The Great Grid Upgrade

Eastern Green Link 5 (EGL 5)

Preliminary Environmental Information Report

Volume 1
Part 3
Chapter 17 Coastal and Marine Physical Processes

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nationalgrid

Contents

17. Coastal and Marine Physical Processes

17.1 Introduction

17.1.1 This chapter presents the preliminary findings of the Environmental Impact Assessment (EIA) undertaken to date for the Eastern Green Link (EGL) 5 English Offshore Scheme, with respect to the marine physical processes, including hydrodynamics, geomorphology, sediment transport and water / sediment quality. The preliminary assessment is based on information obtained to date. It should be read in conjunction with the description of the Project provided in **Volume 1, Part 1, Chapter 4: Description of the Project**.

17.1.2 This chapter describes the methodology used, the datasets that have informed the assessment, baseline conditions, environmental measures, and the effects that could result from the English Offshore Scheme during the construction, operation (and maintenance), and decommissioning phases. Specifically, it relates to the English Offshore elements of the Scheme seaward of Mean High Water Springs (MHWS) where the English Offshore Scheme makes landfall at Anderby Creek on the Lincolnshire coastline to the border between English and Scottish adjacent waters.

17.1.3 Outputs from the coastal and marine physical processes assessments presented in this Preliminary Environmental Information Report (PEIR) chapter inform the assessment of significance of effect on biological receptors such as a temporary increase in suspended sediments and subsequent deposition, and social receptors such as commercial fisheries and marine archaeology.

17.1.4 This chapter should be read in conjunction and considered alongside the following chapters:

- **Volume 1, Part 1, Chapter 2: Regulatory and Policy Overview;**
- **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology;**
- **Volume 1, Part 3, Chapter 18: Intertidal and Subtidal Benthic Ecology;**
- **Volume 1, Part 3, Chapter 19: Fish and Shellfish;**
- **Volume 1, Part 3, Chapter 20: Intertidal and Offshore Ornithology;**
- **Volume 1, Part 3, Chapter 21: Marine Mammals and Marine Reptiles;**
- **Volume 1, Part 3, Chapter 23: Commercial Fisheries;**
- **Volume 1, Part 3, Chapter 25: Marine Archaeology;** and
- **Volume 1, Part 4, Chapter 27: Cumulative Effects.**

17.1.5 There is also spatial overlap with the onshore assessments that are being progressed for the English Onshore Scheme (see **Volume 1, Part 2 English Onshore Scheme**), with the Intertidal Zone sharing common receptors. This chapter should also therefore be read in conjunction with the following chapters:

- **Volume 1, Part 2, Chapter 9: Water Environment;** and
- **Volume 1, Part 2, Chapter 10: Geology and Hydrogeology.**

17.1.6 This chapter is supported by the following figures**:**

- **Volume 3, Part 3, Figure 17-1: Study Area;**
- **Volume 3, Part 3, Figure 17-2: Bathymetry and Seabed Features;**
- **Volume 3, Part 3, Figure 17-3: Tidal Range for Mean Spring and Neap Tides;**
- **Volume 3, Part 3, Figure 17-4: Mean Spring ad Neap Peak Tidal Flows;**
- **Volume 3, Part 3, Figure 17-5: Tidal Excursions for Mean Spring and Neap Tides;**
- **Volume 3, Part 3, Figure 17-6: Wind and Wave Roses;**
- **Volume 3, Part 3, Figure 17-7: Seabed Sediments and Percentage of Fines from Particle Size Analysis (PSA);**
- **Volume 3, Part 3, Figure 17-8: Seabed Sediments and Percentage of Sands from Particle Size Analysis (PSA);**
- **Volume 3, Part 3, Figure 17-9: Seabed Sediments and Percentage of Gravels from Particle Size Analysis (PSA);**
- **Volume 3, Part 3, Figure 17-10: Seabed Sediments Median (d50) Grain Size;**
- **Volume 3, Part 3, Figure 17-11: Annual Mean Suspended Sediment Concentration;**
- **Volume 3, Part 3, Figure 17-12: Seasonal Mean Suspended Sediment Concentration;**
- **Volume 3, Part 3, Figure 17-13: Arsenic Concentrations – NOAA Effect Range and Cefas Action Levels;**
- **Volume 3, Part 3, Figure 17-14: Designated Sites;** and
- **Volume 3, Part 3, Figure 17-15: Predicted Sediment Plume Areas.**

17.1.7 This chapter is supported by the following appendices:

- **Volume 2, Part 1, Appendix 2.A: Regulatory and Planning Context;**
- **Volume 2, Part 1, Appendix 5.B: Outline Code of Construction Practice;**
- **Volume 2, Part 1, Appendix 5.C: Outline Construction Environmental Management Plan (CEMP);**
- **Volume 2, Part 3, Appendix 17.A: Fine Sediment Modelling Spreadsheet;**
- **Volume 2, Part 3, Appendix 17.B: Wave Modelling;** and
- **Volume 2, Part 3, Appendix 17.C: Water Framework Directive (WFD) Offshore Assessment.**

17.1.8 As set out in **Volume 1, Part 1, Chapter 1: Introduction**, cable installation and some associated activities beyond 12 Nautical Miles (NM), and emergency repair of the installed cable within the draft Order Limits are exempt under the Marine and Coastal Access Act 2009 (MCAA 2009). This chapter presents a preliminary assessment of the cable route from MHWS at the Anderby Creek Landfall to the maritime boundary between England and Scotland adjacent waters. This is to ensure all likely significant effects of the English Offshore Scheme have been assessed. However, consent is not being sought for the exempt cable and only external cable protection and dredging for sandwave clearance will be included in the Deemed Marine Licence (DML) beyond 12 NM.

Limitations

17.1.9 The information provided in this PEIR is preliminary and presents the initial assessment of effects on coastal and marine physical processes with the purpose of obtaining feedback from stakeholders to inform the final assessment. The final assessment of likely significant effects will be reported in the Environmental Statement (ES). The PEIR has been produced to fulfil the Applicant's consultation duties in accordance with Section 42 of the Planning Act 2008 (PA2008) and enable consultees to develop an informed view of the preliminary significant effects of the English Offshore Scheme.

17.1.10 This PEIR has been collated based on a range of publicly available data, supported by available survey data collected for the English Offshore Scheme.

17.1.11 The Project description, including details pertaining to construction methods is still being developed and to address uncertainty in methods and design parameters, a precautionary approach has been adopted.

17.1.12 A Cable Burial Risk Assessment (CBRA) has not yet been completed. Indicative areas requiring cable protection and pre-sweeping (including volumes) have been calculated based on the existing marine characterisation surveys and these are used to support the PEIR assessments. The CBRA will be used to inform the Outline Cable Specification and Installation Plan (CSIP) which will be submitted with the Development Consent Order (DCO) application. This chapter will be reviewed and updated for the ES following completion of the CBRA and CSIP.

17.1.13 Various technical assessments were undertaken to inform the EGL 3 and EGL 4 EIA. Where relevant (i.e., where construction methodologies are essentially identical, or where an impact pathway would occur over a similar spatial / temporal scope) the conclusions of those assessments have been used to scope 'in' or 'out' various impact pathways. These are not necessarily proposed to be repeated to inform the PEIR for this Project.

17.1.14 In the absence of data, a precautionary approach has been taken and professional judgement, based on experience of similar linear projects, have been used where required to inform the scope of the assessment.

Preliminary significance conclusions

17.1.15 The preliminary coastal and marine physical processes assessment presented in Sections 17.10 to 17.15 has concluded that all the potential effects assessed are Negligible and have been assessed as Not Significant in EIA terms.

17.1.16 A spreadsheet model was applied to assess the dispersion of fine sediment disturbed by the English Offshore Scheme. The spreadsheet model makes a number of assumptions which are not fully representative of real-world conditions. In particular, the spreadsheet model assumes a steady state flow, whereas flows will vary both over time and space, altering the plume dispersion. In addition, the spreadsheet model does not account for the effects of flocculation (the process, where fine particles suspended in the water form larger aggregates or flocs), whereas individual fine particles are expected to floc together, altering their settling velocity. Some discussion of the effects of non-steady flow and flocculation on the results presented is included to ensure that the assessment is robust.

17.1.17 Further details of the methodology behind the assessment, and a detailed narrative of the assessment itself are provided within the sections below.

17.2 Relevant Technical Guidance

Technical guidance

17.2.1 The legislation and planning policy which has informed the assessment of effects with respect to coastal and marine physical processes is provided within **Volume 1, Part 1, Chapter 2: Regulatory and Policy Overview** and **Volume 2, Part 1, Appendix 2.A: Regulatory and Planning Context**. Further information on policies relevant to the English Offshore Scheme is provided in **Volume 2, Part 1, Appendix 2.B: Marine Plan Policy Assessment.**

17.2.2 Relevant technical guidance, specific to marine physical processes, that has informed this PEIR and will inform the assessment within the ES is summarised in **Table 17-1**.

Table 17-1 Technical guidance relevant to the marine physical processes assessment

Technical guidance document	Context
Natural England Offshore wind cabling: ten years' experience and recommendations (Ref 17.1).	Details how subsea power cable installation and maintenance interacts with the marine physical environment, identifying potential impacts on seabed sediments and hydrodynamics. Provides recommendations to help minimise these impacts.
Natural England and Joint Nature Conservation Committee, Nature conservation considerations and environmental best practise for subsea cables for English Inshore and UK offshore waters (Ref 17.2).	Details how subsea power cable installation and maintenance interacts with the marine physical environment, identifying potential impacts on seabed mobility, sediment transport, and hydrodynamics. Provides a framework to ensure minimisation of these impacts.
Department for Business, Enterprise and Regulatory Reform (BERR), Review of Cabling Techniques and Environmental Effects applicable to the Offshore Wind farm Industry (Ref 17.3).	Reviews how different cable installation and protection methods interact with the marine environment, identifying potential impacts on sediment dynamics, hydrodynamics and seabed morphology and how these differ for various methods.
Joint Nature Conservation Committee and Natural England, General advice on assessing potential impacts of and mitigation for human activities on Marine Conservation Zone (MCZ) features, using existing regulation and legislation (Ref 17.4).	Explains how to assess and mitigate human activities—including subsea cabling and dredging - in ways that avoid damaging those underlying physical systems which maintain species and habitats.
Cefas, Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Ref 17.5).	Specifies the types of data required to characterise physical processes necessary for accurate assessment of impacts of

Technical guidance document	Context
	developments on the marine physical environment.
OSPAR Assessment of the Environmental Impacts of Cables (Ref 17.6).	Evaluates how subsea cables disturb the seabed, how installation methods affect sediment transport and how cable protection alters hydrodynamics. Provides a comparison of physical impacts of different installation techniques.
OSPAR Guidelines on Best Environmental Practice (BEP) in cable laying and operation (Ref 17.7).	Provides recommendations to help minimise the impact of cable installation on the marine physical environment (including seabed disturbance, hydrodynamics and geomorphological features).
Cefas, Offshore wind farms: guidance note for Environmental Impact Assessment in respect of Food and Environmental Protection Act (FEPA) and Coast Protection Act (CPA) requirements: Version 2. (Ref 17.8).	Details requirements for assessing the impacts of subsea cable installation, burial, protection and maintenance on physical processes (including seabed disturbance, hydrodynamics, scour and potential for morphological change). Also details requirement for assessing the impacts of cable landfall design on coastal processes (including changes to wave climate at the shore, impacts on sediment supply, potential effects on erosion and accretion and interactions with coastal defences).
Natural Resources Wales (NRW), Guidance Note. Marine Physical Processes Guidance to inform Environmental Impact Assessment (EIA). GN041 (Ref 17.9).	Explains how to assess the physical impacts of subsea cable installation including sediment plumes, erosion and deposition patterns, disturbance footprints and recovery times. Provides guidance on data requirements and modelling.
COWRIE, Coastal Process Modelling for Offshore Wind Farm Environmental Impact Assessment: Best Practice Guidance (Ref 17.10).	Provides methods for assessing seabed disturbance and details the modelling framework required to assess how subsea cables interact with waves, currents and sediment transport.
Durning and Broderick, Development of cumulative impact assessment guidelines for offshore wind farms and evaluation of use in project making (Ref 17.11).	Provides a framework for assessing cumulative impacts on marine physical processes.
Planning Inspectorate, Nationally Significant Infrastructure projects: Advice on the Water Framework Directive (Ref 17.12)	Outlines requirements for assessing the impact on physical processes to provide evidence that the subsea cables will not cause a deterioration of the water-body status. This includes sediment plumes, seabed disturbance and coastal impacts.

Technical guidance document	Context
Environment Agency, Flood Risk Assessments: Climate change allowances (Ref 17.13).	Provides climate change allowances for water levels and waves.
UKCP, UKCP18 Science Overview Report, November 2018. UK Met. Office (Ref 17.14).	Provides climate change allowances for water levels and waves.

17.3 Consultation and Engagement

Overview

17.3.1 The assessment has been informed by consultation responses and ongoing stakeholder engagement. An overview of the approach to consultation is provided in Section 5.9 of **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**.

17.3.2 An overview of technical engagement undertaken or planned to inform the coastal and marine physical processes assessment is provided in paragraphs 17.3.4 to 17.3.7.

Scoping Opinion

17.3.3 A Scoping Opinion was adopted by the Secretary of State, administered by the Planning Inspectorate, on 13 October 2025 (Ref 17.15). A summary of the relevant responses received in the Scoping Opinion in relation to the coastal and marine physical processes, and confirmation of how these have been addressed within the assessment to date, is presented in **Table 17-2**. The information provided in the PEIR is preliminary and not all Scoping Opinion comments have been addressed at this stage, however, all comments will be addressed within the ES.

Table 17-2 Summary of EIA Scoping Opinion responses for the coastal and marine physical processes

Consultee	Consideration	How addressed in this PEIR
Planning Inspectorate ID 4.1.1	Disturbance of subtidal seabed morphology during operation: The ES needs to clearly demonstrate that significant effects are not likely in relation to pre-sweeping, taking account of any activity required in proximity such as within the MCZ. The ES should confirm the worst-case parameters for disturbance arising from pre-sweeping to facilitate cable repair and remedial protection over the lifetime of the proposed development.	Section 17.10 demonstrates that significant effects are not predicted in relation to construction activities including trenching and pre-sweeping. Any impacts from pre-sweeping for cable repair during operation would be more localised than from pre-sweeping during construction and the impact pathway continues to remain scoped out for operation as agreed. Worst-case parameters for disturbance arising from trenching and pre-sweeping are set out in Section 17.8.
Planning Inspectorate	Disturbance of intertidal seabed morphology during construction,	Acknowledged. This impact pathway remains scoped out for operation and

Consultee	Consideration	How addressed in this PEIR
ID 4.1.2	operation and decommissioning: This matter can be scoped out of further assessment for these phases subject to a full commitment to trenchless installation at landfall, supported by appropriate baseline data (please see the Planning Inspectorate's comments at ID 2.1.7 of this Opinion). Noting the advice received from the Marine Management Organisation (MMO) and Environment Agency (Appendix 2 of this Opinion), the Planning Inspectorate cannot exclude the possibility of significant effects during construction for example from frac-out of drilling fluids or vibrations during drilling, or from indirect pathways arising from change at landfall with reach into the intertidal area. This matter should be assessed in the ES, or the absence of significant effects should be demonstrated with evidence of agreement from relevant consultation bodies.	decommissioning. Measure OMT01 (D) (outlined in Section 17.6) commits to a trenchless technique being used at Anderby Creek Landfall and measure OMT02 (D) (outlined in Section 17.6) commits to a trenchless technique exit 3 - 6 m below Lowest Astronomical Tide (LAT) depth contour to avoid disturbance to intertidal sediments and habitats. The potential for significant effects arising from disturbance of the Intertidal Zone seabed morphology during construction has been considered by the EIA and assessed in the preliminary assessment - see Section 17.11.
Planning Inspectorate ID 4.1.3	Modifications to tidal and wave regimes and associated impacts to morphological features during construction: If the ES confirms a definitive commitment to using a trenchless method at landfall and that no other infrastructure is used in the nearshore area that could result in alteration of sediment transport in the intertidal area, such as a cofferdam or cable protection, then the Planning Inspectorate agrees that this matter can be scoped out for construction. Otherwise, the Planning Inspectorate cannot exclude the possibility that there would be modification to tidal and wave regimes in the intertidal zone from construction activities and would require this matter to be assessed further in the ES.	The Applicant can confirm that a cofferdam is not proposed as part of the English Offshore Scheme. Measure OMT01 (D) (outlined in Section 17.6) commits to a trenchless technique being used at Anderby Creek Landfall and measure OMT02 (D) (outlined in Section 17.6) commits to a trenchless technique exit 3 - 6 m below Lowest Astronomical Tide (LAT) depth contour to avoid disturbance to the Intertidal Zone sediments and habitats. The closest infrastructure (pipeline) crossing requiring external cable protection is approximately 8.5 km offshore in water depths of 12.3 to 13.8 m. An assessment of the potential impacts of rock berms at these locations has been undertaken to demonstrate that there is no adverse effect on sediment transport either locally, or at the coast. The results from the assessment are presented in **Volume 2, Part 3, Appendix 17.B:**

Consultee	Consideration	How addressed in this PEIR
		Wave Modelling and summarised in Section 17.13. Areas requiring cable protection in areas of hard substrate will be confirmed following the completion of the geotechnical survey and will be provided in the ES. Additional assessment of the potential for impact on wave regimes would be undertaken if cable protection areas are required close to the coast in relatively shallow water depths (so that the berm reduces baseline water depths by more than 10%).
Planning Inspectorate / MMO ID 4.1.4	Release of contaminated sediments during construction, operation and decommissioning: The Scoping Report describes contaminant levels in the vicinity of the proposed development based on seabed testing for EGL 4, for which samples were collected adjacent to the scoping boundary of the proposed development. Based on these samples, contaminated sediment is minimal with all samples aside from arsenic (8 locations), nickel (4 locations), lead and mercury (1 location for each) being below Centre for Environment, Fisheries and Aquaculture Science (Cefas) Action Levels 1 and 2, and National Oceanic and Atmospheric Administration (NOAA) effects range low (ERL) thresholds. It is stated that similar results are expected from testing of EGL 3 samples although these are not yet available. Project specific sampling is proposed to validate that contaminated sediment is not likely to result in a significant effect. Based on the information presented, the Planning Inspectorate agrees that this matter can be scoped out of further assessment. However, if the project specific sampling indicates that contamination levels exceed the relevant Cefas Action Levels or NOAA ERL thresholds then an assessment of any Likely Significant Effects (LSE) arising should be provided.	Data from sediment samples collected for the English Offshore Scheme environmental baseline survey indicates exceedances of Cefas Action Level 1 for some contaminants. An assessment of the impacts of release of contaminated sediments is therefore provided in Section 17.14. Results from the English Offshore Scheme sampling are presented in Section 17.5.

Consultee	Consideration	How addressed in this PEIR
Planning Inspectorate ID 4.1.5	Accidental releases or spills of materials or chemicals during construction, operation and decommissioning: The Planning Inspectorate is content to scope this matter out noting the legal requirements upon vessels to manage any accidental releases or spills of materials or chemicals, and that relevant measures to comply with legislation will be outlined in management plans to be submitted with the DCO application.	The impact continues to remain scoped out as agreed. Several management plans will be provided with the ES to support the DCO application. These will include an Outline Construction Environmental Management Plan (CEMP) and Outline Marine Pollution Contingency Plan (MPCP). These documents will outline measures to be implemented to comply with legislation (e.g., in relation to the prevention of oil and chemical spills) during all phases of the English Offshore Scheme.
Planning Inspectorate ID 4.1.6	Changes to sediment quality from temperature increase during construction, operation and decommissioning: The Planning Inspectorate is content to scope this matter out for construction and decommissioning as the cables would not be in operation during these phases of the proposed development. Regarding operation, the Scoping Report presents findings from heat calculations for EGL 3 and EGL 4, which conclude that based on an ambient seabed temperature of 12°C, seabed temperatures at 0.2 m above the cable is estimated to be 13°C to 14°C with cables operating at maximum temperature. It states that this would result in a low magnitude of impact and no significant effects. The Scoping Report seeks to scope this matter out for the proposed development based on this, as a similar cable system is proposed. In the absence of a CBRA and confirmation of the cable burial depth that would be achieved, the Planning Inspectorate does not have sufficient justification to exclude the possibility of significant effects. This matter should be scoped into the assessment or the ES should demonstrate, with evidence of agreement from relevant consultation bodies, an absence of ILSE.	Heat calculations have been undertaken for the English Offshore Scheme. An assessment of temperature increases has been provided in Section 17.15.

