XLINKS MOROCCO-UK POWER PROJECT

Preliminary Environmental Information Report

Volume 3, Chapter 8: Physical Processes

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Contents

Tables

Figures (See Volume 3, Figures)

Figure Number	Figure Title
8.1	Physical Processes Assessment Study Area
8.2	Environmental Designations 1
8.3	Environmental Designations 2
8.4	Bathymetry
8.5	Locations of Water Level Data
8.6	Wave Buoys Location
8.7	Locations of Current Data
8.8	Locations of Sediment Data

Appendices (See Volume 3, Appendices)

Appendix Number	Appendix Title
8.1	High Level Assessment of Sediment Dispersion
8.2	Wave and Tidal Conditions
8.3	Sediment Sample Chemistry Results
8.4	GEOxyz Environmental Report

Glossary

Term	Meaning
Bathymetry/ bathymetric	Sub-marine topography; the depth of the seabed below mean sea level.
Bottom shear stress	Stress exerted by water on the seabed surface.
Cefas 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 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 features generated by physical, chemical, or biological processes.
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	Meteorological and oceanographic data including wind, currents, and waves.
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.
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	A distinct ocean layer separating the upper mixed layer from the calm 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 such as sediment or organic by-products in a body of water.
Water quality	Increase in physical, chemical and biological contaminants through the suspension of contaminated sediment, tidal currents transporting disturbed sediment leading to increased turbidity and/ or reduced water-quality until sediment settlement.

Acronyms

Acronym	Meaning
BSI	British Standards Institute
CCME	Canadian Council of Ministers of the Environment
CCRA	Climate Change Risk Assessment
Cefas	Centre for Environment Fisheries and Aquaculture Science
CPA	Coast Protection Act 1949
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
HRA	Habitats Regulations Assessment

Acronym	Meaning
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
PSU	Practical Salinity Unit
RCP8.5	Representative Concentration Pathway 8.5
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 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 Preliminary Environmental Information Report (PEIR) presents the preliminary findings of the Environmental Impact Assessment (EIA) work undertaken to date for the United Kingdom (UK) elements of the Xlinks Morocco-UK Power Project. For ease of reference, the UK elements of the Xlinks Morocco-UK Power Project are referred to in this chapter as the 'Proposed Development'.

8.1.2 This chapter considers the potential 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 PEIR chapter:

- sets out the existing and future environmental baseline conditions, established from desk studies, surveys and consultation undertaken to date;
- presents the potential environmental impacts and effects on all aspects of physical processes arising from the Proposed Development, based on the information gathered and the analysis and assessments undertaken to date;
- identifies any assumptions and limitations encountered in compiling the environmental information; and
- highlights any necessary monitoring and/or mitigation measures that could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

8.1.4 The chapter should be read in conjunction with the following Annexes:

- Volume 3, Appendix 8.1: High Level Assessment of Sediment Dispersion
- 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

8.1.5 The PEIR will inform pre-application consultation. Following consultation, comments on the PEIR and any refinements in design will be reviewed and taken into account, where appropriate, in preparation of the Environmental Statement that will accompany the application to the Planning Inspectorate for development consent.

8.2 Legislative and Policy Context

Legislation

8.2.1 The following legislation, relevant to physical processes, will be considered within the assessment process:

- 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 International Convention for the Prevention of Marine Pollution by Ships (MARPOL Convention) 73/78;
- The Marine Works (EIA) Regulations 2007 (amended 2017);
- Marine and Coastal Access Act (MCAA) 2009; and
- Marine Strategy Regulations 2010.

Planning Policy Context

8.2.2 The Proposed Development will be located within UK inshore waters and the UK EEZ offshore waters - beyond 12 nautical miles (nm) from the English coast (with the onshore infrastructure located wholly within Devon, England). As set out in Volume 1, Chapter 1: Introduction, of the PEIR, 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 PEIR
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 dispersion has been completed in support of this physical processes PEIR chapter. Refer to Volume 3, Appendix 8.1 High Level Assessment of Sediment Disturbance for more details on the methodology and findings of this assessment. These methods have been presented, and the Technical Note (Appendix 8.1) issued, to the MMO and Natural England. These consultation bodies have specifically been requested to confirm whether they deem this semi-qualitative assessment (which is presented as a worst-case estimate of likely sediment dispersion distances), as a sufficient level of 'modelling' to inform the ES. Natural England have confirmed that methods are appropriate (**Table 8.7**). The MMO are seeking further review from their scientific advisers Cefas.
'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 impacts on other parts of the coast' (paragraph 5.6.12 of NPS EN-1)	The impact of the proposed project on coastal processes and geomorphology has been considered below MHWS (refer to **sections 8.9** to **8.11** of this PEIR chapter), and takes into account potential impacts as a result of climate change (refer to Future Baseline Conditions section of this PEIR chapter).
'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 PEIR.
'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 effects on designated sites is considered within **sections 8.9** to **8.11** of this PEIR chapter. Specific MCZ assessment and HRA will be submitted with the 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	Mitigation measures adopted as part of the Proposed Development to reduce the potential for impacts on physical processes are outlined in **Table 8.29** of this PEIR chapter.

Summary of NPS requirement	How and where considered in the PEIR
attached to any grant of development consent' (paragraph 5.6.16 of NPS EN-1)	
'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 8.9** to **8.11** of this PEIR chapter), and takes into account potential impacts as a result of climate change (refer to Future Baseline Conditions section of this PEIR 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 8.9** to **8.11** of this PEIR 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 8.9, 8.10, 8.11** and Volume 3, Appendix 8.2: High Level Assessment of Sediment Dispersion of the PEIR for the results from the completion of a high-level sediment transport assessment. Consideration of habitat damage / loss is considered within PEIR Volume 3, Chapter 1: Benthic Ecology.

The National Planning Policy Framework

8.2.5 The National Planning Policy Framework (NPPF) was published in 2012 and updated in 2018, 2019 and 2021 (Department for Levelling Up, Housing and Communities, 2021). The NPPF sets out the Government's planning policies for England.

8.2.6 **Table 8.2** sets out a summary of the NPPF policies relevant to this chapter.

Table 8.2: Summary of NPPF requirements relevant to this chapter

Policy	Key provisions	How and where considered in the PEIR
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 8.5** and the impact assessment in **sections 8.9, 8.10, 8.11**.

8.2.7 The Planning Practice Guidance (PPG) (Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government, 2021) supports the NPPF and provides guidance across a range of topic areas.

Marine Policy

UK Marine Policy Statement

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

- Marine dredging and disposal – 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

8.2.9 **Table 8.3** sets out 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 PEIR
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 8.5** and the impact assessment in **sections 8.9, 8.10, 8.11**.
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 8.5** and the impact assessment in **sections 8.9, 8.10, 8.11**.
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 8.9, 8.10, 8.11** and Volume 3, Appendix 8.2: High Level Assessment of Sediment Dispersion of the PEIR for the results from the completion of a high-level 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 protected areas must demonstrate that	Refer to **sections 8.9, 8.10, 8.11** and Volume 3, Appendix 8.2: High Level Assessment of Sediment Dispersion of the PEIR for the results from the completion of a high-level sediment transport assessment.

Policy	Key provisions	How and where considered in the PEIR
	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

8.2.10 The onshore elements of the Proposed Development are located within the administrative area of Torridge District Council. 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 PEIR
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 8.9, 8.10, 8.11.** Likely no impact as the Project will use Horizontal Directional Drilling to avoid disturbance of the beach and foreshore, including coastal cliffs.

North Devon Biosphere Reserve

8.2.11 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.

8.2.12 The North Devon Biosphere Reserve consists of three zones; a core zone centred around Braunton Burrows SAC / 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.

8.2.13 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.

8.2.14 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

8.2.15 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 will take place with the North Devon Biosphere Reserve Partnership ahead of ES stage to further characterise any potential impacts. **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 PEIR
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 8.29** outlines mitigation measures which have been adopted to reduce the potential for physical processes impacts, including across subtidal sediments.

8.3 Consultation and Engagement

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 and operational 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 PEIR,.

