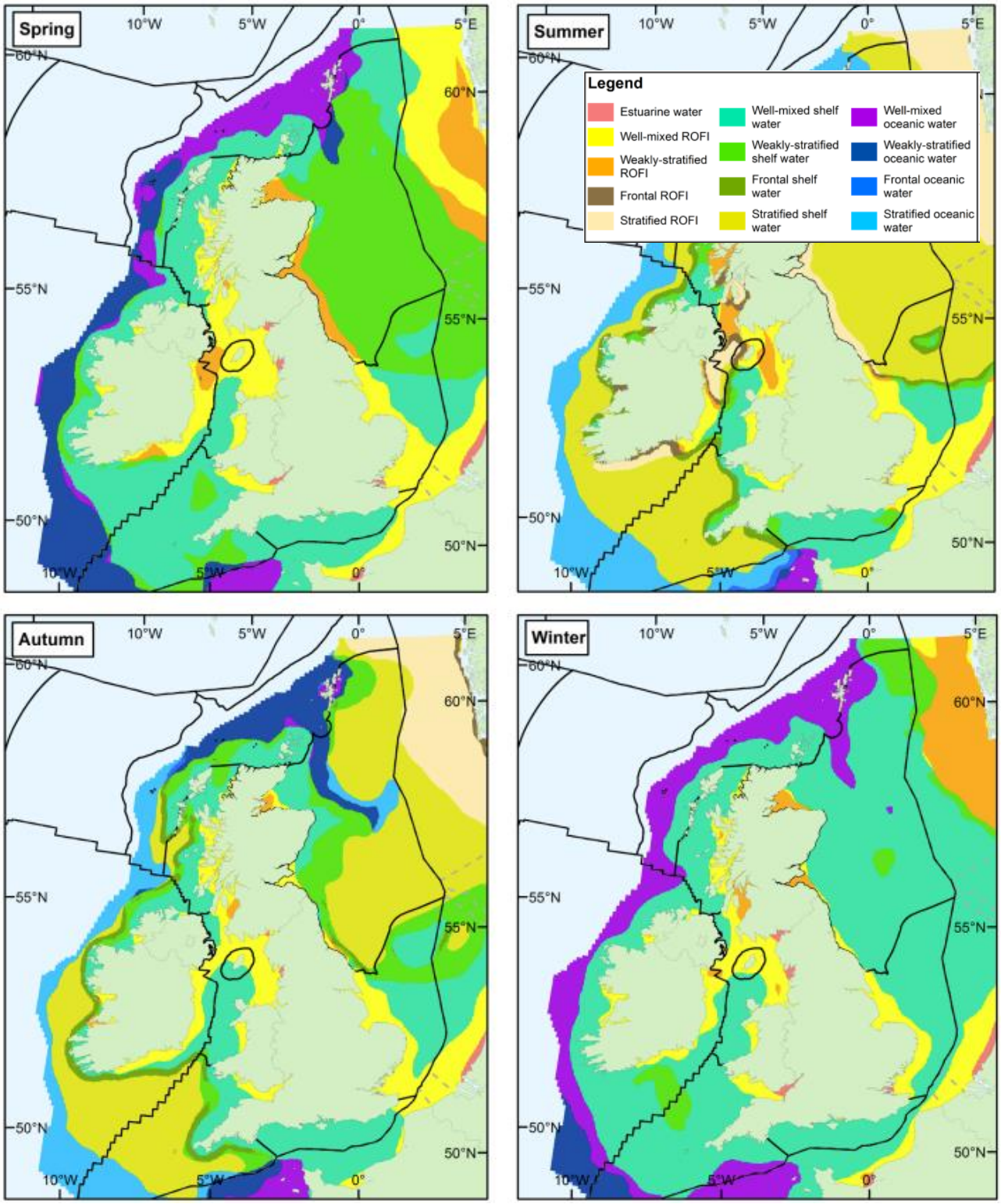

Plate 8.3: Seasonal water mass and water column structure in UK waters (Connor et al., 2007)

WFD Waterbody Status

Barnstaple Bay (Waterbody ID: GB610807680003) [Bideford Bay]

8.7.51 Barnstaple Bay (coastal) waterbody is not classified as a designated artificial or heavily modified waterbody. Its overall classification is 'Moderate' from the most recent assessment in 2022; this was determined based on its 'Moderate' ecological status, and was limited by the Infaunal Quality Index i.e. the Invertebrates classification. It does not require assessment for its chemical status (which was 'Fail' in 2019 due to the presence of Mercury and Polybrominated Diphenyl Ethers).

8.7.52 The water body has an objective to achieve 'Good' chemical status by 2063 to allow for natural recovery time.

8.7.53 The Bideford Bay water body classification is supported by Environment Agency monitoring data, including (amongst others) water quality data from two sites in the southern portion of the Bay i.e. sites 'Barnstaple Bay Off Windbury Point' (NGR 228500, 128500) and 'Barnstaple Bay Off Westward Ho!' (NGR 241000, 130500). Most recent supporting element classifications available (Environment Agency, 2023), from 2019, indicate concentrations of Arsenic, Chromium, Copper, Iron and Zinc consistent with WFD 'High'. All other measured contaminants are classified as 'Good'. Raw Environment Agency water quality data continues to be collected and is available up to and including January 2024.There are three Bathing Waters located within Bideford Bay. These include:

- Westward Ho!
- Saunton Sands
- Croyde Bay

8.7.54 The closest Bathing Water to the Offshore Cable Corridor is Westward Ho! (approximately 2.5 km). The water quality is classified as 'Excellent', based on water samples taken by the Environment Agency between May and August 2024.

8.7.55 The nearest designated Shellfish Waters are located within the estuary of the rivers Taw and Torridge (Taw-Torridge Estuary Shellfish Water), and is designated to protect mussel (*Mytilus spp.*) beds. Further Shellfish Waters are located upstream, the Taw estuary Shellfish Water and the Torridge estuary Shellfish Water. Mussels are farmed within these Shellfish Waters and a small area within the Torridge estuary Shellfish Water is farmed for Pacific oyster (*Crassostrea gigas*).

North Devon Surf Reserve

8.7.56 In 2022, approximately 30 km of the North Devon coastline was recognised as a World Surfing Reserve (WSR). A WSR recognises the quality of the surf, as well as the sport's importance to the wider community, and aims to protect the 'surf ecosystems'. Whilst the Proposed Development does not fall within the North Devon WSR, the proposed activities have the potential to affect physical processes which in turn could affect the quality of surf.

8.7.57 The WSR (World Surf Reserve, 2024) indicates that 'direct threats include new developments, dredging and coastal erosion protection. Indirect threats include poor water quality from various sources i.e. disturbance of contaminated sediments.'.

Designated sites

8.7.58 All designated sites within the study area and qualifying interest features that could be affected by the construction, operation and maintenance, and decommissioning phases of the Proposed Development are set out in **Table 8.27**. Their locations, in reference to the Offshore Cable Corridor, are presented in Volume 3, Figures 8.2 and 8.3 of the ES.

Table 8.27: Designated sites and relevant qualifying interests

Designated Site	Distance to the Proposed Development (nearest point)	Relevant Qualifying Interest
Mermaid's Pool to Rowden Gut SSSI	0 m	Located within Bideford/Bideford Bay, the cliffs expose the only complete sequence of the Culm Measures, a geological strata originating during the Carboniferous Period, consisting of layers of mudstone, siltstone and sandstone.
Bristol Channel Approaches/ Dynesfeydd Mor Hafren SAC	0 m	The proposed offshore cable corridor crosses the SAC. It is designated for the protection of harbour porpoise.
South-West Approaches to Bristol Channel Marine Conservation Zone (MCZ)	Directly adjacent	Located immediately to the south west of the Offshore Cable Corridor, it is designated for its subtidal coarse sediment and subtidal sand, which provide a home to a variety of species that bury into the seabed including razor clams and sea urchins.
North Devon Biosphere Reserve	0 m	The proposed Offshore Cable Corridor bisects the biosphere reserve. It is designated as an area for testing and demonstrating sustainable development on a sub-regional scale.
Hobby to Peppercombe SSSI	4 km	Located within Bideford Bay, to the south-west of the Proposed Development. It is designated mainly for its biological interests, but also its hard maritime cliff and slope.
Marsland to Clovelly Coast SSSI	6 km	Located to the south of the Proposed Development, it is designated for various features, including its coastal geomorphology.
Steeple Point to Marsland Mouth SSSI	25.5 km	Located to the south of the Proposed Development, it is designated mainly for its biological interests.
Lundy SSSI	4.5 km	Located to the north of the Proposed Development, it is designated mainly for its biological interests, including its puffin colony.
Tintagel-Marsland-Clovelly Coast SAC	11.5 km	Located within Bideford Bay, to the south-west of the Proposed Development. It is designated for its vegetated sea cliffs and old sessile oak woods.

Designated Site	Distance to the Proposed Development (nearest point)	Relevant Qualifying Interest
Lundy SAC	3.5 km	Located to the north of the Proposed Development, it is designated for its granite and slate reef system, sandbanks and submerged (or partially submerged) sea caves.
Bideford to Foreland Point MCZ	700 m	Located to the north-east of the Proposed Development, within Bideford Bay. It is designated for its broadscale marine habitats (high energy circalittoral rock), marine habitats (i.e., honeycomb worm reefs) and species of marine fauna (i.e., spiny lobster).
Morte Platform MCZ	15.5 km	Located to the north-east of the Proposed Development, it is designated for its circalittoral rock (high and moderate energy) and subtidal coarse sediment.
Hartland Point to Tintagel MCZ	11.5 km	Located to the south of the Proposed Development, it is designated for its coastal saltmarshes and saline reedbeds, intertidal rock, intertidal sediment, infralittoral rock, circalittoral rock, and subtidal sediments.
Lundy MCZ	4 km	Located to the north of the Proposed Development, it is designated for its spiny lobster.
North West of Lundy MCZ	14.5 km	Located to the north of the Proposed Development, it is designated for its subtidal coastal sediment.
Cape Bank MCZ	23 km	Located to the south-east of the Proposed Development, it is designated for its moderate energy circalittoral rock and subtidal coarse sediment.
East of Haig Fras MCZ	550 m	Located to the north-west of the Proposed Development, within the Celtic Sea, it is designated for its marine habitats (i.e. subtidal muds and sands) and species of marine fauna (i.e. fan mussel).

Site-Specific Surveys

Water Quality

8.7.59 A multi-parameter seawater profiler was used to measure salinity, temperature, depth, dissolved oxygen, pH and turbidity at 23 locations along the Offshore Cable Corridor. The results can be found within Volume 3, Appendix 8.4: GEOxyz Environmental Report of this ES.

8.7.60 Samples were taken between August and October 2023. As influenced by the season during which the samples were taken, and the presence of the Gulf Stream and shallow water depths, offshore surface temperatures were approximately 16°C, with a maximum of 19.4°C. In deeper water, clear stratification of the water column was observed, with a thermocline evident at 30 m. Water temperatures declined readily from approximately 18°C to approximately 11°C. The thermocline was less noticeable, and the water column more mixed, from Stations UK_31 (located to the north of Lands End) to UK_61 (located within Bideford Bay). For locations, refer to Volume 3, Figure 8.8: Locations of Sediment Data of the ES.

8.7.61 Salinity remained relatively constant through the water column at stations located in deeper offshore waters, there was no clear halocline present; salinity very

gradually increased from around 35.4 PSU to 35.7 PSU. Most stations at the shallower stations also demonstrated this trend, with the exception of UK_ENV_CTD_43 and UK_ENV_CTD_46 which both showed an increase in salinity at 15 m depth, from 35.4 PSU to 35.8 PSU before returning to 35.4 PSU at around 28 m depth. At these two stations, a thermocline was present at a similar depth, thus the slight change in mixing could be because of a resultant small halocline. At station UK_ENV_CTD_59 in Bideford Bay the salinity in the first 5 m of the water column was considerably lower than other stations in close proximity, approximately 34.2 PSU before decreasing to 25 PSU at around 10 m depth. It is worth noting that this station could be experiencing the effects of freshwater river outflow from the nearby River Taw, particularly when considering the stormy weather encountered during the survey and thus the likely associated increased runoff and river flow.

8.7.62 Dissolved oxygen (% saturation) was approximately 100% up to a depth of 30 m, decreasing to approximately 90% at 35 m water depth. It continued to decline to approximately 80% in water depths greater than 60 m.

8.7.63 The pH of the water sampled varied. In deep water, pH was elevated up to depths of 30m, ranging between 8.2 and 8.4, decreasing to 8.1 to the seabed. In shallower waters, pH remained constant throughout the water column, between 8.2 and 8.3. GEOxyz report all values as within a 'healthy range' indicative of a healthy ecosystem.

8.7.64 Turbidity was fairly low across stations located in deep waters, with occasional increases where suspended material was present. In shallower waters, turbidity varied between 0 FTU (Formazin Turbidity Units) and approximately 66 FTU at depth. This was most notable at stations within Bideford Bay and was likely as a result of the resuspension of sediment due to bad weather.

Sediment Quality

8.7.65 Fifty one sediment grab stations were sampled along the UK section of the Offshore Cable Corridor. The majority of stations were sampled with a DVV grab (2 x 0.1 m^2) with stations with coarser sediments sampled with a 0.01 m^2 mini-Hamon grab. Samples were acquired to provide data on physico-chemistry and macrofauna at sampling stations. The locations of the grab stations can be found in Volume 3, Figure 8.8: Locations of Sediment Data of the ES.

8.7.66 The sediment particle size analysis is summarised in Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES. Typically, the sediments along the Offshore Cable Corridor are classified as 'Very Fine sand' to 'Medium sand', with median particle size (d_{50}) values between 0.07 mm and 0.47 mm. Coarser sediment of 'Very Fine Pebbles' and 'Medium Pebbles' can be found at two grab stations only. There is generally a very low percentage of fines across the route – the samples exhibited a mean of 8.6% proportion fines (with 33 of the 48 PSA samples with <6% fines).

8.7.67 **Plate 8.3** below shows how the median particle size varies relative to the water depth. Chainage 0.0 is located at the EEZ boundary.