Consultee	Consideration	How addressed in this PEIR
Planning Inspectorate and Natural England ID 4.1.7	The Scoping Report states that the proposed study area is informed by the tidal excursion, resulting in an area defined as the scoping boundary plus 15 km each side. It states that this would be validated through fine sediment modelling carried out for EGL 3 and EGL 4. The applicant's attention is drawn to NE's comments (Appendix 2 of this Opinion) regarding reliance it can place on the outcomes of the spreadsheet model to inform the study area for effects from suspended sediment concentration (SSC) in the absence of detailed calculations. Effort should be made to agree the final study area for this impact pathway with relevant consultation bodies, based on suitable data sources.	A spreadsheet-based model has been applied to assess the potential dispersion of sediment plumes arising from activities during construction, including sandwave clearance, excavation of trenchless technique exit pits and cable trenching operations. The assessment undertaken for EGL 3 and EGL 4 has been updated to consider survey data collected for the English Offshore Scheme. Additional details on the spreadsheet-based modelling approach and results are provided in **Volume 2, Part 3, Appendix 17.A: Fine Sediment Modelling Spreadsheet**. The study confirms that the predicted impacts are constrained within the defined study area.
Planning Inspectorate and Natural England ID 4.1.8	Where the ES uses baseline data from existing public records, it should specify when the data was collected. The most recent available data should be used to inform the design of construction works and assessment of associated effects. The applicant's attention is drawn to NE's comments (Appendix 2 of this Opinion) regarding several data sources including the European Marine Observation and Data Network (EMODnet) digital terrain model (DTM) and SEASTATES metocean data.	Acknowledged. Data sources used to support the preliminary assessment are set out in **Table 17-3**. Natural England recommended the use of the following data sources which have been referred to, along with information on when the data were collected, in developing the baseline description: • Anglian Regional Coastal Monitoring Programme data (bathymetry, coastal habitat mapping, lidar, aerial imagery, tides / wave data); • NCERM2 (Shoreline Management Plans, flood assets, coastal erosion); • Local reports, e.g., Saltfleet to Gibraltar Point Beach Management Strategy; • Designated Site View for information on site condition; • EMODnet DTM data for bathymetric features and ongoing geophysical investigations; and • SEASTATES metocean data.

Consultee	Consideration	How addressed in this PEIR
Planning Inspectorate ID 4.1.9	The list of potential receptors at paragraph 18.6.1 does not include designated sites, as described in Section 18.4 of the Scoping Report. The ES should assess all potential receptors for which significant effects are likely.	The potential for significant effects on designated sites has been considered by the EIA and assessed in the preliminary assessment - see Sections 17.10, 17.12 and 17.14. The list of potential receptors has been updated to include designated sites (Section 17.7).
Planning Inspectorate ID 4.1.10	It is proposed to produce spreadsheet-based models to inform assessment of Suspended Sediment Concentration (SSC) and sedimentation associated with installation activities. The ES should explain the method used and provide a justification as to why the assessment is robust, supported by evidence of agreement with relevant stakeholders.	A spreadsheet-based model has been applied to assess the potential dispersion of sediment plumes and subsequent deposition arising from activities during construction, including sand wave clearance, excavation of trenchless technique exit pits and cable trenching operations. Additional details on the spreadsheet-based modelling approach and results are provided in **Volume 2, Part 3, Appendix 17.A: Fine Sediment Modelling Spreadsheet**.
Planning Inspectorate ID 4.1.11	The Scoping Report states that no new hydrodynamic modelling is currently proposed to inform the assessment although this would be reviewed on receipt of particle size distribution (PSD) analysis. The Planning Inspectorate understands that hydrodynamic modelling carried out for EGL 3 and EGL 4 would be used as the basis for assessment, noting reference to proximity of the proposed development to these projects and that PSD analysis of samples collected for EGL 3 and EGL 4 demonstrate a low percentage of fines. The assessment in the ES should be based on updated modelling covering the area affected or a justification as to why use of existing modelling provides a robust approach, supported by evidence of agreement with relevant consultation bodies.	The spreadsheet model has been updated to consider PSD from sampling data for the English Offshore Scheme. Full results are provided in **Volume 2, Part 3, Appendix 17.A: Fine Sediment Modelling Spreadsheet**.
Planning Inspectorate ID 4.1.12	The ES should confirm the threshold at which effects are significant for this aspect.	See **Table 17-18** for significance matrix.
Planning Inspectorate	The ES should clearly set out the climate change scenarios modelled and justify	Additional consideration has been given to climate change scenarios to

Consultee	Consideration	How addressed in this PEIR
4.1.13	the scenarios used along with the management plan policies within the modelled area. The applicant's attention is drawn to the EA's comments (Appendix 2 of this Opinion) regarding the need to consider upper end and H++ scenarios in respect of sea level rise. The Planning Inspectorate advises that the assessment should include consideration of these scenarios. NE in its consultation response advises that the management strategy for the Lincolnshire shoreline is likely to change due to coastal retreat over the lifetime of the proposed development. The Planning Inspectorate advises that the implications of change both under the current hold the line strategy or a revised no active intervention policy should be considered in the assessment.	include the H++ extreme change scenario (Section 17.5), including sea level rise and coastal retreat predictions. Information on current and future coastal management strategy at the proposed Anderby Creek Landfall is provided in Section 17.5, in both Coastal Geomorphology and Future Baseline. The Anderby Creek Landfall design study is ongoing and will consider both the current and future coastline management strategies.
Planning Inspectorate ID 4.1.14	The ES should include figures illustrating the geomorphological baseline to aid interpretation of the textual description. It would also be beneficial to show the Holderness Inshore MCZ on a figure to illustrate its location relative to the 15 km study area.	See **Volume 3, Part 3, Figure 17-1: Study Area** (which has been updated to show geomorphological features in the study area) and **Volume 3, Part 3, Figure 17-14: Designated Areas** (which has been updated to include the Holderness Inshore MCZ).
Environment Agency	The following additional datasets and guidance may also be of interest. The Environment Agency's Coastal Standards Technical Report LIT 56561 (2022), particularly regarding future wave conditions and climate change allowances. The NCERM (National Coastal Erosion Risk Mapping) may be of interest. This can be obtained here: National Coastal Erosion Risk Mapping (NCERM) - National (2024). Finally, the Surf Zone dataset 2019 may also be of use which is available here. https://environment.data.gov.uk/dataset/77e6f743-d708-4909-.	The Coastal Standards are applicable to flood modelling and these will be considered as part of the flood risk assessment. NCERM data have been included in the baseline desk study. The EMODnet data has been used to inform regional bathymetry (with data collected for the English Offshore Scheme used with the draft Order Limits) as this compiles more recent survey data (up to 2024) than the Surf Zone interpolated bathymetry (2019).
Environment Agency	This section describes how UKCP18 suggests increases in sea level of more than 0.7 metres are possible by 2100 along the Lincolnshire Coast. This is correct for the Higher Central Scenario. Please note it is also important to	Additional consideration has been given to climate change scenarios to include the H++ extreme change scenario (Section 17.5), including sea level rise and coastal retreat predictions.

Consultee	Consideration	How addressed in this PEIR
	consider the potential implications that more extreme climate change will have on sea level and the proposed development, for example in the Upper End and H++ scenarios. Further guidance on which climate change allowances to apply for essential infrastructure and Nationally Significant Infrastructure projects can be found online at: Flood risk assessments: climate change allowances - GOV.UK (www.gov.uk).	Information on current and future coastal management strategy at the proposed Anderby Creek Landfall is provided in Section 17.5, in both Coastal Geomorphology and Future Baseline. The Anderby Creek Landfall design study is ongoing and will consider both the current and future coastline management strategies.
Environment Agency	"*Accidental releases or spills of materials or chemicals*" is currently scoped out for all phases of the project offshore. We recommend that until we have reviewed mitigation strategies, including an Outline Construction Environmental Management Plan and Outline Marine Pollution Contingency Plan, that "*Accidental releases or spills of materials or chemicals*" is to be scoped in, for at least the construction phase. It should also be noted that whilst some measures are included in section 18.5.4 on the management of drilling fluids, the Offshore CEMP / Marine Pollution Plan should include provision for a Drilling Fluid Breakout Plan.	The Planning Inspectorate is content to scope this out as outlined in ID 4.1.5 of the Scoping Opinion. Therefore, impact pathway continues to remain scoped out as agreed. Measures to control and manage drilling fluid and frac-out will be provided as part of the Outline Cable Specification and Installation Plan (CSIP).
Environment Agency	The intertidal area at the Anderby Creek Landfall location is directly within the Moggs Eye designated bathing water, and under 100 m from the Anderby designated bathing water. However, these protected areas do not appear to be mentioned in Sections 9.4.12 – 9.4.23. We accept that they are named briefly in Section 18.4.41, however we would expect the assessment to ensure that works associated with both the onshore and offshore elements do not risk impacting these designated areas. Therefore, for the PEIR and ES stages we would recommend that the bathing waters are included in both Chapter 9 and Chapter 18 for further assessment.	Designated bathing waters have been considered within Section 17.12 and are assessed as part of the Water Framework Directive (WFD) Assessment (**Volume 2, Part 3, Appendix 17.C: Water Framework Directive (WFD) Offshore Assessment**).

Consultee	Consideration	How addressed in this PEIR
Environment Agency	Table 9-1 and Table 18-1 which lists legislation relevant to the Water Environment and to the coastal and marine physical processes assessment, respectively, currently does not include The Bathing Water Regulations 2013. Add this legislation for consideration throughout Chapter 9 and Chapter 18 as the Anderby Creek Landfall location is adjacent to Moggs Eye designated bathing water, and under 100 m from the Anderby designated bathing water.	The Bathing Water Regulations 2013 have been included as part of **Volume 2, Part 1, Appendix 2.A: Regulatory and Planning Context** and are a consideration throughout this PEIR chapter.
Environment Agency	Scoped out during construction - Disturbance of intertidal seabed morphology. It is intended to utilise HDD to cross from subtidal to landfall, and the depths proposed (25 m maximum depth) should avoid / reduce / eliminate direct effects on the intertidal. However, maximum stated depth is not reached instantaneously. It is a gradual process dependent on the curvature of the drill pipes (see Plate 4-2). It is not guaranteed that there will not be a “frack-out” of drilling fluids at shallower levels and / or vibrations during drilling that may induce failure of the subsurface. Therefore, subsequent damage to the intertidal zone cannot be ruled out entirely. Scope this in for construction purposes - as possible worst case.	Acknowledged. This impact pathway remains scoped out for operation and decommissioning. Measure OMT01 (D) (outlined in Section 17.6) commits to a trenchless technique being used at the Anderby Creek Landfall and measure OMT02 (D) (outlined in Section 17.6) commits to a trenchless technique exit 3 - 6 m below Lowest Astronomical Tide (LAT) depth contour to avoid disturbance to the Intertidal Zone sediments and habitats. The potential for significant effects arising from disturbance of the Intertidal Zone seabed morphology during construction has been considered by the EIA and assessed in the preliminary assessment - see Section 17.11.
Joint Nature Conservation Committee (JNCC)	JNCC agree with the approach to bury cables in the seabed, except in areas where trenching is not possible. Section 4.4.25 highlights that a preliminary Cable Burial Risk Assessment (CBRA) will be undertaken based on the results of the geophysical and geotechnical surveys to inform the PEIR and ES. JNCC recommend that the potential for repeat passes of trenching and burying equipment be carefully reviewed as part of the DCO application process and suggests that if this is included as potential mitigation, it is clearly detailed how and where this may be possible	Acknowledged. As suggested, the potential for repeat passes during trenching will be carefully reviewed as part of the DCO application process and areas where this may be possible will be included in the CBRA.

Consultee	Consideration	How addressed in this PEIR
	using information from the surveys and CBRA. All rock placement will need to be clearly justified against the CBRA risks to the cable and predicted burial success. We have no further comments on the proposed design and control measures.	
MMO	Section 5.2 of the Scoping Report specifies a 'Receptor Based' approach to the EIA i.e., scoping in depends on there being a defined receptor for the impact. Receptor definition for coastal processes are listed in 18.6.1 and include geomorphology, currents and water levels, waves, bathymetry (and seabed features), water quality and sediment quality. There is no indication that these are restricted to designated areas or that effects will only be assessed for ecological receptors so this allows for a wide-ranging assessment.	The listed receptors have been redefined as pathways for coastal and marine physical processes, with the broad assessment approach adopted to enable an assessment of indirect effects for other chapters. The assessment considers the potential for impacts within designated areas where direct impacts to coastal and marine physical processes could occur.
MMO	The report proposes to scope out impacts from repair and maintenance of cables due to this affecting a smaller area (i.e., not the whole area affected during construction). However, the magnitude of the impact locally may be important, so the scoping should note any areas with particular sensitivity to disturbance i.e., transport pathways to major seabed features within Marine Conservation Zones ("MCZ"), if any. The MMO also notes that the cable route is not yet determined and may pass through an MCZ, where re-work (potentially repeated) may be of greater significance compared to other sections.	Areas of particular sensitivity have been noted within the assessment for construction where relevant (Section 17.10, Section 17.12 and Section 17.14).
MMO	Table 18-9 specifically scopes out effects in the intertidal seabed – because the intention is for Horizontal Directional Drilling of the cable beneath this zone to avoid any direct impact. This appears to be reasonable, however the MMO notes that there may be an indirect pathway to impact, depending on the dynamics of the actual landfall location i.e., if the subtidal cable is affecting a process with reach into the intertidal. It	Measure OMT01 (D) (outlined in Section 17.6) commits to a trenchless technique being used at Anderby Creek Landfall and measure OMT02 (D) (outlined in Section 17.6) commits to a trenchless technique exit 3 - 6 m below Lowest Astronomical Tide (LAT) depth contour to avoid disturbance to intertidal sediments and habitats. Therefore, direct impacts to the Intertidal Zone remain scoped out.

Consultee	Consideration	How addressed in this PEIR
	is not possible to comment on this at this stage therefore, the MMO advises that the Applicant remains aware that this could be questioned at a later date.	The potential for indirect effects on the Intertidal Zone has been assessed in the preliminary assessment - see Section 17.12 and 17.13).
MMO	The Scoping Report has also scoped out impacts to hydrodynamics due to construction, as these will be assessed for the operational development. As above, this is generally reasonable, however it should be noted that the impact of construction works in the shallower waters should be assessed to ensure that indirect impacts do not reach into the intertidal.	Impact of construction activities are assessed along the full route, including in the shallower nearshore areas. Assessment of whether sediment plumes from construction in the subtidal could reach the Intertidal Zone has been included in Section 17.12.
MMO	The MMO notes that the assessment will consider "*any residual effects that are reported as non-negligible (or equivalent) within the technical chapters. Minor effects, while not significant, are considered in the assessment on the basis that multiple minor effects may interact to result in a significant effect.*" Exclusion of negligible effects appears reasonable in a physical process context but it might be worth noting that they may have a different significance if assessed as an ensemble e.g., multiple isolated physical disturbances assessed as negligible due to their scale, versus multiple sequential or adjacent disturbances whose combined scale is larger. The Applicant should remain aware of any potential for this to occur.	Acknowledged and considered within the assessment.
MMO	The geomorphology baseline description (paragraphs 18.26 - 18.35) provides a good level of detail but none of the named locations or processes are shown on graphics so there is no geographical reference to interpret the information relative to the physical data. For the future assessments and the ES, it would be beneficial for the named locations and processes to be marked on at least one of the accompanying graphics in the relevant chapter.	Named locations have been added to **Volume 3, Part 3, Figure 17-2: Bathymetry and Seabed Features.**

Consultee	Consideration	How addressed in this PEIR
Natural England	The Applicant states that: "*The Study Area identified acts a precautionary maximum zone of influence and incorporates the area within which there is the potential for direct impacts associated with the deposition of suspended sediments. It has been validated through reference to fine sediment modelling calculations presented in the Eastern Green Link (EGL) 3 and EGL 4 PEIR which indicates suspended sediment concentrations of more than 10 mg/l are constrained to less than 10 km from the English Offshore Scheme Scoping Boundary* (Ref 18.26)." In our advice to Eastern Green Link (EGL) 3 and EGL 4 PEIR, Natural England highlighted the need to report on the type of the spreadsheet-based model used for calculations for suspended sediment concentrations, its setting and validation and data input, as only modelling results were provided. Therefore, until more information is provided on the fine sediment modelling calculations, Natural England cannot consider these data as a reliable source to inform the boundary of the Study Area. Natural England advises the Applicant provides information on the fine sediment modelling calculations and the description of the modelling techniques presented in the Eastern Green Link (EGL) 3 and EGL 4 PEIR, as the spreadsheet based model used for calculations suspended sediment concentrations was not described in the Eastern Green Link (EGL) 3 and EGL 4 PEIR. Until more information is provided on the fine sediment modelling calculations, Natural England cannot consider these data as a reliable source to inform the boundary of the Study Area.	Details on the approach are provided in: **Volume 2, Part 3, Appendix 17.A: Fine Sediment Modelling Spreadsheet** which has been updated based on advice provided on EGL 3 and EGL 4. Further engagement with Natural England will be undertaken, including the establishment of a coastal and marine physical processes technical group which will include consideration of any further outcomes on the EGL 3 and EGL 4 project where relevant.

Consultee	Consideration	How addressed in this PEIR
Natural England	It is stated that, "*The EMODnet DTM has been used to inform the baseline understanding of bathymetry across the Study Area. The DTM is based on bathymetric data from various sources including UKHO survey data.*" The Applicant has not provided information on when the data used to create the EMODnet DTM were collected. Natural England advises it is important that the most recent bathymetric data are available to inform construction works. However, it is understood (Table 18.10) that the Applicant has undertook geophysical surveys, including Multi Beam Echo Sounder (MBES)) within the Study Area. Natural England advises the most recent bathymetric data are available to inform construction work methods, such as bedforms clearance, excavation of HDD pits, etc, and related impacts. It is understood that the EMODnet DTM data has provided an initial baseline for the bathymetric features and ongoing geophysical investigations.	Surveys of the English Offshore Scheme have been used to inform the bathymetry, location of bedforms – the EMODnet DTM is only used to inform water depths across the wider area and then only in areas where no UK Hydrographic Office (UKHO) survey data is available. Bathymetry data across the wider area is used for wave modelling and to show water depths in a wider spatial context than possible from survey data of the English Offshore Scheme alone.
Natural England	Metocean data and use on wave modelling and EIA assessment. Natural England advises the temporal range of metocean data (e.g., from SEASTATES) considered for the EIA assessment should be provided, especially if those data are then used for wave modelling or any wave modelling undertook in previous project relies on those or different data.	Wave modelling is based on data from Wavenet buoys, information on the temporal range of data used is provided in **Table 17-3**. SEASTATES is used to provide an overview of wave climate across the study area, the temporal range of data used in SEASTATES is provided in **Table 17-3.**
Natural England	The document notes "*The Lincolnshire shoreline management plan along the coastline within the Study Area is to hold the line for the epoch 2025 to 2055. The strategy for 2055 to 2105 is pending agreement*." In Table 18-9 under Disturbance of intertidal seabed morphology, for the operation phase it notes that the "*The proposed Landfall is sited in areas where coastal*	Acknowledged, text revised accordingly and assessment updated in Section 17.13. The Anderby Creek Landfall design is ongoing and will consider both the current and future coastline management strategies as well as the

Consultee	Consideration	How addressed in this PEIR
	management practices are to hold the line". Natural England advises this is not strictly true as the strategy has not been published and the policy for this period agreed. If the scheme starts in 2035 and is operational for 40 years Natural England advises the Applicant needs to consider exposure due to coastal retreat over this period i.e., up until at least 2075. Natural England advises the Applicant should consider the future coastline i.e., with regards to climate change and sea-level rise. It is likely that over the 40 years of proposed operation that there will be changes to the coastline due to coastal retreat even under a 'Hold the Line' scenario but more importantly if the strategy changes to a No Active Intervention policy with the cessation of beach nourishment.	potential for a change in strategy to No Active Intervention.
	Please check the Site of Special Scientific Interest (SSSI) citation for reason of notification for Chapel Point to Wolla Bank SSSI as this is a geological site and while intertidal sediments are a feature of interest, marshes and sand dunes are not mentioned in the citation. Natural England advises this minor point is clarified.	Acknowledged, updated in **Table 17-7.**
Natural England	The Ossian, ODOW offshore windfarm export cables and the EGL 3 and EGL 4 interconnector projects are planned to make landfall at Anderby Creek, Lincolnshire. The potential for cumulative effects will be considered as part of the future EIA documents in accordance with the approach and guidance outlined within **Volume 1, Part 4, Chapter 27: Cumulative Effects**. Natural England notes that cumulative effects from landfall of cables at Anderby Creek and other industrial activities will be assessed in future EIA documents.	The Cumulative Effects chapter of the PEIR (**Volume 1, Part 4, Chapter 27: Cumulative Effects**) presents the long and short lists of 'other developments' for the inter-project cumulative effects which will be considered at the ES stage.