Table 8.6: Summary of Scoping Responses

Comment	How and where considered in the PEIR
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 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 provided at **paragraph 8.4.10**. 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 are ongoing, which include specific discussion of key methods and datasets – e.g. **Table 8.7**. The Physical processes ES chapter will include 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).	Physical processes ES chapter will include the Westward Ho! designated bathing water and permitted sites, discharges and/ or abstractions, as receptors. Other receptors listed here are not applicable to Physical Processes chapter; Jennetts Reservoir and Gammaton Lower Reservoir are discussed in Volume 2, Chapter 3: Hydrology and Flood Risk of this PEIR, whilst Torridge Estuary designated shellfish water is assessed in Volume 3, Chapter 2: Fish and Shellfish Ecology of this PEIR.
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.	Physical processes ES chapter will be updated to include an assessment of secondary (localised) scour, building on recent modelled estimates of bed currents. Methodologies to be 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 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.	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 significant enough that the effects of the seabed, on waves and currents, are negligible. Refer to **Table 8.20**, and supporting text,

Comment	How and where considered in the PEIR
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.	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.	Physical processes ES chapter to be updated to include an assessment of secondary (localised) scour, building on recent modelled estimates of bed currents. Methodologies to be 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 dispersion has been completed in support of this physical processes PEIR chapter. Refer to Volume 3, Appendix 8.1 High Level Assessment of Sediment Disturbance for more details on the methodology and findings of this assessment. These methods have been presented to, and the Technical Note (Appendix 8.1) issued, to the MMO and Natural England. These consultation bodies have specifically been requested to confirm whether they deem this semi-qualitative assessment (which are presented as a worst-case estimate of likely sediment dispersion distances), as a sufficient level of 'modelling' to inform the ES. Natural England have confirmed that methods are appropriate (**Table 8.7**). The MMO are seeking further review from their scientific advisers Cefas.
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	Justification is included in **paragraphs 8.4.8** and **8.4.9** and within **sections 8.9** to **8.11** of this PEIR chapter.

Comment	How and where considered in the PEIR
this is on the basis such impacts are not anticipated 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 is included in **paragraphs 8.4.8** and **8.4.9** and within **sections 8.9** to **8.11** of this PEIR 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 is included in **paragraphs 8.4.8** and **8.4.9** and within **sections 8.9** to **8.11** of this PEIR 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 is included in **paragraphs 8.4.8** and **8.4.9** and within **sections 8.9** to **8.11** of this PEIR 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	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 PEIR chapter.

Comment	How and where considered in the PEIR
Figure 8.9.1. The ES should make clear the study 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 8.9** to **8.11** of this PEIR 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 PEIR chapter will inform the final HRA and MCZ assessments.
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.	Physical processes ES chapter to be updated to include an assessment of secondary (localised) scour, building on recent modelled estimates of bed currents. Methodologies to be 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 dispersion has been completed in support of this physical processes PEIR chapter. Refer to Volume 3, Appendix 8.1 High Level Assessment of Sediment Disturbance for more details on the methodology and findings of this assessment. These methods have been presented to, and the Technical Note (Appendix 8.1) issued, to the MMO and Natural England. These consultation bodies have specifically been requested to confirm whether they deem this semi-qualitative assessment (which are presented as a worst-case estimate of likely sediment dispersion distances), as a sufficient level of 'modelling' to inform the ES. Natural England have confirmed that methods are appropriate (**Table 8.7**). The MMO are seeking further review from their scientific advisers Cefas.
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 dispersion has been completed in support of this physical processes PEIR chapter. Refer to Volume 3, Appendix 8.1 High Level Assessment of Sediment Disturbance for more details on the methodology and findings of this assessment.

Comment	How and where considered in the PEIR
	These methods have been presented to, and the Technical Note (Appendix 8.1) issued, to the MMO and Natural England. These consultation bodies have specifically been requested to confirm whether they deem this semi-qualitative assessment (which are presented as a worst-case estimate of likely sediment dispersion distances), as a sufficient level of 'modelling' to inform the ES. Natural England have confirmed that methods are appropriate (**Table 8.7**). The MMO are seeking further review from their scientific advisers Cefas.
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 dispersion (plume modelling) has been completed in support of this physical processes PEIR chapter. Refer to Volume 3, Appendix 8.1 High Level Assessment of Sediment Disturbance for more details on the methodology and findings of this assessment. These methods have been presented to, and the Technical Note (Appendix 8.1) issued, to the MMO and Natural England. These consultation bodies have specifically been requested to confirm whether they deem this semi-qualitative assessment (which are presented as a worst-case estimate of likely sediment dispersion distances), as a sufficient level of 'modelling' to inform the ES. Natural England have confirmed that methods are appropriate (**Table 8.7**). The MMO are seeking further review from their scientific advisers Cefas.
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 8.4.8** and **8.4.9** of this PEIR 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 8.9** to **8.11** of this PEIR 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 that the effects of the seabed, on waves, are negligible. Refer to **Table 8.20**, and supporting text, for more evidence that this assumption is appropriate. Further consideration is not included within the physical processes PEIR chapter. This scoping

Comment	How and where considered in the PEIR
	response will be discussed with the Environment Agency to confirm any additional requirements expected at final ES stage.
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 proposed development will be resilient to coastal erosion and deposition, taking account of climate change, during the project's operational life and decommissioning period'.	The impact of the proposed project on coastal processes and geomorphology has been considered below MHWS (refer to **sections 8.9** to **8.11** of this PEIR chapter), and takes into account potential impacts as a result of climate change (refer to Future Baseline Conditions section of this PEIR chapter). The physical processes ES chapter will include additional detail on how the impacts will be managed to minimise adverse impacts on the coast (within Bideford Bay).
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.	Noted - to be incorporated within the Baseline Environment section of the physical processes ES chapter.
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.	Noted - to be included within the Baseline Environment section of the physical processes ES chapter.
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.	Noted - to be included within the Baseline Environment section of the physical processes ES chapter.
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	Noted - to be included within the Baseline Environment section of the physical processes ES chapter.
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.

Comment	How and where considered in the PEIR
Natural England	
Please note that impacts from secondary scouring around cable protection should also be factored into both marine processes and benthic assessment.	Physical processes ES chapter to be updated to include an assessment of secondary (localised) scour, building on recent modelled estimates of bed currents. Methodologies to be agreed with relevant stakeholders.

8.3.3 Following scoping, consultation and engagement with interested parties specific to physical processes has continued.

8.3.4 A summary of the key issues raised during consultation activities undertaken to date is presented in **Table 8.7**, together with how these issues have been considered in the production of this PEIR 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 PEIR
March 2024	Marine Management Organisation consultation meeting	Presented results from semi-qualitative assessment of sediment dispersion along the Offshore Cable Corridor, in response to comments received as part of the ES Scoping Opinion. Technical note to be shared with Cefas for comment on methodology used.	Refer to Volume 3, Appendix 8.1 High Level Assessment of Sediment Disturbance 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 dispersion 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 High Level Assessment of Sediment Disturbance)—confirm methods as appropriate, i.e. a sufficient level of 'modelling' to inform the ES.	Refer to Volume 3, Appendix 8.1 High Level Assessment of Sediment Disturbance for more details on the methodology and findings of this assessment.

8.4 Methodology

Relevant Guidance

8.4.1 Guidance documents relevant to physical processes, that will be considered within the assessment process, 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);
- 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.

Scope of the Assessment

8.4.2 The scope of this PEIR has been developed in consultation with relevant statutory and non-statutory consultees as detailed in

8.4.4 **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.

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

8.4.6 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.

Table 8.8: Issues considered within this assessment

Activity	Potential effects 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 Phase	
HDD exit point	Changes to metocean conditions.
Placement of scour protection and/or additional rock at cable crossings.	Secondary (localised) scour
Operational Phase – repair activities only	
Maintenance activities (similar to installation methodology).	Sediment disturbance or seabed change; Changes to water quality.
Decommissioning Phase – removal	
Removal of all cables	Sediment disturbance or seabed change; Changes to water quality.
Decommissioning Phase – *in situ*	
No relevant activities	No potential effects scoped into assessment.

8.4.7 Effects which are not considered likely to be significant have been scoped out of the assessment. A summary of the effects scoped out is presented in **Table 8.9**.

Table 8.9: Issues scoped out of the assessment

Activity	Potential effects scoped out of the assessment
Construction Phase	
Route preparation, i.e. clearance of uneven seabed.	Changes to metocean conditions
Laying of cables.	Changes to metocean conditions
Placement of scour protection and/ or additional rock at pipeline or cable crossings.	Changes to metocean conditions
Operational Phase including repair activities	
Operational phase	Sediment disturbance or seabed change Changes to water quality
Maintenance activities (similar to construction phase methodologies).	Changes to metocean conditions
Decommissioning Phase including removal and *in situ*	
Removal of all cables	Changes to metocean conditions
In situ	Changes to metocean conditions Sediment disturbance or seabed change Changes to water quality

8.4.8 Changes to metocean conditions have been scoped out of the construction, maintenance and decommissioning phases. However, they are scoped in for the operational phase. 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). Refer to **Table 8.20** for more evidence that this assumption is appropriate.

8.4.9 Sediment disturbance or seabed change, and changes to water quality, have been scoped out of the operational and decommissioning (*in-situ*) phases on the basis that there will be no disturbance to the seabed and therefore, there will be no potential for the release of sediments and/ or contaminants in the water column. These assumptions around operational phase water quality (lack of potential activity to influence water quality) will be revisited at ES stage following completion of the secondary (localised) scour assessment.

Study area

8.4.10 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 PEIR). It is anticipated that this study area will allow for robust characterisation of the baseline physical processes, whilst also encompassing any likely effects as a result of the Proposed Development.

8.4.11 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.

8.4.12 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.