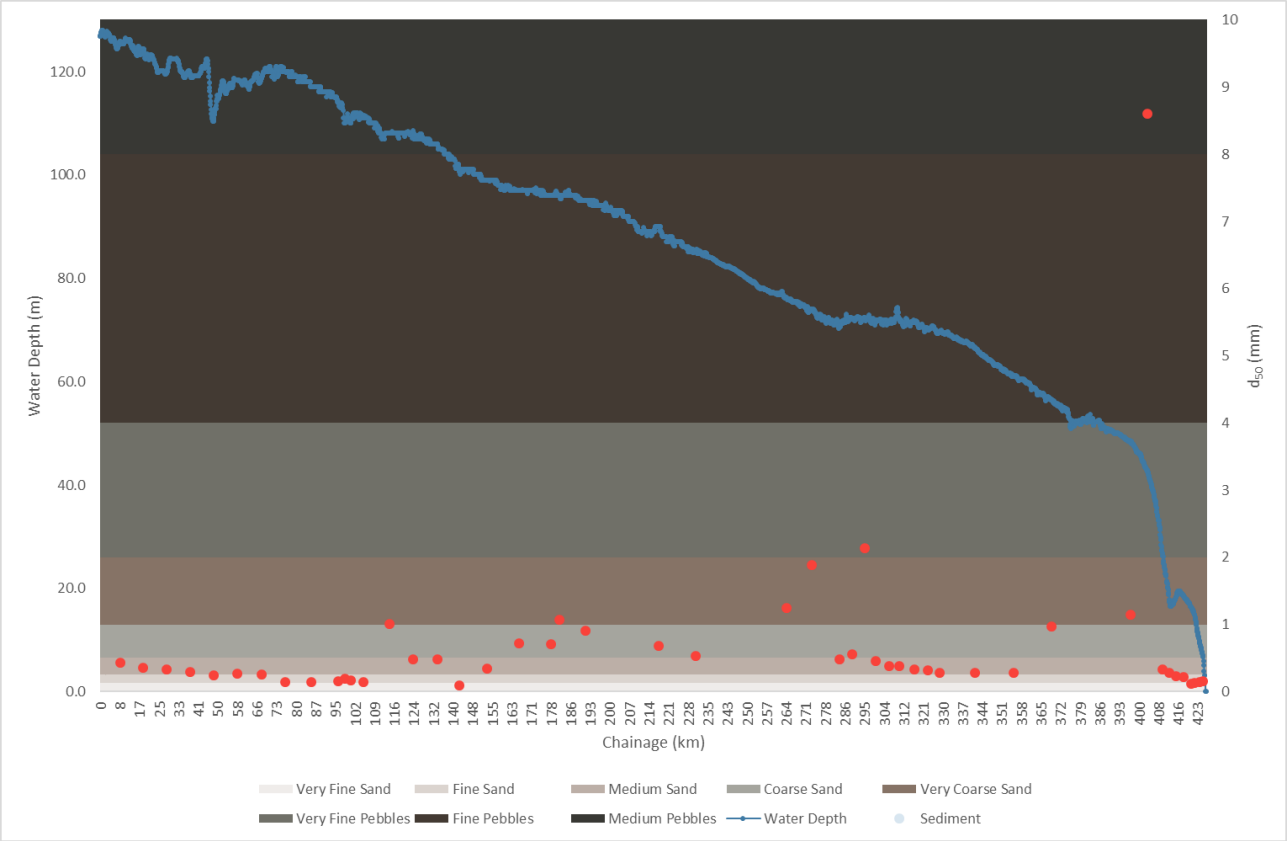

Plate 8.4: Wentworth Classification of Sediment along Offshore Cable Corridor

8.7.68 The sediment samples were analysed for metals and PAHs and compared to Sediment Quality Guidelines (SQGs), namely Cefas Action Level 1 and 2 and Threshold Effects Level (TEL) / Probable Effects Level (PEL); for results, refer to Volume 3, Appendix 8.3: Sediment Sample Chemistry Results of the ES.

8.7.69 Cefas Action Levels are generally used to determine the contaminant loading of a material in the context of suitability for disposal at sea. Below Action Level 1, contaminant levels are generally considered to be of no concern and, above Action Level 2, materials are considered to be unsuitable for disposal at sea.

8.7.70 The TEL and PEL thresholds consider sediment chemical concentrations at which a toxic response is observed in benthic organisms. For the TEL, a toxic response has started to be observed. For the PEL, a large percentage of benthic organisms will show a toxic response.

8.7.71 Analysis of the sediment concentrations against Cefas Action Level 1 and Action Level 2 revealed arsenic concentrations above the Level 1 threshold at eight of the locations sampled (within Bideford Bay and off the north coast of Devon); however all arsenic concentrations were below Action Level 2. Concentrations of Arsenic were found to be less than the Probable Effect Level (PEL). As noted by Cefas in consultations, background arsenic concentrations in this area (Celtic Sea) are known to be high and elevated sediment arsenic concentrations are not considered unusual, or indicative of anthropogenic influence.

8.7.72 All other metal concentration levels were found to be below Cefas Action Level 1 (cAL1). These results are consistent with previous sampling carried out in the Torridge estuary (at Appledore in 2005) as recorded in the Cefas Action Levels Tool (Cefas, 2018).

8.7.73 The Proposed Development's sample analysis did not include zinc. 2010 data from a capital dredge for Appledore Shipyard inside the Torridge Estuary, found a zinc concentration of 72 mg/kg (well below the AL1 of 108 mg/kg); concentrations in Bideford Bay would be expected to be lower and with the confirmed low levels of TOC, Zinc is considered of low concern. Further zinc analysis will confirm this assumption, in consultation with the MMO, post submission of the DCO.

8.7.74 TBT in samples from 2005 capital dredge monitoring at Appledore was measured at 0.077 mg/kg and 0.002 mg/kg, which is below cAL1 and concentrations would a) be expected to have reduced since as the effects of the TBT ban are observed; and b) be expected to be lower off the coast. Additional sample analysis for organotins, which is scheduled, with results to be shared with the MMO post DCO submissions, will further validate these baseline characterisations ahead of any marine licensing of Proposed Development activities.

8.7.75 Overall, the sediment sampling carried out indicates low levels of metal and PAH baseline contamination.

Cone Penetration Testing

8.7.76 A Cone Penetration Testing (CPT) survey was undertaken by GeoXYZ in September 2023 at 44 locations, with a total of 25 re-attempts conducted due to insufficient penetration, failure to meet class specification requirements or in one instance, as a result of a communication issue with the CPT unit during the acquisition (UK_GT_CPT_53). All but one station achieved CPT accuracy class determination of either 1 or 2 based on the reference deck offset readings and the classification limits specified by International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE, 1999).

8.7.77 A comparison of the CPT results at the start (seabed surface) and end (depth below seabed) of the investigation was undertaken (see Volume 3, Appendix 8.1 Sediment Source Concentrations and Assessment of Disturbance of the ES) to provide an indication of whether surface grab samples could be taken to be representative of sediment characteristics throughout the surface layers. The results of this comparison show very similar sediment characteristics at the start and end of the CPTs (other than at location 1 where trenching will not take place, since HDD is proposed).

8.7.78 A further review of the CPT logs and interpretative report confirms that the upper 1 to 2 m of the seabed predominantly comprises fine, medium and coarse sands (other than areas where chalk bedrock is present). This provides confidence in the analysis and homogeneity of the upper seabed substrate.

8.7.79 Therefore, the sediment classification, the associated d50 values, and the chemical characterisations associated with the surface grab samples, are deemed suitable to apply to (be representative of) the marine sediments across all surface layers. In other words, the sediment chemistry characterisation is suitably representative of all sediments that could be disturbed by cable trenching (from the seabed surface to the approximate maximum trench depth of 1.6 m).

Future Baseline Conditions

8.7.80 Schedule 4, paragraph 3 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 require that '*an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge'* is included within the ES. This section provides an outline of the likely future baseline conditions in the absence of the Proposed Development.

8.7.81 Future baseline conditions for the physical processes assessment will be affected primarily by climate change predictions, including predicted sea level rise, sea temperature and salinity changes and extremes of weather. Bathymetric/coastal changes could also affect the Proposed Development but are not expected to change dramatically in relation to the proposed works and/or are very difficult to predict reliably over the development lifetime.

8.7.82 Sea level rise projections have been obtained for the UKCP18 RCP8.5 higher central (70th percentile), upper end (95th percentile) and H++ scenarios and applied to uplift tidal water levels to the desired epochs. The percentile describes the proportion of possible scenarios that fall below scenario i.e. an allowance based on the 70th percentile is exceeded by 30% of the projections in the range (Environment Agency, 2022). The H++ allowance is the maximum scenario and assumes 1.9 m of total sea level rise by 2100.

8.7.83 A baseline year of 2032 has been assumed (anticipated year of project completion) and future epoch of approximately +50 years (2083) in line with the operational design life.

8.7.84 The predicted rise in mean sea-level over this period is shown in **Table 8.28**. Please note that the sea level rise in 2032 is calculated from a baseline year of 2018 (based on the data extracted from the Environment Agency Coastal Flood Boundary Extreme Sea Levels dataset) hence a maximum increase of 0.15 m is given.

Table 8.28: Sea Level Rise Allowances (Environment Agency, 2022)

Year	Higher Central	Upper End	H++
2032	0.05m	0.06m	0.15m
2083	0.54m	0.71m	1.13m

8.7.85 Furthermore, offshore wind speeds and extreme wave heights are likely to increase as a result of climate change. Appropriate allowances for anticipated increases are shown in **Table 8.29** below. These allowances should be added to present day wind speeds and wave heights i.e. assuming a present-day typical significant wave height of 2.5 m (in shallow water in Bideford Bay), the 2032 significant wave height should be estimated as 2.63 m and 2.75 m in 2083. The sensitivity test values should be used when assessing credible maximum scenarios for infrastructure projects of national significance (such as the Proposed Development). The purpose of the sensitivity test is to ensure that the development can adapt to 'large-scale climate change' over its lifetime (Environment Agency, 2022).

Table 8.29: Offshore Wind Speeds and Extreme Wave Height Climate Change Allowances (Environment Agency, 2022)

Year	Offshore Wind Speeds		Extreme Wave Height	
	Allowance	Sensitivity Test	Allowance	Sensitivity Test
2032	5%	10%	5%	10%
2083	10%	10%	10%	10%

8.7.86 As part of the in-combination climate change assessment, completed for the project (Volume 4, Chapter 1: Climate Change of the ES), the UKCP18 Marine Report (Palmer et al., 2018) was interrogated within the UK Climate Risk Independent Assessment (CCRA3), Chapter 4: Infrastructure (Jaroszweski, D., Wood, R., and Chapman, L., 2021). The following offshore climate projections have been determined:

- The North Atlantic will warm at a slower rate in comparison to other oceans (global mean sea surface temperatures are expected to increase by 2.9°C by 2100).
- Average inshore wave heights are predicted to decrease in the south west by 0.2m. However, uncertainty with modelled projections of offshore wave heights mean that an increase in the maximum wave height should be considered (+1m).
- Average wind speeds are predicted to reduce in the south west, including in the Celtic Sea and Bristol Channel. Maximum wind speeds, associated with storm surges, should be expected to increase, by +1.5 m/s (due to uncertainty in modelled results).
- Under RCP8.5, sea level rise in the south west is expected to increase by approximately 0.7 m by 2100.

Key Receptors

8.7.87 **Table 8.30** identifies the receptors taken forward into the assessment. Within this ES, Physical Processes is treated as an impact 'pathway' as well as having associated receptors in its own right. **Section 8.10** presents a 'Pathways Assessment' which describes the scale of change to Physical Processes elements such as water quality. This pathways scale of change is an interim step in the determination of effects on Physical Processes receptors and is also used to inform other dependent assessments (other EIA disciplines such as Fish and shellfish – Volume 3, Chapter 2 of the ES).

8.7.88 Please note that the value only is presented in **Table 8.30**, as the final receptor sensitivity is impact specific (and is therefore discussed within the Impact Assessments where relevant).

Table 8.30: Key receptors taken forward to assessment

Receptor	Description	Value
Surrounding sub-tidal sea bed	Consideration of scour or deposition (of sediment) effects on surrounding sea bed morphology and character (contaminated or uncontaminated sediments).	Low
Surrounding coastline	Consideration of erosion (including shore platform down wearing/ damage and coastal retreat) or accretion at nearby beaches/ estuaries.	High
Nationally or internationally designated sites	The following nature conservation designations include geological and geomorphological features within the study area relevant to the physical processes ES chapter: • Mermaid's Pool to Rowden Gut SSSI • Bristol Channel Approaches/ Dynesfeydd Mor Hafren SAC • North Devon Biosphere Reserve • Bideford to Foreland Point MCZ • South-West Approaches to Bristol Channel MCZ East of Haig Fras MCZ	High
Barnstaple Bay WFD waterbody	Barnstaple Bay is a WFD (coastal) waterbody (GB 610807680003). Its overall classification is 'Moderate' from the most recent assessment in 2022. Its target status is 'Good' by 2063, hence a sensitivity/ value of 'Medium' is considered appropriate.	Medium
Westward Ho! Bathing Water	Reference 33900. 2023 classification (most recent data) indicates that the Bathing Water had excellent water quality.	Medium

8.8 Mitigation Measures Adopted as Part of the Proposed Development

8.8.1 For the purposes of the EIA process, the term *'measures adopted as part of the Proposed Development'* is used to include the following types of mitigation measures (adapted from IEMA, 2016). These measures are set out in Volume 1, Appendix 3.1: Mitigation Schedule of the ES.

- Embedded mitigation. This includes the following.
  - Primary (inherent) mitigation - measures included as part of the Proposed Development design. IEMA describes these as '*modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project and do not require additional action to be taken'*. This includes modifications arising through the iterative design process. These measures will be secured through the consent itself through the description of the project and the parameters secured in the DCO and/or marine licences. For example, a reduction in footprint or height.
  - Tertiary (inexorable) mitigation. IEMA describes these as '*actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects*'. It may be helpful to secure such measures through a Construction Environmental Management Plan or similar.

- Secondary (foreseeable) mitigation. IEMA describes these as '*actions that will require further activity in order to achieve the anticipated outcome'*. These include measures required to reduce the significance of environmental effects (such as lighting limits) and may be secured through environmental management plans.

8.8.2 In addition, where relevant, measures have been identified that may result in enhancement of environmental conditions. Such measures are clearly identified within Volume 1, Appendix 3.1: Mitigation Schedule of the ES. The measures relevant to this chapter are summarised in **Table 8.31**.

8.8.3 Embedded measures that will form part of the final design (and/or are established legislative requirements/good practice) have been taken into account as part of the initial assessment presented in **section 8.10** to **8.13** below (i.e., the initial determination of impact magnitude and significance of effects assumes implementation of these measures). This ensures that the measures to which the Applicant is committed are taken into account in the assessment of effects.

8.8.4 Where an assessment identifies likely significant adverse effects, further or secondary mitigation measures may be applied. These are measures that could further prevent, reduce and, where possible, offset these effects. They are defined by IEMA as actions that will require further activity in order to achieve the anticipated outcome and may be imposed as part of the planning consent, or through inclusion in the ES (referred to as secondary mitigation measures in IEMA, 2016). For further or secondary measures both pre-mitigation and residual effects are presented.