Consultee	Consideration	How addressed in this PEIR
Natural England	Disturbance of intertidal seabed morphology. This impact has been scoped out for potential impacts on coastal and marine physical processes during the three stages of the project on the assumption that HDD will be utilised. The uncertainty around the trenchless crossing feasibility at the landfalls options is further highlighted in Paragraph 3.9.5, which states that: "*it would be necessary to carry out ground investigation works before confirming whether an HDD trenchless solution is feasible at either landfall*". Natural England's experience HDD is not always fully successful at this location, therefore, the worst-case scenario for impacts in intertidal coastal areas is the open-cut trench scenario. For this impact pathway to be scoped out, Natural England advises the Applicant must be confident and fully committed within the application documents to a trenchless installation technique such as HDD at landfall. Natural England advises the Applicant to refer to our advice provided to the EGL 3 and EGL 4 project at Section 42 PEIR on this matter.	Acknowledged. This impact pathway remains scoped out for operation and decommissioning. Measure OMT01 (D) (outlined in Section 17.6) commits to a trenchless technique being used at the Anderby Creek Landfall and measure OMT02 (D) (outlined in Section 17.6) commits to a trenchless technique exit 3 - 6 m below Lowest Astronomical Tide (LAT) depth contour to avoid disturbance to the Intertidal Zone sediments and habitats. The successful delivery of Viking Link and Triton Knoll by Horizontal Directional Drilling (HDD), suggests this is a viable design option. The relevant surveys and technical studies will be undertaken to inform detailed design and confidence in this installation method.
Natural England	There is potential for the project to cause 'Modifications to tidal and wave regimes and associated impacts to morphological features' from nearshore cable protection and potentially alter sediment transport particularly within the intertidal zone. The Wash and North Norfolk Coast SAC, the Humber Estuary SAC and Saltfleetby to Theddlethorpe Dunes SAC are within the zone of influence for the scoping boundary. Both sites contain features which rely on sediment transport along the coast. Natural England agrees this impact pathway could be scoped out for the construction phase, providing the project is committed to trenchless installation	Measure OMT01 (D) (outlined in Section 17.6) commits to a trenchless technique being used at Anderby Creek Landfall and measure OMT02 (D) (outlined in Section 17.6) commits to a trenchless technique exit 3 - 6 m below Lowest Astronomical Tide (LAT) depth contour to avoid disturbance to intertidal sediments and habitats.

Consultee	Consideration	How addressed in this PEIR
	technique such as HDD at landfall and that no other infrastructure is used during construction such as cofferdams (noting the commitment to no use of a cofferdam in Para 4.2.24). Otherwise, modification to tidal and wave regimes within the intertidal zone from construction activities as well as O&M and decommissioning should be scoped in. It is Natural England's preference as a precaution this impact pathway is scoped in.	
Natural England	Temporary increase and deposition of suspended sediments (Changes in suspended solids and water clarity) impact pathway. Natural England advises any assessment of temporary increase and deposition of suspended sediments should be informed by data whose source is clearly explained. Any modelling of suspended sediment concentrations should be fully reported to assess the appropriateness of methods and techniques, not just presenting the modelling results. Natural England advises the Applicant should provide information on the assessment methods and if data are the results of modelling of suspended sediment concentrations, modelling techniques should be presented in full.	Details on the approach are provided in: **Volume 2, Part 3, Appendix 17.A: Fine Sediment Modelling Spreadsheet** which has been updated based on advice provided on EGL 3 and EGL 4. Further engagement with Natural England will be undertaken, including the establishment of a coastal and marine physical processes technical group which will include consideration of any further outcomes on the EGL 3 and EGL 4 project where relevant.
Natural England	It is stated that wave modelling from the EGL 3 and EGL 4 application may be used to assess and inform this study. Natural England advises any model outcomes should be reported with full details of modelling techniques and data sources.	Wave modelling undertaken for EGL 3 and EGL 4 has been updated to provide an assessment of impacts for the English Offshore Scheme. Full details on the modelling techniques and data sources are provided in **Volume 2, Part 3, Appendix 17.B: Wave Modelling.**

Technical engagement

17.3.4 In respect of the coastal and marine physical processes assessment, key consultees have been identified and focussed engagement (through both informal and formal consultation) will be undertaken and recorded throughout the pre-application stage of the Project. Key consultees identified to date are:

- Natural England;
- Joint Nature Conservation Committee (JNCC);
- Marine Management Organisation (MMO);
- Centre for Environment, Fisheries and Aquaculture Science (Cefas);
- The Crown Estate; and
- The Environment Agency (EA).

17.3.5 Key areas of consultation with stakeholders are intended to include engagement on coordination with the EA regarding the ongoing beach nourishment scheme at Anderby Creek, the assessment process for effects related to cumulative external cable protection in shallow waters, marine physical process methods, impact assessment conclusions and proposed mitigation.

17.3.6 Local or specialist groups will be contacted should the assessment process identify a need to engage further detailed local knowledge, or if requested during the statutory consultation process.

17.3.7 Feedback from the EGL 3 and EGL 4 consultation has also been considered for this Project. A Coastal and Marine Physical Processes Technical Working Group (TWG) meeting was held on 22 January 2026 where details on the spreadsheet model and wave modelling were presented. Feedback received will be considered and implemented as the Project progresses.

17.4 Data Gathering Methodology

Study area

17.4.1 The study area for coastal and marine physical processes includes the English Offshore Scheme draft Order Limits plus an additional 19.8 km each side. This buffer is informed by the tidal excursion, which varies both along the English Offshore Scheme and over time in response to lunar variations in tidal forcing. The maximum spring tide tidal excursion in the English Offshore Scheme draft Order Limits was used to define the study area.

17.4.2 Tidal excursions were derived using the Atlas of UK Marine Renewable Energy Resources (Ref 17.16). The Atlas provides tidal excursions on a mean tide only, further this data is only available visually via an online viewer. Therefore, spring tide tidal excursions were calculated from peak spring flow speed data which are available in downloadable shape files, enabling flow speeds to be extracted at locations within the English Offshore Scheme draft Order Limits. Peak spring flow speeds were converted to spring tide tidal excursions assuming a sinusoidal variation in flow speed throughout the tide.

17.4.3 Spring tide tidal excursions vary within the English Offshore Scheme draft Order Limits, increasing from 8 km in the nearshore to a maximum of 19.8 km offshore of Spurn Head, before reducing again to around 6 km in the northern offshore area.

17.4.4 The study area identified provides a precautionary maximum Zone of Influence (ZoI) and incorporates the area within which there is the potential for direct and indirect impacts associated with the deposition of suspended sediments. Results from the spreadsheet model applied to assess dispersion of fine sediment disturbed by the English Offshore

Scheme confirm that predicted impacts are confined within the study area (**Volume 2, Part 3, Appendix 17.A: Fine Sediment Modelling Spreadsheet**).

17.4.5 The study area for the coastal and marine physical processes assessment is presented in **Volume 3, Part 3, Figure 17-1: Study Area**.

Desk study

17.4.6 A summary of open-source data that has been used in the desk study is outlined, along with information on the nature of the data in **Table 17-3.**

Table 17-3 Data sources used to inform the coastal and marine physical processes assessment

Organisation	Data source	Data provided
The European Marine Observation and Data Network (EMODnet)	Ref 17.17	Digital Terrain Model (DTM), 2024.
UK Hydrographic Office (UKHO)	Ref 17.18	Admiralty bathymetric survey data used to generate navigational charts and a major data source in the EMODnet DTM.
UKHO	Admiralty Total Tide (ATT) software package (Ref 17.19)	Tidal planes and tidal diamonds informing water levels and tidal flows.
Environment Agency (EA)	EA Coastal Design Sea Levels for the UK (Ref 17.20)	Coastal flood boundary conditions around the coast.
EA	National Coastal Erosion Risk Map 2 (NCERM2) (Ref 17.21)	National picture of current and future coastal erosion risk.
EA	Ref 17.22	Report on beach management at Saltfleet to Gibraltar Point.
Anglian Regional Coastal Monitoring Programme (ARCMP)	Ref 17.23	Beach profile data, tides and wave data.
MetOffice	UK climate change projections (Ref 17.14)	Sea level rise predictions along the coast.
EA	Ref 17.13	Climate change allowances.
ABPmer	Atlas of UK Marine Renewable Energy Resources (Ref 17.16)	Maps of tidal range (spring and neap), peak tidal flows (spring and neap) and mean tidal ellipses, annual wave heights, wind speeds and sediment transport.

Organisation	Data source	Data provided
ABPmer	SEASTATES (Ref 17.24)	Modelled hindcast wind and wave data (based on data from 1979 – 2012).
Saha, S., *et al.*,	The NCEP Climate System Forecast Reanalysis (CFSR) (Ref 17.25)	Hourly hindcast wind data at 0.2 degree resolution, spanning 44 years (1979 – 2023), used to drive SEASTATES.
British Geological Society (BGS)	(Ref 17.26)	Maps of seabed sediments, quaternary deposit thickness and structural geology offshore.
EA and Department for Environment, Food and Rural Affairs (DEFRA)	Shoreline Management Plan 2 – Flamborough Head to Gibraltar Point SMP3 (Ref 17.27)	Shoreline Management Plan and management approach.
EA and DEFRA	Shoreline Management Plan – Lincolnshire Coastline 5 – Viking Gas Terminal (Mablethorpe) to southern end of Skegness O (Ref 17.28)	Shoreline Management Plan and management approach.
Joint Nature Conservation Committee (JNCC)	Coasts and seas of the UK (Ref 17.29)	Region 6 Eastern England: Flamborough Head to Great Yarmouth – description of coastal landform, sediment transport and geology.
Kenyon MarineGeo and ABPmer	Sandbanks, sand transport and offshore wind farms (Ref 17.30)	Detail on offshore and littoral sediment transport, including morphological form and behaviour of offshore sandbanks.
Centre for Environment, Fisheries and Aquaculture Science (Cefas)	Monthly average non-algal suspended particulate matter concentrations (Ref 17.31)	Non-algal Suspended Particulate Matter (SPM) – monthly, seasonal and annual maps (Cefas).
International Council for the Exploration of the Sea (ICES)	Database on the Marine Environment (Ref 17.32)	Sediment quality data.
DEFRA	Environment Agency Bathing Waters map and monitoring data (Ref 17.33)	Water quality.
DEFRA	Magic maps (Ref 17.34)	GIS layer for exploring designates sites and habitats.

Organisation	Data source	Data provided
JNCC	UK Marine Protected Area Datasets (Ref 17.35)	Marine Designated Sites shapefile layer, including features like Special Areas of Conservation (SACs), Special Protection Areas (SPAs), and Marine Conservation Zones (MCZs).
Natural England	Ref 17.36	Information on condition of designated sites.
The Crown Estate	Marine Data Exchange (Ref 17.37)	Environmental Impact Assessment Report (EIAR) for English Offshore Wind Farm (OWF) projects including Triton Knoll (RWE Npower, 2012), Lincs, Lynn and Inner Dowsing (Offshore wind power, 2003), Hornsea 1 and 2.
Cefas	OneBenthic Dataset (Ref 17.38)	Seabed macrofauna and sediment particle size data.
The Crown Estate	Physical processes ES and technical reports for existing OWF and associated extensions that are within the public domain: Dogger Bank Hornsea projects; Triton Knoll; Race Bank; Dudgeon Shoal (and Extension); Sheringham Shoal (and Extension); Lynn and Inner Dowsing; Humber Gateway, Westermost Rough (Ref 17.39 to Ref 17.44)	Baseline physical process (hydrodynamic; morphological; coastal) conditions of relevance to the respective OWFs. Physical processes assessments for each of the OWFs.
Cefas	WaveNet (Ref 17.45)	Wave monitoring network for the UK (using data from January 2020 to February 2025).
National Grid	EGL 3 and EGL 4 Marine Characterisation Surveys (Ref 17.46 to Ref 17.51)	Results of the environmental baseline assessment and habitat assessment survey for EGL 3 and EGL 4.
National Grid	EGL 5 Marine Characterisation Surveys (Ref 17.52, Ref 17.53)	Results of the English Offshore Scheme environmental baseline assessment and habitat assessment survey.

Survey work

17.4.7 To inform the baseline within the study area, a range of environmental and technical surveys have been conducted. The surveys undertaken, along with the dates on which they were carried out are set out in **Table 17-4**. A sample plan to ensure sufficient data was acquired to inform the assessment of the impacts was developed in line with the principles and feedback provided on the EGL 3 and EGL 4 project. The principles have been incorporated into the sample plan for the English Offshore Scheme.

17.4.8 The surveys provide essential data to identify baseline characteristics, assess potential impacts, and support the DCO application. The following surveys have been undertaken:

- Geophysical survey of the English Offshore Scheme (Ref 17.53). The aim of the survey was to obtain bathymetric data, backscatter data (for seabed classification) and seabed and sub-bottom imagery 150 m either side of the Route Plan Line (RPL) in depths up to 70 m below LAT and 250 m either side of the RPL in depths deeper than 70 m below LAT. Bathymetry data was obtained at a 0.5 m resolution.
- Environmental Baseline Survey (EBS) of the English Offshore Scheme (Ref 17.52). The aim of the EBS was to assess any existing contamination in the natural environment by pollutants and a detailed description of the physico-chemical and biological characteristics of the study area, including the description of any sensitive habitats and species. Of particular relevance to the coastal and marine physical processes assessment, this included the collection of 173 surficial sediment samples analysed for Particle Size Distribution (PSD) and the collection of 113 surficial sediment samples analysed for physico-chemical properties.

17.4.9 Draft survey reports and data relevant to the coastal and marine physical processes assessments have been provided and are included in the assessments in this PEIR.

17.4.10 In addition, the following survey is ongoing:

- Geotechnical survey of the English Offshore Scheme. The aim of this survey is to obtain information to enable the characterisation of the shallow sediment structure in the English Offshore Scheme. This will include Cone Penetration Testing (CPT) and vibrocore sampling. In addition, magnetometer data will be collected to identify ferromagnetic obstacles as surface, buried or linear debris and the actual positions of third-party assets (cables and pipelines). Information collected from the geotechnical survey will be considered in the ES.

Table 17-4 English Offshore Scheme survey campaign dates

Survey	Dates
Geophysical	April to June 2025
EBS	May to June 2025
Geotechnical	December 2025 ongoing

17.5 Overall Baseline

Current baseline

17.5.1 This section provides a characterisation of the current baseline environment and describes the coastal and marine physical processes within the English Offshore Scheme study area.

17.5.2 Kilometre Points (KPs) have been used where relevant to provide reference points along the English Offshore Scheme draft Order Limits. KP 0 is defined as MHWS at the landfall at Anderby Creek, with KP 412 the border between English and Scottish adjacent waters – the northern most extent of the English Offshore Scheme.

17.5.3 This section has been divided into the following aspects:

- Bathymetry and seabed features;
- Water levels;
- Currents;
- Wind and waves;
- Geology and seabed sediments;
- Geomorphology and sediment transport;
- Coastal geomorphology;
- Suspended sediment and water quality;
- Sediment quality; and
- Designated sites.

Bathymetry and seabed features

17.5.4 Bathymetric data collected during the geophysical survey have been used to inform the baseline understanding of bathymetry along the English Offshore Scheme and the European Marine Observation and Data Network (EMODnet) Digital Terrain Model (DTM) has been used to inform the baseline understanding of bathymetry across the wider study area. The DTM is based on bathymetric data from various sources including UKHO survey data.

17.5.5 Water depths across the study area generally increase with distance along the English Offshore Scheme, being 25 m below Mean Sea Level (MSL) offshore of Spurn Head (around KP 50), 55 - 60 m below MSL offshore of Flamborough Head (around KP 150) and 75 m below MSL at the northern end of the study area as illustrated in **Volume 3, Part 3, Figure 17-2: Bathymetry and Seabed Features.**

17.5.6 In addition to the gradual deepening from south to north along the English Offshore Scheme, there are some notable bathymetric features in the study area. The most prominent feature is the deepening of the route around KP 65 where the English Offshore Scheme crosses Silver Pit, a naturally deep, glacially carved channel with steep-sided topography which reaches depths of 96 m below LAT. The English Offshore Scheme crosses Silver Pit for 2.8 km between KP 65 and KP 68. The English Offshore Scheme is approximately 2 km wide in this location and therefore occupies an area of approximately 5.6 km^2 of Silver Pit. The maximum depth of Silver Pit in the English Offshore Scheme is

54 m below LAT. Other paleo channel features in the southern North Sea include Sole Pit, Wells Deep and Outer Silver Pit, however the English Offshore Scheme does not intersect these features. Deepest water depths in the English Offshore Scheme are approximately 95 m below LAT at KP 350.

17.5.7 The southern North Sea contains several regions of shoals and sandbanks including the Dogger Bank, Triton Knoll sandbank, Inner Dowsing Falls, the Outer Dowsing Shoal and Berwick Bank, however the English Offshore Scheme does not intersect these features.

17.5.8 Sand waves and megaripples are present in some areas of the English Offshore Scheme with a continuous sand wave field extending between KP 120 to KP 130 and with other areas of sand waves at KP 274 and KP 398 to KP 400. Over 12,000 surface boulder contacts, and over 23,000 sub-surface boulder contacts were identified by the geophysical survey, primarily between KP0 to KP116 (99 percent of all surface contacts) (Ref 17.53). Thin layers of surface sediments and rock outcropping were identified in some areas of the English Offshore Scheme, primarily between KP 144 and KP 234.

Water Levels

Tidal

17.5.9 Water levels in the study area are predominantly driven by tidal processes. Tides in the study area are semi-diurnal, with two high and two low tides per day. The southern North Sea tidal regime is under the influence of an amphidromic point located close to the Danish coast, such that the tides rotate anticlockwise around this point. Both the spring and neap tidal ranges increase in a shoreward direction with distance from the amphidrome.

17.5.10 Tidal planes have been extracted from the Admiralty Total Tide (ATT) software package at Skegness (at the southern extent of the study area on the coast) and at T022B (approximately 31 km west of KP 375) and are given in **Table 17-5**. The tide varies across the study area, with largest spring tidal ranges of approximately 6 m close to the proposed Anderby Creek Landfall, reducing offshore and northwards to 2.5 m at the northern extent of the study area. Neap tidal ranges are approximately half the spring tidal range. The tide arrives from the north so that high water at the northern extent of the study area occurs approximately three hours before high water at the proposed Anderby Creek Landfall.