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

Methodology for Baseline Studies

Desk Studies

8.4.14 To inform this PEIR chapter, a high-level desk-based assessment has been conducted for physical processes receptors using a range of e.g. 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.	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.

Source	Summary
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.
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.

8.4.15 As part of the desk-based assessment for the physical processes chapter and to support the assessment of likely impacts, a high-level analysis using semi-empirical methods 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: High Level Assessment of Sediment Dispersion of the PEIR.

Site-Specific Surveys

8.4.16 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, included 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 DDV and grab surveys.

Source	Summary
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

8.4.17 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 potential 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 PEIR.

Receptor Sensitivity/Value

8.4.18 The criteria for defining value in this chapter are outlined in **Table 8.12** below. 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

Value	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

8.4.19 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.
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

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

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.

Magnitude of impact		Definition
		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

8.4.21 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.

8.4.22 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.

8.4.23 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			
	No Change	**Negligible**	**Low**	**Medium**	**High**
Negligible	No change	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	No change	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	No change	Negligible or Minor	Minor	Moderate	Moderate or Major
High	No change	Minor	Minor or Moderate	Moderate or Major	Major
Very High	No change	Minor	Moderate or Major	Major	Major

8.4.24 Where the magnitude of impact is ‘no change’, no effect would arise.

8.4.25 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

8.4.26 The physico-chemical data, obtained for the 51 grab samples, does not contain data for Zinc, Dibutyltin, Tributyltin, Total Hydrocarbon Content, or Polychlorinated Biphenyls, which are typically expected to be included within a sediment contaminant analysis suite for comparison to Chemical Action Levels ('Cefas Action Levels'). However, the data are not intended to support a sediment disposal licence but rather to provide a general indication of offshore sediments contamination status; thus, the suite of analysis is deemed appropriate.

Metocean Measurements

8.4.27 No project specific metocean data has been collected. The analysis within this PEIR 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).

8.4.28 This data has been presented to the MMO and Natural England as part of the High Level Assessment of Sediment Dispersion (Appendix 8.1). Natural England have confirmed that they are happy with the approach (including metocean data used to inform the assessment). The MMO are seeking further review from their scientific advisers Cefas.

Sediment Dispersion

8.4.29 A high-level analysis of sediment dispersion has been undertaken using semi-empirical methods and readily available metocean data, each of which have some inherent limitations.

8.4.30 The approach is based on 2D depth-averaged tidal current velocities (converted to bed velocity using semi-empirical relationships) and ignores the effects of surges or waves (which are not expected to significantly influence sediment transport/dispersion in deep water but could be very influential in coastal and shallow water areas).

8.4.31 This high-level analysis suggests that disturbed sediment (as a result of activities associated with the construction of the Offshore Cable Corridor) is only mobilised into suspension during peak spring (and neap) tide currents, which occur for less than 3% of the month. Associated results should thus be viewed as highly precautionary.

8.4.32 For more information, please refer to Volume 3, Appendix 8.1: High Level Assessment of Sediment Dispersion of the PEIR.

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

8.4.34 Natural England have confirmed that methods are appropriate. The MMO are seeking further review from their scientific advisers Cefas.

8.5 Baseline Environment

Desk Study

8.5.1 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
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

8.5.2 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.

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

Bathymetry

8.5.4 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.

8.5.5 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).

8.5.6 The seabed typically has a shallow, uniform slope with typical gradients of 1:60 in shallow waters (up to 0.3 km from landfall), 1:500 in coastal waters (up to 10 km from landfall), and 1:3500 in deep water.

8.5.7 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. 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

8.5.8 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

Deep Water

8.5.9 Measured water level data was obtained from Admiralty Total Tide for various offshore locations within the Celtic Sea (**Table 8.18**). 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 8.18: 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

8.5.10 The ABPmer Renewables Atlas was used to obtain annual and seasonal average wave heights along the Offshore Cable Corridor, refer to

8.5.11 **Table** 8.19.

Table 8.19: 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

8.5.12 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, Appendix 8.3: Location of Water Level Data of the PEIR, for locations). **Table 8.20** summarises typical wave heights and directions of the eight locations analysed. For more detail, please refer to Volume 3, Appendix 8.4: Wave and Tidal Conditions of the PEIR.

Table 8.20: Summary of Wave Heights and Directions

Name	Measured/ Modelled	Water Depth (m)	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

8.5.13 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.

8.5.14 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

8.5.15 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).

8.5.16 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.

8.5.17 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.

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

8.5.19 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 8.21**. Currents are higher at Hartland Point as measured data are around the headland.

Table 8.21: 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

Tidal currents

Deep Water

8.5.20 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.

8.5.21 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.

8.5.22 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).

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

8.5.24 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 8.22** and **Table 8.23**.

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	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 8.23: 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

8.5.25 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.

8.5.26 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.

8.5.27 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.

8.5.28 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.

8.5.29 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.

Sediment Transport

8.5.30 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 (Halcrow, 2010). 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 only occurs during storm events.

Deep Water

Geology

8.5.31 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).

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

Sediment Transport

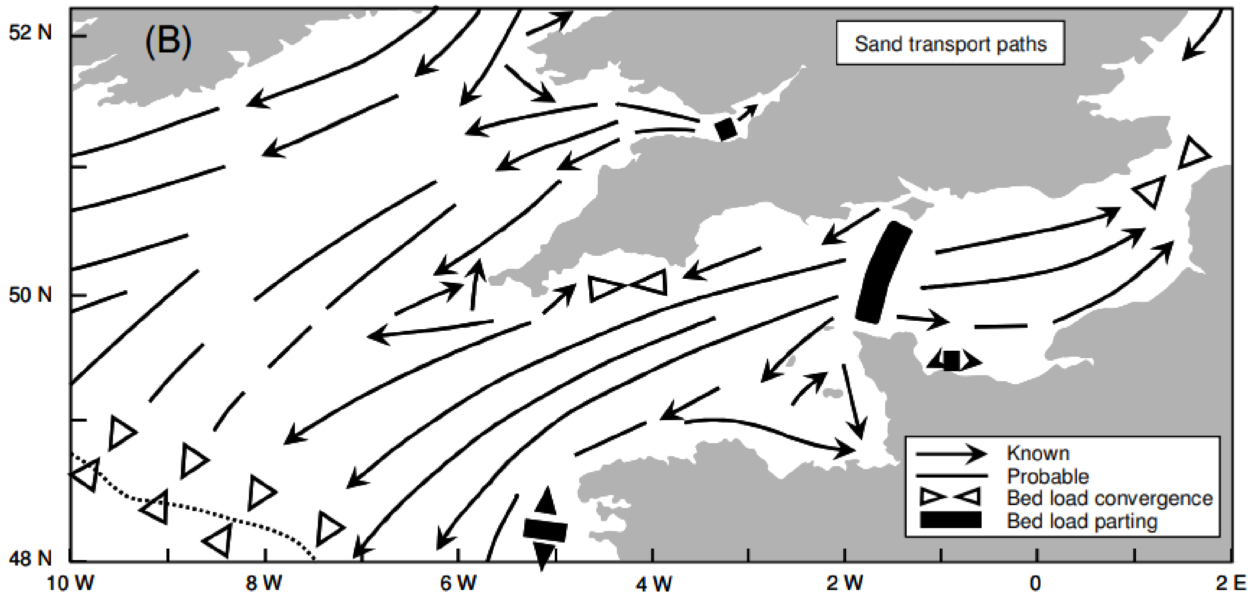
8.5.33 Maximum bottom shear stresses of 0.5 and 2 Pascals are predicted along the North Cornwall/Devon Coast, within the Bristol Channel approaches (Uncles and Stephens, 2007). This roughly equates to depth-averaged velocities (assuming an average water depth of 90 m along the offshore cable corridor)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

8.5.34 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.

8.5.35 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: High Level Assessment of Sediment Dispersion of this PEIR.

8.5.36 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 and Sediment Quality

Suspended Sediment Concentrations

8.5.37 In 2016, Cefas mapped the spatial distribution of average annual suspended sediment concentrations across the UK continental shelf, between 1998 and 2015.

8.5.38 Within Bideford Bay, average annual sediment concentrations are in the region of 15 mg/l, decreasing to 3 mg/l to 10 mg/l along the North Devon/ Cornwall Coast and Celtic Sea within the study area.

Physical Characteristics

8.5.39 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.

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

Sediment Quality

8.5.41 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.

8.5.42 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.

8.5.43 Estimates of concentrations of 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. All levels of Cadmium found fall below Cefas Action Level 1.
- Mercury: typically, between 0.2 – 0.5 µg/l, similar to background levels within the Atlantic Ocean. At some locations, levels of Mercury exceed Cefas Action Level 1 (between 0.3 and 3 mg/kg).
- Lead concentrations are typically below the Cefas Action Level 1 requirements (between 0.5 – 5 µg/l).
- Levels of PCBs found in sandy sediments are typically below detection limits (between 0.2 – 0.5 µg/kg) (below Cefas Action Level 1 requirements).
- Polycyclic Aromatic Hydrocarbons (PAHs) are low or undetectable (maximum concentration of 15 ng/l) (below Cefas Action Level 1 requirements).
- Levels of Total Hydrocarbons are typically between 0.3 – 6.4 µg/l (below Cefas Action Level 1 requirements).