Table 8.31: Mitigation measures adopted as part of the Proposed Development

Commitment Number	Measure Adopted	How the Measure Will be Secured
Embedded Measures		
OFF02	Cable protection measures - Where possible introduced cable protection i.e. rock placement (and potentially concrete mattresses), would be kept level with the seabed, and if above the seabed would be kept to a maximum of c.1 m above seabed level (excluding crossings).	Design parameters set out in the Outline Offshore CEMP (document ref. 7.9).
OFF03	Micro-routing of the offshore cables, within the defined Order Limits, will be undertaken to minimise any potential damage to Annex I habitats, to avoid sand waves or large ripples (that would otherwise require pre-lay seabed flattening), and to avoid direct impacts where possible on archaeology and cultural heritage assets and submerged land surfaces.	Set out as 'Further Commitments' in the Outline Offshore CEMP (document ref. 7.9).
OFF05	An Offshore CEMP will set out the detailed approach to offshore construction activities and would implement those measures and environmental commitments identified in the EIA as far as reasonably practicable. The following measures will be included in the Offshore CEMP: marine pollution prevention; waste management; marine invasive species (via the Offshore Biosecurity Plan); and dropped object procedures. An Outline Offshore CEMP (document reference 7.9)	The Offshore CEMP is a requirement of the Deemed Marine License.

Commitment Number	Measure Adopted	How the Measure Will be Secured
	forms part of the application for DCO (with a final Offshore CEMP finalised by the offshore contractor).	
OFF09	HDD methods will be employed to avoid any direct disturbance of the intertidal zone, the beach and the coastal cliffs.	Works activity as set out in the Deemed Marine Licence.
OFF11	The Navigational Safety and Vessel Management Plan (NSVMP) will confirm the types and numbers of vessels that would be engaged on the Proposed Development and consider vessel coordination including indicative transit route planning. The NSVMP will include protocols for vessel communications, lighting and maintenance of "safe" distances (which will be monitored by guard vessels during the construction period). An outline NSVMP is provided as Volume 3, Appendix 5.2 Navigational Safety and Vessel Management Plan of the ES; the NSVMP will be updated to final by the offshore construction contractor.	Requirement of the Outline Offshore CEMP (document ref. 7.9).
OFF12	Route optimisation studies, including multiple desktop studies and marine investigation surveys, have informed the routing of the Offshore Cable Corridor to avoid sensitive locations where possible and as far as reasonably practicable.	The Offshore Cable Corridor is defined in the Deemed Marine Licence authorised scheme grid coordinates.
OFF25	Cable crossing and proximity agreements will endeavour to be entered into with asset owners. Crossing design will adhere to industry standard to minimise fishing gear snagging risk.	Outline Offshore CEMP (document ref. 7.9).
Secondary (Further) Measures		
OFF34	All potential sediment disturbance activities in Bideford Bay are to avoid peak spring tides and significant wave activity, to limit any potential for sediment mobilisation as far as reasonably practicable. These activities would include the excavation / sediment clearance at the HDD exit pits and trenching works.	Requirement of the Outline Offshore CEMP (document ref. 7.9).
Enhancement Measures		
N/A		

8.9 Key Parameters for Assessment

Maximum Design Scenario

8.9.1 The maximum design scenarios identified in **Table 8.32** have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the information provided in Volume 1, Chapter 3: Project Description of the ES. Effects of greater adverse significance are not predicted to arise should any other development

scenario, based on details within the Project Design Envelope (e.g. different infrastructure layout), to that assessed here be taken forward in the final design. Therefore, this comprises a conservative assessment of a worst case scenario.

Table 8.32: Maximum design scenario considered for the assessment of impacts

Impact	Phase[1]					Maximum Design Scenario	Justification
Changes to metocean conditions	×	✓	×	×	×	**Operation and Maintenance phase** Potential impacts to local metocean processes from the presence of any above seabed 'structures' (within study area) i.e.: • HDD exit point (concrete mattresses installed below baseline sea bed level). • Rock placement for cable protection (some degree of rock protection is potentially required at up to 150 km of the Offshore Cable Corridor, noting that above seabed level placement would be avoided wherever possible). • In service cable crossings – e.g. concrete mattresses and rock placement.	The maximum design scenario considers activities likely to result in the most significant change to the existing seabed. These physical changes may result in temporary and/ or permanent impacts to the local metocean processes in shallow water.
Sediment disturbance or seabed change – direct disturbance due to Proposed Development activities	✓	✓	✓	✓	✓	**Construction phase** Potential impacts to local seabed geology and morphology (within study area) from: • Route preparation i.e., clearance of uneven seabed. • Laying of cables. • Placement of rock protection and/ or additional rock at existing cable crossings. **Operation and Maintenance phase** Potential impacts to local seabed geology and morphology (within study area) from: • Rock protection and/ or additional rock at cable crossings (during operation). • Cable repair and maintenance activities. • Cable remedial burial. • Maintenance of external cable protection (i.e. rock placement). • Placement of new external cable protection (i.e. rock placement).	The maximum design scenario will consider activities likely to result in the most significant disturbance of the existing seabed and include dredging and excavation of trenches to lay/ remove cables. This could result in temporary and/ or permanent impacts to the local sediment regime along the cable corridor.

Impact	Phase[1]					Maximum Design Scenario	Justification
						Decommissioning phase Potential impacts to local seabed geology and morphology (within study area): • Removal of all cables, or; • Leaving HDD cables *in-situ*.	
Changes to water quality - direct disturbance due to Proposed Development activities	✓	✓	✓	✓	×	**Construction phase** Potential increase in contaminants (within study area) from: • Route preparation i.e., clearance of uneven seabed. • Laying of cables. • Placement of rock protection and/ or additional rock at pipeline or cable crossings.	The maximum design scenario will consider activities likely to result in the most significant disturbance of the existing seabed and include dredging and excavation of trenches to lay/ remove cables. This likely result in a temporary and/ or permanent increase in physical, chemical and biological contaminants through the suspension of contaminated sediment.
						Operation and Maintenance phase Potential increase in contaminants (within study area) from: • Cable repair and maintenance. • Cable remedial burial. • Maintenance of external cable protection (i.e. rock placement). • Placement of new external cable protection (i.e. rock placement).	
						Decommissioning phase Potential increase in contaminants (within study area) from: • Removal of all cables.	
Secondary (localised) scour –	✓	✓	✓	×	✓	**Construction phase** Potential impacts to local seabed geology and morphology (within study area) from:	The maximum design scenario will consider activities likely to result in the most significant disturbance of the existing seabed and include

Impact	Phase[1]					Maximum Design Scenario	Justification
indirect disturbance due to Proposed Development activities						• Placement of rock protection and/ or additional rock at pipeline or cable crossings. **Operation and Maintenance phase** Potential impacts to local seabed geology and morphology (within study area) from: • Cable repair and maintenance. • Cable remedial burial. • Maintenance of external cable protection (i.e. rock placement). • Placement of new external cable protection (i.e. rock placement). **Decommissioning phase** Potential impacts to local seabed geology and morphology (within study area): • Leaving HDD cable in-situ.	dredging and excavation of trenches to lay/ remove cables. This likely result in a temporary and/ or permanent increase in localised scour of the seabed within the study area (notably adjacent to rock protection).

[1] C=construction, Op=operation and maintenance, D=decommissioning

8.10 Pathways Assessment

8.10.1 Within this ES, Physical Processes is treated as an impact 'pathway' as well as having associated receptors in its own right. This section presents a 'Pathways Assessment' (**Table 8.34**) which describes the scale of change to Physical Processes elements such as water quality. This pathways scale of change is an interim step in the determination of effects on Physical Processes receptors and is also used to inform other dependent assessments (other EIA disciplines such as Fish and Shellfish in Volume 3, Chapter 2 of this ES).

8.10.2 The pathways assessment criteria are shown in **Table 8.33**, with definitions provided beneath.

Table 8.33: Pathway Assessment (Scale of Change) Criteria

	Pathway Extent		
Magnitude/ extent	**Localised**	**Near-Field**	**Far-Field**
Small	Low	Negligible	Negligible
Moderate	Medium	Low	Negligible
Large	High	Medium	Low

8.10.3 The magnitude of the change to the pathway (e.g. water quality change) is given a qualitative rating i.e. small/ moderate/ large. The pathway extent is given as localised (<0.1 km)/ near-field (<5km)/ far-field (<30 km). The scale of pathway change is negligible/ low/ medium/ high as defined in **Table 8.33**.

8.10.4 The sources are:

- ***Seabed preparation*** – e.g. local pre-lay grapnel and local preparation using Mass Flow Excavation (MFE).
- ***Cable trenching*** – Mechanically cutting or water jetting max. 1.5 m deep by 1 m wide trenches for cable laying.
- ***HDD exit pits*** – Four 15 m by 15 m HDD exit pits located within Bideford Bay, at water depths of 5 to 10 m. Excavated by long-arm excavator bucket or MFE.
- ***Scour protection*** - Placement of rock protection and/ or additional rock at cable crossings.

8.10.5 The pathways change may be a result of:

- ***Metocean change*** - changes to tidal current flows and/ or wave conditions (height/ direction).
- ***Seabed change*** – physical change, i.e. lowering or raising of seabed, as a result of scour, accretion etc.
- ***Water-quality change*** - tidal currents transporting disturbed sediment leading to increased turbidity and/ or reduced water-quality until sediment settlement.

Table 8.34: Pathway Assessment (Scale of Change) Criteria

Source			Pathway		
Activity	**Activity Description**	**Preliminary Source Assessment**	**Preliminary Pathway Assessment**	**Magnitude/ Extent**	**Scale of Pathway Change**
Construction Phase					
Seabed preparation (associated with ***deep and coastal water*** only as cable route starts at HDD exit pit and is therefore located in a tunnel beneath 'shallow' water).	Localised route preparation (swath width of 20 m where worst case surface plough is deployed; total length of requirement not confirmed). Would involve limited change in seabed level (there are no megaripples identified in UK waters that would require removal), e.g. sand waves are typically small in height and transient in nature. Local preparation works would be undertaken using mass flow excavation or surface plough.	Localised clearance / flattening of bathymetric features will cause ***sediment disturbance***. The magnitude of sediment released from this disturbance is expected to be ***small*** in volumetric terms (due to limited feature size) but is dependent on method to be used, e.g. mass flow excavation or surface plough.	This activity will cause a change in ***water-quality*** (due to increased turbidity). In ***deep and coastal water***, assessment indicates that during most tidal states current velocities are too low to mobilise disturbed sediment, it will therefore settle in the immediate vicinity and remain ***localised*** (settlement expected over tens of metres). During peak spring tides however (approximately <3% of the time), ***metocean conditions*** (e.g. tidal currents and waves) could transport disturbed sediment 6.9 to 15.2 km (depending on location along the OCC) in an east northeast and west southwest direction (before settling out). There is expected to be a high degree of dispersion due to the ***small*** volumes of disturbed sediment at source and ***far-field*** spatial extent over which the sediment could travel.	Most tides: small/ localised Peak spring tides (~3% of the time): small/ near-field	Low Negligible
Cable trenching (***deep and coastal water*** only as cable route starts at HDD exit pit and is therefore located in a tunnel beneath 'shallow' water).	Cable trenching will be undertaken (using mechanical cutters and water-jetting) over a localised spatial extent (target 1 m width of trench) to target depth of 1.5 m.	Installation of cable trenches will cause ***sediment disturbance***. The magnitude of this disturbance will be ***small*** (due to the limited volumes to be removed but is also dependent on the method to be used).	This activity will cause a change in ***water-quality*** (due to increased turbidity). In ***deep and coastal water***, preliminary assessment indicates that during most tidal states current velocities are too low to mobilise disturbed sediment, it will therefore settle in the immediate vicinity and remain ***localised*** (settlement expected over tens of metres). During peak spring tides however (approximately <3% of the time), ***metocean conditions*** (e.g. tidal currents and waves) could transport disturbed sediment 6.9 to 15.2 km (depending on location along the OCC) in an east northeast and west southwestdirection (before settling out). There is expected to be a high degree of dispersion due to the ***small*** volumes of disturbed sediment at	Most tides: small/ localised Peak spring tides (~3% of the time): small/ near-field	Low Negligible

Source			Pathway		
Activity	**Activity Description**	**Preliminary Source Assessment**	**Preliminary Pathway Assessment**	**Magnitude/ Extent**	**Scale of Pathway Change**
			source and ***far-field*** spatial extent over which the sediment could travel.		
	The HDD exit pits (4no.) will be located in coastal water between approximately 5-10 m water depth (corresponding to ~500 to 1800 m from shore) and be 15x15 m in plan area x c.2-5 m deep (depending on superficial deposits depth), cleared using long-arm excavator bucket operating from jack-up barge, or using MFE. Cable protection will take the form of concrete mattresses i.e. low profile and not extending above baseline seabed surface.	Clearance of the HDD exit pit (and subsequent placement of concrete mattresses as cable protection) will cause ***sediment disturbance***. The magnitude of this disturbance will be ***small*** (due to the limited footprint and volumes to be dredged) but is also dependent on the method to be used.	This activity will cause a change in ***water-quality*** (due to increased turbidity). In ***deep and coastal water***, preliminary assessment indicates that during most tidal states current velocities are too low to mobilise disturbed sediment, it will therefore settle in the immediate vicinity and remain ***localised*** (settlement expected over tens of metres). During peak spring tides however (approximately <3% of the time), ***metocean conditions*** (e.g. tidal currents and waves) could transport disturbed sediment 6.9 to 15.2 km (depending on location along the OCC) in an east northeast and west southwest direction (before settling out). There is expected to be a high degree of dispersion due to the ***small*** volumes of disturbed sediment at source and ***far-field*** spatial extent over which the sediment could travel.	Most tides: small/ localised Peak spring tides (~3% of the time): small/ near-field	Low Negligible
		Temporary ***seabed change*** is expected during dredging of the HDD exit pit. The magnitude of this change is considered ***small*** (due to the limited area/ size of the HDD exit pit).	Due to the limited size and short-term duration of this activity, the effects on ***metocean conditions*** are considered to remain ***localised***.	Small/ localised	Low
Operational and Maintenance Phase - normal					
Presence of above bed level scour protection at cable crossings and where trenching/ burial not fully possible due to geology.	The size of each scour protection area will vary according to location but could be up to 500x7 m in plan area and up to 1.4 m above the seabed (max crossing structure dimensions). Rock placement elsewhere would be limited to <1 m height above seabed level.	Permanent ***seabed change*** will occur following placement of scour protection. The magnitude of this change is considered **small** (due to the limited area/ size of the scour protection proposed).	Due to the limited size of seabed change, the effects on ***metocean conditions*** are considered to remain ***localised***.	Small/ localised	Low
Operational and Maintenance Phase – repair activities only					

Source			Pathway		
Activity	**Activity Description**	**Preliminary Source Assessment**	**Preliminary Pathway Assessment**	**Magnitude/ Extent**	**Scale of Pathway Change**
Cable and cable protection repairs (if damaged during storms or due to anchor drags or other construction).	Activities assumed to be similar in nature to construction but on a vastly reduced scale	Placing of new or adjustment of existing scour protection could cause ***sediment disturbance*** and ***seabed change*** but in both cases this is expected to be **small** as isolated repairs only.	Due to the limited size of repairs any pathway effects on ***water-quality*** or ***metocean processes*** are likely to remain ***localised***.	Small/ localised	Low
Decommissioning Phase – *in-situ*					
De-energise and leave cables *in-situ*	No additional sources of pathways change	n/a	n/a	n/a	n/a
Decommissioning – removal					
Removal of all cables and scour protection and reinstatement of seabed levels.	Details not known at this stage – would be subject to consenting and EIA processes at time of decommissioning (c.50+ years from commissioning). Activities assumed to be similar in type and scale to those of the construction phase.	Removal of all cables will cause ***sediment disturbance***. The magnitude of this disturbance will be ***small*** (due to the limited volumes to be removed but is also dependent on the method to be used).	This activity will cause a change in ***water-quality*** (due to increased turbidity). In ***deep and coastal water***, preliminary assessment indicates that during most tidal states current velocities are too low to mobilise disturbed sediment, it will therefore settle in the immediate vicinity and remain ***localised*** (settlement expected over tens of metres). During peak spring tides however (approximately <3% of the time), ***metocean conditions*** (e.g. tidal currents and waves) could transport disturbed sediment 6.9 to 15.2 km (depending on location along the OCC) in an east northeast and west southwest direction (before settling out). There is expected to be a high degree of dispersion due to the ***small*** volumes of disturbed sediment at source and ***far-field*** spatial extent over which the sediment could travel.	Small/ localised	Low
	Details not known at this stage – would be subject to consenting and EIA processes at time of decommissioning (c.50+ years from now). Activities assumed to be similar in type and scale to those of the construction phase.	Permanent ***seabed change*** will occur following removal of scour protection. The magnitude of this change is considered **small** (due to the limited area/ size of the scour protection proposed).	Due to the limited size of seabed change, the effects on ***metocean conditions*** are considered to remain ***localised***.	Small/ localised	Low

8.11 Assessment of Construction Effects

Introduction

8.11.1 The impacts of the construction of the Proposed Development have been assessed. The impacts arising from the construction phase of the Proposed Development are listed in **Table 8.32**, along with the maximum design scenario against which each impact has been assessed.