Table 17-5 Tidal levels extracted from ATT (Ref 17.19)

	Tide level (m relative to LAT)	
	Skegness	**T022B – approx. 31 km west of KP 375**
Highest Astronomical Tide (HAT)	7.4	4.0
Mean High Water Spring (MHWS)	6.7	-
Mean High Water Neap (MHWN)	5.1	-
Mean Low Water Neap (MLWN)	2.3	-

	Tide level (m relative to LAT)	
	Skegness	**T022B – approx. 31 km west of KP 375**
Mean Low Water Spring (MLWS)	0.7	-
Lowest Astronomical Tide (LAT)	0	0

Non-Tidal

17.5.11 Non-tidal or meteorological effects can also influence the water level. Data from the EA's coastal flood boundary conditions (Ref 17.20) has been used to inform the baseline understanding of non-tidal influences on water levels. The height of a 1 in 200-year return period storm surge near the proposed Anderby Creek Landfall is 4.8 m above MSL.

Currents

17.5.12 Data from the UK renewables atlas (Ref 17.16) have been used to inform the baseline understanding on tidal flows across the study area. Peak spring tidal flows across the study area are shown in **Volume 3, Part 3, Figure 17-4: Mean Spring and Neap Peak Tidal Flows**.

17.5.13 The southern North Sea is particularly prone to surge-driven flows during winter months, when intense low-pressure systems, particularly from the North Atlantic, dominate the region. These systems can generate strong easterly and / or northerly winds and heightened sea levels, driving elevated surge flows into the southern North Sea which is relatively shallow compared to the deeper North Sea basins. These flows are accentuated by strong surface winds occurring at high tide (particularly during a spring tide), topography that funnels flows into narrow channels and shallow regions of seabed including coastlines. Elevated surge flows can temporarily lead to an increase in sediment resuspension and transport, particularly in shallow regions and along coastlines (Ref 17.54)

17.5.14 Tidal currents in the study area are generally orientated southwards on the flood tide and northwards on the ebb tide (Ref 17.19). The currents close to the proposed Anderby Creek Landfall are bi-directional in nature, aligned with the coast, while currents become slightly more orbital in nature offshore. Fastest currents occur offshore of Spurn Head where peak spring tide current speeds are up to approximately 1.45 m/s. Close to the proposed Anderby Creek Landfall peak spring tide current speeds are lower at approximately 1 m/s, and at the northern end of the study area range between approximately 0.42 and 0.48 m/s.

17.5.15 Peak neap current speeds are approximately half the quoted peak spring tide current speeds. There is a slight dominance in the southward flowing flood currents, particularly in the southern part of the study area. Superimposed on the regional scale flow pattern, local flow variations can be expected to occur in response to bathymetric features (for example to realign with channel features, or around banks).

Winds and Waves

17.5.16 Climatological wind and wave data from SEASTATES (Ref 17.24) have been used to inform the baseline understanding of the wind and wave climate across the study area. SEASTATES is driven by the CFSR wind dataset (Ref 17.25).

17.5.17 Wind roses shown in **Volume 3, Part 3, Figure 17-6: Wind and Wave Roses** (Ref 17.24) indicate a dominance in winds from the south to westerly sectors with weakest winds close to the proposed Anderby Creek Landfall and with strongest at the northern extent of the study area. The strength of the winds increases with distance offshore because of coastal sheltering to the dominant wind directions inshore. Mean wind speeds increase from 6.1 m/s close to the proposed Anderby Creek Landfall to 8.6 m/s at the northern extent of the study area.

17.5.18 Significant wave height (Hs) is influenced by wind speed, fetch (the distance over which wind blows), and water depth. The wave climate across the study area is controlled by a combination of locally generated wind waves and swell waves generated elsewhere in the North Sea. Wave roses shown in **Volume 3, Part 3, Figure 17-6: Wind and Wave Roses** (Ref 17.24) indicate the most frequent wave direction close to the proposed Anderby Creek Landfall is from the northeast, while at the northern extent of the study area the most frequent wave direction is from the north. This change reflects the varying fetch lengths for different wind directions with distance along the English Offshore Scheme. Mean significant wave heights increase from 0.6 m close to the proposed Anderby Creek Landfall to 1.7 m at the northern extent of the study area (Ref 17.24). Storm waves can be notably larger than the quoted mean wave heights, with an annual 10 percent exceedance significant wave height of 1.0 to 1.5 m close to the coast (Ref 17.55).

Geology and Seabed Sediments

17.5.19 The bedrock geology across the study area is characterised by sand and clay based superficial sediments, overlaying glacial tills, comprised of gravels and stiff clays. Several similar formations consisting of middle to Late Pleistocene deposits of firm clays with interbedded sands, fine to medium sands and gravels and poorly sorted sands are present across the study area. Bedrock is pre-quaternary in origin and consists of sedimentary bedrock in the south, and crystalline bedrock in the north (Ref 17.46).

17.5.20 Quaternary deposits are between 5 m - 20 m thickness near the Lincolnshire coast. Localised areas of thicker deposits to the east - southeast of Spurn Head of greater than 50 m contrast with some areas of thinner deposits (less than 5 m) offshore to the north of Flamborough Head.

17.5.21 The English Offshore Scheme geophysical survey noted that the seabed morphology and composition exhibit marked spatial variability along the route. From the shoreline to KP 112, the seabed is characterised by a heterogeneous assemblage of coarse sediments, mixed sediments, and sand, containing a substantial proportion of all identified boulders. Between KP 112 and KP 144, the seabed transitions to predominantly sand while the section from KP 144 to KP 209 is dominated by numerous rock outcrops. Finally, from KP 209 to KP 412, the seabed returns mainly to sandy composition (Ref 17.53).

17.5.22 The percentages of fines (clays and silt sized sediment), sands and gravels from the English Offshore Scheme survey are shown in **Volume 3, Part 3, Figure 17-7: Seabed Sediments and Percentage of Fines from Particle Size Analysis (PSA)** to **Figure 17-9: Seabed Sediments and Percentage of Gravels from Particle Size Analysis (PSA)**, while the sediment median grain size classification is shown in **Volume 3, Part 3, Figure 17-10: Seabed Sediments and Median (d50) Grain Size**. Results of the PSD analysis of replicate samples from the 208 stations along the proposed cable routes survey area generally comprised two main sediment types. The sediments along the offshore section of the cable route comprised predominantly sand, whilst the nearshore section of the cable to the shore comprised a more mixed coarser sediment. Varying percentages of gravel and fines were recorded in most samples, with fines becoming more predominant in the offshore section of the proposed cable and gravel being recorded in higher proportions in the nearshore section of the proposed cable route to the shore. The highest proportion of fines was, however, recorded at station KP 10 near the coast, indicating the heterogeneous nature of the sediments in the area (Ref 17.52).

17.5.23 Rocky outcrops were identified along some sections of the route including between KP 144 and KP 145 and between KP 147.8 and 148.9 (Ref 17.53).

17.5.24 The study area intersects some active marine aggregate extraction zones including Humber (Area 514) 1, 2, 3 and 4 to the north of the proposed subsea cable corridor close to KP 53 and Off Saltfleet (Area 197), Humber Estuary (Area 400 and Area 106) and Humber Overfalls (Area 493) to the south of the proposed subsea cable corridor close to KP 20 to KP 30, all of which are licenced until at least the end of 2029. These are shown on **Figure 17-10: Coastal and Marine Physical Processes Seabed Sediments and Median (d50) Grain Size**.

17.5.25 Information on subsurface sediments properties will be obtained from core samples collected during the geotechnical survey (currently ongoing) and these will be presented in the ES.

Geomorphology and Sediment Transport

17.5.26 The Lincolnshire coast is a diverse mixture of dune fronted flood plains, shingle barrier beaches, saltmarsh and soft cliffs. There are no significant geological ‘hard rock’ coastal areas and thus large proportions of the coast are vulnerable to marine flooding and erosion.

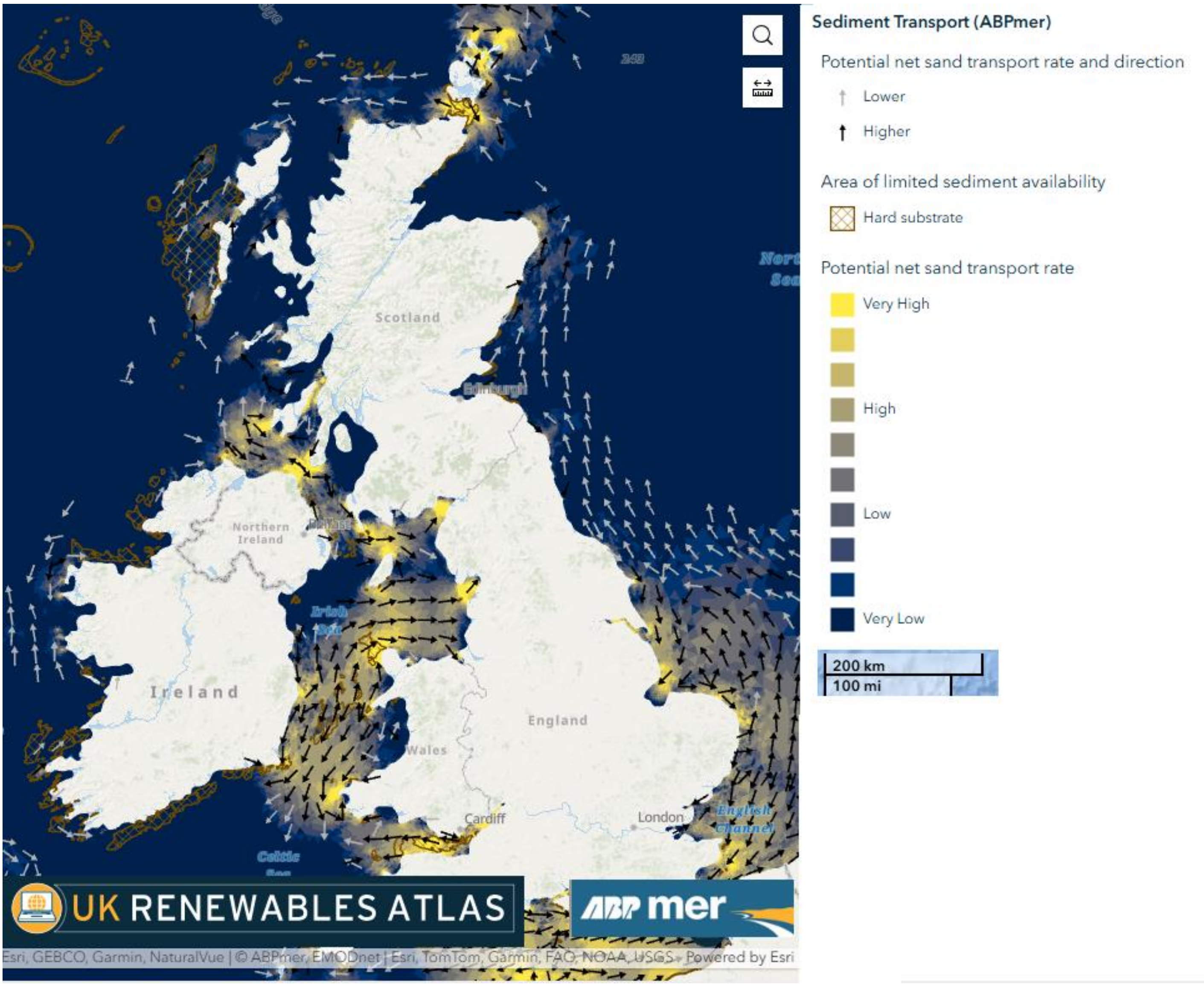
17.5.27 Net southward residual tidal flows transport sand eroded from the Holderness cliffs and offshore sources southwards close to the coast. A northerly directed net transport is separated from the southerly directed net transport along the coast by a bedload parting zone (Ref 17.30). Further north the sediment transport is driven by wave action and little sediment transport is expected (with wave driven transport restricted to shoals and / or storm events). An overview of sediment transport pathways around the UK coast is shown in **Plate 17-1** (Ref 17.16).

17.5.28 Sand waves and megaripples were identified in some parts of the study area, indicating areas of mobile seabed. In particular, a continuous sand wave field extends between KP 120 to KP 130. Other areas of sandwaves were identified at KP 274 and KP 398 to KP 400.

17.5.29 The River Humber is a source of sediment to the northern Lincolnshire coast. However, the Holderness coast does not primarily transfer this sediment to the northern Lincolnshire coast near Grimsby. Most of this sediment circulates in clockwise motion within the Humber being deposited on the inter-tidal flats behind Spurn Head, or sediment is transported to The Binks bank just offshore of Spurn Head. Sediment that crosses the mouth of the Humber is believed to settle on the foreshore of Donna Nook (Ref 17.56).

17.5.30 Surge driven flows in the study area are not expected to contribute significantly to sediment transport (Ref 17.30).

Plate 17-1 Sediment Transport Pathways (Ref 17.16)



Coastal Geomorphology

17.5.31 The coastline within the study area extends along the Lincolnshire coast from Sand Haile Flats in the north to just north of Gibraltar Point in the south. The coastline includes wide inter-tidal sand flats between Grimsby and Donna Nook in the Humber, decreasing in width towards Mablethorpe. The sand flats are currently accreting, fed by sediment from the eroding Holderness cliffs and the foreshore is steepening. Erosion of the Holderness cliffs and shore platform are a major source of coarse and fine sediment (i.e., gravel, sand and muds) feeding Spurn Head and offshore sandbanks noted within the Flamborough Head to Gibraltar Point Shoreline Management Plan (Ref 17.27).

17.5.32 At Donna Nook and Gibraltar Point there is extensive and well-developed saltmarsh. In some locations (including Donna Nook, Saltfleetby and Gibraltar Point) sand dunes have formed.

17.5.33 The Lincolnshire shoreline management plan along the coastline within the study area is to hold the line for the epoch 2025 – 2055. The strategy for 2055 – 2105 is pending agreement (Ref 17.27).

17.5.34 The beaches between Saltfleetby and Gibraltar Point are formed of a thin layer of sand, overlying clay. Historically during storms, the thin layer of sand has been eroded exposing the underlying clay. To counter this erosion the EA has historically undertaken annual beach nourishment along the entire coast between Mablethorpe and Skegness. The beach nourishment has been undertaken since 1994. Each year between Easter and mid-July, a dredger is used to transport approximately 400,000 m^3 of sand from licenced offshore sites and pump it onto the beach (Ref 17.22). Much of this coastline also has a variety of 'hard' defences and dunes behind the beaches which, along with the ongoing beach nourishment, provide protection against flooding.

17.5.35 The ongoing beach nourishment offsets the natural tendency for erosion along the coastline, but it does not prevent the net southward longshore drift.

17.5.36 Due to the increased levels and frequency of sand that would be required under future sea level rise and climate change projection, this method of flood risk management is not considered by the EA as sustainable in the future (Ref 17.22). The preferred beach management strategy for the future looks to introduce rock structures in combination with continued nourishment. The structures the EA propose to introduce as part of the strategy could take a number of shapes and configurations. Rock fishtail structures or rock groynes could both help manage tidal flood risk by absorbing energy from incoming waves and stabilising sand movement and losses. This would reduce the amount of work required to maintain beach levels and protect both soft dunal systems and hard seawalls from the impact of wave action and tides. The reduction in sand required would also lead to a reduction in carbon footprint and flood risk management work. At present annual beach nourishment is ongoing, while permissions are obtained for the introduction of the structures. The progress of this will be monitored by the Applicant.

17.5.37 Based on the timeline provided in the strategy, construction of the first set of groynes is expected to occur in the next five years (2026 – 2031). The first set of structures will most likely be built between Mablethorpe and Skegness, where the greatest volumes of sands are currently eroded from (Ref 17.22).

Suspended Sediment and Water Quality

17.5.38 Sea temperatures off the coast of eastern England vary from 5 - 6 °C in February and early March to 15 - 16 °C in August. The temperature is governed by the influx of warm water associated with the Gulf Stream (Ref 17.57).

17.5.39 Data from the Cefas Suspended Sediment Climatology model (Ref 17.31) provides long term average (1998 – 2015) annual and monthly readings of non-algal Suspended Particulate Matter (SPM) (note that Cefas use the term non-algal SPM rather than Suspended Sediment Concentration (SSC), but these terms are analogous, and further discussion adopts the term SSC). An updated climatology considering data collected over a longer duration is believed to be under development but as of January 2026 has not yet been made publicly available. The availability of an updated climatology will be checked for the ES.

17.5.40 Data from the Cefas Suspended Sediment Climatology model (Ref 17.31), show that over the period between 1998 – 2015, average SSCs were approximately 30 mg/l close to the proposed Anderby Creek Landfall. The SSCs are influenced by terrestrial sediment sources from the Humber Estuary and eroding Holderness Cliffs. As distance from the coast increases, average SSCs reduce to 5 mg/l or less, as shown in **Volume 3, Part 3, Figure 17-11: Annual Mean Suspended Sediment Concentration.**

17.5.41 SSC is also seasonally variable as depicted in **Volume 3, Part 3, Figure 17-12: Seasonal Mean Suspended Sediment Concentration**, which shows SSC for representative months for winter (January) and summer (June). In January, SSC is significantly higher than in June, especially along the coastal areas and extending offshore within the southern section of the study area and over Dogger Bank. This is likely due to increased winter storm activity, stronger wave action, and turbulent mixing, which resuspend sediments from the seabed (Ref 17.58). In contrast, summer months show a decrease in SSC, particularly along the coastline and offshore areas. This reduction is likely attributed to calmer sea conditions and potentially increased biological productivity causing sediment particles to settle.

17.5.42 It should be noted that these measurements of SSC are representative of near-surface conditions under non-storm / cloud free conditions and as such are likely to provide an underestimate of average conditions, particularly near the seabed. Other studies have shown that there are likely to be frequent short-term increases in background SSC in the near-bottom waters because of natural events, with much higher values during storm events (Ref 17.59).

17.5.43 The English Offshore Scheme traverses the Water Framework Directive (WFD) coastal Lincolnshire Water Body (ID GB640402492000) as it approaches the proposed Anderby Creek Landfall. This waterbody is ‘heavily modified’ due to flood protection works and is currently (2022 classification) at moderate overall status, based on moderate ecological potential and a chemical status which ‘does not require assessment’ (noting, this waterbody was failing to achieve good chemical status in the previous (2019) classification) (Ref 17.60).

17.5.44 There are seven designated bathing waters within 15 km of the proposed Anderby Creek Landfall as illustrated in **Volume 3, Part 3, Figure 17-14: Designated Areas**. These sites include Mablethorpe Town, Sutton-on-Sea, Huttoft and Marsh Yard (previously referred to as Moggs Eye), Anderby, Chapel St Leonards, Ingoldmells and Skegness. All of which achieved excellent classification based on samples taken from 2021 – 2025 (Ref 17.33). The draft Order Limits pass directly through the Huttoft and Marsh Yard bathing water and within 750 m of the Anderby bathing water, while Chapel St Leonards and Sutton-on-Sea are approximately 5 km to the south and north of the draft Order Limits, respectively.

Sediment Quality

17.5.45 The concentrations of metals in sediments within the North Sea are generally higher in the coastal zone and around estuaries, decreasing offshore indicating that river input and run-off from land are significant sources. The sediments within the study area are typically coarse sediments (sands and gravels with only low mud content), which pose a low risk for anthropogenic contaminants.

17.5.46 Sediment samples from the marine characterisation survey collected from 113 locations along the English Offshore Scheme were analysed for trace and heavy metals, specifically aluminium, arsenic, barium, cadmium, chromium, copper, lead, lithium, mercury, nickel, tin and zinc. In addition, sediment samples were analysed for hydrocarbon content, including Total Hydrocarbon Content (THC), total n-alkanes (nC12 to nC36) and Polyaromatic Hydrocarbons (PAHs), specifically the United States Environmental Protection Agency’s (US EPA) 16 priority PAH pollutants (US EPA 16 PAHs) and alkylated PAHs.