8.5.44 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.

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

WFD Waterbody Status

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

8.5.46 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).

8.5.47 The water body has an objective to achieve ‘Good’ chemical status by 2063 to allow for natural recovery time.

8.5.48 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

8.5.49 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.

8.5.50 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*).

Identification of Designated Sites

8.5.51 All designated sites within the study area and qualifying interest features that could be affected by the construction, and operation and maintenance phases of the Proposed Development are set out in **Table 8.24**. Their locations, in reference to the Offshore Cable Corridor, are presented in Volume 3, Figures 8.1 and 8.2 of the PEIR.

Table 8.24: Designated Sites and Relevant Qualifying Interests

Designated Site	Distance to the Offshore Cable Corridor	Relevant Qualifying Interest
Mermaid's Pool to Rowden Gut Site of Special Scientific Interest (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 Special Area of Conservation (SAC)	0 m	The proposed offshore cable corridor bisects the SAC. It is designated for the protection of harbour porpoise.
South-West Approaches to Bristol Channel Marine Conservation Zone (MCZ)	Directly adjacent	Located to the south of the Proposed Development, 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.
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.

Designated Site	Distance to the Offshore Cable Corridor	Relevant Qualifying Interest
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 lobstor.
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

8.5.52 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 PEIR.

8.5.53 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 PEIR.

8.5.54 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 increased runoff and river flow as a result of this.

8.5.55 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.

8.5.56 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' when comparing to Canadian Council of Ministers of the Environment (CCME) 1987 reference values, which are indicative of a healthy ecosystem.

8.5.57 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.

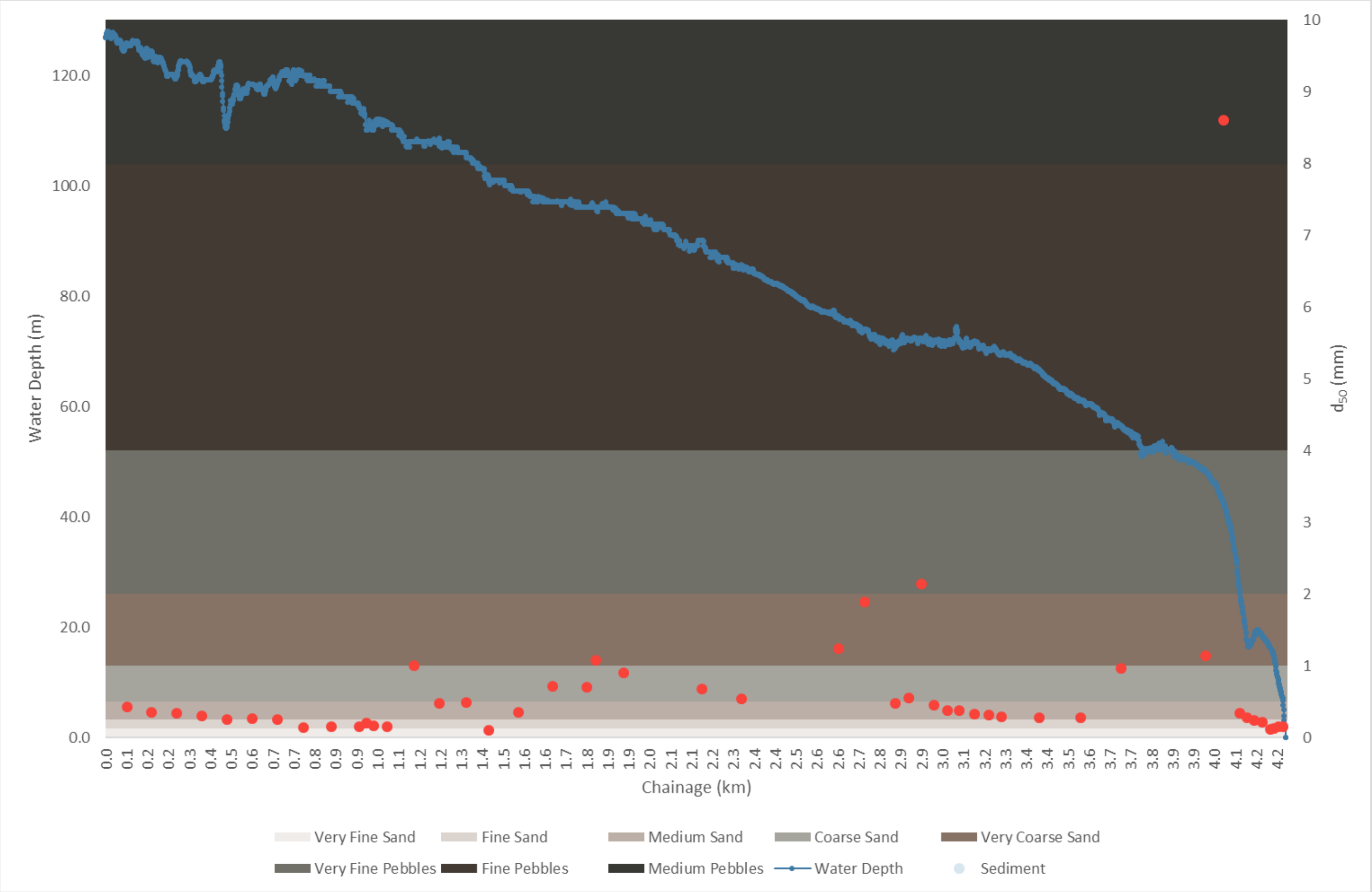
Sediment Quality

8.5.58 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 PEIR

8.5.59 The sediment particle size analysis is summarised in Volume 3, Appendix 8.1: High Level Assessment of Sediment Dispersion of the PEIR. Typically, the sediments along the Offshore Cable Corridor are classified as 'Very Fine' to 'Medium' sands, 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.

8.5.60 **Plate 8.2** below shows how the median particle size varies relative to the water depth. Chainage 0.0 is located at the EEZ boundary

Plate 8.2: Wentworth Classification of Sediment along Offshore Cable Corridor



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

8.5.62 The Cefas Action Levels are 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 considered to be unsuitable for disposal at sea.

8.5.63 The TEL and PEL approach consider the sediment contamination concentration 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.

8.5.64 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). This corresponds with recent data available from the Environment Agency water quality monitoring site – ‘Bideford Bay Off Westward Ho!’ - which indicates that levels of Arsenic are high. However, levels of Arsenic are less than the Probable Effect Level (PEL).

8.5.65 Chromium, Copper and Iron levels are all below Cefas Action Level 1.

Future Baseline Conditions

8.5.66 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.

8.5.67 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.

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

8.5.69 The predicted rise in mean sea-level over this period is shown in **Table 8.25**. 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 8.25: 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

8.5.70 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 8.26** 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 8.26: 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%

8.5.71 As part of the in-combination climate change assessment, completed for the project (Volume 4, Chapter 1: Climate Change of the PEIR), the UKCP18 Marine Report (Palmer et al., 2018) was interrogated within the UK Climate Risk Independent Assessment (CCRA3), Chapter 4: Infrastructure (Jaroszweki et al., 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

8.5.72 **Table 8.27** identifies the receptors taken forward into the Physical Processes impact assessment. Within this PEIR, Physical Processes is treated as an impact 'pathway' as well as having associated receptors in its own right. **Section 8.8** 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 PEIR).

8.5.73 Please note that the value only is presented in **Table 8.27**, as the final receptor sensitivity is impact specific (and is therefore discussed within the Impact Assessments where relevant).

Table 8.27: 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 character (contaminated or uncontaminated sediments).	Low
Surrounding coastline	Consideration of erosion 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 PEIR 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

8.6 Key Parameters for Assessment

Maximum Design Scenario

8.6.1 The maximum design scenarios identified in **Table 8.28** 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 Project Design Envelope provided in Volume 1, Chapter 3: Project Description of the PEIR. 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 scheme. Therefore, this comprises a conservative assessment of a worst case scenario. **Table 8.28** should be read in conjunction with **Table 8.8** and **Table 8.9** which confirm those issues that are scoped in and scoped out of the assessment respectively.

Table 8.28: Maximum design scenario considered for the assessment of potential impacts

Potential Impact	Phase[1]					Maximum Design Scenario	Justification
	C	Op	Op repair	D in-situ	D remove		
Changes to metocean conditions	No	Yes	No	No	No	**Operation and Maintenance phase** Potential impacts to local metocean processes from the presence of any above seabed 'structures' i.e.: • 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 sea bed 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	Yes	No	Yes	No	Yes	**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 pipeline or cable crossings. **Operation and Maintenance phase repair activities** Potential impacts to local seabed geology and morphology (within study area) from: • Maintenance activities (similar to installation methodology).	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.