8.11.2 A description of the likely effect on receptors caused by each identified impact is given below.

Sediment Disturbance or Seabed Change

8.11.3 During construction, there is the potential for sediment disturbance or seabed change. This is as a result of the following activities:

- Seabed preparation, i.e. localised seabed plough (no large scale removal of e.g. sand waves required in UK waters based on the outline CBRA, see Volume 1, Appendix 3.4 of the ES);
- Cable installation using the mechanical cutter and water jetter, or placement of additional rock protection where full target burial is not possible; and,
- Placement of rock protection and/ or additional rock at cable crossings.

8.11.4 For all activities, there is the potential to disturb seabed sediment. A high-level assessment of potential sediment transport has been undertaken to inform this ES, using tidal current velocities (obtained from the DHI MIKE Global Tide Model) and a combination of modelled and measured wave data (where available), and the results from the sub-tidal sediment grab surveys (please refer to Volume 3, Appendix 8.1: High Level Assessment of Sediment Disturbance of the ES for more details on the methodology and findings of this assessment).

8.11.5 The assessment showed that sediment can be mobilised and remain in suspension along approximately 18% of the Offshore Cable Corridor (where it is characterised by predominantly fine sandy sediments) under baseline conditions. Baseline sediment mobilisation (and subsequent transport over significant distances) can occur during peak spring tide current velocities only (representing approximately <3% of overall time of the worst-case months tested).

8.11.6 If disturbed by activities associated with the Proposed Development, sediment would be expected to go into (and remain in) suspension within Bideford Bay (location 1) and to the south-west of the Isles of Scilly (location 9), and is expected to travel towards the south-west during peak spring tides. The maximum distance travelled (across all locations/ sections of the OCC) has been estimated to be 15.2 km (during peak spring tide conditions within Bideford Bay) with the associated sediment plumes expected to remain close to the seabed, i.e. within 2 m of the bed. This assumption is based on findings within BERR (2008). Refer to Volume 3, Appendix 8.1: High Level Assessment of Sediment Disturbance of the ES for more details.

8.11.7 Limitations in the methodology adopted for the sediment transport assessment mean that dispersion/ dilution of the sediment plume as it spreads from the point of disturbance cannot be quantified. Based on experienced judgement however, concentrations of suspended sediment are likely to be generally small – given the

scale and transient nature of the activities, variation in background conditions (in terms of background turbidity but also importantly tidal current velocities and wave climate) and potential transport distances.

Table 8.35: Sediment Transport Results for the Peak Spring Tide Scenario (c.f. Volume 3, Appendix 8.1 of the ES)

Calculation Location	Sediment Sampling Stations	Average Water Depth (m)	Average d_{50} (mm)	Distance above bed (m)	Max. Time in Suspension (hrs)	Max. Distance Travelled (km)
1	UK_55-61	12.5	0.16	1	6	~14.0
9	UK_6-15	115	0.18	1	4	~6.9
1	UK_55-61	12.5	0.16	2	6	~15.2
9	UK_6-15	115	0.18	2	4	~7.5

Sensitivity of the Receptor

8.11.8 Based on the potential maximum distance travelled and proximity of the cable route to nationally or internationally designated sites, the construction activities have the potential to affect:

- the surrounding sub-tidal seabed;
- surrounding coastline;
- Mermaids Pool to Rowdon Gut SSSI, Hobby and Peppercombe SSSI, Tintagel-Marsland-Clovelly Coast SAC/SSSI, Northam Burrows SSSI, Taw-Torridge Estuary SSSI, Braunton Burrows SSSI/SAC, Saunton Coast SSSI, Bristol Channel SAC, Hartland Point MCZ, Bideford to Foreland Point MCZ, and North Devon Biosphere Reserve nationally or internationally designated sites;
- Bideford Bay waterbody receptors; and,
- Westward Ho! Bathing Water.

8.11.9 The sensitivity of the surrounding sub-tidal seabed receptor is **low.** This is on the basis that the receptor is of a regional or local value and is considered to have reasonable tolerance to the impacts as it will be routinely exposed to temporary periods of elevated suspended sediment during e.g. winter storm events.

8.11.10 Whilst the value of the surrounding coastline receptor is **high,** the sensitivity of this receptor to temporary uplifts in suspended sediment is considered to be **low.** This is on the basis that the coastline will be routinely exposed to temporary periods of elevated suspended sediment during winter storm events.

8.11.11 The value of the nationally or internationally designated sites receptor is **high,** however the sensitivity of the geological and geomorphological features of the receptor to temporary uplifts in suspended sediment is considered to be **low.** This is on the basis that the coastline will be routinely exposed to temporary periods of elevated suspended sediment during e.g. winter storm events.

8.11.12 The sensitivity of the Bideford Bay waterbody receptor is considered **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact.

8.11.13 The sensitivity of the Westward Ho! Bathing Water receptor is considered **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact.

Magnitude of Impact

8.11.14 Based on the sediment transport assessment completed to support this ES, likely impacts are limited to construction activities within Bideford Bay. Following the outputs of the sediment transport modelling (c.f. Volume 3, Appendix 8.1: Sediment Dispersion Technical Note of the ES) it is anticipated that dispersal of sediment will be very limited along the section of the offshore cable corridor adjacent to the South West Approaches to Bristol Channel MCZ. The Technical Note confirms that even worst case peak spring currents would be insufficient to maintain sediments in suspension and thus sediment dispersal in these sections is expected to be limited to tens of metres i.e. immediate settling of disturbed sediments.

8.11.15 As stated within the UK Marine SAC project (Parr et al., 1998), "dredging activities often generate no more increased suspended sediments than commercial shipping operations, bottom fishing or generated during severe storms". It is likely that natural events, such as storms, floods and large tides, can increase SSC over much larger areas, and for longer time periods. Furthermore, the effects on SSC, as a result of cable burial activities, are generally short term (<1 week) and near field (<1 km from the activity) (Berr, 2008).

8.11.16 The qualitative assessment of sediment disturbance from cable laying, undertaken by Berr (2008), indicates a relatively low level of disturbance (where a score of 1 is low, and 10 is high). For the construction activities associated with the Offshore Cable Corridor, ploughing has a score of 1 for disturbance (in all sediment types relevant to the Proposed Development), jetting has a score of 2 (for fluidisation), and mechanical cutting has a score of 3. This indicates that the level of disturbance associated with the Proposed Development is low.

8.11.17 The two activities likely to cause the largest increases in SSC's are the dredging (associated with route preparation) and jetting (associated with cable burial). The Environment Agency's SeDiChem Tool indicates a maximum SSC increase of 400 mg/l for dredging and 400 mg/l for jetting (but could be nearer 10 mg/l). Therefore, there would be a maximum, short-term, nearfield increase in SSC of 0 – 390 mg/l. However, based on the real-time monitoring completed during construction, as part of Nysted Offshore Wind Farm, increases are more likely to be between 18 and 75 mg/l, which would remain trapped within the bottom 1 – 2 m of the water column. This would be an increase of between 40% and 450% on (indicative) background surface SSC's.

8.11.18 The largest potential for impact is likely to be associated with the construction of the exit pits required for the HDD. The total area of disturbance from the HDD exit pits will be 15 m x 15 m for each exit pit, that will be located between c.500 m and 1800 m offshore (between c.5 m and 10 m water depth). From the sediment transport assessment (Volume 3, Appendix 8.1 of the ES), sediment in this location could travel approximately 15.2 km in a south-westerly direction but only if construction activities were to take place during a peak spring tide current velocity window and/ or significant wave action (with the sediment plume expected to be constrained principally within 2 m above the bed – refer to **paragraph 8.11.6** for more details).

8.11.19 Sediment is expected to settle downwards at a calculated settling velocity of between 0.01 m/s (fine sand) to 0.27 m/s (gravel). From the sediment transport assessment (Volume 3, Appendix 8.1 of this ES), sediment deposition resulting from route preparation/cable burial activities (as a worst case) could range from 0 mm - 1.5 mm depending on location and tidal conditions during construction (average deposition across the plume area).

8.11.20 Since the impact is predicted to involve very low volumes of sediment release over a very limited portion of the overall tidal cycle and constrained to a localised spatial extent, the magnitude is expected to be **low**.

Significance of the Effect

8.11.21 Overall, the magnitude of the impact to the surrounding sub-tidal seabed receptor is **low** and the sensitivity of the receptor is **low**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

8.11.22 Overall, the magnitude of the impact to the surrounding coastline receptor is **low** and the sensitivity of the receptor is **low**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

8.11.23 Overall, the magnitude of the impact to the nationally or internationally designated sites is **low** and the sensitivity of the receptor is **low**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

8.11.24 Overall, the magnitude of the impact to the Bideford Bay waterbody is **low** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **minor** adverse significance, which is not significant.

8.11.25 Overall, the magnitude of the impact to the Westward Ho! Bathing Water is **low** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **minor** adverse significance, which is not significant.

Further (Secondary) Mitigation and Residual Effect

8.11.26 There are no significant impacts predicted and therefore no further mitigation is considered necessary. However, for completeness, it is recommended that the construction of the HDD exit pits avoids working during peak spring tides and significant wave activity, to limit any potential for sediment mobilisation. This will be included within the final offshore CEMP (an outline offshore CEMP is submitted as part of the DCO application (document reference 7.9)) and is included in the Proposed Development's Commitments Register (Volume 1, Appendix 3.1: Commitments Register of the ES).

Future Monitoring

8.11.27 No future monitoring is required due to there being no significant effects identified to receptors.

Changes to Water Quality

8.11.28 During construction, there is the potential for the following activities to cause changes to water quality – principally via sediment disturbance:

- Seabed preparation, e.g. grapnel runs and local flattening with sea bed plough;
- Cable installation using the mechanical cutter, plough and water jetter;
- Placement of rock protection, including at cable crossings; and
- Release of drill fluids to the marine environment during punch out of the HDDs at the subtidal exit pits.

8.11.29 Fifty one sediment grab samples were analysed for metals, organotins and PAHs (for results, refer to Volume 3, Appendix 8.3: Sediment Sample Chemistry Results of the ES). In the absence of specific sediment EQS, the general framework that is used when determining sediment disposal marine licences has been applied here. Analysis of the sediment concentrations against Cefas Action Level 1 and Action Level 2 revealed Arsenic concentrations above the Level 1 threshold at eight of the locations sampled (within Bideford Bay and off the north coast of Devon) but less than the Probable Effect Level (PEL). As the levels sampled were less than the PEL, but above the Threshold Effect Level (TEL), and between Cefas Action Levels 1 and 2, further consideration is recommended to determine the likelihood of environmental consequences. This further assessment is undertaken below.

8.11.30 Within shallow and coastal waters, the results from the CBRA (an Outline CBRA is presented as Volume 1, Appendix 3.4 of the ES) indicate that, at locations where Arsenic exceeds Action Level 1, there are no identified sand waves and/ or large ripples and there is low risk of extensive seabed preparation being required. Furthermore, the burial risk of the cable, within Bideford Bay, appears minimal (based on assumed suitable bed conditions from the subtidal DDV survey results) meaning that additional rock protection is unlikely to be required in these areas.

8.11.31 However, in deep water locations where Arsenic is present at levels in excess of Cefas Action Level 1, there are areas where seabed preparation may be required (localised sand waves, trawl scars, etc.) and a high gravel content and/ or outcropping bedrock could cause mechanical cutting and water jetting to fail. Furthermore, data indicate that there may also be cable crossings where high concentrations of Arsenic can be found, noting that sediment disturbance as a result of rock placement at cable crossings would be expected to be modest, in comparison to e.g. MFE. Offshore arsenic sediment concentrations are known to be naturally elevated (normal background) across this region.

Sensitivity of receptor

8.11.32 Based on the estimated maximum distance travelled for disturbed sediments and the proximity of cable route to nationally or internationally designated sites, the construction activities have the potential to affect the following receptors:

- Nationally or internationally designated sites (Mermaids Pool to Rowdon Gut SSSI, Hobby and Peppercombe SSSI, Tintagel-Marsland-Clovelly Coast SAC, Bristol Channel Approaches / Dynesfeydd Mor Hafren SAC, North Devon Biopshere Reserve and South-West Approaches to Bristol Channel MCZ); and,
- Bideford Bay waterbody.
- Westward Ho! Bathing Water.

8.11.33 The sensitivity of the nationally or internationally designated site receptors is **high** because the receptors have international and national value**.**

8.11.34 The sensitivity of the Bideford Bay waterbody receptor is **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact.

8.11.35 The sensitivity of the Westward Ho! Bathing Water receptor is **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact.