17.5.47 A variety of reference values are used to assist in the interpretation of the sediment quality data as no approach is relevant for all the sediment quality analyses undertaken.

Contaminant concentrations were compared with Cefas Action Levels (cAL) 1 and 2 (Ref 17.61). Cefas action levels are non-statutory and are intended to inform decision making on the disposal of dredged sediment to sea rather than as indicator of contamination. Levels below cAL1 are of no concern while levels above cAL2 are generally considered to be unsuitable for disposal at sea. National Oceanic and Atmospheric (NOAA) developed the Effect Range Low (ERL) and Effect Range Median (ERM) levels for hydrocarbons and metals, whereby at that level adverse effects were reported in 10 percent (ERL) and 50 percent (ERM) of the data (Ref 17.62). The United Kingdom Offshore Operators Association (UKOOA) sediment quality reference values for the UK southern North Sea provide natural background levels for various parameters giving a measure of the median level (50^{th} percentile) and the level which is exceeded for 5 percent of data (the 95^{th} percentile) (Ref 17.63).

17.5.48 Statistics of all collected samples are summarised in **Table 17-6**, with reference given to the number of samples exceeding the cAL1 and ERL reference value thresholds. Substances without reference values (Aluminium, Barium, Lithium and Tin) have been omitted from this table but are reported on in the EBS (Ref 17.52). Analysis of the samples corroborated the expected spatial pattern for lower concentrations at offshore relative to nearshore sites. No samples of any contaminant exceeded the higher levels of threshold (cAL2 and ERM).

17.5.49 Thirteen samples exceeded cAL1 for Arsenic, while 39 samples exceeded ERL due to the lower threshold. A map plot showing the location of Arsenic concentrations which exceed the cAL1 threshold and the ERL threshold are provided in **Volume 3, Part 3, Figure 17-13: Arsenic Concentrations – NOAA Effect Range and Cefas Action Levels.** Locations of sandwaves are also shown for reference. The UKOOA has not provided specific background levels for arsenic in the southern North Sea. Elevated arsenic levels can be attributed to natural geological sources as well as anthropogenic activities, including mining, smelting, chemical manufacturing, and agricultural runoff from major rivers in the southern North Sea. As expected, arsenic levels are therefore higher in the parts of the English Offshore Scheme closest to the coast and in particular around the Humber and offshore of the eroding Holderness coastline.

17.5.50 Only one sample exceeded any other cAL1 or ERL threshold – Lead at KP 137 (this sample also exceeded cAL1 and ERL for Arsenic). This sample was taken close to where the English Offshore Scheme passes through the Wollaston gas field. Analysis of sediment samples from the ICES DOME Portal showed no elevated contaminants above cAL1, including at a sampling site within 3 km of the Wollaston gas field (Ref 17.32), indicating that the area of enhanced contaminant is of limited spatial extent. KP 137 is away from sand wave areas and outside of all designated sites.

17.5.51 Gas Chromatography–Flame Ionisation Detection (GC-FID) Hydrocarbon Profiles indicate a slight prevalence of the odd-numbered heavier n-alkanes (those from nC25), which is indicative of plant waxes originating from terrestrial runoff. Some profiles also indicate a petrogenic input, most likely from shipping activities.

17.5.52 THC from all samples ranged from 1.0 µg/g to19.8 µg/g (with a mean value of 5.5 µg/g) which is below the cAL1 of 100 µg/g. For samples taken in locations where pre-sweeping could be required, values ranged from 2.70 µg/g at station KP 116 to 10.9 µg/g at station ST078 (which is on the route through the Marine Conservation Zone (MCZ) which was considered during Scoping but is not being taken forward).

17.5.53 Generally, total 2 to 6 ring PAH concentrations were elevated along the nearshore section of the proposed routes and within the MCZ compared to stations located to the north of the survey area. Most samples collected from the southern and central sections of the

English Offshore Scheme exceeded cAL1, with PAH likely to originate from both pyrolytic and petrogenic sources. Notably, samples from the northern section of the cable route were primarily of pyrolytic origin. All individual and total 2 to 6 ring PAH concentrations were below their respective ERL values for all samples.

Table 17-6 Heavy and trace metal concentrations

Parameter	Statistic	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)
		mg/kg							
Sediment samples (113)	Mean	10.56	0.02	12.28	2.07	<0.03	6.04	11.38	20.58
	Standard Deviation	9.38	0.01	3.53	1.55	0	3.29	7.95	12.62
	Minimum	2.37	0.01	5.97	0.60	<0.03	1.50	3.50	6.80
	Maximum	63.80	0.05	23.10	9.60	<0.03	16.20	65.00	102.00
	Number of Samples Above NOAA ERL	39	0	0	0	0	0	1	0
	Number of Samples above cAL1	13	0	0	0	0	0	1	0
Reference Values	NOAA ERL	8.2	1.2	81	34	0.15	20.9	46.7	150
	NOAA ERM	70	9.6	370	270	0.71	51.6	218	410
	Cefas cAL1	20	0.4	40	40	0.3	20	50	130
	Cefas cAL2	100	5	400	400	3	200	500	800

17.5.54 There are numerous closed disposal sites within the study area, many of which are associated with OWF developments. These closed disposal sites include Spurn Head (HU100), Hornsea disposal area (HU209), Triton Knoll (HU204), West of Inner Dowsing Bank (HU200) and Sheringham Shoal drillings (HU123). One active dredge disposal site exists within the study area, the Hornsea OWF disposal area (HU205).

Designated Sites

17.5.55 Designated sites in the study area which are of relevance to the coastal and marine physical processes topic are shown in **Volume 3, Part 3, Figure 17-14: Designated Areas.**

17.5.56 The English Offshore Scheme passes through the following designated sites:

- Greater Wash Special Protection Area (SPA) (KP 0 to KP 30 and KP 35 to KP 38): which supports breeding and foraging areas for many bird species. Specific marine habitats that provide supporting habitat to the designated features include intertidal mudflats and sandflats, subtidal sandbanks and biogenic reef.

- Holderness Offshore MCZ (KP 65 to KP 70): an area of mixed coarse sediment and sand, supporting habitats for a wide variety of species, such as, ocean quahog (*Arctica islandica*), crustaceans (crabs and shrimp), starfish and sponges. The site is also a spawning and nursing ground for a range of fish species; and includes the northern tip of the Silver Pit North Sea glacial tunnel valley.
- Southern North Sea Special Area of Conservation (SAC) (KP 86 to KP 130): an area of importance for harbour porpoise (*Phocoena phocoena*). The mixed seabed of coarse and sandy sediments found here are an important physical characteristic, as these are preferred by harbour porpoise, due to availability of prey.

17.5.57 In addition, the designated sites presented in **Table 17-7** and shown in **Volume 3, Part 3, Figure 17-14: Designated Areas** lie within the study area but are avoided by the English Offshore Scheme. Additional information on designated sites is provided in **Volume 2, Part 1, Appendix 2.C: Habitat Regulations Assessment (HRA) Stage 1 Screening Report**.

17.5.58 Key features of relevance to coastal and marine physical processes include intertidal sediments at Chapel Point to Wolla Site of Special Scientific Interest (SSSI) and sandbanks and coastal habitats (mudlflats, saltmarsh and dunes) present in many of the other designations.

Table 17-7 Designated sites within the study area

Designated site	Summary	Distance from English Offshore Scheme
Chapel Point to Wolla Bank Site of Special Scientific Interest (SSSI)	A nationally important geological site for its intertidal sediments, which record the evidence of early Holocene sea level change.	2.03 km
Inner Dowsing, Race Bank and North Ridge SAC	A site characterised by sandbanks and biogenic reefs, protecting benthic communities & ecology.	6.75 km
Saltfleetby to Theddlethorpe Dunes SSSI	Designated for important tidal sand and mudflats, marshes, and sand dunes.	7.31 km
Humber Estuary SPA, SAC, and SSSI	Features several Annex I habitats including salt-meadows, coastal lagoons, dunes, mudflats and sandflats and sandbanks.	7.31 km, 7.68 km and 10.06 km respectively.
Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC	An extensive and complex area which exhibits a range of dune types including shifting dunes, fixed dunes with herbaceous vegetation and dunes which supports sea-buckthorn (*Hippophae rhamnoides*). The dune slacks at this site are part of a successional transition	7.83 km

Designated site	Summary	Distance from English Offshore Scheme
	between a range of dune features, and some have developed from saltmarsh to freshwater habitats. Advice from Natural England states that the protected features of this SAC rely on sediment transport along the coast.	
Swallow Sand MCZ	Supports a diverse range of marine flora and fauna due to the low energy environment. Subtidal sand is the most abundant feature, with evidence of patches of coarse and mixed sediments as well as mud.	8.7 km
North East of Farnes Deep Highly Protected Marine Area (HPMA)	Designated for the protection of the entire marine ecosystem of the area. The boundary overlaps with that of the North East of Farnes Deep MCZ.	12.29 km
North East of Farnes Deep MCZ	Characterised by predominantly sandy sediment, with patches of gravelly sand and mud. The seabed is important for its 'mosaic of habitats' supporting a diverse range of marine flora and fauna.	12.29 km
Gibraltar Point SSSI	Designated for its sand dunes and other coastal habitats, and associated fauna, notably invertebrates and passage and breeding birds. Gibraltar Point is also of great importance for its coastal geomorphology, including offshore sandbanks, a well-developed ridge and runnel foreshore, a spit, sand dunes and saltmarshes in various stages of evolution.	15.19 km

17.5.59 Where available, details on the condition of these sites is provided in **Table 17-8** (Ref 17.36).

Table 17-8 Condition of designated sites (Ref 17.36)

Designated site	Number of features	Favourable	Unfavourable - Recovering	Unfavourable - Declining	Unfavourable no change	Not Recorded
Inner Dowsing, Race Bank and North Ridge SAC	2	0%	0%	0%	100%	0%

Designated site	Number of features	Favourable	Unfavourable - Recovering	Unfavourable - Declining	Unfavourable no change	Not Recorded
Saltfleetby to Theddlethorpe Dunes SSSI	18	66.67%	27.78%	5.56%	0%	0%
Humber Estuary SPA	16	68.75%	18.75%	12.50%	0%	0%
Humber Estuary SSSI	44	38.64%	4.55%	22.73%	15.91%	18.18%
Gibraltar Point SSSI	23	56.52%	30.43%	8.70%	0%	4.35%

Future baseline

17.5.60 Due to climate change and natural cycles, some aspects of the baseline environment are expected to undergo change over time. For the purposes of this assessment, the future baseline is defined for 2075 (assuming a design life of 40 years and construction start year of 2030, to be operational from 2035).

17.5.61 UK Climate Projections (UKCP) 2018 provides the most up to date assessment of climate change projections (Ref 17.14). The future change in climate will depend strongly on future emissions of greenhouse gases. UKCP18 uses scenarios for future greenhouse gases called the Representative Concentration Pathways (RCPs) which were designed to cover a range of assumptions around future population, economic development and to explicitly include the possibility of mitigation of greenhouse gas emissions towards international targets. The RCPs led to a broad range of climate outcomes but are neither forecasts nor policy recommendations (Ref 17.64). They are as follows:

- RCP2.6 represents a future in which the world aims for and can implement sizeable reductions in emissions of greenhouse gases, giving a sizeable chance of limiting global average warming to 2 °C.
- RCP8.5 represents a world in which global greenhouse gas emissions continue to rise.
- RCP4.5 and RCP6.0 consider some emission reductions based on pledges to reduce emissions as per the Paris climate agreement, which extends to the year 2030. If, after 2030, no further emission reductions are achieved but emissions do not rise then several studies suggest the temperature outcome of RCP4.5 may be the most likely. However, RCP6.0 allows for some further increase in emissions.

17.5.62 The four RCPs considered in UKCP18 attempt to capture a range of potential alternative futures, spanning a range of outcomes. The projected extreme sea levels at all UK tide gauge locations, released as part of UKCP18, were uplifted using the exploratory extended time-mean sea-level projections and available from 2020 – 2300. UKCP18 suggests an increase in MSL from 2000 of 0.5 m (RCP2.6) to more than 0.7 m at 2100 along the Lincolnshire coastline (RCP8.5). For RCP8.5 the sea level rise between 2033 and 2073 is 0.47 m at the 95th percentile at Anderby Creek.

17.5.63 The RCP8.5 sea level rise is higher than projected sea level rise based on the EAs annual sea level allowances, in which the UK is split into ten regions (Ref 17.13) with the proposed Anderby Creek Landfall lying within the Anglian region. The higher central sea level rise allowances for the Anglian region are 5.8 mm per year for the epoch 2000 – 2035, 8.7 mm per year for the epoch 2036 – 2065, 11.6 mm per year for the epoch 2066 – 2095 and 13 mm per year for the epoch 2096 – 2125. These allowances yield an increase in sea level of 0.36 m between 2033 and 2073.

17.5.64 Low-likelihood high-impact climate scenarios in the UK are currently characterised through the H++ scenarios for change in sea level developed for UKCP09 (Ref 17.65). UKCP09 presented one range for H++ of 0.93 to 1.90 m at 2095, that represents all UK coastal waters. The EA flood risk guidance adopts the use of the upper end of this range (i.e., 1.9 m).

17.5.65 Future changes in storm surges have been predicted to be indistinguishable from background variation (Ref 17.65), although extreme surge level event frequency is likely to increase (Ref 17.64).

17.5.66 In addition to sea level rise, extreme water levels in response to surge are also expected to be increased in 2068, compared to the present day. The extreme levels for the future baseline are provided for a range of return periods in **Table 17-9**.

Table 17-9 95th percentile extreme water levels for 2070 (Ref 17.19)

Return period (years)	Level (m relative to ordnance datum)
1	4.36
10	4.73
50	5.06
100	5.20
200	5.37
500	5.61

17.5.67 UKCP18 conclude that there are no compelling trends in storminess (as determined by maximum gust speeds) from the UK wind network over the last four decades. Further, global projections do not show a trend in winds in the first half of the 21st Century. However, changes in future wind and wave conditions provided in EA guidance (Ref 17.13) states that Flood Risk Assessments (FRAs) should allow for an increase in wind speeds and wave heights by 10 percent for the planned lifetime of a project (2056 – 2115 epoch).

17.5.68 A rise in sea level and increased storminess may allow larger waves, and therefore more wave energy, to reach the coast resulting in increases in local erosion rates.

17.5.69 The current shoreline management strategy at the proposed Anderby Creek Landfall is to hold the line (Ref 17.27). There will be no change from the present management in the short and medium term (Ref 17.21). Significantly increased management activity may be required to carry out this policy in the longer term. In the longer term, it may be necessary to consider the use of new defences to ensure sustainable flood protection to assets as sea level rise accelerates. The management intent will be to hold the line for all timeframes continuing to the present-day standard of protection against flooding. In the longer term, localised Managed Realignment could be considered in appropriate areas to increase defence sustainability. Specific sites have not been identified, but further detailed studies in the future should investigate potential sites.

17.5.70 Over the forty years of proposed operation there is a risk that the current shoreline management strategy could change to a ‘no active intervention’ policy with the cessation of beach nourishment.

17.5.71 Increases to water temperature is expected to continue throughout the next century, with thermal expansion contributing to sea level rise (Ref 17.14). The southern North Sea has experienced the greatest rate of sea surface temperature warming, and this is expected to continue over the coming century, with a rise of 3.11°C expected by the end of the century (Ref 17.66).

17.5.72 There is evidence of an increasing trend in the annual average SSC concentrations in some regions, which may result from increased wind and wave energy or changes to land use and river management (Ref 17.31).

17.6 Environmental Measures

17.6.1 As set out in **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**, the environmental measures are characterised as design measures or control and management measures. A range of environmental measures would be implemented as part of the English Offshore Scheme and will be secured in the DML and DCO as required. **Table 17-10** outlines how these design and control measures will influence the coastal and marine physical processes assessment.

17.6.2 Design measures that are relevant to coastal and marine physical processes are denoted by a (D) the ID reference column in **Table 17-10**. These are also included in **Volume 2, Part 1, Appendix 5.A: Outline Register of Design Measures.** Compliance with these measures will be secured by way of the DCO application.

17.6.3 Several management plans will be provided as Outline Management Plans with the DCO application to support the Deemed Marine Licences. These will include an Outline CEMP, Outline MPCP and Outline CSIP. These documents will outline measures to be implemented to comply with legislation (e.g., in relation to the prevention of oil and chemical spills) during all phases of the English Offshore Scheme. Final management plans will be submitted in accordance with the DML to discharge the licence conditions. Control and management measures that are relevant to the coastal and marine physical processes assessment are denoted by a (C) in the ID reference column in **Table 17-10**. These control and management measures are also included within the Outline CEMP that can be found in **Volume 2, Part 1, Appendix 5.C: Outline Construction Environmental Management Plan (CEMP)**.

Table 17-10 Summary of the environmental measures

Receptor	Potential changes and effects	Environmental measures	ID reference
Intertidal, coastal and seabed geomorphology	Disturbance of intertidal sediments and habitats.	The Intertidal Zone would be crossed by a trenchless technique to avoid disturbance to intertidal sediments and habitats.	OMT01 (D)
Intertidal, coastal and seabed geomorphology	Disturbance of intertidal sediments and habitats.	The trenchless technique exit will be below the 3 m lowest astronomical tide (LAT) depth contour.	OMT02 (D)
Currents, water levels, waves, bathymetry and seabed features	Changes in seabed substrate and water depths.	The cables shall be buried in the seabed, except in areas where burial is not possible e.g., where ground conditions do not allow or at infrastructure crossings.	OMT03 (D)
Intertidal, coastal and seabed geomorphology	Changes in seabed substrate and water depths.	External cable protection features would only be installed where considered necessary for the safe operation of the English Offshore Scheme. This includes the repair of cables due to accidental damage, where depth of lowering is not achieved and at infrastructure crossings.	OMT04 (D)
Currents, water levels, waves, bathymetry and seabed features	Changes to water depths, seabed features and sediment types.	In sites designated for benthic features, external cable protection materials would be selected to match the environment (e.g., when cables are installed in areas of cobbles or other natural rock features, rock of similar diameter as the receiving environment should be used as an alternative to the current normal approach of using terrestrially sourced granite, where feasible).	OMT05 (D)
Intertidal, coastal and seabed geomorphology	Disturbance of seabed sediments and habitats.	Designated (and as minimal as possible) anchoring areas and protocols shall be employed during marine operations to minimise physical disturbance of the seabed.	OMT7 (D)
Subtidal morphology	Disturbance of seabed sediments and habitats.	No cable burial trial trenching will be undertaken within the Holderness Offshore Marine Conservation Zone, unless otherwise agreed in writing by the MMO.	OMT08 (D)

Receptor	Potential changes and effects	Environmental measures	ID reference
Subtidal morphology	Changes to water depths, seabed features and sediment types.	A Cable Burial Risk Assessment (CBRA) will be undertaken to identify appropriate target depth of burial based on geology, water depths and Automatic Identification System (AIS) data. A risk based burial approach will be used, assessing external cable protection risk factors such as sediment type, shallow geology, sediment mobility, fishing activity, shipping movements and anchor deployment along the route.	OMT09 (D)
Intertidal, coastal and seabed geomorphology	Changes in seabed substrate and water depths.	Sediment displaced for exit pits and cable installation (sandwave clearance and trenching) will be side cast / locally placed or dispersed to maintain sediment within the local system to facilitate recovery to baseline conditions.	MPP01 (D)
Currents, water levels, waves, bathymetry and seabed features	Changes in seabed substrate and water depths.	The profile of rock berms used for external cable protection would be designed to minimise the potential for scour to occur as much as possible (including alignment with flow and profiling).	MPP02 (D)
Water quality (including bathing waters)	Release of pollutants.	Drilling fluids required for trenchless operations would be carefully managed to minimise the risk of breakouts into the marine environment. This would include the use of biodegradable drilling fluids (pose little or no risk (PLONOR) substances) where practicable.	OMT01 (C)
Water quality (including bathing waters)	Release of pollutants.	All oil, fuel and chemical spills would be reported to the Marine Management Organisation (MMO) Marine Pollution response team in accordance with the MPCP.	OMT03 (C)
Water quality (including bathing waters)	Release of pollutants.	Chemicals will be chosen from the list of chemicals approved under the Offshore Chemical Notification Scheme (OCNS) (Ref 17.67).	OMT04 (C)
Water quality (including bathing waters)	Release of pollutants.	All project vessels must comply with the International Regulations for Preventing Collisions at Sea (COLREGs) (1972), as amended, particularly with respect to the display of lights, shapes and signals. The masters of other vessels are expected to be familiar with and comply with the COLREGs. Additionally, project vessels would	OMT08 (C)

Receptor	Potential changes and effects	Environmental measures	ID reference
		adhere to regulations relating to International Convention for the Prevention of Pollution from Ships (the MARPOL Convention 73 / 78) with the aim of preventing and minimising pollution from ships and the Safety of Life at Sea (SOLAS).	
Intertidal, coastal and seabed geomorphology	Changes in seabed substrate.	Micro-routeing within the English Offshore Scheme draft Order Limits will be deployed to avoid sensitive seabed features where possible.	OMT13 (C)

17.7 Scope of the Assessment

Spatial scope and study area

17.7.1 The spatial scope of the assessment of coastal and marine physical processes covers the area of the English Offshore Scheme contained within the draft Order Limits, together with the Zones of Influence (ZoIs) / study area(s). The study area for coastal and marine physical processes is informed by the tidal excursion. The tidal excursion varies both along the English Offshore Scheme and over time in response to lunar variations in tidal forcing. The maximum spring tide tidal excursion in the English Offshore Scheme draft Order Limits was used to define the study area.