Potential Impact	Phase[1]					Maximum Design Scenario	Justification
	C	Op	Op repair	D in-situ	D remove		
						Decommissioning phase assuming cable removal Potential impacts to local seabed geology and morphology: • Removal of all cables.	
Changes to water quality - direct disturbance due to Proposed Development activities	Yes	No	Yes	No	Yes	**Construction phase** Potential increase in contaminants (within study area) from: • Route preparation i.e., clearance of uneven seabed. • Laying of cables. • Placement of scour protection and/ or additional rock at pipeline or cable crossings. **Operation phase repair activities** Potential increase in contaminants, within study area, from: • Maintenance activities (similar to installation methodology). **Decommissioning phase assuming cable removed** Potential increase in contaminants, within study area, from: • Removal of all cables.	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.

[1] C=Construction phase, Op=Operational phase, Op_{repair}=Operational phase repair activities, $D_{in\text{-}situ}$=Decommissioning phase assuming cable de-energised and left *in-situ,* D_{remove}=Decommissioning phase assuming cable removed

8.7 Mitigation Measures Adopted as Part of the Proposed Development

8.7.1 As part of the Proposed Development design process, a number of mitigation measures have been adopted to reduce the potential for impacts on physical processes. These mitigation measures will evolve over the development process as the EIA progresses and in response to consultation. They will be fed iteratively into the assessment process.

8.7.2 As there is a commitment to implementing these measures, and also to various standard sectoral practices and procedures, they are considered inherently as part of the design of the Proposed Development and are set out in this PEIR. **Table 8.29** sets out the relevant mitigation measures to the Physical Processes assessment.

8.7.1 The mitigation measures proposed as part of the Proposed Development include the following types of mitigation:

- Primary (inherent) mitigation – measures included as part of the Proposed Development design. The Institute of Environmental Management and Assessment (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 Proposed Development 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 Proposed Development and the parameters secured in the DCO and/or marine licences. For example, a reduction in footprint or height.
- 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 an environmental management plan.
- 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 the Offshore Construction Environmental Management Plan (an outline Offshore CEMP is provided as PEIR Volume 1, Appendix 3.3, which will continue to be developed and submitted as part of the DCO application).

Table 8.29: Mitigation Measures Adopted as Part of the Proposed Development

Measure Adopted	How the Measure Will be Secured
Primary mitigation	
Route optimisation studies have included consideration of substrate types, with e.g., outcropping bedrock avoided where possible.	Inherent in defining the Offshore Cable Corridor.
Micro-routing within the Offshore Cable Corridor will allow, where possible, the avoidance of sand waves or large ripples that would otherwise require pre-lay seabed flattening.	There will be multiple factors to consider within micro-routing including habitats, burial risk assessment, marine heritage and surface bed features. The micrositing principles will be set out within the final Offshore Construction Environmental Management Plan (CEMP) and accompanying documents including the archaeological WSI.
HDD methods will be employed to avoid any direct disturbance of the intertidal, the foreshore and the coastal cliffs.	Part of DCO project description.
Cable lay and burial will be undertaken within close timescales, avoiding any long-term exposed trenching.	Secured within DCO requirements and outline Offshore CEMP.
Installation will utilise specialist ROVs which will minimise trench width and sediment disturbance (compared to less precise trenching tools).	Secured within DCO requirements and outline Offshore CEMP.
Where additional rock protection is required, the preference will be placement within the trench i.e. with the finished level of rock cover will be below seabed level. The least favourable option (where protection / full protection via other techniques is not possible) is to result in rock protection above the level of the existing sea bed.	Secured within DCO requirements and outline Offshore CEMP.
Where crossings of existing in-service cables are required, these will be constructed adhering to international best practice design (and may include concrete mattresses and/or shallow rock berms and are deemed overtrawlable)	Secured within DCO requirements and outline Offshore CEMP.
Secondary mitigation	
N/A	
Tertiary mitigation	
N/A	

8.8 Pathways Assessment

8.8.1 Within this PEIR, 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 8.31**) 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 PEIR).

8.8.2 The pathways assessment criteria are shown in **Table 8.30**, with definitions provided beneath.

Table 8.30: 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

8.8.3 The magnitude of effect (e.g. water quality disturbance at source) is given a qualitative rating i.e. small/ moderate/ large. The pathway extent is given as localised (<0.1km)/ near-field (<5km)/ far-field (<30km). The scale of pathway change (assuming reducing concentration with distance from source due to dispersion) is negligible/ low/ medium/ high as defined in **Table 8.30**.

8.8.4 The sources are:

- ***Seabed preparation*** – Removal of sand waves and other bathymetric features, localised to the OCC, using a swath plough.
- ***Cable trenching*** – Mechanically cutting or water jetting max. 1.5 m deep by max. 1.5 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 6 to 9m. Excavated by mechanical cutters, water jetting or long-arm excavator bucket.
- ***Scour protection*** - Placement of rock protection and/ or additional rock at pipeline or cable crossings.

8.8.5 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 8.31: Pathways Assessment

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).	Removal of sand waves (and other bathymetric features) is expected to take place over a localised spatial extent (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 (up to 2 m reduction for 'mega-ripples'), e.g. sand waves are typically small in height and transient in nature. Removal will 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***, preliminary assessment indicates that during most tidal states (approximately 97% of the time) current velocities are too low to mobilise disturbed sediment, it will therefore settle in the immediate vicinity and remain ***localised***. During peak spring (and neap) tides however (approximately <3% of the time), ***metocean conditions*** (e.g. tidal currents) could transport disturbed sediment 0.7 to 3.9 km (depending on location along the OCC) in a south west 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 (97% of the time): small/ localised Peak spring (and neap) 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 (up to 1.5m width of trench) to target depth of 1.5m.	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 (approximately 97% of the time) current velocities are too low to mobilise disturbed sediment, it will therefore settle in the immediate vicinity and remain ***localised***. During peak spring (and neap) tides however (approximately <3% of the time), ***metocean conditions*** (e.g. tidal currents) could transport disturbed sediment 0.7 to 3.9km (depending on location along the OCC) in a south west 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	Most tides (97% of the time): small/ localised Peak spring (and neap) 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**
			far-field spatial extent over which the sediment could travel.		
	The HDD exit pits (4no.) will be located in ***coastal water*** approximately 6-9m water-depth (~540 to 1360m from shore) and be 15x15m in plan area x 2-5m deep (depending on superficial deposits depth), created using mechanical cutters, water-jets, or long-arm excavator bucket depending on the seabed characteristics.	Dredging of the HDD exit pit (and subsequent placement of rock armour) 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 (approximately 97% of the time) current velocities are too low to mobilise disturbed sediment, it will therefore settle in the immediate vicinity and remain ***localised***. During peak spring (and neap) tides however (approximately <3% of the time), ***metocean conditions*** (e.g. tidal currents) could transport disturbed sediment 0.7 to 3.9km (depending on location along the OCC) in a south west 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 (97% of the time): small/ localised Peak spring (and neap) 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 Phase					
Presence of above bed level scour protection at HDD exit, 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 500x7m in plan area and up to 1.4m above the seabed (max crossing structure dimensions).	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 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 now). 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 (approximately 97% of the time) current velocities are too low to mobilise disturbed sediment, it will therefore settle in the immediate vicinity and remain ***localised***. During peak spring (and neap) tides however (approximately <3% of the time), ***metocean conditions*** (e.g. tidal currents) could transport disturbed sediment 0.7 to 3.9km (depending on location along the OCC) in a south west 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

8.9 Preliminary Assessment of Construction Effects

8.9.1 The impacts of the construction of the Proposed Development have been assessed. The potential preliminary impacts arising from the construction phase of the Proposed Development are listed in **Table 8.28**, along with the maximum design scenario against which each impact has been assessed.

8.9.2 A description of the potential effect on Physical Processes receptors caused by each identified impact is given below.

Sediment Disturbance or Seabed Change

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

- Seabed preparation, notably, the removal of sand waves and large ripples;
- Cable installation using the mechanical cutter and water jetter, or placement of additional rock protection where burial is not possible; and,
- Placement of rock protection and/ or additional rock at pipeline or cable crossings.

8.9.4 For all activities, there is the potential to disturb seabed sediment. A high-level assessment of potential sediment dispersion has been undertaken to inform this PEIR, using tidal current velocities (obtained from the DHI MIKE Global Tide Model) 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 PEIR for more details on the methodology and findings of this assessment).

8.9.5 The assessment showed that sediment will be mobilised along most of the Offshore Cable Corridor (characterised by predominantly sandy bed sediments) under baseline conditions. Baseline sediment mobilisation can occur during peak spring (and neap) tide current velocities (representing approximately <3% of overall time of the worst-case months tested).