Magnitude of impact

8.11.36 Based on the sediment transport assessment completed to inform this ES, likely impacts are limited to construction activities within Bideford Bay. The assessment of sediment disturbance showed that sediment would be expected to mobilise during peak spring tide current velocities (representing approximately <3% of overall time of the worst-case months tested). Sediment disturbed by construction activities is expected to travel towards the south-west (during peak springs only) up to a maximum distance of 15.2 km (if suspended 2 m above the bed – refer to **paragraph 8.11.6** for more details). The concentrations of dispersed sediment beyond the immediate area around construction activities are likely to be generally small – given the small scale and transient nature of the activities (at any one location). For more detail, refer to **paragraphs 8.11.16** to **8.11.19.**

8.11.37 The sediment transport excursion ellipses do not consider the concentration of suspended sediment.

8.11.38 In reality, as tidal currents transport sediment away from the disturbance activity (e.g. trench excavation), the suspended sediment concentration will reduce (due to advection and/ or dispersion) as distance from the activity increases. Therefore, at the furthest point (along the predicted ellipse) from the activity, sediment concentrations will be lowest, tending towards background.

8.11.39 The maximum sediment disturbance distance predicted above is the worst case scenario associated with works in the inner Bideford Bay where fine sands are prevalent. The concentrations of sediment disturbance are discussed in Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES.

8.11.40 Any water quality effects will be associated with mobilisation of pollutants associated with the existing fine sands i.e. not from introduction of any new pollutants. The fine sands of Bideford Bay will routinely be reworked and mobilised into suspension as part of normal, baseline conditions. The sediment chemistry baseline found no elevated contamination, that represents a concern for short-term and localised disturbance (at any one location). The water quality conditions that are predicted as a result of the Proposed Development, associated with local sediment disturbance from construction phase activities (principally plough trenching), would be expected to routinely be exhibited under baseline conditions e.g. during peak tidal events or during storm events. In other words the predicted water quality conditions will likely be within the range of normal, baseline water quality variability.

8.11.41 The release of drill fluids to the marine environment during punch out of the HDDs at the subtidal exit pits will be minimised by careful HDD planning, which will involve full diameter drilling for the majority of the borehole length prior to breakthrough. The position of the drill will be closely monitored on it's approach to

the exit pit breakthrough, such that the drill fluid pressure can be monitored and minimised as much as possible. Final (Pre-Construction) HDD method statements and the Pre-Construction Bentonite Breakout Plan (adhering to the principles of the Outline Bentonite Breakout Plan; Document Ref. 7.20) will include methods and measures where necessary to minimise drill fluid release to the marine environment. HDD punch out i.e. break through to the exit pits, will not be undertaken during peak Spring tides or periods of significant wave activity in Bideford Bay, to minimise dispersion of any disturbed sediments. The use of bentonite as the drill fluid will minimise any potential for adverse water quality effects. Bentonite is a Pose Little or No Risk to the Environment (PLONOR) substance that flocculates rapidly, particularly under saline conditions

8.11.42 The impact is predicted to be of local spatial extent and short-term duration, with very low volumes of sediment to be disturbed, or drill fluids released during HDD bore breakthrough. The magnitude is therefore considered **negligible**.

Significance of effect

8.11.43 Overall, the magnitude of the impact to the nationally or internationally designated sites is **negligible,** and the sensitivity of the receptor is **high**. The effect will, therefore, be of **minor** adverse significance, which is not significant.

8.11.44 The magnitude of the impact to Bideford Bay waterbody is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible or minor** adverse significance, which is not significant.

8.11.45 The magnitude of the impact to Westward Ho! Bathing Water is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible or minor** adverse significance, which is not significant.

Further (Secondary) Mitigation and Residual Effect

8.11.46 No further mitigation is required due to there being no significant effects identified to receptors.

Future Monitoring

8.11.47 No future monitoring is required due to there being no significant effects identified to receptors.

Secondary (localised) Scour

8.11.48 During construction, there is the potential for the placement of rock protection (including at cable crossings and where cable protection offered by natural sediments is insufficient) to cause secondary (localised) scour. Secondary scour is as a result of the interaction of flow (i.e. bed currents) around the edge of protection (i.e. for cables) resulting in the potential erosion of the sea bed.

Sensitivity of receptor

8.11.49 Based on the estimated maximum distance travelled for disturbed sediments and the proximity of cable route to nationally or internationally designated sites, the construction activities have the potential to affect the following receptors:

- Nationally or internationally designated sites (Mermaids Pool to Rowdon Gut SSSI, Hobby and Peppercombe SSSI, Tintagel-Marsland-Clovelly Coast SAC/SSSI, Northam Burrows SSSI, Taw-Torridge Estuary SSSI, Braunton Burrows SSSI/SAC, Saunton Coast SSSI, Bristol Channel SAC, Hartland Point MCZ, Bideford to Foreland Point MCZ, and North Devon Biosphere Reserve nationally or internationally designated sites);
- Bideford Bay waterbody; and
- Westward Ho! Bathing Water.

8.11.50 The sensitivity of the nationally or internationally designated site receptors is **high** because the receptors have international and national value**.**

8.11.51 The sensitivity of the Bideford Bay waterbody receptor is **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact.

8.11.52 The sensitivity of the Westward Ho! Bathing Water receptor is **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact

Magnitude of impact

8.11.53 Theoretical maximum scour depths and lengths (in the direction of wave travel) were estimated using a method for determining scour around submerged structures (Young, et al., 2006).

8.11.54 The impact is predicted to be of local spatial extent (between 1.91 and 5.77 m, with an average of 3.35 m) and short-term duration, with very low volumes of sediment to be disturbed (between 0 and 0.43 m, with an average of 0.056 m). For more detail, refer to Volume 3, Appendix 8.1 of the ES.

8.11.55 The magnitude is therefore considered **negligible**.

Significance of effect

8.11.56 Overall, the magnitude of the impact to the nationally or internationally designated sites is **negligible,** and the sensitivity of the receptor is **high**. The effect will, therefore, be of **minor** adverse significance, which is not significant.

8.11.57 The magnitude of the impact to Bideford Bay waterbody is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible or minor** adverse significance, which is not significant.

8.11.58 The magnitude of the impact to Westward Ho! Bathing Water is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible or minor** adverse significance, which is not significant.

Further (Secondary) Mitigation and Residual Effect

8.11.59 No further mitigation is required due to there being no significant effects identified to receptors.

Future Monitoring

8.11.60 Future monitoring of any scour around the cable protection and crossing locations is recommended to confirm that levels of secondary scour are modest as predicted, and to rapidly identify any local areas of scour that may require additional remedial actions to mitigate further sediment disturbance. Post installation monitoring is proposed, to be undertaken as part of routine cable inspection surveys under the following survey schedule:

- Routine surveys of the offshore submarine cables shall commence two years from the commissioning of the first Bipole.
- If no issues are found, the next follow up survey would be in three years, with the interval increasing by one year each time, until the period between surveys reaches five years.
- If no issues are found, routine surveying through the remainder of the operational phase is likely to be conducted on a five-year basis.
- If an issue is found, it will be flagged for further investigation, and mobilisation of repair as appropriate.

8.12 Assessment of Operation and Maintenance Effects

8.12.1 The impacts of the operation and maintenance phase of the Proposed Development have been assessed. The impacts arising from the operation and maintenance phase of the Proposed Development are listed in **Table 8.32**, along with the maximum design scenario against which each impact has been assessed.

8.12.2 A description of the likely effect on receptors caused by each identified impact is given below.

Changes to Metocean Conditions

8.12.3 During operation, potential for changes to metocean conditions in shallow or coastal water have been identified. This is as a result of the following activities:

- Localised changes to water depth (associated with any (localised) seabed preparation associated with maintenance activities, e.g. local use of MFE to expose and rebury cable repairs).
- Presence of rock protection (above seabed – up to 1 m height) where burial was not fully possible at construction.
- Presence of cable crossing 'structures' which consist of the placement of rock or concrete mattresses on the seabed (up to 1.4 m height).

8.12.4 The above activities (where relevant) have the potential to affect metocean conditions by resulting in changes to water depth, which in turn could impact on waves and currents. For example, the removal of sand waves (only localised, small scale flattening activities are anticipated in UK waters during the construction phase) will result in an increase in water depth (operational and maintenance phase), whilst placement of rock/ concrete mattresses above seabed level would result in a decrease in water depth. Changes to metocean

conditions are only being considered for shallow and coastal waters (<20 m water depth; refer to **Table 8.9** for justification); potential impacts are presented here for completeness, noting immediately that there are no reductions in water depth expected in shallow or coastal waters.

Sensitivity of receptor

8.12.5 The impact has the potential to affect the surrounding sub-tidal seabed, surrounding coastline receptor, nationally or internationally designated sites (notably Mermaids Pool to Rowdon Gut SSSI, Hobby and Peppercombe SSSI, Tintagel-Marsland-Clovelly Coast SAC/SSSI, Northam Burrows SSSI, Taw-Torridge Estuary SSSI, Braunton Burrows SSSI/SAC, Saunton Coast SSSI, Bristol Channel SAC, Hartland Point MCZ, Bideford to Foreland Point MCZ, and North Devon Biosphere Reserve nationally or internationally designated sites), Bideford Bay waterbody and Westward Ho! Bathing Water receptors.

8.12.6 The sensitivity of the surrounding sub-tidal seabed receptor is **low.** This is on the basis that the receptor is of a regional or local value and is considered to be able have reasonable tolerance to the impacts on the basis that it will be routinely exposed to a large range of metocean conditions, e.g. during winter storm events.

8.12.7 The sensitivity of the surrounding coastline receptor is **high** (considered precautionary). This is because the coastline forms part of the nationally or internationally designated sites which have international and national value.

8.12.8 The sensitivity of the nationally or internationally designated sites receptor is **high** because the receptors have international and national value.

8.12.9 The sensitivity of the Bideford Bay waterbody receptor is **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact.

8.12.10 The sensitivity of the Westward Ho! Bathing Water receptor is **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact.

Magnitude of impact

8.12.11 The results from the Cable Burial Risk Assessment (outline CBRA is presented as Volume 1, Appendix 3.4: Outline Cable Burial Risk Assessment of the ES) indicates that very little seabed preparation will be required within shallow and coastal waters, due to no identified sand waves and/ or large ripples. Furthermore, full target burial depth is likely to be possible and therefore the chance of requiring cable protection measures above the level of the existing seabed is considered highly unlikely. There are thus expected to be no permanent changes to the seabed during the operational and maintenance phase.

8.12.12 There is no requirement for construction of cable crossings within shallow or coastal waters.

8.12.13 The requirement for localised cable protection at the x4 HDD exit points will be required – in addition to burial alone. The planned cable protection is informed by the characterisation of nearshore sea bed sediments including that provided by the HDD feasibility report (LMR (2023)). Cable protection at the HDD exit locations, if needed, would be limited to deployment of either low-profile concrete mattresses or highly localised rock placement to protect ducts. These protection options would be deployed below the level of the unconsolidated sediments -

there is c.5 m of unconsolidated sediments known to be present across the potential HDD exit area, which will offer sufficient cover to avoid any localised scour effects and there is no anticipated reduction in water depth or local sediment movements. Temporary, localised above/on seabed protection cannot be fully discounted at this stage – this is considered unlikely but for completeness potential temporary / short-term protection prior to final burial works is assumed here (strictly a construction phase activity however presented here with other rock protection considerations). For completeness the potential for metocean change associated with some rock placement at HDD exit pits is thus assessed.

8.12.14 The footprint of the activity is small (likely to be in the order of tens of square metres but the total exit pit area across the x4 exit points is assumed for worst case assessment purposes i.e. 900 m^2 or 0.0009 km^2). This is small in scale in comparison to the Bideford Bay waterbody (0.00081% of the c.111 km^2 waterbody area), and the North Devon Biosphere Reserve (approximately 140 km^2). Any local, temporary changes to the seabed are expected to have a negligible change on the wider metocean processes (which operate at much greater scales). Therefore, the magnitude is **negligible**.

Significance of effect

8.12.15 Overall, the magnitude of the impact to the surrounding sub-tidal seabed receptor is **negligible** and the sensitivity of the receptor is **low**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

8.12.16 Overall, the magnitude of the impact to the surrounding coastline receptor is **negligible** and the sensitivity of the receptor is **high**. The effect will, therefore, be of **minor** adverse significance, which is not significant.

8.12.17 Overall, the magnitude of the impact to nationally or internationally designated sites is **negligible** and the sensitivity of the receptor is **high**. The effect will, therefore, be of **minor** adverse significance, which is not significant.

8.12.18 Overall, the magnitude of the impact to the Bideford Bay waterbody is **negligible** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible** adverse significance, which is not significant.

8.12.19 Overall, the magnitude of the impact to the Westward Ho! Bathing Water is **negligible** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible** adverse significance, which is not significant.

Further (Secondary) Mitigation and Residual Effect

8.12.20 No additional mitigation is proposed due to there being no significant effects identified to receptors.

Future Monitoring

8.12.21 No future monitoring is required due to there being no significant effects identified to receptors.

Sediment Disturbance or Seabed Change

8.12.22 During operation and maintenance, there is the potential for sediment disturbance or seabed change. This is as a result of the following activities:

- Physical disturbance associated with cable repair and maintenance activities.
- Physical disturbance associated with cable remedial burial activities.
- Physical disturbance associated with maintenance of external cable protection (i.e. replacement of rock armour).
- Physical disturbance associated with new external cable protection (i.e. rock placement).

8.12.23 The installation methodology for maintenance activities would be broadly the same as per the equivalent construction activities, however note that the scale of any isolated repair activities would likely be on a much reduced geographic scale compared to the construction phase.

8.12.24 For these activities, there is the potential to disturb seabed sediment. An analysis of sediment transport and local sediment disturbance concentrations (at source) has been undertaken, the results of which are discussed in the construction phase impact section above and within Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES.

Sensitivity of receptor

8.12.25 Based on potential maximum distance travelled and proximity of the Offshore Cable Corridor to nationally or internationally designated sites, the maintenance activities have the potential to affect Mermaids Pool to Rowdon Gut SSSI, Hobby and Peppercombe SSSI, Tintagel-Marsland-Clovelly Coast SAC and North Devon Biosphere Reserve (nationally or internationally designated sites), the Bideford Bay waterbody and the Westward Ho! Bathing Water receptors. It also has the potential to affect the surrounding sub-tidal seabed receptor and surrounding coastline receptor.

8.12.26 Whilst the value of the nationally or internationally designated sites receptor is **high,** the sensitivity of the geological and geomorphological features of the receptor to temporary uplifts in suspended sediment is considered to be **low.** This is on the basis that the coastline will be routinely exposed to temporary periods of elevated suspended sediment during e.g. winter storm events.

8.12.27 The sensitivity of the Bideford Bay waterbody receptor is **medium**. This is because the receptor has regional value and limited capacity to tolerate the impact.

8.12.28 The sensitivity of the Westward Ho! Bathing Water receptor is **medium**. This is because the receptor has regional value and limited capacity to tolerate the impact.