17.7.2 Spring tide tidal excursions vary within the English Offshore Scheme draft Order Limits, increasing from 8 km in the nearshore to a maximum of 19.8 km offshore of Spurn Head, before reducing again to around 6 km in the northern offshore area.

17.7.3 Results from the spreadsheet model applied to assess dispersion of fine sediment disturbed by the English Offshore Scheme confirm that predicted impacts are confined within the study area (**Volume 2, Part 3, Appendix 17.A: Fine Sediment Modelling Spreadsheet**).

17.7.4 The study area for coastal and marine physical processes is shown on **Volume 3, Part 3, Figure 17-1: Study Area.** The English Offshore Scheme and study area have been refined since the Scoping Report was submitted. In particular the optionality around cable routes through and around the Holderness Offshore MCZ has been removed. The study area has been extended to the maximum spring tide tidal excursion in the English Offshore Scheme to ensure that all predicted impacts are confined within the study area.

Temporal scope

17.7.5 The temporal scope of the assessment of coastal and marine physical processes is consistent with the period over which the English Offshore Scheme would be carried out. It assumes construction of the English Offshore Scheme will commence in 2030 and cover a period of 5 years. Operation would commence in 2035, with periodic maintenance required during the Operation and Maintenance phase of the English Offshore Scheme. It is assumed that maintenance and repair activities could take place at any time during the life span of the English Offshore Scheme.

17.7.6 The English Offshore Scheme is expected to have a life span of more than 40 years. If decommissioning requires full or partial removal of the English Offshore Scheme at this point in time, then activities and effects associated with the decommissioning phase are expected to be of a similar level to those during the construction phase, albeit with a lesser duration. The English Offshore Scheme could also remain operational for a period after the 40 years or be taken out of service and left within the draft Order Limits after 40 years. Acknowledging the complexities of completing a detailed assessment for decommissioning works up to 40 years in the future, based on the information available, it has been concluded that impacts from decommissioning of the English Offshore Scheme would be no greater than those during the construction phase. Furthermore, should decommissioning take place it is expected that an assessment in accordance with the legislation and guidance at the time of decommissioning would be undertaken. In addition, it is expected that the DCO will include a requirement for a written scheme of decommissioning for approval by the relevant consenting authority.

Identification of receptors

17.7.7 For the most part Coastal and Marine Physical Processes are not in themselves receptors but are instead 'pathways' with changes to Coastal and Marine Physical Processes having the potential to indirectly impact other environmental receptors. The principal coastal and marine physical processes pathways and receptors that have been identified as being potentially subject to impacts are summarised in **Table 17-11.**

Table 17-11 Coastal and marine physical processes pathways and receptors subject to potential impacts

Pathway / receptor	Reason for consideration
Intertidal, coastal and seabed geomorphology	Changes to seabed geomorphology in the subtidal associated with sand wave clearance could temporarily alter the seabed (including some small areas of the Holderness Offshore MCZ and the southern North Sea SAC). Changes to seabed geomorphology in the subtidal associated with rock placement for external cable protection could alter the substrate (including some small areas of the Holderness Offshore MCZ and the southern North Sea SAC).
Currents, water levels, waves, bathymetry	Changes to seabed levels associated with rock placement for external cable protection have the potential to locally alter bathymetry, with a subsequent impact on currents, water levels and waves. This is particularly relevant in nearshore areas where there could be an indirect effect on sediment transport and coastal processes.
Water quality (including bathing waters and Water Framework Directive water bodies)	Suspension of fine sediment and contaminants during construction have the potential to affect water quality.
Sediment quality	Increases in seabed temperature due to cable operation has the potential to impact sediment quality and seabed habitats.

Potential effects considered within this assessment

17.7.8 The impacts on coastal and marine physical processes receptors which have the potential to be significant and have been taken forward for detailed assessment within this chapter are summarised in **Table 17-12.**

Table 17-12 Coastal and marine physical processes pathways and receptors scoped in for further assessment

Pathway / receptor	Likely significant effects
Seabed geomorphology (construction, operation and decommissioning)	Disturbance of sub-tidal seabed morphology.
Water quality and seabed geomorphology (construction, operation and decommissioning)	Temporary increase and deposition of suspended sediments (Changes in suspended solids and water clarity). Disturbance of contaminated sediment resulting in adverse impacts on water quality.
Currents, water levels, waves bathymetry and seabed features (operation and decommissioning)	Modifications to tidal and wave regimes and associated impacts to morphological features.
Sediment quality – temperature increase (operation)	Heating of the sediment impacting seabed habitats.

17.7.9 The receptors / impacts detailed in **Table 17-13** have been scoped out from being subject to further assessment because the potential effects are not considered likely to be significant.

Table 17-13 Summary of impacts scoped out of the coastal and marine physical processes assessment

Receptors / potential effects	Justification
Intertidal and coastal geomorphology – disturbance of intertidal seabed morphology (construction, operation and decommissioning)	Measure OMT01 (D) (outlined in Section 17.6) commits to a trenchless technique being used at Anderby Creek Landfall and measure OMT02 (D) (outlined in Section 17.6) commits to a trenchless technique exit 3 - 6 m below LAT depth contour to avoid disturbance to intertidal sediments and habitats. Therefore, there will be no disturbance to the intertidal and coastal morphology. The Anderby Creek Landfall is sited in areas where coastal management practices are to hold the line. Based on the assumption that the ducts from the trenchless technique would remain in place, there would be no impacts in the Intertidal Zone. Should the decommissioning method change, this would be assessed at the time of decommissioning.
Currents, water levels, waves bathymetry and seabed features - Modifications to tidal and wave regimes and associated impacts to morphological features (construction)	Measure OMT01 (D) (outlined in Section 17.6) commits to a trenchless technique being used at Anderby Creek Landfall and measure OMT02 (D) (outlined in Section 17.6) commits to a trenchless technique exit 3 - 6 m below LAT depth contour to avoid disturbance to intertidal sediments and habitats. Therefore, there will be no disturbance to the

Receptors / potential effects	Justification
	intertidal and coastal morphology. Potential impacts from external cable protection would be assessed in operation as the continued presence during operation causes the impact. It has therefore been scoped out for the construction stage.
Water quality and sediment quality - Accidental releases or spills of materials or chemicals (Hydrocarbon and PAH contamination) (construction, operation and decommissioning)	Project vessels and contractors will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78 which relate to pollution from oil from equipment, fuel tanks and release of sewage (black and grey water). It is a legal requirement that all vessels have a SOPEP. Compliance with Regulations will be sufficient to minimise the risk to the environment. Several management plans will be provided as outline management plans with the application for development consent, to be secured as a condition of the DML. These will include an Outline CEMP and Outline MPCP. These documents will outline measures to be implemented to comply with legislation (e.g., in relation to the prevention of oil and chemical spills) during all phases of the English Offshore Scheme. The Planning Inspectorate agreed this could be scoped out in ID 4.1.5 in the Scoping Opinion.
Sediment quality – temperature increase (construction and decommissioning)	There is no impact pathway identified for construction and decommissioning.

17.8 Key Parameters for Assessment

Realistic worst-case design scenario

17.8.1 The assessment has followed the Rochdale Envelope approach as outlined in **Volume 1, Part 1, Chapter 4: Description of the Project** and **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology.** The assessment of effects has been based on the description of the Projects and parameters outlined in **Volume 1, Part 1, Chapter 4: Description of the Project**. However, where there is uncertainty regarding a particular design parameter, the realistic worst-case design parameters are provided below with regards to coastal and marine physical processes, along with the reasons why these parameters are considered worst-case. The preliminary assessment for coastal and marine physical processes has been undertaken on this basis. Effects of greater adverse significance are not likely to arise should any other development scenario, based on details within the Rochdale Envelope (e.g., different infrastructure layout within the draft Order Limits), to that assessed here be taken forward in the final design.

17.8.2 In relation to Coastal and Marine Physical Processes assessment, the following assumptions are made regarding the design parameters for the English Offshore Scheme to ensure a realistic worst-case assessment has been undertaken:

- For sand wave clearance, it is assumed that 629,965 m^3 (allowing for 10 percent contingency) require levelling along a 20.04 km;
- With respect to the trenchless technique exit pit excavation, it is assumed that up to three pits (based on two ducts plus one spare duct in case of failure) would require excavation, each with an in-situ volume of up to 1,875 m^3;
- For external cable protection (excluding infrastructure crossings), it is assumed that external cable protection will have a height of 1.5 m and a base width of 16 m; and,
- With regards to external cable protection at pipeline crossings, it is assumed that that crossing berms have a height of 2.5 m, a base width of 16 m and a crest width of 1 m. This is the upper limit of the berm dimensions, providing the greatest potential for an impact to the wave climate.

17.8.3 As detailed in **Volume 1, Part 1, Chapter 4: Description of the Project**, the timing of construction activities set out within this PEIR is indicative. To allow for any unexpected circumstances and a realistic worst-case assessment, the impact assessment for the English Offshore Scheme considers the following construction scenarios to ensure the worst-case scenario for each aspect can be identified and assessed:

- With regards to sandwave clearance it is assumed that a large Trailing Suction Hopper Dredger (TSHD) with a hopper size of 30,000 m^3 and a high production rate of 7,000 m^3 per hour will be used. It is assumed that dredged sediment will be placed via the hopper doors after the hopper is filled. These assumptions provide the greatest rates of sediment disturbance and potential for fine sediment plume dispersion during sand wave clearance;
- With regards to trenchless technique exit pit excavation, it is assumed a jet trencher or Controlled Flow Excavator (CFE) will be used as this will result in the greatest mass and rate of release of fine sediment; and
- With regards to cable trenching, it is assumed that a jet trencher or CFE will be used, achieving a trench Cross Sectional Area (CSA) of 5.25 m^2 (representing a rectangular trench of 1.5 m wide and 3.5 m deep) and an installation speed of 286 m per hour. These assumptions provide the maximum realistic rate of sediment disturbance and greatest potential for fine sediment plume dispersion during cable trenching.

17.8.4 In addition to the above, the assumptions within **Table 17-14** are made regarding the English Offshore Scheme design parameters to ensure worst-case scenario has been considered.

Table 17-14 Key parameters for the coastal and marine physical processes assessment

Impact	Phase C	Phase O	Phase D	Maximum Design Scenario (MDS)	Justification
Temporary disturbance of subtidal seabed geomorphology	ü	ü	ü	<u>**Construction**</u> **Total subtidal temporary seabed disturbance = 13.91 km^2.** **Seabed Preparation** • **Trenchless technique exit pits** – 2 x 750 m^2. • **Boulder clearance** - 8.46 km^2, pre-lay plough with swathe of 20 m assumed across approximately 423 km of the English Offshore Scheme (20 m x 423 km of route) (assumed to be within footprint of pre-lay grapnel run (PLGR)). • **Sand wave clearance** – 1.2 km^2 precautionary footprint for use of trailing suction hopper dredger and / or Controlled Flow Excavation (CFE). Precautionary estimate assuming clearance along 60 m width x 20.04 km). • **Pre-Lay Grapnel –** 12.9 km^2 footprint with swathe of 30 m x 423 km route length. • **Cable burial trial trenching -** 125,000 m^2 footprint of trial trenching (25 m x 5,000 m length).	The MDS for temporary habitat loss / seabed disturbance relates to seabed preparation for pre-installation activities, jack-up vessel and anchoring operations and cable installation. Pre-sweeping area based on maximum width (between 20 m and 60 m) and length with a 10% contingency applied. It should be noted that where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint. An MDS for the Intertidal Zone temporary habitat is not included as trenchless technique exit pits will be within the subtidal environment and as such there will be no direct effects on the Intertidal Zone. The subtidal habitat disturbance MDS includes other de-minimis footprints such as from the jack-up barge, anchors and temporary deposits.

Impact	Phase C	O	D	Maximum Design Scenario (MDS)	Justification
				Cable Installation Impact will occur fully within combined footprint from seabed preparation activities.	
				<u>**Operation**</u> **Total subtidal temporary seabed disturbance = 0.315 km^2.** De-burial and re-burial of cable failure points across 13 km of bundled cables (25 m cable plough footprint x 13,000 m length).	Assumes 13 cable repairs and 8 cable remediations over English Offshore Scheme lifetime.
				<u>**Decommissioning**</u> Refer to the construction phase MDS.	MDS is similar (or less) to that of the construction phase.
Permanent disturbance of subtidal seabed geomorphology	ü	ü	ü	<u>**Operation**</u> **Total permanent seabed disturbance = 1,936,000 m^2.** **External Cable Protection** • **Cable Crossings** – 464,000 m^2 assuming rock berm 16 m width and 500 m in length (58 crossings). • **External Cable Protection** – 1,472,000 m^2 to reach target burial depth assuming rock berm (16 m width x 22% of the cable requires protection).	Maximum effect of permanent seabed disturbance will occur because of the maximum area of seabed covered by external cable protection and infrastructure crossings protection (i.e., rock berms). Fifty-eight crossings allows for the forty-five existing crossings plus contingency for thirteen additional crossings.

Impact	Phase C	O	D	Maximum Design Scenario (MDS)	Justification
				Decommissioning Refer to the operation phase MDS.	If the English Offshore Scheme is left in-situ, permanent habitat loss will be the same as operation.
Temporary increase in suspended sediments and sediment deposition and release of contaminated sediment.	ü	ü	ü	**Construction** **Total sediment volume = 736,199 m^3** **Seabed Preparation** Pre-Sweeping [TSHD] – Suspension of 33,715 m^3 during placement and 26,972 m^3 during dredging. **Cable Installation** • Cable Trenching [jet trencher or CFE] – Suspension of 666,225 m^3 (30% of CSA x route length). **Trenchless Technique Operations** • Exit Pit Excavation – Suspension of 1,687.5 m^3 (30% of volume for 3 exit pits). • Drilling Fluid Release – Maximum volume and mass of drilling fluid released per trenchless technique – 7,600 m^3 (304 m^3 of bentonite) over 12 hours with estimated release rate of 19.7 kg/s.	For seabed preparation the MDS results from placement of dredged sediment from a TSHD. While the overall volume of sediment suspended is less than that disturbed by CFE, the rate of release and height of release are such that clearance by TSHD is the MDS. While all dredged sediment is released in suspension, only 10% will form a passive plume (with the other 90% descending rapidly to the bed as a dynamic plume). Only a small proportion of this sediment will disperse more than 100 m from the placement site (the fine sediment fractions). The quoted volumes include a 20% contingency. For cable installation, the MDS results from cable trenching with a jet trencher or CFE with 30% of sediment expected to be suspended. Only a small proportion of this sediment will disperse more than 100 m from the placement site (the fine sediment fractions). Length of 423 km x 1.5 m wide x 3.5 m deep rectangular trench.

Impact	Phase C	Phase O	Phase D	Maximum Design Scenario (MDS)	Justification
					For trenchless technique operations, the MDS results from using a CFE for exit pit excavation with 30% of sediment expected to be suspended. Maximum release: 7,600 m^3 of drilling fluid at punch-out. Drilling fluid 4% bentonite, 96% water. Density of bentonite 2,800 kg/m^3.
				Operation • De-burial and re-burial of cable failure points across 13 km of bundled cables (25 m cable plough footprint x 13,000 m length).	Assumes 13 cable repairs and 8 cable remediations over English Offshore Scheme lifetime.
				Decommissioning Refer to the construction phase MDS.	If the English Offshore Scheme is left in-situ, permanent habitat loss will be the same as operation.
Temperature increase		ü		**Operation** • 2 x cables (bundled) up to 423 km. • Target average burial depth of 1.5 m (maximum target depth of 3.5 m).	The maximum heat change will result from the maximum cable voltage. Maximum extent of heat change will result from the maximum length of the cable bundles.

17.9 Assessment Methodology

Overview

17.9.1 The generic Project-wide approach to the assessment methodology is set out in **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**, and specifically in Sections 5.4 to 5.6. However, whilst this has informed the approach that has been used in the coastal and marine physical processes assessment, it is necessary to set out how this methodology has been applied, and adapted as appropriate, to address the specific needs of this coastal and marine physical processes assessment. The details are provided below.

Desk-Based Assessments

17.9.2 The scope of the coastal and marine physical processes assessment is to characterise the baseline physical processes within the study area and to consider the magnitude and duration of potential impacts of the English Offshore Scheme and to determine the significance of effects in EIA terms.

17.9.3 The English Offshore Scheme survey data (detailed in Section 17.5) is being used to inform the CBRA, which will consider:

- Micro-routeing;
- Minimum burial depths along the proposed subsea cable corridor;
- Identification of potential burial tools and methods; and
- Methods and locations of external cable protection where full cable burial cannot be achieved, or risk of subsequent cable exposure is high.

17.9.4 The CBRA has not yet been completed but preliminary calculations of areas requiring external cable protection and pre-sweeping (including volumes) have been made based on the completed marine characterisation surveys. Further engineering studies will be undertaken to further refine this.

17.9.5 The assessment of potential effects has been established using the standard Source-Pathway-Receptor Approach. The assessment of coastal and marine physical processes follows the guidance documents listed in Section 17.2, where they are specific to this topic.

17.9.6 A more detailed literature review has been undertaken for the EIA to expand on the high-level overview provided within the Scoping Report. The assessment approach included a range of desktop analyses and spreadsheet-based models, and this has been supplemented by evidence from analogous assessments and monitoring data.

17.9.7 A spreadsheet-based model has been applied to assess the potential SSC and sedimentation associated with installation activities for a range of hydrodynamic conditions and sediment types to capture the impact (in terms of plume extent, concentration and extent and thickness of deposits on the seabed). The assessment is focussed on the realistic worst-case installation scenario. The available baseline information and geophysical and environmental baseline surveys informed the data inputs for this assessment. The effects have been assessed in terms of the difference caused relative to the normal range of natural occurrence and variability. An assessment of duration of increases in SSC is informed by results from the evidence base which includes multiple similar assessments using numerical modelling tools to assess impacts from cable installation for a range of methods.

17.9.8 Particle Size Distribution (PSD) analysis was undertaken on samples collected for the English Offshore Scheme. The average percentage of fines within samples was 8.8 percent from a total of 173 samples. While the percentages of fines is similar to that from sediment samples collected along the EGL 3 and EGL 4 projects (8.3 percent and 10.7 percent, respectively), the spreadsheet modelling was updated to reflect the actual data collected for the English Offshore Scheme. The results from the spreadsheet modelling for the English Offshore Scheme (presented in **Volume 2, Part 3, Appendix 18.A: Fine Sediment Modelling Spreadsheet**) were found to be broadly similar to the results presented for EGL 3 and EGL 4 (Ref 17.68).