8.9.6 If disturbed by activities associated with the Proposed Development, sediment would be expected to go into suspension at a maximum of 10 locations (out of the 51 representative locations) and is expected to travel towards the south-west (peak springs) or north-east (peak neaps). The maximum distance travelled (across all sites) has been estimated to be 3.9 km (during peak spring tide conditions). Whilst concentrations are currently unknown, the volumes of dispersed sediment are likely to be generally small – given the small scale and transient nature of the activities (at any one location).

Table 8.32: Sediment Dispersion Results (c.f. Volume 3, Appendix 8.1)

Sediment Sampling Station	Water Depth (m)	d_{50} (mm)	Estimated Peak Spring Bed Current, $u_{t(z)}$ (m/s)	Max. Time in Suspension (hrs)	Max. Distance Travelled (km)
UK_09	123.3	0.13	0.20	4	~1.9
UK_10	120.2	0.14	0.20	3	~1.3
UK_11	117.4	0.15	0.19	2	~0.7
UK_15	114.3	0.14	0.18	2	~0.7
UK_19	104.1	0.09	0.18	5	~2.0
UK_56	22.3	0.21	0.32	1	~0.1
UK_57	20.1	0.11	0.33	5	~3.8
UK_58	18.5	0.12	0.34	5	~3.9
UK_59	13.5	0.14	0.39	4	~3.3
UK_61	10.1	0.15	0.45	4	~3.8

Sensitivity of the Receptor

8.9.7 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 and North Devon Biosphere Reserve nationally or internationally designated sites; and
- Bideford Bay waterbody receptors.

8.9.8 The sensitivity of the surrounding sub-tidal seabed receptor is **low.**

8.9.9 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 will be routinely exposed to temporary periods of elevated suspended sediment during extreme events.

8.9.10 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.**

8.9.11 The sensitivity of the Bideford Bay waterbody receptor is considered **medium.**

Magnitude of Impact

8.9.12 Based on the sediment dispersion assessment completed to support this PEIR, likely impacts are limited to construction activities within Bideford Bay.

8.9.13 At this stage, volumes of sediment that will be disturbed are unknown (but expected to very low to negligible due to route preparation, cable laying and placement of scour protection). Further characterisation of sediment volumes / concentration uplifts will be provided in the final ES to support these assumptions.

8.9.14 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 are located approximately 540 m offshore or at a water depth of 9 m (approximately 1,360 m offshore). From the sediment transport assessment (Volume 3, Appendix 8.1), sediment in this location could travel approximately 3.8 km in a south-westerly direction but only if construction activities take place during a peak spring tide current velocity window and/ or significant wave action. The volumes of sediment that could be released will be further explored within the final ES.

8.9.15 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

8.9.16 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.

8.9.17 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.

8.9.18 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.

8.9.19 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.

Further Mitigation

8.9.20 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.

Future Monitoring

8.9.21 No future monitoring is required.

Changes to Water Quality

8.9.22 During construction, there is the potential for the following activities to cause changes to water quality:

- Seabed preparation, notably, the removal of sand waves and large ripples;
- Cable installation using the mechanical cutter and water jetter; and,
- Placement of rock protection, including at cable crossings.

8.9.23 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 PEIR). 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 study is recommended to determine the likelihood of environmental consequences. This further assessment is undertaken here, and will be refined at ES stage.

8.9.24 Within shallow and coastal waters, the results from the Burial Assessment Study 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 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.

8.9.25 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 (mega ripples, 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 (to be confirmed following receipt of further design information and to be assessed at ES stage).

8.9.26 For all activities, there is the potential to disturb seabed sediment which could result in an increase in suspended sediment concentrations. Very high-level initial estimates anticipate short-term suspended sediment concentration increases of approximately 10 – 500 mg/l, although concentrations are highly dependent on the exact construction plant to be used. This is in comparison to background suspended sediment concentrations, which are estimated to be in the region of 3 – 15 mg/l. The suspended sediment concentration uplifts and associated volumes of sediment that could be released, as a result of activities associated with the Proposed Development, will be further explored within the final ES.

8.9.27 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 is expected to travel towards the south-west (peak springs) or north-east (peak neaps). The maximum distance travelled has been estimated to be 3.9 km (during peak spring tide conditions). The volumes of dispersed sediment are likely to be generally small – given the small scale and transient nature of the activities (at any one location).

Sensitivity of the Receptor

8.9.28 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.

8.9.29 The sensitivity of the nationally or internationally designated site receptors is **high.**

8.9.30 The sensitivity of the Bideford Bay waterbody receptor is **medium.**

Magnitude of Impact

8.9.31 Based on the sediment dispersion assessment completed to inform this PEIR, likely impacts are limited to construction activities within Bideford Bay (at and around the location of the UK_56 grab sample). Cable laying and rock placement would be expected to result in some sediment suspension which will likely settle before impacting upon any sensitive receptors in this location. The volumes of sediment that could be released, as a result of activities associated with the Proposed Development, will be further explored within the final ES.

8.9.32 Suspended sediment and any contaminant disturbed in this location, as a result of construction activities, could travel a maximum distance of 0.1 km in a south-westerly direction (estimated to settle within approximately 1 hour). Refer to Volume 3, Appendix 8.1: High Level Assessment of Sediment Disturbance of the PEIR for more details on the methodology and findings of this assessment).

8.9.33 It should be noted that this assessment is based on a worst-case scenario of completing construction activities during a peak spring tide.

8.9.34 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**, however this will be further assessed at ES stage.

Significance of the Effect

8.9.35 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.

8.9.36 The magnitude of the impact to Bidford 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.

Further Mitigation

8.9.37 No further mitigation is required.

Future Monitoring

8.9.38 No future monitoring is required.

Secondary (localised) Scour

8.9.39 An assessment of secondary (localised) scour will be included within the physical processes ES chapter, as a result of comments received as part of the Scoping Opinion.

8.10 Preliminary Assessment of Operational Effects

8.10.1 The impacts of the operation and maintenance phase of the Proposed Development have been assessed. The potential preliminary impacts arising from the operation and maintenance phase of the Proposed Development are listed in **Table 8.28**, along with the maximum design scenario against which each impact has been assessed.

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

Changes to Metocean Conditions

8.10.3 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:

- Seabed preparation; notably, the removal of any sand waves and large ripples.
- Cable installation where burial is not possible.
- Cable crossings which include the placement of rock or concrete mattresses on the seabed.
- Any above seabed cable protection installed specifically at the HDD exit points.

8.10.4 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 and large ripples will result in an increase in water depth, whilst laying the cable on the seabed and placement of rock/ concrete mattresses will result in a decrease in water depth. Please note that changes to metocean conditions is only being considered for shallow and coastal waters (refer to **Table 8.9** for justification).

Sensitivity of the Receptor

8.10.5 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 and North Devon Biosphere Reserve) and Bideford Bay waterbody receptors.

8.10.6 The sensitivity of the surrounding sub-tidal seabed receptor is **low.**

8.10.7 The sensitivity of the surrounding coastline receptor is **high** (considered precautionary).

8.10.8 The sensitivity of the nationally or internationally designated sites receptor is **high.**

8.10.9 The sensitivity of the Bideford Bay waterbody receptor is **medium.**

Magnitude of Impact

8.10.10 The results from the Burial Assessment Study indicate that very little seabed preparation will be required within shallow and coastal waters, due to no identified sand waves and/ or large ripples and there will be no permanent change to the seabed during the operational phase. 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 (which again would mean no permanent changes to the seabed during the operational phase).

8.10.11 There is no requirement for construction of cable crossings within the shallow/ coastal waters.

8.10.12 The requirement for localised or short-term cable protection (e.g. additional rock placement) at the x4 HDD exit points may be required. This is deemed unlikely, based on the characterisation of nearshore sea bed sediments provided by the HDD feasibility report (LMR (2023)), however, some localised above/on seabed protection cannot be discounted at this stage; particularly in the short term prior to final burial works. For completeness the potential for metocean change associated with some rock placement at HDD exit pits is assessed.

8.10.13 The footprint of the activity is small (likely to be in the order of tens of square metres but the total exit pit area is assumed for worst case assessment purposes i.e. 450 m^2). This is small in scale in comparison to the Bideford Bay waterbody (approximately 111 km^2), and the Mermaids Pool to Rowdon Gut SSSI (approximately 0.26 km^2) 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 the Effect

8.10.14 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.

8.10.15 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.

8.10.16 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.

8.10.17 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.

Further Mitigation

8.10.18 No additional mitigation is proposed.

Future Monitoring

8.10.19 No future monitoring is required.

Sediment Disturbance or Seabed Change

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

- Maintenance activities (assuming similar to installation methodology – noting that the scale of any isolated repair activities will be on a much reduced geographic scale compared to the construction phase)

8.10.21 For this activity, there is the potential to disturb seabed sediment. A preliminary analysis of sediment dispersion has been undertaken, the results of which are discussed in the construction phase impact section above and within Volume 3, Appendix 8.1: High Level Assessment of Sediment Dispersion of the PEIR.