8.12.29 Whilst the value of the surrounding coastline receptor is **high,** the sensitivity of this receptor to temporary uplifts in suspended sediment is considered to be **low.** This is on the basis that the coastline will be used to temporary periods of elevated suspended sediment concentrations during extreme events.

8.12.30 The sensitivity of the surrounding sub-tidal seabed receptor is low. This is on the basis that the receptor is of a regional or local value and is considered to be able have reasonable tolerance to the impacts on the basis that it will be routinely exposed to temporary periods of elevated suspended sediment during winter storm events.

Magnitude of impact

8.12.31 Based on the sediment transport analysis, potential impacts are likely limited to maintenance activities, if needed, within Bideford Bay. The assessment of sediment disturbance showed that sediment would be expected to mobilise during peak spring tide current velocities (representing approximately <3% of overall time of the worst-case months tested). Under these conditions sediment disturbed by any maintenance / repair activities would be expected to travel towards the south-west (during peak springs) up to a maximum distance of 15.2 km (if suspended 2 m above the bed). The concentrations of dispersed sediment beyond the immediate area around these construction-type activities are likely to be generally small – given the small scale and transient nature of any maintenance and repair activities, at any one location. For more detail on the scale of associated sediment disturbance, refer to **paragraphs 8.11.16** to **8.11.19.**

8.12.32 The sediment transport excursion ellipses do not consider the concentration of suspended sediment. In reality, as tidal currents transport sediment away from the disturbance activity (e.g. trench excavation), the suspended sediment concentration will reduce (due to advection and/ or dispersion) as distance from the activity increases. Therefore, at the furthest point (along the predicted ellipse) from the activity, sediment concentrations will be lowest, tending towards background.

8.12.33 It should be noted that this analysis is based on a worst-case scenario of completing maintenance activities during a peak spring tide.

8.12.34 The impact is predicted to be of local spatial extent and short-term duration. The magnitude is therefore **negligible**.

Significance of effect

8.12.35 Overall, the magnitude of the impact to the nationally or internationally designated sites is **negligible** and the sensitivity of the receptor is **low**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

8.12.36 Overall, the magnitude of the impact to the Bideford Bay waterbody is **negligible** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible** adverse significance, which is not significant.

8.12.37 Overall, the magnitude of the impact to the Westward Ho! Bathing Water is **negligible** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible** adverse significance, which is not significant.

8.12.38 Overall, the magnitude of the impact to the surrounding sub-tidal seabed receptor is **negligible** and the sensitivity of the receptor is **low**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

8.12.39 Overall, the magnitude of the impact to the surrounding coastline receptor is **negligible** and the sensitivity of the receptor is **low**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

Further (Secondary) Mitigation and Residual Effect

8.12.40 It is recommended that, for any maintenance activities, contractors avoid working during the peak spring tides, to minimise the potential for distribution of any sediments disturbed.

Future Monitoring

8.12.41 No future monitoring is required due to there being no significant effects identified to receptors.

Potential Changes to the Assessment as a Result of In-Combination Climate Impacts

8.12.42 Increased bed currents, as a result of climate change over the period of the operational and maintenance phase, could result in greater sediment transport during maintenance activities. However, it is unlikely that increases in currents will have a significant impact on the magnitude of impacts and, therefore, the significance of effect.

8.12.43 This is because anticipated increases in storm events, associated with climate change over the period of operation, would mean more frequent future baseline mobilisation and reworking of sediments in Bideford Bay, potentially reducing the sensitivity of the local receptors to any Proposed Development impact.

8.12.44 For information about the anticipated likely climate change effects, refer to **paragraphs 8.7.81 to 8.7.88**.

Changes to Water Quality

8.12.45 During the operation and maintenance phase, there is the potential for changes to water quality. This is as a result of the following activities:

- Placement of very small quantities of plastic in the marine environment (associated with concrete scour mattress ties).
- Cable repair and maintenance activities.
- Cable remedial burial activities.
- Maintenance of external cable protection (i.e. replacement of rock protection).
- New external cable protection (i.e. placement of additional rock e.g. to mitigate against local scour).

8.12.46 For these activities, there is the potential to disturb 'contaminated' seabed sediments. An analysis of sediment transport has been undertaken, the results of which are discussed in the construction phase impact section above and within Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES.

8.12.47 Fifty one grab samples were analysed for metals and PAHs (for results, refer to Volume 3, Appendix 8.3: Sediment Sample Chemistry Results, and Volume 3, Appendix 8.4: GEOxyz Environmental Report of the ES). Analysis of the sediment concentrations against Cefas Action Level 1 and Action Level 2 revealed Arsenic concentrations above the Level 1 threshold at eight of the locations sampled (within Bideford Bay and off the north coast of Devon), however elevated arsenic concentrations are a known characteristic of the baseline offshore sediments (offshore of Devon).

8.12.48 For all activities, there is the potential to disturb seabed sediment which could result in a temporary increase in suspended sediment concentrations.

Sensitivity of receptor

8.12.49 Based on the sediments likely maximum distance travelled and proximity of cable route to nationally or internationally designated sites, the maintenance activities have the potential to affect nationally or internationally designated sites (notably Mermaids Pool to Rowdon Gut SSSI, Hobby and Peppercombe SSSI, Tintagel-Marsland-Clovelly Coast SAC, Bristol Channel Approaches/ Dynesfeydd Mor Hafren SAC, North Devon Biosphere Reserve and South-West Approaches to Bristol Channel MCZ), the Bideford Bay waterbody and the Westward Ho! Bathing Water.

8.12.50 The sensitivity of the nationally or internationally designated sites receptor is **high** because the receptors have international and national value.

8.12.51 The sensitivity of the Bideford Bay waterbody receptor is medium. This is because the receptor has regional value and limited capacity to tolerate the impact.

8.12.52 The sensitivity of the Westward Ho! Bathing Water receptor is medium. This is because the receptor has regional value and limited capacity to tolerate the impact.

Magnitude of impact

8.12.53 Based on the sediment transport analysis, likely impacts are limited to maintenance activities within Bideford Bay. The assessment of sediment disturbance showed that sediment would be expected to mobilise during peak spring (and neap) tide current velocities (representing approximately <3% of overall time of the worst-case months tested). Sediment disturbed by any maintenance / repair activities is expected to travel towards the south-west (during peak springs) up to a maximum distance of 15.2 km (if suspended 2 m above the bed - refer to **paragraph 8.11.6** for more details). The concentrations of dispersed sediment beyond the immediate area around construction activities are likely to be generally small – given the small scale and transient nature of the activities (at any one location). For more detail, refer to **paragraphs 8.11.16** to **8.11.19.**

8.12.54 The sediment transport excursion ellipses do not consider the concentration of suspended sediment. In reality, as tidal currents transport sediment away from the disturbance activity (i.e. ploughing of trench), the suspended sediment concentration will reduce (due to advection and/ or dispersion) as distance from the activity increases. Therefore, at the furthest point (along the predicted ellipse) from the OCC, sediment concentrations will be lowest, tending towards background.

8.12.55 It should be noted that this analysis is also based on a worst-case scenario of completing (sediment disturbance) activities during a peak spring tide.

8.12.56 Any water quality effects will be associated with mobilisation of pollutants associated with existing fine sands i.e. not from introduction of any new pollutants. The fine sands of Bideford Bay will routinely be reworked and mobilised into suspension as part of normal, baseline conditions. The sediment chemistry baseline found no elevated contamination, that represents a concern for short-term and localised disturbance (at any one location). The water quality conditions that are predicted as a result of the Proposed Development, associated with local sediment disturbance from operational and maintenance phase activities (principally any targeted cable recovery and repair activities), would be expected to routinely be exhibited under baseline conditions e.g. during peak tidal events or

during storm events. In other words the predicted water quality conditions will be within the range of normal, baseline water quality variability.

8.12.57 The impact is predicted to be of local spatial extent and short-term duration. The magnitude is therefore **negligible**.

Significance of effect

8.12.58 Overall, the magnitude of the impact to the nationally or internationally designated sites is **negligible,** and the sensitivity of the receptor is **high**. The effect will, therefore, be of **minor** adverse significance, which is not significant.

8.12.59 The magnitude of the impact to Bideford Bay waterbody is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

8.12.60 The magnitude of the impact to the Westward Ho! Bathing Water is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

Further (Secondary) Mitigation and Residual Effect

8.12.61 No further mitigation is required due to there being no significant effects identified to receptors.

Future Monitoring

8.12.62 No future monitoring is required due to there being no significant effects identified to receptors.

Potential Changes to the Assessment as a Result of In-Combination Climate Impacts

8.12.63 Increased (wave-induced) bed currents, as a result of climate change over the period of the operational and maintenance phase, may result in greater sediment transport during maintenance activities (over the period of the operational and maintenance phase). However, it is unlikely that increases in currents will have a significant influence on the magnitude of impacts and, therefore, the significance of effect.

8.12.64 Anticipated increases in storm event magnitude and frequency associated with climate change over the period of operation, would mean more frequent future baseline mobilisation and reworking of sediments in Bideford Bay, potentially reducing the sensitivity of the local receptors to any Proposed Development impact.

8.12.65 For information about the anticipated likely climate change effects, refer to **paragraphs 8.7.81 to 8.7.88**.

Secondary (localised) Scour

8.12.66 During operation and maintenance, there is the potential for the following activities to cause secondary (localised) scour:

- Presence of scour protection and/or additional rock at cable crossings;

- Any above seabed level long-term cable protection;
- Cable repair and maintenance activities;
- Cable remedial burial activities;
- Maintenance of external cable protection (i.e. replacement of rock); and
- New external cable protection should this be deemed necessary following routine monitoring (i.e. placement of rock during the operational and maintenance phase).

Sensitivity of receptor

8.12.67 Based on the estimated maximum distance travelled for disturbed sediments and the proximity of the Offshore Cable Corridor to nationally or internationally designated sites, the operational and maintenance phase activities have the potential to affect the following receptors:

- Nationally or internationally designated sites (Mermaids Pool to Rowdon Gut SSSI, Hobby and Peppercombe SSSI, Tintagel-Marsland-Clovelly Coast SAC/SSSI, Northam Burrows SSSI, Taw-Torridge Estuary SSSI, Braunton Burrows SSSI/SAC, Saunton Coast SSSI, Bristol Channel SAC, Hartland Point MCZ, Bideford to Foreland Point MCZ, and North Devon Biosphere Reserve nationally or internationally designated sites);
- Bideford Bay waterbody; and
- Westward Ho! Bathing Water.

8.12.68 The sensitivity of the nationally or internationally designated site receptors is **high** because the receptors have international and national value.

8.12.69 The sensitivity of the Bideford Bay waterbody receptor is **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact.

8.12.70 The sensitivity of the Westward Ho! Bathing Water receptor is **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact.

Magnitude of impact

8.12.71 Theoretical maximum scour depths and lengths (in the direction of wave travel) were estimated using a method for determining scour around submerged structures (Young, et al., 2006).

8.12.72 The impact is predicted to be of local spatial extent (between 1.91 and 5.77 m, with an average of 3.35 m) and short-term duration, with very low volumes of sediment to be disturbed (between 0 and 0.43 m, with an average of 0.056 m). For more detail, refer to Volume 3, Appendix 8.1 of the ES.

8.12.73 The magnitude is therefore considered **negligible**.

Significance of effect

8.12.74 Overall, the magnitude of the impact to the nationally or internationally designated sites is **negligible,** and the sensitivity of the receptor is **high**. The effect will, therefore, be of **minor** adverse significance, which is not significant.

8.12.75 The magnitude of the impact to Bideford Bay waterbody is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible or minor** adverse significance, which is not significant.

8.12.76 The magnitude of the impact to Westward Ho! Bathing Water is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible or minor** adverse significance, which is not significant.

Further (Secondary) Mitigation and Residual Effect

8.12.77 No further mitigation is required due to there being no significant effects identified to receptors.

Future Monitoring

8.12.78 Future monitoring of scour around the cable protection and crossing locations is recommended to ensure maintenance or mitigation measures can be planned well in advance of implementation.

Potential Changes to the Assessment as a Result of In-Combination Climate Impacts

8.12.79 Increased bed currents, as a result of climate change over the period of the operational and maintenance phase, could result in increased scour depths around cable protection. However, it is unlikely that increases in currents will have a significant influence on the magnitude of impacts and, therefore the significance of effect. This is because of the very modest percentage/ scale of change to bed currents post-development, resulting in a negligible resultant increase to any potential for secondary scour.

8.13 Assessment of Decommissioning Effects

8.13.1 The impacts of the decommissioning phase of the Proposed Development have been assessed. The impacts arising from the operation and maintenance phase of the Proposed Development are listed in **Table 8.32**, along with the maximum design scenario against which each impact has been assessed.

8.13.2 A description of the likely effect on receptors caused by each identified impact is given below.

Sediment Disturbance or Seabed Change

8.13.3 During decommissioning (removal), there is the potential for sediment disturbance or seabed change. This is as a result of the following activity:

- Removal of all cables (decommissioning-removal) or,
- Leaving HDD crossing in-situ (decommissioning-*in-situ*).

8.13.4 For the removal of all cables, there is the potential to disturb seabed sediment. Methods would be confirmed during specific decommissioning phase Environmental Impact Assessment (EIA) closer to the time (50 years distant) but activities would be similar, albeit potentially of lesser footprint, to those associated with the construction phase. An analysis of sediment transport has been

undertaken, the results of which are discussed in the construction phase discussions above (**section 8.11**) and within Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES.

Sensitivity of receptor

8.13.5 Based on the likely maximum distance travelled and proximity of the Offshore Cable Corridor to nationally or internationally designated sites, the decommissioning activities have the potential to affect Mermaids Pool to Rowdon Gut SSSI, Hobby and Peppercombe SSSI, Tintagel-Marsland-Clovelly Coast SAC and North Devon Biosphere Reserve (nationally or internationally designated sites), the Bideford Bay waterbody and the Westward Ho! Bathing Water receptors. It also has the potential to affect the surrounding sub-tidal seabed receptor and surrounding coastline receptor.

8.13.6 Whilst the value of the nationally or internationally designated sites receptor is **high,** the sensitivity of the geological and geomorphological features of the receptor to temporary uplifts in suspended sediment is considered to be **low.** This is on the basis that the coastline will be routinely exposed to temporary periods of elevated suspended sediment during extreme events.

8.13.7 The sensitivity of the Bideford Bay waterbody receptor is **medium**. This is because the receptor has regional value and limited capacity to tolerate the impact.

8.13.8 The sensitivity of the Westward Ho! Bathing Water receptor is **medium**. This is because the receptor has regional value and limited capacity to tolerate the impact.

8.13.9 Whilst the value of the surrounding coastline receptor is **high,** the sensitivity of this receptor to temporary uplifts in suspended sediment is considered to be **low.** This is on the basis that the coastline is routinely exposed to temporary periods of elevated suspended sediment, e.g. during winter storm events.