17.9.9 The assessment of operational impacts associated with changes to the substrate and water depths associated with external cable protection measures quantifies the areas of impact and relative changes in water depth. These areas of change have been considered alongside baseline information, results from the benthic survey and expert judgement to determine the likely impact on receptors.

17.9.10 The following approach was adopted:

- Identify where external cable protection is required and determine the relative depth change.
- For crossings where depth changes are more than 5 percent, wave modelling was undertaken to assess the potential for impacts on wave climate and indirect impacts on sediment transport (both locally and at the coast).
- A spectral wave model, which was developed for similar assessments for the EGL 3 and EGL 4 projects (Ref 17.69) was adapted and applied to assess the potential impacts of rock berms at nearshore infrastructure crossings for the English Offshore Scheme.

17.9.11 The wave modelling focussed on the infrastructure crossings within shallow waters close to the coastline as these represent the worst-case with respect to the potential impact pathway for modifications to tidal and wave regimes. The results are also representative of the impact pathway for external cable protection (excluding infrastructure crossings) in the nearshore area, the locations of which are unknown but is assumed to occur within the draft Order Limits. External cable protection (excluding infrastructure crossings) would be of a lower height (1.5 m) than external cable protection at infrastructure crossings and therefore the above modelling is considered conservative. The wave modelling would be updated for submission at ES once external cable protection locations and designs are progressed further.

17.9.12 A WFD assessment has been undertaken to assess the potential impacts of the English Offshore Scheme on water and sediment quality (presented in **Volume 2, Part 3, Appendix 17.C: Water Framework Directive (WFD) Offshore Assessment**. The assessment of water quality impacts in this PEIR focus on the impact on turbidity using the results from spreadsheet-based models, with release of contaminated sediments.

Surveys

17.9.13 Data from site specific geophysical and benthic surveys of the study area provide a more detailed site characterisation and, along with geotechnical survey data from EGL 3 and EGL 4 fill key data gaps such as positions of seabed features, particle size distributions and levels of sediment contamination. Existing studies from comparable projects will also be used where relevant to further inform the likely scale of any potential impacts.

17.9.14 The Applicant has commenced a marine characterisation survey within the English Offshore Scheme. To date geophysical and benthic surveys have been completed (April to June 2025), with geotechnical surveys to be completed in 2026.

17.9.15 The objective of the survey campaigns is to obtain baseline data that contribute to determining the physical and ecological conditions, the location and design of the final cable route and inform the environmental assessments necessary to obtain consent for the English Offshore Scheme.

17.9.16 The geophysical survey campaign sought to provide detailed mapping of nearshore shallow geological and seabed character; mapping of seabed relief (bathymetry) and features along offshore sections and environmental characterisation mapping across the English Offshore Scheme.

17.9.17 The scope of the geophysical and geotechnical campaign is outlined in **Table 17-15**. Data has been acquired across a 300 m wide corridor in water depths < 70 m and a 500 m wide corridor in water depths > 70 m. Further details on the benthic surveys are provided in **Volume 1, Part 3**, **Chapter 18: Intertidal and Subtidal Benthic Ecology.**

Table 17-15 Summary of site investigation methodologies

Survey type	Methods	Description
Geophysical Survey	Multi Beam Echo Sounder (MBES) Sub-Bottom Profiling (SBP) Remotely Operated Vehicle (ROV) Ultra-short Baseline (USBL)	The geophysical survey undertook the following tasks: • Measured intertidal topography and seabed bathymetry, surface morphology and identified the nature of the seabed sediments - in particular, the height, length, and slopes of bedforms (MBES). • Identified the distribution and thickness of superficial sediments and rock head where possible (SBP). • Identified the distribution of subsea geological features such as areas of exposed bedrock (MBES). • Identified the location, extent, and nature of any impediments to laying or burial of the cables such as wrecks, debris on seafloor, rock outcrop, other cables, pipelines (MBES).
Geotechnical Survey	Vibrocore (VC) Cone Penetrometer Tests (CPT)	The geotechnical survey is undertaking the following data collection: • Vibrocores (VC) - core samples of sediments down to 3-6 m depth, acquired to allow ground truthing of the geophysical interpretation. • Cone Penetrometer Tests (CPT) - measure the resistance of sediments, allowing determination of the types of sediments present and their structure. VCs and CPTs are typically acquired at the same sample station and will be positioned along the proposed centreline of the cable.

Survey type	Methods	Description
		It is expected that geotechnical sampling locations will be spaced every 2 km and therefore shall comprise nominally of the following: • 206 VCs • 206 CPTs If the seabed is found to be broadly similar, then distance between sampling stations will increase, and conversely if the seabed is found to be more varied spacing will decrease.

Assessment of Significance

17.9.18 The coastal and marine physical processes assessment generally follows the assessment approach framework as set out in **Part 1, Chapter 5: PEIR Approach and Methodology**. However, while this has informed the approach, it is necessary to set out how this methodology has been applied, and adapted as appropriate, to address the specific needs of the coastal and marine physical processes assessment.

17.9.19 In line with the industry standard approach across offshore EIAs, a four-category sensitivity and magnitude scale, from "Negligible" to "High" has been used. While **Part 1, Chapter 5: PEIR Approach and Methodology** provides for a "Very High" category, this is based on onshore specific guidance, rather than being applicable to offshore receptors. The criteria for characterising the sensitivity of receptors for the coastal and marine physical processes assessment is outlined in **Table 17-16**.

17.9.20 The criteria for characterising the magnitude of impact for the coastal and marine physical processes has been refined since Scoping and in **Table 17-17.**

17.9.21 The significance of an effect, either adverse or beneficial, will be determined using a combination of the magnitude of the impact and the sensitivity of the receptor. A matrix approach is used throughout all topic areas to ensure a consistent approach within the assessment, as shown in **Table 17-18**.

Table 17-16 Criteria for characterising the sensitivity and value of receptors

Receptor sensitivity / value	Definition
High	Receptor has low / no capacity to return to pre-impact conditions, e.g., low tolerance to change and low recoverability such as loss of access with no alternatives. Receptor is very high value or critical importance to local, regional or national economy or environment.
Medium	Receptor is generally vulnerable to the impacts and recoverability is slow or costly. Receptor is high value with reasonable contribution to local, regional or national economy or environment.
Low	Receptor has moderate levels of recoverability. Receptor is medium value with small contributions to local, regional or national economy or environment.

Receptor sensitivity / value	Definition
Negligible	Receptor is tolerant to change with no effect on its character. Receptor is of low value with little contributions to local, regional or national economy or environment.

Table 17-17 Criteria for characterising the magnitude of impact

Receptor sensitivity / value	Definition
High	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements.
Medium	Loss of resource, but not adversely affecting the integrity; partial loss of / damage to key characteristics, features or elements.
Low	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to one or more key characteristics, features or elements.
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements.

Table 17-18 Significance evaluation matrix

Sensitivity or value	Magnitude of change			
	High	Medium	Low	Negligible
High	Major (significant)	Major (significant)	Moderate (potentially significant)	Minor (not significant)
Medium	Major (significant)	Moderate (potentially significant)	Minor (not significant)	Minor (not significant)
Low	Moderate (potentially significant)	Minor (not significant)	Minor (not significant)	Negligible (not significant)
Negligible	Minor (not significant)	Minor (not significant)	Negligible (not significant)	Negligible (not significant)

Preliminary assessment of cumulative effects

17.9.22 **Volume 1, Part 4, Chapter 27: Cumulative Effects** defines the methodology for the assessment of cumulative effects. The coastal and marine physical processes assessment of cumulative effects has been considered in this PEIR and will be reviewed and updated within the ES to be submitted with the application for development consent.

17.9.23 The ZoI for the inter-project cumulative effects assessment of coastal and marine physical processes comprises the draft Order Limits, plus an additional 19.8 km buffer each side informed by the spring tide tidal excursion. This is a precautionary maximum ZoI that encompasses the worst-case scenario of potential impact pathways from increased suspended sediment concentrations.

17.9.24 **Volume 1, Part 4, Chapter 27: Cumulative Effects** and **Volume 2, Part 4, Appendix 27.A Long List of other Developments** present the long and short lists of 'other developments' for the inter-project cumulative effects which will be considered at the ES stage (with updates as necessary), and the methodology which allowed for the identification of these other developments, to allow consultation bodies to form a view and provide comment on the other developments included. The long list will be reviewed and if necessary, updated, in the lead up to the ES, as the Project design further evolves and in response to any comments raised at statutory consultation.

17.10 Preliminary Impact Assessment of Disturbance of Sub-tidal Seabed Morphology

Construction

17.10.1 Seabed preparation and subsea cable installation activities have the potential to directly disturb the seabed morphology. While the proposed subsea cable corridor has been routed to avoid seabed features such as sandbanks, sand waves and notable bathymetric depressions as far as practical there are some sections of the route where sand wave clearance and external cable protection would still be required.

Sandwave clearance

17.10.2 Discrete sections of the subsea cable corridor may require pre-sweeping of mobile sandwaves. Such pre-sweeping will ensure that that the cable burial machine would not topple or tilt during installation and that they could reach the desired burial depth reducing the risk of cable exposure during operation.

17.10.3 The sensitivity of sandwaves is considered low as the temporary nature of the proposed works are not likely to influence the overall form and function of the bedform system which can be expected to recover through natural sediment transport processes in the short to medium term. Sand wave recovery will be aided by the deposition of dredged material upstream of the extraction site, where feasible.

17.10.4 A study of seabed dynamics and morphology undertaken on behalf of Ørsted Energy to estimate restoration of seabed morphology after construction of the Race Bank Offshore Wind Farm (OWF) (which is in the southern North Sea, approximately 30 km east of the landfall) found that in the areas of high sediment mobility surveyed the seabed was found to be fully, or almost fully, recovered (>75 percent recovery in all areas) within the one to two years between the post trenching survey in 2016 – 2017 and the subsequent survey in 2018. Net sand wave migration rates at Race Bank were observed to be in the range of 7 to 31 m/year. Differences in peak spring flow speeds (0.7 to 1 m/s within the sand wave areas of the English Offshore) compared to those at Race Bank (0.8 to 1.2 m/s), coupled with the deeper water depths within the English Offshore Scheme suggest that sandwave migration rates would be lower than observed at Race Bank and as a result recovery timeframes could be slightly longer than those given at Race Bank, but would be expected to recover in the order of a few years and would therefore not be a long term effect.

17.10.5 Estimates of bedload transport based on the method of (Ref 17.70), as outlined in (Ref 17.71), indicate that for the flow and sediment conditions in the areas where sandwaves are present, it would take several years to move the volume of sediment within a sandwave.

17.10.6 The English Offshore Scheme has been routed to minimise the requirement for sandwave clearance in the Holderness Offshore MCZ. Approximately 5 km of the English Offshore Scheme passes through the MCZ and no sandwaves requiring clearance were identified by the English Offshore Scheme surveys. The English Offshore Scheme also avoids the Inner Dowsing, Race Bank and North Ridge SAC. Given the avoidance of the Holderness Offshore MCZ (and no proposal for sandwave clearance in any SACs with benthic features) and the temporary nature of the impact, the sensitivity of non-designated sandwaves are assessed as low, the magnitude of the impact is considered low, and the significance of effect is assessed as Minor (not significant).

17.10.7 Other seabed preparation activities including displacement of seabed debris and boulder removal during PLGR and boulder clearance activities will cause potentially permanent disturbance to the seabed bathymetry. Seabed disturbance of this kind will be very localised and therefore, despite the potential permanent nature of the change, the sensitivity is negligible, the magnitude of the impact is considered negligible and the effect is assessed as **Negligible (not significant)**.

External Cable Protection

17.10.8 In areas where cables are buried, trenches will be back-filled so that the seabed is returned to its baseline state (i.e., the change in bathymetry will be temporary).

17.10.9 Where the required burial depth cannot be achieved, external cable protection will be required. The areas where burial cannot be achieved include areas of hard substrate and areas where the route crosses other cables or pipelines.

17.10.10 The percentage of the route requiring rock protection due to hard substrate is indicative and is expected to be approximately 22 percent (92 km), covering an area of 1,472,000 m^2. These numbers are based on the requirements for EGL 3 (Ref 17.72), as the information is not currently available to allow for values for the English Offshore Scheme to be calculated. This will be reviewed and included as part of the ES. In the instance of hard substrate, the addition of external cable protection will not significantly alter the physical bed characteristics (with rock berms providing a broadly similar bed type to bed rock) although there will be a permanent change to bathymetry (at least for the lifetime of the English Offshore Scheme) – see Section 17.13.

17.10.11 In the instance of cable and pipeline crossings, the addition of external cable protection in areas of softer sediments will lead to localised change in substrate. Further, in areas where the critical bed shear stress exceeds the threshold for motion (either as a result of near bed flow speeds or orbital wave motion reaching the bed), localised scouring could occur, resulting in a coarsening of sediments (within finer grains scoured away). Where feasible, best practice will be used in the design of the rock protection to minimise scour, for example aligning rock berms parallel to the current direction where possible.

17.10.12 The MDS considers up to 58 infrastructure crossings, accounting for 45 assets identified by the English Offshore Scheme survey plus contingency for 13 additional crossings that may be required for new assets. This is considered to represent a worst-case as some assets may be sufficiently close together that one berm could cross multiple assts. Adopting a length of 500 m (250 m either side) and a width of 16 m for infrastructure crossings, the rock protection for cable and pipeline crossings will cover an area of up to 464,000 m^2.

17.10.13 The total area of rock protection expected to be required for the English Offshore Scheme (due to both hard substrate and infrastructure crossings) is approximately

1,936,000 m^2. This footprint will be reviewed and further assessment provided in the ES once geotechnical information is available to allow for specific calculations of areas where target burial depths are not achievable for the English Offshore Scheme.

17.10.14 Maximum berm heights are expected to be up to 1.5 m above bed level, except at up to ten infrastructure crossing where pipeline bridges could be required increasing the berm height to 2.5 m above bed level. Most of the areas requiring external cable protection are likely to be sufficiently far offshore and in sufficiently deep waters that the relative change in water depths would be less than a 10 percent change to baseline water depths.

17.10.15 An assessment of the impact of external cable protection on sediment transport during operation is provided in Section 17.13.

17.10.16 The sensitivity to change and the magnitude of the effect have been assessed as negligible and low respectively and therefore the effect of changes to subtidal morphology is assessed as **Negligible (not significant).**

Trenchless Technique Exit Pits

17.10.17 A trenchless technique will be used to connect the offshore cable to the onshore cable at Anderby Creek Landfall. The trenchless technique punch out location will depend on the outcome of further technical studies and design but is it is anticipated to be 1.6 km and would exit the seabed between 3 m and 6 m below LAT. Excavated exit pits could be required at the punch out locations, each requiring up to 1,875 m^3 of sediment to be excavated, with up three exit pits (based on two ducts plus one spare duct in case of failure). Excavation would either be by backhoe dredger or CFE. Ducts laid in the exit pits may require weighting using clump weights or rock bags. Once the cable is installed any weighting would be removed and material excavated for the exit pits would be used to backfill the pits (either manually or naturally).

17.10.18 Peak spring flow speeds in this area are between 0.6 and 1 m/s increasing offshore (Ref 17.16). The median sediment grain size from a sample collected during the English Offshore Scheme survey is 5,000 µm (gravel) in the nearshore area (at KP 2). The sediment is mixed in nature with 28 percent being medium sand or finer (i.e., less than 500 µm). Most of the excavated sediment would not be mobilised by tidal flow alone, but would be mobilised by wave processes, particularly during storms. The recovery timeframes of the exit pits would therefore be sensitive to the time of year if they were left to infill naturally. Estimates of bedload transport (based on the method of Ref 17.70, as outlined in Ref 17.71) indicate that a single large storm would be sufficient to infill the exit pits. While there is a risk that some excavated sediment could be transported away from the exit pits, in this instance natural sediment on the bed would backfill the exit pits. The sensitivity of the change to subtidal morphology is assessed as negligible as the sediments are not sensitive to the change and would fully recover. Any changes to subtidal morphology associated with the exit pits will be localised and temporary and the magnitude of impact is assessed to be low.

17.10.19 Any changes to sub-tidal seabed morphology resulting from the excavation of exit pits will be localised and temporary and will not result in a change to the baseline character. The sensitivity to change and the magnitude of the effect have been assessed as negligible and low respectively and therefore the effect of changes to subtidal morphology is assessed as **Negligible (not significant).**

Decommissioning

17.10.20 Once the English Offshore Scheme has reached the end of its life, it is anticipated that the cables within 12 NM would be removed, except for any parts of the cables or external cable protection where it is considered preferable for them to remain in situ and at the Anderby Creek Landfall. The seabed would be restored where reasonably possible and practical to the baseline condition.

17.10.21 Potential impacts of decommissioning are likely to be of similar or lower magnitude than for construction, while the sensitivity of the site is likely to be unchanged. The effect of changes to the subtidal morphology during decommissioning are therefore assessed as **Negligible (not significant).**

17.11 Preliminary Impact Assessment of Disturbance of Intertidal Morphology

Operation

17.11.1 Direct effects on intertidal seabed morphology have been scoped out of the assessment as outlined in ID 4.1.2 of the Planning Inspectorate's Scoping Opinion. However, the potential for indirect effects arising from changes to the subtidal morphology associated with rock protection has been assessed.

17.11.2 External cable protection will be required at pipeline and cable crossings and in areas of hard substrate where target burial depths cannot be achieved. Most of the areas requiring external cable protection are likely to be sufficiently far offshore and in sufficiently deep waters that no indirect effect on Intertidal Zone morphology would occur. Detailed information is not available at present to confirm whether this is the case for areas of hard substrate, and this assumption will be reviewed as part of the ES.

17.11.3 There is an area where multiple pipeline crossings are required in relatively shallow depths (11.7 m to 12.8 m LAT) and within relatively close proximity (8.5 km) of the shore. In these areas the changes in water depth from external cable protection could be around 13 percent shallower than the baseline water depth increasing to up to 21 percent shallower than the baseline water depth at locations where crossing bridges are required.

17.11.4 Sediment transport in the area of the proposed crossing is likely to be influenced by both tidal currents and waves, with tidal currents resulting in an ongoing regular forcing, while waves will likely only influence the sediment transport during larger wave events. The changes in bed elevation due to the proposed rock berms will only result in very localised changes to tidal currents around the structures (which are aligned almost parallel to the dominant flow direction) and the potential for changes to sediment transport from these changes would also be highly localised to the berms and would therefore not impact the Intertidal Zone morphology.

17.11.5 To assess the potential for an indirect impact to Intertidal Zone morphology from crossings in the nearshore area a Spectral Wave (SW) model was developed and applied (see **Volume 2, Part 3, Appendix 17.B: Wave Modelling**). Results from the wave modelling assessment showed that the presence of the 1.5 m high rock berms (with a base width of 16 m) only resulted in localised and small changes in wave heights and directions and with no changes predicted for wave periods. Wave heights were locally increased over the rock berms (by around 0.06 m, equivalent to a 1.5 percent change) and reduced in the lee (by around 0.025 m). Reductions in wave heights of up to 0.05 m (around a 1.25 percent change) are predicted to extend up to 1.2 km from the rock berms, while reductions of more than 0.05 m only occur local to the rock berms. No changes in wave height of more than 0.01 m (0.25 percent change relative to the baseline conditions) were predicted to occur within 7 km of the coastline.

17.11.6 Given the ongoing cycle of natural erosion and beach nourishment along the adjacent coastline, the sensitivity of the coastline to change is assessed as low. Should the present-day strategy of 'hold the line' change to a 'no active intervention' policy the sensitivity of the adjacent coastline would change to medium.