Sensitivity of the Receptor

8.10.22 Based on likely 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), and the Bideford Bay waterbody receptors. It also has the potential to affect the surrounding sub-tidal seabed receptor and surrounding coastline receptor.

8.10.23 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.**

8.10.24 The sensitivity of the Bideford Bay waterbody receptor is **medium.**

8.10.25 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.

8.10.26 The sensitivity of the surrounding sub-tidal seabed receptor is **low.**

Magnitude of Impact

8.10.27 Based on the sediment dispersion analysis, potential impacts are likely limited to maintenance activities, if needed, within Bideford Bay. At this stage, volumes of sediment that will be disturbed are unknown (which will in large part be dependent on repair requirements) however, it is assumed cable repairs, will require similar construction methodologies as during the construction phase, albeit likely on a much reduced geographic scale. Thus the activity is anticipated to result in minimal sediment suspension, which will likely dissipate throughout the water column before impacting upon any sensitive receptors.

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

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

Significance of the Effect

8.10.30 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.

8.10.31 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.

8.10.32 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.

8.10.33 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 Mitigation

8.10.34 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

8.10.35 No future monitoring is required.

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

8.10.36 Increased bed currents, as a result of climate change over the period of the operational phase, could result in greater sediment dispersion 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.

Changes to Water Quality

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

- Maintenance activities (assuming similar activity types and methodologies as employed during the construction phase)

8.10.38 For this activity, there is the potential to disturb contaminated seabed sediments. A high-level analysis of sediment dispersion has been undertaken, the results of which are discussed in the construction phase impact section above and within Volume 3, Appendix 8.1: High Level Assessment of Sediment Dispersion of the PEIR.

8.10.39 Fifty one grab samples were analysed for metals, organotins and PAHs (for results, refer to Volume 3, Appendix 8.3: Sediment Sample Chemistry Results of the PEIR). 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).

8.10.40 For all activities, there is the potential to disturb seabed sediment which could result in a temporary increase in suspended sediment concentrations. Sediment concentrations released at source are anticipated to be approximately 10 – 500 mg/l, although concentrations are highly dependent on the exact construction plant to be used. This is in comparison to background suspended sediment concentrations, which are in the region of 3 – 15 mg/l.

8.10.41 The assessment of sediment disturbance showed that sediment is expected to be mobilised during peak spring (and neap) tide current velocities (representing approximately <3% of overall time of the worst-case months tested). Sediment is expected to travel towards the south-west (peak springs) or north-east (peak neaps). The maximum distance travelled (across all grab locations) has been estimated to be 3.9 km (during peak spring tide conditions). The volumes of dispersed sediment are likely to be generally small – given the small scale and transient nature of the activities (at any one location).

Sensitivity of the Receptor

8.10.42 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) and the Bideford Bay waterbody.

8.10.43 The sensitivity of the nationally or internationally designated sites receptor is **high.**

8.10.44 The sensitivity of the Bideford Bay waterbody receptor is **medium.**

Magnitude of Impact

8.10.45 Based on the high-level sediment dispersion analysis, likely impacts are limited to maintenance activities within Bideford Bay (at and around the location of the UK_56 grab sample). Sediment in this location could travel a maximum distance of 0.1 km in a south-westerly direction. Sediment will settle within 1 hour. Maintenance activities would result in minimal sediment suspension which will likely settle before impacting upon any sensitive receptors in this location.

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

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

Significance of the Effect

8.10.48 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.

8.10.49 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.

Further Mitigation

8.10.50 No further mitigation is required.

Future Monitoring

8.10.51 No future monitoring is required.

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

8.10.52 Increased bed currents, as a result of climate change over the period of the operational phase, may result in greater sediment dispersion 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.

Secondary (localised) Scour

8.10.53 An assessment of secondary (localised) scour will be included within the physical processes ES chapter, as a result of comments received as part of the Scoping Opinion.

8.11 Preliminary Assessment of Decommissioning Effects

8.11.1 The impacts of the decommissioning phase of the Proposed Development have been assessed. The potential preliminary impacts arising from the decommissioning phase of the Proposed Development are listed in **Table 8.28**, along with the maximum design scenario against which each impact has been assessed.

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

Sediment Disturbance or Seabed Change

8.11.3 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

8.11.4 For this activity, there is the potential to disturb seabed sediment. A high-level analysis of sediment dispersion has been undertaken, the results of which are discussed in the construction phase discussions above (**section 8.9**) and within Volume 3, Appendix 8.1: High Level Assessment of Sediment Dispersion of the PEIR.

Sensitivity of the Receptor

8.11.5 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), and the Bideford Bay waterbody receptors. It also has the potential to affect the surrounding sub-tidal seabed receptor and surrounding coastline receptor.

8.11.6 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.**

8.11.7 The sensitivity of the Bideford Bay waterbody receptor is **medium.**

8.11.8 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 extreme storm events.

8.11.9 The sensitivity of the surrounding sub-tidal seabed receptor is **low.**

Magnitude of Impact

8.11.10 Based on the high-level sediment dispersion analysis, likely impacts are limited to decommissioning activities within Bideford Bay. At this stage, volumes of sediment that will be disturbed are unknown however, cable removal will result in some sediment suspension which will likely dissipate rapidly.

8.11.11 It should be noted that the analysis of sediment dispersion (Volume 3, Appendix 8.1: High Level Assessment of Sediment Dispersion of the PEIR) is based on a worst-case scenario of sediment disturbance taking place during a peak spring tide.

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

Significance of the Effect

8.11.13 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.

8.11.14 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.

8.11.15 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.

8.11.16 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 Mitigation

8.11.17 It is recommended that, for any maintenance activities, contractors avoid working during the peak spring tides. Further work, in the form of numerical modelling, should be undertaken to determine appropriate construction working windows to avoid mobilising sediment.

Future Monitoring

8.11.18 No future monitoring is required.

Changes to Water Quality

8.11.19 During decommissioning, there is the potential for changes to water quality. This is as a result of the following activity:

- Removal of all cables

8.11.20 For this activity, there is the potential to disturb contaminated seabed sediment. A high-level analysis of sediment dispersion has been undertaken, the results of which are discussed in the construction phase discussions above (**section 8.9**) and within Volume 3, Appendix 8.1: High Level Assessment of Sediment Dispersion of the PEIR.

8.11.21 Fifty one grab samples were analysed for metals, organotins and PAHs (for results, refer to Volume 3, Appendix 8.3: Sediment Sample Chemistry Results of the PEIR). 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).

8.11.22 For all activities, there is the potential to disturb seabed sediment which could result in an increase in suspended sediment concentrations. Sediment concentrations released at source are anticipated to be approximately 10 - 500 mg/l, although concentrations are highly dependent on the exact plant to be used. This is in comparison to background suspended sediment concentrations, which are in the region of 3 – 15 mg/l.

8.11.23 The assessment of sediment disturbance showed that sediment will be mobilised during peak spring (and neap) tide current velocities (representing approximately <3% of overall time of the worst-case months tested). Sediment is expected to travel towards the south-west (peak springs) or north-east (peak neaps). The maximum distance travelled (across all grab sample locations) has been estimated to be 3.9 km (during peak spring tide conditions). The volumes of dispersed sediment are likely to be generally small – given the small scale and transient nature of the activities (at any one location).

Sensitivity of the Receptor

8.11.24 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) and the Bideford Bay waterbody.

8.11.25 The sensitivity of the nationally or internationally designated sites receptor is **high.**

8.11.26 The sensitivity of the Bideford Bay waterbody receptor is **medium.**

Magnitude of Impact

8.11.27 Based on the high-level sediment dispersion analysis, likely impacts are limited to decommissioning activities within Bideford Bay (at and around the location of the UK_56 grab sample). Sediment in this location is predicted to travel a maximum distance of 0.1 km in a south-westerly direction. Sediment would settle within 1 hour. Decommissioning will result in minimal sediment suspension which will likely settle before impacting upon any sensitive receptors in this location.

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

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

Significance of the Effect

8.11.30 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.

8.11.31 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.

Further Mitigation

8.11.32 No further mitigation is required.

Future Monitoring

8.11.33 No future monitoring is required.

8.12 Cumulative Effects Assessment

8.12.1 The Cumulative Effects Assessment (CEA) takes into account the impacts 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 PEIR). 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.

8.12.2 The physical processes CEA methodology has followed the methodology set out in Volume 1, Chapter 5: EIA methodology of the PEIR. 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 (as advocated under the Planning Act, 2008).

- Tier 1
  - Under construction
  - Permitted application(s), but not yet implemented;
  - Submitted application(s), not yet determined;
  - 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.