8.13.10 The sensitivity of the surrounding sub-tidal seabed receptor is **low**. This is on the basis that the receptor is of a regional or local value and is considered to be able have reasonable tolerance to such impacts given it will be routinely exposed to periods of elevated suspended sediment during e.g. winter storm events.

Magnitude of impact

8.13.11 Based on the sediment transport analysis, likely impacts are limited to decommissioning activities within Bideford Bay for the removal of all cables.

8.13.12 The assessment of sediment disturbance showed that sediment would be expected to mobilise during peak spring tide current velocities (representing approximately <3% of overall time of the worst-case months tested). Sediment disturbed by decommissioning activities is expected to travel towards the south-west (during peak springs) up to a maximum distance of 15.2 km (if suspended 2m above the bed - refer to **paragraph 8.11.6** for more details). The concentrations of dispersed sediment beyond the immediate area around construction activities are likely to be generally small – given the small scale and transient nature of the activities (at any one location). For more detail, refer to **paragraphs 8.11.16** to **8.11.19.**

8.13.13 The sediment transport excursion ellipses do not consider the concentration of suspended sediment. In reality, as tidal currents transport sediment away from the

disturbance activity (e.g. de-burial), the suspended sediment concentration will reduce (due to advection and/ or dispersion) as distance from the disturbance activity increases. Therefore, at the furthest point (along the predicted ellipse) from the disturbance activity, sediment concentrations will be lowest, tending towards background.

8.13.14 It should be noted that the analysis of sediment transport (Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES) is based on a worst-case scenario of sediment disturbance taking place during a peak spring tide (prior to implementation of further mitigation).

8.13.15 The maximum scour depth in Bideford Bay has been estimated as 0.43 m over a maximum length of 2.7 m.

8.13.16 The impact is predicted to be of local spatial extent and short-term duration. The magnitude is therefore **negligible**.

Significance of effect

8.13.17 Overall, the magnitude of the impact to nationally or internationally designated sites is **negligible** and the sensitivity of the receptor is **low**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

8.13.18 Overall, the magnitude of the impact to the Bideford Bay waterbody is **negligible** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible** adverse significance, which is not significant.

8.13.19 Overall, the magnitude of the impact to the Westward Ho! Bathing Water is **negligible** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible** adverse significance, which is not significant.

8.13.20 Overall, the magnitude of the impact to the surrounding sub-tidal seabed receptor is **negligible** and the sensitivity of the receptor is **low**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

8.13.21 Overall, the magnitude of the impact to the surrounding coastline receptor is **negligible** and the sensitivity of the receptor is **low**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

Further (Secondary) Mitigation and Residual Effect

8.13.22 It is recommended that, for any decommissioning activities, contractors avoid working within Bideford Bay during peak spring tides, to minimise the potential for distribution of any sediments disturbed (to be secured via the appropriate decommissioning environmental management plans, or similar, at that time).

Future Monitoring

8.13.23 No future monitoring is required due to there being no significant effects identified to receptors.

Changes to Water Quality

8.13.24 During decommissioning, there is the potential for changes to water quality. This is as a result of sediment disturbance associated with the following activity:

- Removal of all cables.

8.13.25 For this activity, there is the potential to disturb contaminated seabed sediment. An analysis of sediment transport has been undertaken, the results of which are discussed in the construction phase discussions above (**section 8.11**) and within Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES.

8.13.26 Fifty one grab samples were analysed for metals and PAHs (for results, refer to Volume 3, Appendix 8.3: Sediment Sample Chemistry Results of the ES). Analysis of the sediment concentrations against Cefas Action Level 1 and Action Level 2 revealed Arsenic concentrations above the Level 1 threshold at eight of the locations sampled (within Bideford Bay and off the north coast of Devon).

8.13.27 As noted in Table 8.7, an initial meeting with the MMO took place on 17/10/24 to discuss their comments. A subsequent meeting took place with Cefas, as the MMO's technical advisors, on 8/11/24 to further discuss the existing sediment chemistry characterisation and analysis methods used by the laboratory when testing baseline grab samples. At the time of drafting this chapter, it is recommended that the laboratory methods and the resultant sediment baseline characterisations are suitable for the purposes of this ES, with additional analysis to take place as agreed with Cefas in the meeting (refer to **Table 8.7** and **Paragraph 8.6.15** for further details).

8.13.28 For all activities, there is the potential to disturb seabed sediment which could result in an increase in suspended sediment concentrations.

Sensitivity of receptor

8.13.29 Based on the sediments likely maximum distance travelled and proximity of cable route to nationally or internationally designated sites, the decommissioning activities have the potential to affect nationally or internationally designated sites (notably Mermaids Pool to Rowdon Gut SSSI, Hobby and Peppercombe SSSI, Tintagel-Marsland-Clovelly Coast SAC, Bristol Channel Approaches/ Dynesfeydd Mor Hafren SAC, North Devon Biosphere Reserve and South-West Approaches to Bristol Channel MCZ) the Bideford Bay waterbody and the Westward Ho! Bathing Water.

8.13.30 The sensitivity of the nationally or internationally designated sites receptor is **high** because the receptors have international and national value.

8.13.31 The sensitivity of the Bideford Bay waterbody receptor is medium. This is because the receptor has regional value and limited capacity to tolerate the impact.

8.13.32 The sensitivity of the Westward Ho! Bathing Water receptor is medium. This is because the receptor has regional value and limited capacity to tolerate the impact.

Magnitude of impact

8.13.33 Based on the sediment transport analysis, likely impacts are limited to decommissioning activities within Bideford Bay. The assessment of sediment disturbance showed that sediment would be expected to mobilise during peak spring tide current velocities (representing approximately <3% of overall time of the worst-case months tested). Sediment disturbed by decommissioning activities is expected to travel towards the south-west (during peak springs) up to a

maximum distance of 15.2 km (if suspended 2 m above the bed - refer to **paragraph 8.11.6** for more details). The concentrations of dispersed sediment beyond the immediate area around construction activities are likely to be generally small – given the small scale and transient nature of the activities (at any one location). For more detail, refer to **paragraphs 8.11.16** to **8.11.19.**

8.13.34 The sediment transport excursion ellipses do not consider the concentration of suspended sediment. In reality, as tidal currents transport sediment away from the disturbance activity (e.g. de-burial), the suspended sediment concentration will reduce (due to advection and/ or dispersion) as distance from the activity increases. Therefore, at the furthest point (along the predicted ellipse) from the activity, sediment concentrations will be lowest, tending towards zero.

8.13.35 It should be noted that this analysis is based on a worst-case scenario of completing decommissioning activities during a peak spring tide.

8.13.36 Any water quality effects will be associated with mobilisation of pollutants associated with the existing fine sands i.e. not from introduction of any new pollutants. The fine sands of Bideford Bay will routinely be reworked and mobilised into suspension as part of normal, baseline conditions. The water quality conditions that are predicted as a result of the Proposed Development, associated with local sediment disturbance from decommissioning phase activities (principally deburial), would be expected to routinely be exhibited under baseline conditions e.g. during peak tidal events or during storm events. In other words the predicted water quality conditions with the Proposed Development are anticipated to be within the range of normal, baseline water quality variability.

8.13.37 The impact is predicted to be of local spatial extent and short-term duration. The magnitude is therefore **negligible**.

Significance of effect

8.13.38 Overall, the magnitude of the impact to the nationally or internationally designated sites is **negligible,** and the sensitivity of the receptor is **high**. The effect will, therefore, be of **minor** adverse significance, which is not significant.

8.13.39 The magnitude of the impact to Bideford Bay waterbody is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

8.13.40 The magnitude of the impact to Westward Ho! Bathing Water is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant.

Further (Secondary) Mitigation and Residual Effect

8.13.41 It is recommended that, for any decommissioning activities, contractors avoid working during the peak spring tides, to minimise the potential for distribution of any sediments disturbed.

Future Monitoring

8.13.42 No future monitoring is required.

Secondary (localised) Scour

8.13.43 During decommissioning, there is the potential for the following activities to cause secondary (localised) scour:

- Presence of scour protection and/or additional rock at cable crossings where left *in-situ*;
- Any above seabed level long-term cable protection, where left *in-situ*; and
- Leaving HDD ducts *in-situ*.

8.13.44 At the point of decommissioning, the depth of scour around any above seabed protection is expected to have reached a state of dynamic equilibrium. If intervention measures have been required to supplement above seabed protection throughout the 50 year operational lifetime of the Proposed Development these areas would receive specific attention when designing the decommissioning plan. The maximum scour depth in Bideford Bay is estimated as 0.43 m – noting that this estimate is a theoretical worst case, and in reality no above seabed level rock placement is anticipated in Bideford Bay, based on the CBRA (an Outline CBRA is presented as Volume 1, Appendix 3.4 of the ES). Scour depth is however dependent on wave heights which may increase in the future (with sea-level rise and/ or increased storm intensity), which could increase the predicted scour depths. To reiterate, any influence from a changed wave regime would only likely be relevant to the coastal waters (<20 m depth) in Bideford Bay and the Proposed Development does not anticipate any above seabed level cable protection to be required in this area – following review of the CBRA (see Volume 1, Appendix 3.4: Outline Cable Burial Risk Assessment of the ES.

Sensitivity of receptor

8.13.45 Based on the estimated maximum distance travelled for disturbed sediments and the proximity of cable route to nationally or internationally designated sites, the construction activities have the potential to affect the following receptors:

- Nationally or internationally designated sites (Mermaids Pool to Rowdon Gut SSSI, Hobby and Peppercombe SSSI, Tintagel-Marsland-Clovelly Coast SAC/SSSI, Northam Burrows SSSI, Taw-Torridge Estuary SSSI, Braunton Burrows SSSI/SAC, Saunton Coast SSSI, Bristol Channel SAC, Hartland Point MCZ, Bideford to Foreland Point MCZ, and North Devon Biosphere Reserve nationally or internationally designated sites);
- Bideford Bay waterbody; and
- Westward Ho! Bathing Water.

8.13.46 The sensitivity of the nationally or internationally designated site receptors is **high** because the receptors have international and national value.

8.13.47 The sensitivity of the Bideford Bay waterbody receptor is **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact.

8.13.48 The sensitivity of the Westward Ho! Bathing Water receptor is **medium.** This is because the receptor has regional value and limited capacity to tolerate the impact.

Magnitude of impact

8.13.49 The magnitude of impact will be equivalent to that associated with the operational and maintenance phase impacts – refer to **paragraphs 8.12.71 to 8.12.72**. Furthermore, after 50 years in-situ, and by addressing any localised, unforeseen scour issues during that Proposed Development's lifetime (identified via the committed operational and maintenance phase surveys), hydrodynamic equilibrium around any cable protection would be expected. Therefore, the magnitude of impact is reasonably expected to be **negligible**.

8.13.50 The impact is predicted to be of local spatial extent and short-term duration, with very low volumes of sediment to be disturbed. The magnitude is therefore considered **negligible**.

Significance of effect

8.13.51 Overall, the magnitude of the impact to the nationally or internationally designated sites is **negligible,** and the sensitivity of the receptor is **high**. The effect will, therefore, be of **minor** adverse significance, which is not significant.

8.13.52 The magnitude of the impact to Bideford Bay waterbody is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible or minor** adverse significance, which is not significant.

8.13.53 The magnitude of the impact to Westward Ho! Bathing Water is **negligible,** and the sensitivity of the receptor is **medium**. The effect will, therefore, be of **negligible or minor** adverse significance, which is not significant.

Further (Secondary) Mitigation and Residual Effect

8.13.54 No further mitigation is required.

Future Monitoring

8.13.55 No future monitoring is required.

8.14 Cumulative Environmental Assessment

8.14.1 The Cumulative Effects Assessment (CEA) takes into account the impact associated with the Proposed Development together with other projects and plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see Volume 1, Appendix 5.3: CEA Screening Matrix of the ES). Each project has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

8.14.2 The physical processes CEA methodology has followed the methodology set out in Volume 1, Chapter 5: EIA methodology of the ES. As part of the assessment, all projects and plans considered alongside the Proposed Development have been allocated into 'tiers' reflecting their current stage within the planning and development process.

- Tier 1

  - Under construction
  - Permitted application
  - Submitted application
  - Those currently operational that were not operational when baseline data were collected, and/or those that are operational but have an ongoing impact
- Tier 2
  - Scoping report has been submitted
- Tier 3
  - Scoping report has not been submitted
  - Identified in the relevant Development Plan
  - Identified in other plans and programmes.

8.14.3 This tiered approach is adopted to provide a clear assessment of the Proposed Development alongside other projects, plans and activities.

8.14.4 The CEA also considers the Proposed Development and the anticipated National Grid Electricity Transmission (NGET) substation (which will be implemented by NGET and thus, does not form part of the Proposed Development) together. This is because the NGET substation will be required for the connection of the Proposed Development to the national grid.

8.14.5 The specific projects, plans and activities scoped into the CEA, are outlined in **Table 8.36**. The locations of such projects, plans and activities are presented on Volume 1, Figure 5.1 of the ES.