17.11.7 Given the localised and small changes to wave conditions from the berms, the potential for changes to sediment transport (which can be driven by long period waves) is very low and the magnitude of impact on sediment transport along the coast is therefore assessed to be negligible and the effect of external cable protection on Intertidal Zone morphology are assessed as **Minor (not significant)** (for both present day and potential future sensitivity).

17.11.8 This information will be reviewed on completion of the CBRA to ensure that there are no more extensive nearshore areas where external cable protection could influence wave processes and consequently alter near shore sediment transport and impact Intertidal Zone morphology. Further assessment to understand the potential impact of higher berms where pipeline bridges are required will be presented in the ES.

17.12 Preliminary Impact Assessment of Temporary Increases in SSCs and Subsequent Deposition

Construction

17.12.1 Sediment suspended during seabed preparation and installation of the subsea cable could result in temporary increases in SSC having an adverse effect on water quality. Subsequent deposition once material re-settles to the bed could result in changes to the bed level. There is also the potential for changes in sediment characteristics, with a reduction in fines close to the disturbance site and with an increase in fines further away (due to the shorter settling times for coarser grained sediments).

17.12.2 A spreadsheet based model (**Volume 2, Part 3, Appendix 17.A: Fine Sediment Modelling Spreadsheet**) has been applied to assess the potential dispersion of sediment plumes arising from activities during construction, including sandwave clearance, excavation of trenchless technique exit pits, release of drilling fluids at trenchless technique punch out and cable trenching operations. Settling velocities for releases at 5 m above the bed (for sediment releases associated with cable trenching with jet trencher or CFE) and releases at 50 m above the bed (for sediment releases from dredging with a TSHD) are provided along with settling distances for a range of peak flow speeds in **Table 17-19**.

17.12.3 The calculated settling distances indicate that only fine sands and silts will disperse beyond the draft Order Limits. Silt sized material will remain in suspension for much longer durations and could disperse away from the site of sediment release.

17.12.4 The maximum dispersion distance is set to be the maximum spring tide tidal excursion associated with the peak flow speed. Typically, fine sediment particles will not travel in suspension beyond this maximum distance. However, for particles which remain in suspension for a long period of time and where there is either a notable tidal or non-tidal (surge) residual, sediment in suspension could travel beyond the maximum distances quoted. Given that dispersion processes will also act to dilute the concentration of silt carried in suspension, elevated SSC levels at such large distances would be greatly reduced compared to those in close proximity to the site of sediment release and would be immeasurable in practice.

Table 17-19 Calculated settling velocity for different size sediment grain sizes and associated settling times

Peak flow speed (m/s)	Fines (<63 μm)		V fine sand (125 μm)		Fine Sand (250 μm)		Medium sand (500 μm)	
	Settling time (hours)	Settling distance (km)	Settling time (hours)	Settling distance (km)	Settling time (hours)	Settling distance (km)	Settling time (hours)	Settling distance (km)
Release at 5 m above the bed								
1.43	0.7 to 407	3.8 to 19.8	0.5	2,4	0.1	0.7	0.03	0.1
1.2		3.1 to 16.6		2.0		0.6		0.1
0.8		0.7 to 11.1		1.3		0.4		0.08
0.4		1.1 to 5.5		0.7		0.2		0.04
Release at 50 m above the bed								
1.43	5 to 4,070	19/8	1.4	7.2	0.3	1.5	0.1	0.4
1.2		16.6		6.0		1.2		0.3
0.8		11.1		4.0		0.8		0.2
0.4		5.5		2.0		0.4		0.1

17.12.5 The rate of fine sediment disturbance was estimated for each activity based on information on the English Offshore Scheme design and results from the environmental surveys. The sediment release rates are summarised in **Table 17-20**. The following assumptions were applied when calculating the release rates:

- For sandwave clearance by dredging, rates assume that 10 percent of sediment dredged would be released in suspension near the surface during placement via the hopper doors, with the rest forming a dynamic plume which would settle straight to the bed (Ref 17.72);
- For trenchless technique exit pit excavation and cable installation, rates are based on a productivity of 1,500 m^3 per hour, assuming that 30 percent of all sediment disturbed would be dispersed in suspension (Ref 17.73); and
- For drilling fluid release at punch-out, rates are based on up to 7,600 m^3 of drilling fluid containing 4 percent bentonite (assumed to be 100 percent clay sized particles) released over a 12-hour period. The volume is the maximum likely volume for punch out at two ducts, accounting for simultaneous drilling of both ducts.

17.12.6 The cable installation speed is expected to be highly variable with speeds in the range of 25 m/hour to 300 m/hour. The actual speed will depend on the sediment encountered (with lower speeds in sediments with a higher percentage of fines) and the type of plant used. The trench cross sectional area (CSA) (5.25 m^2) has been calculated using the maximum trench width (1.5 m) and depth (2.5 m) assuming a rectangular trench. Achieving these trench dimensions at the expected installation speeds would require a productivity of 262.5 m^3/hour to 5,250 m^3/hour. Values at the lower end of this range provide a more realistic productivity rate that could be achieved, particularly in soils with a higher percentage of fines. The assessment is therefore based on a maximum productivity of 1,500 m^3/hour, yielding an installation speed of 286 m/hour. Higher installation speeds would be achievable for much smaller trench dimensions, but the overall sediment disturbance rate is unlikely to exceed the values calculated based on the assumptions outlined.

17.12.7 The impact of cable trenching was assessed at multiple KPs in the English Offshore Scheme to capture the variability in sediment plume extent which would occur in response to variations in PSD and flow speed. The KPs modelled were selected to provide a worst-case assessment, relating to areas of either a higher percentage of fines and / or higher flow speeds. Plume extents between KPs modelled would be expected to be less than the quoted extents at given KPs.

17.12.8 In the near-field (within 5 to 10 m of the activity) sediment disturbed by construction activities will result in very high sediment concentrations which will last while the activity resulting in the sediment disturbance persists. A large proportion of this sediment will settle back onto the seabed within the draft Order Limits (or where sediment is released in the case of sediment disposal following dredging of sand waves), with the actual amount depending on the grain size characteristics and the flow conditions.

17.12.9 As sediment in the plume is dispersed and deposited away from the site of the activity sediment concentrations will reduce to much lower levels. The release rates detailed in **Table 17-20** were applied in the spreadsheet model to provide estimates of the maximum distance that increases in SSC would exceed 10 and zero mg/l (also summarised in **Table 17-20**). The greatest plume extent above 10 mg/l was associated with trenching in the area where there was the highest percentage of fines and fast peak flows, with peak SSC of more than 10 mg/l occurring up to 8.8 km from the point of release. Any exceedances of more than 10 mg/l will be of short duration beyond the draft Order Limits due to the relatively fast tidal flows. Similar assessments using hydrodynamic modelling tools indicate that impact times are typically of the order of hours or less (Ref 17.744 and Ref 17.75). The plume extents above 10 and zero mg/l are also shown on **Volume 3, Part 3, Figure 17-15: Predicted Sediment Plume Areas.** The calculated plume extents at the quoted KPs are extended to show the plume extents along the full English Offshore Scheme.

17.12.10 Estimates of sediment thickness on the bed following cable trenching were calculated at KP 10 (where there is the highest percentage of fines of all samples collected for the English Offshore Scheme) and KP 199 (where the percentage of fines is more representative of the average fines of all samples collected for the English Offshore Scheme). The sediment thickness calculations can therefore be used to provide an indication of the range in sedimentation thickness following cable trenching within the English Offshore Scheme. Estimates of sediment thickness on the bed following placement of sediment from dredging sand waves were also calculated. Results indicated that beyond the distances for settling of very fine sands (0.1 km), sediment deposits will be very thin (order of mm's or less).

17.12.11 Sediment thickness on the bed following release from trenchless technique punch-out would depend on the formation and settling of flocs. The spreadsheet model does not include flocculation and cannot be applied to provide a reliable estimate of sediment thickness for a release of clay sized grains. Based on the maximum mass of sediment released, if all sediment was deposited within one hour after release the thickness of deposits would be around 2 mm assuming a uniform spread over an area of 7 km by 0.4 m (with the area informed by travel distance over a one hour period and lateral spread based on a dispersion of 0.2 m^2/s).

Table 17-20 Calculated rate of fine sediment release and plume extent associated with different activities

Location	Percentage Fines (%)	Dry sediment density (kg/m^3)	Release rate (kg/s)	Maximum distance where SSC> 10 mg/l (km)	Maximum distance where SSC> 0 mg/l (km)
Activity: Dredging placement following sand wave clearance					
KP 117	4.2	1,500	99.4	2.8	11.1
Activity trenchless technique exit pit excavation					
KP 2	5.1	1,500	9.6	2.7	13.2
Activity: trenchless technique punch out					
KP 2	4	2,080	19.7	8.5	13.2
Activity: Trenching					
KP 10	52.6	1,090	71.7	8.8	16.8
KP 17	34.5	1,236	53.3	7.5	13.2

Location	Percentage Fines (%)	Dry sediment density (kg/m³)	Release rate (kg/s)	Maximum distance where SSC> 10 mg/l (km)	Maximum distance where SSC> 0 mg/l (km)
KP 46	4.7	1,500	8.8	3.8	19.8
KP 117	4.2	1,500	7.9	2.2	11.1
KP 149	5.7	1,500	10.7	2.5	11.1
KP 199	6.7	1,470	12.3	1.9	8.3
KP 249	16.4	1,400	28.6	2.8	7.7
KP 283	29.2	1,282	46.8	3.1	6.3
KP 357	10.7	1,436	19.2	1.6	5.6

17.12.12 Based on the predicted plume extents, cable trenching, exit pit excavation and trenchless technique punch-out have the potential to increase SSC at a number of bathing waters including Huttoft and Marsh Yard (with the English Offshore Scheme) passing directly through this bathing water, although construction activities will only occur offshore with the trenchless technique of the cable under the bathing water), Anderby (750 m south of the English Offshore Scheme), Chapel St Leonards (5 km south of the English Offshore Scheme and Sutton-on-Sea (5 km north of the proposed English Offshore Scheme). However, tidal flows in the nearshore region are predominantly aligned with the coast and given that the excavation of the exit pit and the cable trenching will be constrained to water depths of more than 3 m below LAT, any sediment plume will most likely remain offshore of the bathing water sites. Any sediment plume which impinges onshore would only be expected to result in relatively small increases in SSC (within the levels which naturally occur) and would only result in short duration increases (lasting only as long as the activities in the nearshore persist).

17.12.13 The Environment Agency undertake regular beach renourishment in this region (between the entire coast between Mablethorpe and Skegness). This activity involves pumping large volumes of sediment and water into the intertidal region. Relative to the renourishment activity any sediment disturbance due to exit pit excavation and cable installation is smaller in scale both spatially and temporally.

17.12.14 The sensitivity of the bathing waters to increases in SSC is therefore assessed as negligible, the magnitude of impact is negligible and the significance of impact is assessed to be **Negligible (not Significant)**.

17.12.15 KP 357 was selected as an area with a high percentage of fines in close proximity to the North East of Farnes Deep HPMA. The sediment plume in this section of the route was predicted to extend up to 5.6 km from the source location, while at its closest point, the HMPA is more than 13 km from the English Offshore Scheme. Further, the tidal renewables atlas (Ref 17.16) shows flows to be orientated north-south in this region so that sediment plumes would be advected along the English Offshore Scheme, rather than towards the HPMA so that no increases in SSC would be expected within the

HPMA. None of the designated sites which overlap with the predicted sediment plumes are designated for features which are sensitive to increases in SSC.

17.12.16 Based on these results, the sensitivity of undesignated environmental features to increases in SSC is considered to be negligible, the magnitude of impact is low (persisting only while construction activities are ongoing) and the significance of impact is assessed to be **Negligible (not significant)**.

17.12.17 The potential for interaction of sediment plumes from different activities occurring simultaneously is low, with seabed preparation activities (exit pit excavation and sand wave clearance) expected to occur prior to cable installation activities (punch-out and trenching) and with plumes from separate seabed preparation activities and from cable installation activities unlikely to occur simultaneously.

Operation

17.12.18 External cable protection placed on soft sediment could result in increases in SSC associated with scour. Any effect would be small and localised, and the potential for scour would be managed by aligning the external cable protection with the flow direction where possible.

17.12.19 Impacts during any repair works will be of a smaller magnitude (due to the localised nature of repair works) when compared to impacts during construction and the effect of changes to the SSC and deposition are assessed as **Negligible (not significant).**

Decommissioning

17.12.20 Potential impacts of decommissioning are likely to be of similar or lower magnitude than for construction, while the sensitivity of the site is likely to be unchanged. The effect of changes to the SSC and subsequent sedimentation during decommissioning are therefore assessed as **Negligible (not significant).**

17.13 Preliminary Impact Assessment of Modifications to Tidal and Wave Regimes and Associated Impacts to Morphological Features

Operation

17.13.1 Changes in depth from external cable protection are typically small and localised, with depth reductions of up to 1.5 m over an 8,000 m^2 area (per crossing). Some larger berms could be required where bridge crossings are used to cross pipelines, which could result in depth reductions of up to 2.5 m at up to 10 crossings.

17.13.2 Up to 58 infrastructure crossings, including 45 existing assets and 13 additional crossings for new assets in the future have been identified in the English Offshore Scheme. Approximately half of the crossing locations are in water depths of more than 30 m and as such the change in water depth from external cable protection is small relative to the total water depth (not more than 5 percent reduction in depth) and will not significantly alter flows or waves.

17.13.3 In some locations the infrastructure crossings are in relatively shallow water. In particular, there is an area of six pipeline crossings at KP 12 to KP 17 where depths are approximately 12.5 m LAT and the relative depth reduction is more than 10 percent (and up to more than 20 percent should crossing bridges be required). The English Offshore Scheme also crosses the Viking Link interconnector in this area.

17.13.4 The changes in bed elevation due to the proposed rock berms for infrastructure crossings will only result in very localised changes to tidal currents around the structures (which are aligned almost parallel to the dominant flow direction).

17.13.5 A technical study presented in **Volume 2, Part 3, Appendix 17.B: Wave Modelling** completed wave modelling to assess the potential impacts of external cable protection on waves at pipeline crossings. The results **of Volume 2, Part 3, Appendix 17.B: Wave Modelling** show that external cable protection required for the English Offshore Scheme results in localised and small changes (in the order of centimetres) in wave height and direction, with no changes predicted to wave period. Changes are no more than 1 percent relative to the baseline and predicted to occur no more than 4 km from the external cable protection based on external cable protection heights of 2.5 m.

17.13.6 In areas of hard substrate, cable burial may not be possible and therefore external cable protection would be required. In these areas, rock protection berms with a height of up to 1.5 m above the bed and a base width of up to 16 m would be applied. The percentage change in water depth is expected to be of the order of 5% or less (assuming these areas are in water depths of more than 30 m). This will be confirmed on completion of the CBRA and percentage changes in water depths will be reported within the ES.

17.13.7 Overall, the sensitivity of effect is considered negligible, the magnitude of effect is considered negligible and the significance is also assessed as **Negligible (not significant)**.

Decommissioning

17.13.8 During decommissioning the seabed will be returned where reasonably possible and practical to the baseline condition. The effect of changes to tidal and wave regimes during decommissioning are therefore assessed as **Negligible (not significant).**

17.14 Preliminary Impact Assessment of Release of Contaminated Sediment

Construction

17.14.1 Seabed disturbance during construction has the potential to release contaminants like heavy metals and hydrocarbons held within the seabed's pore water back into suspension. However, results from sediment samples collected in the English Offshore Scheme showed that the presence of contaminated sediment is minimal. All samples were below Cefas Action Level (AL) 1, except for Arsenic at a total of 13 locations (out of 113 sites) and Lead at one location. The National Oceanic and Atmospheric Administration (NOAA) Effects Range Low (ERL) threshold is lower than AL1 for some substances (Arsenic, Mercury and Copper). Thirty-nine locations exceeded NOAA ERL for Arsenic, mainly located inshore of KP 200 and one location exceeded NOAA ERL for Lead. No other locations exceeded NOAA ERL for any other substances. All samples were below Cefas AL 2 and the NOAA ERM threshold for all tested substances.

17.14.2 The contaminant levels from the samples are typical of the southern North Sea and do not indicate areas of specific contamination. Disturbance of the seabed sediments is therefore not expected to result in any detectable changes in water quality or sediment quality within the bathing waters, designated sites or undesignated areas so that the sensitivity is assessed as low.

17.14.3 Based on the generally low levels of contaminants it is considered that the potential for adverse effects on sediment and water quality is negligible, and it is concluded that the effect of disturbance of contaminated seabed sediments is also **Negligible (not significant).**

Operation

17.14.4 Impacts from unforeseen maintenance of the cable will be of smaller magnitude when compared to cable installation, due to the isolated and targeted nature of the maintenance works. The effect of disturbance of contaminated seabed sediments during operation is therefore assessed as **Negligible (not significant).**

Decommissioning

17.14.5 Impacts during decommissioning will be of a similar or lower magnitude when compared to cable installation and therefore the effect has been assessed as **Negligible (not significant)**.

17.15 Preliminary Impact Assessment of Temperature Increases

Operation

17.15.1 During the operation of an HVDC cable heat losses occur because of the resistance in the cable / conductor. This can cause localised heating of the surrounding environment (i.e., sediment for buried cables, or water in the interstitial spaces of external cable protection). There are no specific regulatory limits applied to temperature changes in the seabed, although a 2 °C change between seabed surface and 0.2 m depth is used as a guideline in Germany (Ref 17.76).

17.15.2 Heat calculations were undertaken for the English Offshore Scheme and are reported in **Volume 2, Part 1, Appendix 4.B: EGL 5 Heat Calculations Technical Report.** It is reported that, assuming an ambient seabed temperature of 12 °C, seabed temperatures at 0.2 m immediately above the cables are estimated to be 13 - 14 °C, with the cables operating at maximum operating temperatures. The actual system is unlikely to reach these temperatures as the system would have to operate at full load continuously for an extended period to meet these temperatures.

17.15.3 Seawater temperatures within the study area vary seasonally and the impact of any localised variations in temperature is expected to be of negligible significance. Therefore, the effect of an increase in temperature on coastal and marine physical processes is assessed as **Negligible (not significant)**.

17.16 Transboundary Effects

17.16.1 The EIA Regulations require an ES to consider the transboundary effects of a development (paragraph 5 of Schedule 4). Given the nature of the English Onshore Scheme and its proposed location, significant transboundary effects are unlikely as there are no pathways for effects to occur outside of the UK. Similarly, the English Offshore Scheme lies wholly in UK waters. As outlined in the Planning Inspectorate's Advice Note

Twelve (Ref 17.77) the screening process for transboundary effects will be carried out by the Planning Inspectorate. Information to inform this screening assessment will be provided as part of the application for the DCO.

17.17 Further Work to be Undertaken

17.17.1 The information provided in this PEIR is preliminary, the final assessment of potential significant effects will be reported in the ES. This section describes the further work to be undertaken to support the coastal and marine physical processes assessment presented in the ES.

Baseline

17.17.2 The CBRA is yet to be completed. Once completed the assessment will be updated to include details on the locations where external cable protection is required for hard substrate.

17.17.3 The geotechnical survey was ongoing at the time of preparation of the PEIR and data from the survey will be considered and used to undertake a CBRA and update the relevant sections of this Coastal and Marine Physical Processes chapter for the ES.

Assessment

17.17.4 The assessments undertaken for the PEIR will be reviewed following stakeholder consultation feedback, further design refinement and additional baseline information.

17.17.5 The following assessments will be updated where required:

- Updated assessment of increases in SSC and subsequent deposition. This will be based on a refined version of the spreadsheet model applied for the assessment in the PEIR, taking account of how any changes in design of the English Offshore Scheme alter sediment release rates which are a key input in the spreadsheet model; and
- Wave modelling of external cable protection.

Further environmental measures

17.17.6 Further consultation with relevant statutory consultees will be undertaken to define the scope and extents of the environmental measures set out in the assessment above. If, following stakeholder consultation feedback, further design refinement and further assessment, it is identified that additional measures are required, these will be detailed as part of the ES.

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