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

8.12.4 The specific projects, plans and activities scoped into the CEA, are outlined in **Table 8.33**.

Table 8.33: 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						
Celtic Interconnector (MLA/2021/00323)	Permitted	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 211km in length placed on or beneath the seabed. It passes approximately 30km west of the Isles of Scilly and approximately 75km 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 cable crossings, with a linear extent of between 0km and 80km or 0 to 270 tonnes. A fibre optic link shall be laid along the cable route for operational control, communication, and telemetry purposes.	2024-2027	2027	No overlap with construction, however there will be overlap with operational phase of the Proposed Development
White Cross Floating Offshore Windfarm	Permitted	7.8 (overlap with White Cross export cable corridor)	Proposed floating offshore wind farm, comprising 6 to 8 turbines, 52 km off the North Cornwall and North Devon coast.	Proposed 2024	Proposed from 2026	
Tier 2						

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?
None identified						
Tier 3						
The Crown Estate's Celtic Sea Floating Offshore Wind Leasing Round 5 - Project Development Area 3 (PDA3)	Future planned development	Overlaps with portion of the offshore cable corridor	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.	Unknown (the schedule for PDA 3 is unknown, however, pre-consent metocean surveys are planned for early 2024 and geotechnical investigations are planned for summer 2024)	Unknown	As the schedule for PDA 3 is currently unknown, there is the potential for both construction and operational phases to overlap with the Proposed Development

Cumulative Effects Assessment

8.12.5 A description of the significance of potential cumulative effects upon physical process receptors is given below.

Construction

Tier 1 Projects

8.12.6 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). As the Tier 1 project is to be constructed first, it is assumed that burial will not be possible at the crossing location, a specifically designed crossing structure will be required, as per other in-service cable crossings. There is 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.

8.12.7 The White Cross construction phase is 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.

Tier 3 Projects

8.12.8 There would be no overlap of the potential Tier 3 project with that of the Proposed Development's construction phase.

Operation and Maintenance

Tier 1 Projects

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

8.12.10 A section of the White Cross export cable will be installed in close proximity to the Proposed Development (the provisional 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).

8.12.11 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

8.12.12 There will be no cumulative effects, during operation and maintenance, as a result of the Tier 3 project (refer to the Tier 1 discussion directly above).

Decommissioning

Tier 1 Projects

8.12.13 There will be no cumulative effects, during decommissioning, as a result of the Tier 3 projects.

8.12.14 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).

8.12.15 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 8.11** (and there will be no cumulative effects – it is assumed that any cable removal activities for the Proposed Development and White Cross schemes would be unlikely to be scheduled concurrently. In any event, this could easily be avoided by sensible scheduling across the two projects).

Tier 3 Projects

8.12.16 There will be no cumulative effects, during decommissioning, as a result of the Tier 3 project (refer to **paragraph 8.12.14** and **8.12.15**).

8.13 Transboundary Effects

8.13.1 A screening of transboundary impacts has been carried out and has identified that there is no potential for transboundary effects with regard to physical processes from the Proposed Development upon the interests of other states. This differs from the initial precautionary assumptions that were set out in the physical processes ES scoping chapter, on account of the review of data obtained through site specific surveys and the completion of further assessment work.

8.13.2 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 transboundary 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.

8.13.3 Effects associated with sediment disturbance and seabed change, have also been scoped out as the high-level assessment of potential sediment dispersion shows that the maximum distance that sediment will travel, if suspended, is roughly 3.9 km. The high-level assessment of potential sediment dispersion (please refer to Volume 3, Appendix 8.1 High Level Assessment of Sediment Disturbance of the PEIR) shows that the nearest location, at which sediment is anticipated to be suspended is approximately 75 km from the EEZ boundary .

8.13.4 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 EEZ boundary.

8.14 Inter-related Effects

8.14.1 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), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three phases (e.g., construction noise effects from piling and operational substation noise).
- Receptor led effects: Assessment of the scope for all effects (including inter-relationships between environmental topics) to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on physical processes, such as disturbance of sediment, may interact to produce a different, or greater effect than when the effects are considered in isolation. Receptor-led effects may be short term, temporary or transient effects, or incorporate longer term effects.

8.14.2 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 PEIR.

8.15 Summary of Impacts, Mitigation Measures and Monitoring

8.15.1 Information on physical processes within the study area was collected through a combination of desktop review, site surveys and high-level empirical analysis.Table 8.34 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); and,
- Changes to water quality (construction, operation and maintenance, and decommissioning).

8.15.2 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.

8.15.3 **Table 8.33** presents a summary of the potential cumulative impacts, mitigation measures and residual effects. The cumulative impacts assessed include:

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

8.15.4 Overall, it is concluded that there will be no significant cumulative effects from the Proposed Development alongside other projects/plans.

8.15.5 The following potential transboundary impacts have been assessed:

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

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

Table 8.34: Summary of potential environmental effects

Receptor	Sensitivity of receptor	Description of impact	Short / medium / long term	Magnitude of impact	Significance of effect	Significant / Not significant	Notes
Construction phase							
Surrounding sub-tidal seabed	Low	Sediment disturbance or seabed change	Short term	Low	Negligible or minor adverse	Not significant	
Surrounding coastline	Low	Sediment disturbance or seabed change	Short term	Low	Negligible or minor adverse	Not significant	
Nationally or internationally designated sites	Low	Sediment disturbance or seabed change	Short term	Low	Negligible or minor adverse	Not significant	It is recommended that the construction of the HDD exit pits avoids working during the peak spring tides.
Bideford Bay	Medium	Sediment disturbance or seabed change	Short term	Low	Minor adverse	Not significant	
Nationally or internationally designated sites	High	Change in water quality	Short term	Negligible	Minor adverse	Not significant	
Bideford Bay	Medium	Change in water quality	Short term	Negligible	Negligible or minor adverse	Not significant	
Operational phase							
Surrounding sub-tidal seabed	Low	Changes to metocean conditions	Long term	Negligible	Negligible or minor adverse	Not significant	
Surrounding coastline	High	Changes to metocean conditions	Long term	Negligible	Minor adverse	Not significant	

Receptor	Sensitivity of receptor	Description of impact	Short / medium / long term	Magnitude of impact	Significance of effect	Significant / Not significant	Notes
Nationally or internationally designated sites	High	Changes to metocean conditions	Long term	Negligible	Minor adverse	Not significant	
Bideford Bay	Medium	Changes to metocean conditions	Long term	Negligible	Negligible	Not significant	
Nationally or internationally designated sites	Low	Sediment disturbance or seabed change	Short term	Negligible	Negligible or minor adverse	Not significant	
Bideford Bay	Medium	Sediment disturbance or seabed change	Short term	Negligible	Negligible	Not significant	
Surrounding sub-tidal seabed	Low	Sediment disturbance or seabed change	Short term	Negligible	Negligible or minor adverse	Not significant	
Surrounding coastline	Low	Sediment disturbance or seabed change	Short term	Negligible	Negligible or minor adverse	Not significant	
Nationally or internationally designated sites	High	Changes in water quality	Short term	Negligible	Minor adverse	Not significant	
Bideford Bay	Medium	Change in water quality	Short term	Negligible	Negligible or minor adverse	Not significant	
Decommissioning phase							
Nationally or internationally designated sites	Low	Sediment disturbance or seabed change	Short term	Negligible	Negligible or minor adverse	Not significant	
Bideford Bay	Medium	Sediment disturbance or seabed change	Short term	Negligible	Negligible	Not significant	
Surrounding sub-tidal seabed	Low	Sediment disturbance	Short term	Negligible	Negligible or minor adverse	Not significant	

Receptor	Sensitivity of receptor	Description of impact	Short / medium / long term	Magnitude of impact	Significance of effect	Significant / Not significant	Notes
		or seabed change					
Surrounding coastline	Low	Sediment disturbance or seabed change	Short term	Negligible	Negligible or minor adverse	Not significant	
Nationally or internationally designated sites	High	Changes in water quality	Short term	Negligible	Minor adverse	Not significant	
Bideford Bay	Medium	Change in water quality	Short term	Negligible	Negligible or minor adverse	Not significant	

Table 8.35: Summary of potential cumulative environmental effects

Receptor	Sensitivity of receptor	Description of impact	Short / medium / long term	Magnitude of impact	Significance of effect	Significant / Not significant	Notes
Construction phase							
Surrounding sub-tidal seabed	Low	Sediment disturbance or seabed change	Short term	Negligible	Negligible or minor adverse	Not significant	
Nationally or internationally designated sites	High	Sediment disturbance or seabed change	Short term	Negligible	Minor adverse	Not significant	
Nationally or internationally designated sites	High	Change in water quality	Short term	Negligible	Minor adverse	Not significant	

8.16 Next Steps

8.16.1 The baseline characterisation will be supplemented with additional data sources identified in Scoping Opinion responses. Where relevant, these will further inform the impact assessment presented in the final ES chapter.

8.16.2 Consultations are ongoing and will continue to inform the methods detail and the ultimate physical processes assessment. The ES chapter will include specific assessment of potential secondary scour, which will build on e.g. bed current velocities that have been determined through the recent sediment dispersion assessments.

8.17 References

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