Table 8.36: List of cumulative developments considered within the CEA

Project	Status	Distance from Proposed Development (nearest point, km)	Description	Dates of Construction (if available)	Dates of Operation (if available)	Overlap with the Proposed Development?
Tier 1						
White Cross Floating Offshore Windfarm	Permitted	7.8 (with the Offshore Cable Corridor overlapping / directly adjacent to the White Cross Cable Corridor)	Proposed offshore windfarm located in the Celtic Sea with a capacity of up to 100 MW. The Windfarm Site is located over 52 km off the North Cornwall and North Devon coast (west-north-west of Hartland Point), in a water depth of 60 m – 80 m. The Windfarm Site covers 50 km2. The current wind turbine design envelope for the project is a WTG capacity of 12-24 MW, 6-8 three bladed horizontal axis turbines with a rotor diameter of 220-300 m.	Spring/ Summer 2028 – Spring/ Summer 2029	Unknown	Yes - Offshore Cable Corridor overlapping / directly adjacent to the White Cross Cable Corridor
Celtic Interconnector	Under Construction	Crosses offshore cable corridor	700 MW high-voltage direct current submarine power cable under construction between the southern coast of Ireland and the north-west coast of France. The UK elements of the Celtic Interconnector comprise: • A submarine cable within the UK EEZ approximately 211 km in length placed on or beneath the seabed. It passes approximately 30 km west of the Isles of Scilly and approximately 75 km west of Land's End, but does not enter UK Territorial Waters. • Secondary rock protection using rock placement (if required), where target depth of cable lowering is not fully achieved or at	2024 - 2026	Unknown	Yes - Crosses offshore cable corridor

Project	Status	Distance from Proposed Development (nearest point, km)	Description	Dates of Construction (if available)	Dates of Operation (if available)	Overlap with the Proposed Development?
			cable crossings, with a linear extent of between 0 km and 80 km or 0 to 270 tonnes. • A fibre optic link shall be laid along the cable route for operational control, communication and telemetry purposes.			
New dwelling and flood defence wall flanking River Torridge	Permitted	4.5	It is proposed to construct a new four bedroom, three-storey residential dwelling with ground floor parking, driveway, and landscaped border. As part of the proposed development, it is proposed to modify and extend the existing flood defence wall which runs for a 40 metre (m) length along the eastern site boundary. These works are required to provide necessary flood protection to the proposed dwelling.	August 2024 – March 2025	Unknown	No
Shellfish cultivation pilot at seaweed farm	Permitted	1	Algapelago Marine Limited intend to trial a shellfish cultivation pilot to establish the commercial feasibility of shellfish cultivation at their existing site in Bideford Bay. The shellfish pilot study will last four years, to enable species to reach full market size. Two species are in scope for the cultivation pilot trials: i) Mytilus edulis - spat sourced from natural settlement and ii) Pecten maximus - spat sourced from Scallop Ranch Ltd. The pilot trial is anticipated to run from August 2024 - August 2028. Infrastructure: algapelago intend to install 4 x 200 m submerged longlines for the propagation of shellfish. All infrastructure will be deployed within algapelago's existing licenced area.	Unknown	Unknown	No

Project	Status	Distance from Proposed Development (nearest point, km)	Description	Dates of Construction (if available)	Dates of Operation (if available)	Overlap with the Proposed Development?
Tier 2						
None identified						
Tier 3						
The Crown Estate's Celtic Sea Floating Offshore Wind Leasing Round 5 - Project Development Area 3 (PDA3)	Future Development	Overlaps with portion of the offshore cable corridor	Project Development Area (PDA) 3 sits within English Governance and is one of three suitable PDAs identified within the Celtic Sea for floating offshore wind development, each of which having a potential capacity of up to 1.5 GW. Currently in the early stages of the project, the schedule for PDA 3 is unknown, however, pre-consent surveys are planned as follows:.	Spring 2023 – Summer 2024 (marine surveys only)	Unknown	Yes - Overlaps with portion of the offshore cable corridor

Scope of Cumulative Effects Assessment

8.14.6 The cumulative effects presented and assessed in this section have been based on the Project Design Envelope set out in Volume 1, Chapter 5: Project Description of the ES as well as the information available on other projects and plans. The maximum design scenario as described for the Proposed Development (see **Table 8.32**) has been assessed cumulatively with the following other projects/plans:

- White Cross Floating Offshore Windfarm;
- Celtic Interconnector;
- New dwelling and flood defence wall flanking River Torridge;
- Shellfish cultivation pilot at seaweed farm; and
- The Crown Estate's Celtic Sea Floating Offshore Wind Leasing Round 5 - Project Development Area 3 (PDA3)

8.14.7 The CEA has considered the Proposed Development, alongside the NGET substation to be developed at the existing Alverdiscott Substation Site. The assessed design of NGET substation has been based upon a combination of reasonable worst case parameters, as detailed within Volume 1, Chapter 3: Project Description of the ES. The development area for the NGET substation would comprise up to 3.8 ha of land. Within that area it is assumed that the substation itself will occupy a footprint of approximately 2.8 ha, with a maximum height of 15 m, excluding connecting tower structures. If further information is available for the proposal before the Proposed Development receives development consent, the Applicant will review the information and provide any update needed to the CEA.

Cumulative Effects Assessment

8.14.8 A description of the significance of cumulative effects upon physical processes receptors arising from construction, operation and maintenance and decommissioning is given below.

Construction

Tier 1 Projects

8.14.9 At present, the precise location of the crossing with the Celtic Interconnector cable is unknown (assumed in deep water, as opposed to shallow/ coastal waters). It is assumed that burial will not be possible at the crossing location (assuming the Celtic Interconnector cable is constructed first), a specifically designed crossing structure will be required, as per other in-service cable crossings. The number of crossings and presentation of associated footprint areas throughout this ES includes the anticipated crossing of the Celtic Interconnector cable. There are no anticipated additional cumulative effects in relation to this project compared to all other cable crossings. The description of cumulative effects will not differ from that of the Proposed Development in isolation.

8.14.10 The White Cross and River Torridge Dwelling construction phases are scheduled to take place in advance of the Proposed Development's construction. There will

be no overlap of construction activities and there are no anticipated construction phase cumulative effects.

8.14.11 The construction phase of the shellfish cultivation pilot is unknown however, there will be no overlap of construction activities and there are no anticipated construction phase cumulative effects. Resident shellfish will be habituated to short-medium term sediment disturbance events associated with e.g. storm conditions, that will routinely mobilise the fine sands within the shallow coastal waters (<20 m depth) of Bideford Bay. Thus any short-term, localised sediment disturbance associated with the Proposed Development would not be expected to impact upon the trial project. Communication with the Seaweed farm directly and also via Notice to Mariners etc will ensure that working periods are known and these data can be accounted for within their trial analyses.

Tier 3 Projects

8.14.12 There is assumed to be no overlap of the potential Tier 3 project with that of the Proposed Development's construction phase.

Operation and Maintenance

Tier 1 Projects

8.14.13 There will be no cumulative effects, during operation and maintenance, as a result of the Tier 1 projects.

8.14.14 A section of the White Cross export cable will be installed in close proximity to the Proposed Development (the provisional offshore cable corridors partially overlap) but the two schemes are consulting with each other and plan to coordinate to maximise the distance between the project installations. Even should the final layouts include short sections where the two projects' cable installations are in close proximity (order of 100 m for purposes of impact discussions) then there are no anticipated cumulative impacts. Changes to metocean conditions have been scoped out due to anticipated water depths exceeding 20 m (and therefore, effects on the seabed are anticipated to be negligible).

8.14.15 Furthermore, there will be no sediment disturbance or seabed change, nor changes to water quality once the cable is *in-situ*, and any potential effects as a result of maintenance would not contribute to cumulative effects (it is highly unlikely that any repair activities in the 'adjacent' cables would be required at the same time). The description of cumulative operational phase effects will not differ from that of the Proposed Development in isolation.

Tier 3 Projects

8.14.16 There is inherently less certainty associated with Tier 3 projects (with very few available details in terms of schedule and infrastructure design), however TCE's Celtic Sea Floating Offshore Wind Leasing Round 5 – PDA 3, which is in its early stages (no developers identified at time of drafting), is identified as having the potential for cumulative impact within the Study area.

8.14.17 Cumulative increase in suspended sediment concentrations and sediment deposition have been considered with regards the Proposed Development's operational and maintenance phase with the construction of PDA 3 schemes.

8.14.18 The additive impact of increased suspended sediment concentrations with the Round 5 PDA 3 development(s) is anticipated to be modest on the basis of a) limited potential for coincident sediment generating activities (particularly given the operational and maintenance phase of the Proposed Development), and b) given the broadly coarse sediments in this portion of the study area which lend themselves towards low dispersal (as above).

8.14.19 It is anticipated that the additive impact of the operational and maintenance phase of the Proposed Development, with limited suspended sediment concentration increases and deposition associated with the construction (and to a lesser extent the subsequent operational and maintenance) phases of PDA 3, will generate a low impact magnitude and very slight adverse change from baseline conditions (no change in EIA terms).

8.14.20 Taking into consideration the maximum sensitivity of offshore physical processes receptors to increases in suspended sediment concentration and sediment deposition being low, and the localised, short-term nature of the (theoretical) additive impacts, it is concluded that the significance of effect from temporary disturbance arising from the Proposed Development cumulatively with Tier 3 projects/developments is of minor adverse significance, which is not significant.

Decommissioning

Tier 1 Projects

8.14.21 There will be no cumulative effects, during decommissioning, as a result of the Tier 1 projects.

8.14.22 Changes to metocean conditions are scoped out due to anticipated water depths of the cable crossing exceeding 20 m (and therefore, effects on the seabed are negligible).

8.14.23 Furthermore, there will be no sediment disturbance or seabed change, nor changes to water quality if the cable remains in-situ, and any likely effects, as a result of the removal of the cable, are already considered as part of **section 8.13** and there will be no cumulative effects – it is assumed that any cable removal activities for the Proposed Development and other schemes would be unlikely to be scheduled concurrently, and this could easily be avoided by sensible scheduling across the two projects. In any event, decommissioning of the Proposed Development would be subject to specific EIA closer to the proposed time (which would benefit from application of latest technologies and legislation/guidance applicable at that time).

Tier 3 Projects

8.14.24 There are no anticipated cumulative effects with the identified Tier 3 project, during decommissioning of the Proposed Development. There is a small portion of potential decommissioning works that would be in proximity to the PDA3, and it is assumed that PDA3 schemes would be operational at that time. Thus there would be a very low probability of coincident disturbance type activities across the developments, with the scale of any additional cumulative impact, beyond the significance associated with Proposed Development activities alone, to be insignificant. In any event, decommissioning of the Proposed Development would be subject to specific EIA closer to the proposed time (which would benefit from application of latest technologies and legislation/guidance applicable at that time).

8.15 Transboundary Effects

8.15.1 A screening of transboundary impacts has been carried out and any potential for significant transboundary effects with regard to physical processes from the Proposed Development upon the interests of other states has been assessed as part of this ES.

8.15.2 The potential transboundary impacts assessed within Volume 1, Appendix 5.2: Transboundary Screening are summarised below.

8.15.3 Effects associated with changes to metocean conditions have been scoped out on the basis that, in water depths greater than 20 m (water depths at the UK EEZ boundary are in the region of 120 – 130 m), the effects on the seabed, of waves and currents, are negligible. Therefore, there are unlikely to be direct effects on physical processes at the UK EEZ boundary.

8.15.4 Effects associated with sediment disturbance and seabed change, have also been scoped out as the assessment of potential sediment transport shows that the maximum distance that sediment will travel, if suspended, is roughly 15.2 km (maximum across the entire OCC). The assessment of potential sediment transport (please refer to Volume 3, Appendix 8.1: Sediment Source Concentrations and Assessment of Disturbance of the ES) shows that the nearest location, at which sediment is anticipated to be suspended at all, is approximately 50 km from the UK EEZ boundary.

8.15.5 On this basis and, following a review of contaminants present within the sediment, changes to water quality can also be scoped out. Only arsenic exceeds Cefas Action Levels, and stations where this was noted are located along the north coast of Devon and within Bideford Bay, i.e. not in the vicinity of the UK EEZ boundary.

8.16 Inter-related Effects

8.16.1 Inter-relationships are the impacts and associated effects of different aspects of the Proposed Development on the same receptor. These are as follows.

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the Proposed Development (construction, operation and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three phases.
- Receptor led effects: Assessment of the scope for all relevant effects (including inter-relationships between environmental topics) to interact, spatially and temporally, to create inter-related effects on a receptor.

8.16.2 A description of the likely interactive effects arising from the Proposed Development on physical processes is provided in Volume 4, Chapter 5: Inter-related effects of the ES.

8.17 Summary of Impacts, Mitigation Measures and Monitoring

8.17.1 Information on physical processes within the study area was collected through a combination of desktop review, site surveys and semi-empirical analysis. Table 8.37 presents a summary of the impacts, measures adopted as part of the Proposed Development and residual effects in respect to physical processes. The impacts assessed include:

- Changes to metocean conditions (operation and maintenance only);
- Sediment disturbance or seabed change (construction, operation and maintenance, and decommissioning);
- Changes to water quality (construction, operation and maintenance, and decommissioning); and,
- Secondary (localised) scour (construction, operation and maintenance, and decommissioning).

8.17.2 Overall, it is concluded that there will be no significant effects arising from the Proposed Development during the construction, operation and maintenance or decommissioning phases.

8.17.3 The cumulative impacts assessed include:

- Sediment disturbance or seabed change (construction only); and,
- Changes to water quality (construction only).

8.17.4 Overall, it is concluded that there will be no significant cumulative effects from the Proposed Development alongside other projects/plans, and the summary of impacts presented in **Table 8.37** may be regarded as inclusive of the cumulative effects assessment.

8.17.5 The following transboundary impacts have been identified in regard to effects of the Proposed Development:

- Changes to water quality (construction, operation and maintenance, and decommissioning).

8.17.6 Overall, it is concluded that there will be no significant transboundary effects from the Proposed Development.

Table 8.37: Summary of environmental effects

Description of Impact	Phase[a]			Embedded Mitigation	Sensitivity of receptor	Magnitude of impact	Significance of Effect	Further Mitigation	Residual Effect	Proposed Monitoring
	C	O	D							
Sediment disturbance or seabed change	✓	✓	✓	OFF02, OFF09 and OFF05 (see **Table 8.31**)	C: Low to Medium O: Low to Medium D: Low to Medium	C: Low O: Negligible D: Negligible	C: Negligible to Minor adverse O: Negligible to Minor adverse D: Negligible to Minor adverse (not significant)	OFF34 (see **Table 8.31**)	C: Negligible O: Negligible D: Negligible (not significant)	None
Changes to water quality	✓	✓	✓	OFF05 (see **Table 8.31**)	C: High to Medium O: High to Medium D: High to Medium	C: Negligible O: Negligible D: Negligible	C: Negligible to Minor adverse O: Negligible to Minor adverse D: Negligible to Minor adverse (not significant)	None	C: Negligible to Minor adverse O: Negligible to Minor adverse D: Negligible to Minor adverse (not significant)	None
Secondary (localised) scour	✓	✓	✓	OFF02 and OFF05 (see **Table 8.31**)	C: High to Medium O: High to Medium D: High to Medium	C: Negligible O: Negligible D: Negligible	C: Negligible to Minor adverse O: Negligible to Minor adverse D: Negligible to Minor adverse (not significant)	None	C: Negligible to Minor adverse O: Negligible to Minor adverse D: Negligible to Minor adverse (not significant)	None
Changes to metocean conditions	×	✓	×	OFF02, OFF05 and OFF11 (see **Table 8.31**)	O: Low to High	O: Negligible	O: Negligible to Minor adverse (not significant)	None	O: Negligible to Minor adverse (not significant)	None

Table 8.38: Summary of cumulative environmental effects

Description of Impact	Phase[a]			Receptor	Embedded Mitigation	Sensitivity of receptor	Magnitude of impact	Significance of Effect	Further Mitigation	Residual Effect	Proposed Monitoring
	C	O	D								
	Tier 1										
Sediment disturbance or seabed change	✓	×	×	Surrounding sub-tidal seabed	OFF02, OFF09 and OFF05 (see **Table 8.31**)	*C: Low*	C: Negligible	C: Negligible or minor adverse (not significant)	None	C: Negligible or minor adverse (not significant)	None
Sediment disturbance or seabed change	✓	×	×	Nationally or internationally designated sites	OFF02, OFF09 and OFF05 (see **Table 8.31**)	*C: High*	C: Negligible	C: Minor adverse (not significant)	None	C: Minor adverse (not significant)	None
Change in water quality	✓	×	×	Nationally or internationally designated sites	OFF05 (see **Table 8.31**)	C: High	C: Negligible	C: Minor adverse (not significant)	None	C: Minor adverse (not significant)	None

8.18 References

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